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# Leveraging Land Development Returns to Finance Transportation Infrastructure Improvements

## Final Report

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16. Abstract

The United States faces a crisis in transportation finance. Increasing fuel prices coupled with increasing demand for fuel-efficient cars is driving down fuel consumption, and the associated fuel tax revenues. At the same time, the demand for new transportation infrastructure currently outpaces construction, driving up prices for asphalt, concrete, and steel. This combination of declining revenues and higher costs is causing financing shortfalls for new transportation infrastructure and the maintenance of existing infrastructure. As one effort to bridge this gap, Texas House Bill 3588 authorized the creation of Regional Mobility Authorities (RMAs), which have the ability to apply tax-increment finance (TIF) to capture land development returns associated with land development improvements. This research identified the magnitude of property value increases associated with transportation infrastructure improvements, the assessment levels and investment horizon needed to recapture the costs of transportation infrastructure improvements, and how these revenue streams may be further leveraged to support local and regional investments in transportation infrastructure. Using a quasi-experimental design, property values in areas that recently underwent significant transportation infrastructure improvements were compared against nearby control groups. The relative property value increases determine the relative margin of benefit from which TIF revenues may be drawn against the transportation infrastructure capital costs. This study will be used to enhance ongoing efforts at the state level, including a forthcoming professional training course as well as an academic course on public-private partnerships and funding. The course will be offered within Texas A&M University's Master of Science in Land Development Program and will be offered as a course in Texas A&M's interdisciplinary Graduate Certificate in Transportation Planning, developed with University Transportation Center for Mobility™ funding (see Transportation Research Board TRID Accession #01124562 and #01324966 and http://archone.tamu.edu/laup/Programs/CTP_Overview.html).

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# Executive Summary

The United States faces a crisis in transportation finance. Increasing fuel prices coupled with increasing demand for fuel-efficient cars is driving down fuel consumption, and the associated fuel tax revenues. At the same time, the demand for new transportation infrastructure currently outpaces construction, driving up prices for asphalt, concrete, and steel. This combination of declining revenues and higher costs is causing financing shortfalls for new transportation infrastructure and the maintenance of existing infrastructure. As one effort to bridge this gap, Texas House Bill 3588 authorized the creation of Regional Mobility Authorities (RMAs), which have the ability to apply tax-increment finance to capture land development returns associated with land development improvements.

This research identified the magnitude of property value increases in selected areas of the Dallas-Fort Worth Metroplex associated with transportation infrastructure improvements between 2004 and 2008, and how these revenue streams may be used to support local and regional investments in transportation infrastructure. Property values in areas that recently underwent transportation infrastructure improvements were compared against nearby areas. The relative property value increases determined the financial benefit based on being located near transportation infrastructure. Illustrative case studies are included to specifically highlight the types of projects benefiting from proximity to various transportation infrastructure improvements yet not contributing financially to the maintenance of the nearby transportation infrastructure. After analyzing property values at the parcel level and highlighting illustrative case studies, this report examines the amount of value that could be captured for bond issuance by a regional mobility authority implementing tax-increment finance districts related to transportation. The total amount of bond issuance provides a creative financing mechanism to offset current and future transportation infrastructure capital costs by providing an additional financing mechanism.

# 1 Problem and Background

The significance of this study is to analyze the possible impact of the implementation of regional mobility authorities and the ability of RMAs to generate revenue via tax-increment finance improvements and/or the use of transportation reinvestment zones (TRZs) to recapture transportation infrastructure costs and leverage additional transportation. The existing funding mechanisms deemed to be innovative include roadway privatization, tollways and high-occupancy toll (HOT) lanes, and grant anticipated revenue bonds, all of which fail to capitalize on the benefits of transportation infrastructure improvements on surrounding property values. As the property values increase due to the improvements, the public sector reaps the benefits through increased property-tax revenue, while the private sector benefits from increased business revenue, higher rental prices, visibility, and accessibility. Analyzing the property value impact from these transportation infrastructure improvements provides an opportunity to determine the likely amount of revenue that could be captured by a financing vehicle such as tax-increment finance that can be implemented by an RMA or a TRZ. More importantly, the financial analysis can be used to identify the relative time needed for the tax-increment finance vehicle to capture revenue for bond issuance and related transportation infrastructure improvement financing methods.

Traditional ways of supplying funding for transportation are falling behind the existing demand for the construction, maintenance, and operation of existing and proposed transportation improvements. Despite the fuel tax, many studies demonstrate that improved fuel mileage may decrease fuel tax revenue by 20 percent or more in the coming decades. The increasing use of tolling to subsidize new highways provides another source of funding, but much of this funding is dedicated to the maintenance of the specific toll road. Alternative funding methods include increasing the gas tax, which is obviously not politically popular, and better mechanisms to establish user fees. User fee improvements would likely be based on mileage fees and distance-driven metrics (Transportation Research Board, 2006). The existing research and debate constantly discusses the need for broader alternatives to keep up with the costs of existing and proposed transportation improvements, but the majority of the solutions focus on user fees that actively benefit from the use of the transportation improvement. Analyzing real estate surrounding a transportation improvement provides some insight into passive benefits based on proximity to existing and proposed transportation networks.

Oftentimes, in the real estate literature, there is a tendency to demonize transportation infrastructure as a negative amenity, although recent developments such as transit-oriented development soften the negative perspective of living near major transportation routes. The planning literature suffers largely from focusing on designs and policies to minimize sprawl by developing compact cities and increasing density, but the existing transportation infrastructure is not a major point of discussion. While there is development and there is planning, the continual development and redevelopment of cities often occurs around existing transportation infrastructure, but often does not include the transportation infrastructure as part of the development process. The concept behind this research is to determine whether leveraging the returns to development surrounding transportation infrastructure is worth pursuing to improve the existing transportation infrastructure for better access to new development. Understanding the need to focus on this infrastructure finance issue requires discussing real estate and planning literature to highlight understand the problem.

## 1.1 Regional Mobility Authorities

Before discussing the existing literature, regional mobility authorities and transportation reinvestment zones require some discussion due to being unique to Texas as well as being the main mechanism to plan, fund, and implement transportation infrastructure improvements. RMAs are defined in Chapter 370 of the Texas Transportation Code under Title 6—Roadways, Subtitle G—Turnpikes and Toll Projects. This chapter was originally passed as the Regional Mobility Authority Act in 2003 with minor amendments added in 2005 and 2007. The 81-page act provides several requirements for RMAs, but a few requirements for RMAs are worth discussing for their relevance to the current research.

Broadly speaking, an RMA can construct, design, finance, maintain, and operate every type of transportation network. The definition of a transportation project includes a turnpike, a system, passenger or freight rail, a major roadway, a ferry, an airport, a pedestrian or bicycle facility, an intermodal hub, an automated conveyor belt for freight, a border-crossing inspection station, an air quality improvement initiative, a public utility facility, a transit system, and any other project deemed applicable based on state legislation. In addition to new projects, an RMA can also expand existing transportation networks and services. Regional mobility authorities also have a multitude of funding mechanisms ranging from bonds to setting toll rates, as well as limited power to acquire property through condemnation.

One or more counties may authorize the creation of an RMA, which has a board of directors. Given that metropolitan areas often encompass multiple counties, the purpose of this part of the law is to enable regional planning for transportation infrastructure improvements and development. Despite the general nature of this section, there are two interesting clauses that relate to cities able to utilize this authority as de facto counties. The first clause focuses on islands with populations of less than 5,000 people to create an RMA for the purpose of establishing ferry service despite not being a county. The second clause empowers cities along the U.S.-Mexico border with populations in excess of 105,000 to create an RMA.

The nature of an RMA is as a regional governmental subdivision of Texas. In undertaking the duties outlined in the previous two paragraphs, there are two aspects under which the RMA must operate:

1. In all respects, for the benefit of the people of the counties in which an authority operates and of the people of this state, for the increase of their commerce and prosperity, and for the improvement of their health, living conditions, and public safety; and
2. As an essential government function of the state (State of Texas Constitution and Statutes, 2010).

In this regard, an RMA acts as a quasi-governmental agency of the state to implement transportation improvements at the regional and local level. As of the conclusion of this research, there were eight RMAs in Texas, but none currently exist in the Dallas-Fort Worth region under analysis in this research. The eight existing RMAs are:

- Alamo RMA, which serves Bexar County and includes the city of San Antonio;
- Cameron County RMA, a county along the U.S.-Mexico border that contains Harlingen, South Padre Island, and Brownsville;
- Camino Real RMA, which includes El Paso along the U.S.-Mexico border;
- Central Texas RMA, which covers Travis and Williamson Counties, including the city of Austin, and was the first RMA approved in Texas;
- Grayson County RMA, which serves Grayson County located north of the Dallas-Fort Worth metropolitan area;
- Northeast Texas RMA, which serves six counties east and north of the Dallas-Fort Worth metropolitan area from the Dallas county line to the Oklahoma and Arkansas state lines;
- Hidalgo County RMA, which includes one of America's fastest growing cities, McAllen, and is located along the U.S.-Mexico border; and
- Sulphur River RMA, the most recent RMA approved in Texas, which encompasses four counties slightly northeast of Dallas to the Oklahoma state line (TexasTollways, 2011).

The importance of RMAs in resolving current and future transportation issues is that as Texas' metropolitan areas continue to grow, traffic circulation will continue to be a regional problem requiring regional solutions. By using the tax-increment finance (TIF) powers of RMAs, this value capture mechanism provides a means to leverage funding for current and future transportation needs.

## 1.2 Transportation Reinvestment Zones

A recent addition to transportation funding in Texas merits brief mention before continuing the analysis of RMAs and TIFs. TRZs were created mainly as a transportation financing mechanism for cities and counties in the absence of RMAs to fund toll road construction and maintenance. The legislative authority for TRZs are located in Texas Transportation Code Chapter 222—Funding and Federal Aid. The underlying logic of a TRZ is similar to tax-increment finance whereby a baseline is established for appraised property values in the year before the TRZ is created. Any additional property-tax increment above the baseline generated from increasing property values goes toward the financing of nearby transportation infrastructure projects. Unlike tax-increment finance, though, TRZs can only be used for toll-based transportation projects.

Like tax-increment finance, TRZs have a similar purpose in terms of their defining goals and also require a plan to be in place before implementation. Section 222.105 explicitly states that the purpose of TRZs is to:

1. Promote public safety;
2. Facilitate the development or redevelopment of property;
3. Facilitate the movement of traffic; and
4. Enhance a local entity's ability to sponsor a project authorized by pass-through tolls.

So, while tax-increment financing is often used to eradicate blight and improve the overall quality of life in an area, TRZs accomplish similar ends using transportation projects as their means. A benefit of using TRZs to fund a transportation project is that should a surplus exist upon completion of the project, that surplus can then be applied to another transportation project that exists within that same city or county that implemented the original TRZ.

The first city to implement a transportation reinvestment zone was El Paso in 2009 to finance the transportation improvements outlined in the El Paso Comprehensive Mobility Plan. While two other cities in Texas are in some stage of creating a TRZ, El Paso jumped through all the hurdles to formally create a TRZ. El Paso's TRZ, comprised of nine corridors that essentially create a ring around the city, is adjacent to the Texas-New Mexico and Texas-Mexico borders. The TRZ takes advantage of existing highways and proposes improvements in terms of widening areas from two to four lanes, improving and adding interchanges, improving access via frontage roads, and realigning some segments of the highway. The total project estimate for all the improvements is $403 million and will use gas-tax funds, tolls, and the TRZ to fund the entire project, with the initial funding coming from gas-tax funds, then tolls, and lastly the TRZ. In terms of the boundaries of the TRZ, the Texas Department of Transportation and El Paso designated TRZ boundaries of 1 mile from the highway centerline in each direction for seven of the nine corridors, while one of the remaining corridors has a boundary of 1/8 mile and the last corridor has a boundary of zero miles over the right-of-way (Texas Transportation Institute, 2008). Unlike the peer-reviewed literature that uses some basic scientific basis that can be replicated, the justification of the TRZ boundaries is based on case studies.

## 1.3 Tax-Increment Finance Literature

Perhaps the most challenging aspect of transportation reinvestment zones from a peer-reviewed literature standpoint is that there is no exact, perfect match of literature to directly relate to the TRZ concept. While TRZs are similar to TIFs, they differ drastically because TIFs are drawn based on geography and TRZs are buffers of existing and proposed transportation networks. Much of the TIF literature focuses on TIF versus non-TIF geographic areas, but the recent approval and implementation of TRZs does not enable a similar comparison at this time. Additionally, much of the TIF issues focus on cities that use TIFs versus those that do not use TIFs, while TRZs provide an opportunity to resolve the transportation congestion issue at a regional level. This opportunity means that if the TRZ is planned well on a regional level, the benefits of improved transportation will not differ from one city to the next city. Perhaps most importantly, TRZs are only able to be used for toll roads. This important fact means that unless existing highways are turned into toll roads or all future highways are only toll roads, TRZs only address part of the transportation funding issue in relation to capturing real estate value.

In discussing regional mobility authorities and transportation reinvestment zones, there is little to no existing literature that accurately studies either topic. Due to the novelty of transportation reinvestment zones, the nearest comparable literature focuses on tax-increment finance. In terms of transportation-related research, the real estate literature almost exclusively examines transportation as a negative amenity based on proximity to transportation types such as highways and freight railroads. The planning and real estate literature has only recently analyzed transit-oriented development as perhaps transforming transportation infrastructure into a positive amenity given the increased congestion in metropolitan areas, the cost of fuel, and other related issues. The current research proposal addresses several of these overarching issues as they relate to the Dallas-Fort Worth Metroplex.

The real estate literature provides little discussion on financing vehicles such as TIFs, perhaps because it is an instrument used by cities as opposed to developers. Most of the real estate literature focuses on developer-driven development as opposed to city-driven development and oftentimes glosses over infrastructure development. This observation is not so much an indictment of the real estate literature as it is the observation that as cities continue to grow, the need to study the infrastructure that binds developments to one another may require more analysis in the real estate literature in the future.

Huddleston (1981) provides a thorough discussion of the purpose underlying TIFs: the money generated under TIFs will spur development or redevelopment efforts by the private sector. Unlike more recent analyses of TIFs, Huddleston views TIFs as being a public subsidy despite being generated by the property-tax increment of private development. In his study of Wisconsin TIF districts, he finds that TIFs have a significant impact in promoting additional development in suburbs and smaller cities. For Milwaukee and other large cities, though, he sees the property-tax rate as enough to generate adequate taxes for development. Assuming these property taxes collected without TIF districts are redistributed efficiently, a large city could create programs that achieve the same ends as a TIF without having to establish a TIF. The idea that large cities efficiently and effectively redistribute property taxes, though, is a premise that makes the existence of TIFs a self-fulfilling prophecy, and the purpose of TIFs is reinforced largely by the inability of large cities to allocate taxes evenly.

The results of the Wisconsin study conducted by Huddleston are largely offset by a study of TIFs in Michigan. The study includes Michigan cities that adopted TIFs as well as cities that did not implement TIFs to determine the impact of TIFs on property values. The probit analysis results show a consistent and significant positive effect between TIF adoption and property value growth for cities of different sizes. Despite the level of rigor in the model to minimize selection bias inherent in some TIF research, the Michigan study aimed to minimize this bias. A bigger issue that the author alludes to in the conclusion is that the causality of the study is left unanswered. The questionable nature of causality is due to the inability to determine whether growing cities adopt TIFs because of the growth or whether the growth is directly due to TIFs. The resolution of this issue is cast aside in the conclusions as an issue that cannot be examined due to data limitations (Anderson, 1990).

A study of a TIF in Urbana, Illinois, while focusing on a relatively small city, provides a model on the link between investing in public infrastructure and enticing private development. Rather than studying the entire TIF district, the research focuses on a 190-acre section of the TIF consisting largely of a residential area. While bordering on a behavioral analysis of TIFs, the authors attempt to operationalize the present value of revenues generated in a TIF district. More important is the decision-making aspect of a TIF district: accurately determining the cost of infrastructure improvements, land acquisition, and property investment to maximize present value. The outcome of the study is that the large returns stem from a high property-tax rate, a high rate of interest on the TIF fund balance, and a high net return on housing investment. Lower returns occur with high land prices, and the cost of holding onto undeveloped land, as opposed to developing the land, is high (Knaap, Elson, and Donaghy, 1999).

Man (1999) looks at TIFs in Indiana and whether a correlation exists between TIFs and city growth. An underlying premise of TIFs is that city growth may exist, but a TIF will provide a revenue stream to fund further infrastructure improvements to maximize growth. The study aims to figure out what pressures cities face that may steer them toward using TIFs, studying the period before and during TIFs to analyze city conditions, and aims to test whether TIFs are often used alone or with other existing economic development tools. Cities that had a decrease in state aid were more likely to use TIFs. Cities that increased their property-tax rate also had a greater likelihood of implementing TIFs. One interesting result is that some cities often create a TIF because a neighboring city has created a TIF and wants to compete for similar businesses. In terms of whether TIFs are used as a substitute or complement, they are used most often with other property-tax abatement programs but not with property rehabilitation programs that may have a purpose similar to that of TIFs.

Dye and Merriman (2000) offer yet another example from the Midwest, using TIFs in Chicago and determining whether TIFs have any impact on economic development. One thing accomplished early in their article is a discussion of motives underlying economic development incentives that they summarize as focusing on at least one of four motives: market failure, blighted area, bidding war, and revenue shifting. Depending on the situation existing in the target area, remedying market failure and/or blight should result in the economic development impact having a positive result on the target area. One observation from their study is that TIFs help growth within the TIF district, but the growth gained is less than the growth lost outside of the TIF district. So, while a TIF may help the targeted area, it hinders the overall growth rate for a municipality.

Weber, Bhatta, and Merriman (2003) also conducted a study of TIFs in Chicago with a focus on industrial real estate value. This study has some relevance to the current research in that it examines industrial TIF districts compared to TIF districts that have a mix of uses. The results demonstrate that single-use TIFs such as industrial TIFs actually result in a decrease in property value. Industrial properties located in TIFs with diverse property values fared better, as did diverse land use TIFs in general. An issue not covered in the research is that despite the strong industrial presence in Chicago, the overall decline of manufacturing and industrial uses in the United States is largely not mentioned in the study as a possible cause in the decline of property values in TIF districts. In other words, a high density of industrial-only uses may not necessarily show a decline in property value so much as it shows a decline of an industry inherent throughout the United States.

Byrne's work (2005, 2006) on TIFs in the metropolitan Chicago area analyzes the strategic interaction of TIFs. While the research regarding this literature review focuses on transportation reinvestment zones as a regional approach to resolving transportation issues, Byrne's work looks at the municipal impact of a TIF on overlapping areas. Similar to earlier studies regarding municipal competition and the likelihood of creating a TIF, Byrne reinforces this observation with his own research. Other worthwhile observations are the fact that TIFs are more popular in municipalities that have a high percentage of owner-occupied homes. Rather than proposing property-tax rate increases that must be approved at the ballot box through popular vote, a TIF enables policy makers to utilize an alternative that will hopefully prevent a property-tax rate increase and voter revolt.

Smith (2006) provides another angle on TIF districts in Chicago, focusing on the creation of sales price indices to quantify the appreciation rates of properties located within the TIF district compared to those of properties outside the TIF district. Unlike previous studies focusing on Chicago, the unit of observation in this research is multifamily real estate as opposed to all properties. The importance of Smith's study is the finding that higher appreciation rates exist within the TIF compared to outside the TIF, demonstrating that the implementation of the TIF is spurring investment at a greater rate than investment outside the TIF. An underlying condition of implementing a TIF is to act as a vehicle to spur redevelopment and/or reinvestment in blighted areas. While the average values of properties in the TIF were lower than those outside the TIF, the higher rate of appreciation for properties in the TIF leveled the playing field.

Weber, Bhatta, and Merriman (2007) conducted an analysis of TIF district spillovers in Chicago. The goal of their research aims to either legitimize or debunk arguments related to TIF districts and skyrocketing appreciation rates of nearby residential properties. Unlike several other studies cited in this research, they focused not just on TIF districts but on the types of property uses within those TIF districts. One observation worth noting in regards to transportation reinvestment zones is that the rate of housing appreciation increased based on proximity to public transit stations. Their findings suggest that having a TIF district with mixed uses or largely residential uses results in a positive impact on nearby property appreciation rates. On the other hand, TIF districts that are largely commercial or industrial result in a lower predicted appreciation rate.

Of the real estate literature on TIFs, there are essentially two recent articles. Musil's study (2007) of development regulatory variables in the Minneapolis-St. Paul area provides some insight into the intersection of real estate and TIFs in relation to development. Focusing on 24 different variables covering community and development aspects, the only significant results of the study were the uses of TIFs and their correlation to several different development process attributes. The highest correlations exist between TIFs and the commercial/industrial market value, non-residential construction, population, multifamily permits issues, and residential market value in any given city. Despite the inclusion of factors such as project costs, approval processes, and several other characteristics, none of these factors were remotely significant compared to the TIF variables.

Smith (2009) provides yet another look at TIFs in Chicago, this time focusing on commercial real estate. The goal of the research is to analyze sale prices for properties within the TIF and compare the prices to the same properties before the TIF was designated as well as to similar properties outside the TIF. For the period under observation, property sale values in the TIF were slightly greater than those of properties sold outside the TIF. The property appreciation rate for properties located in the TIF before the TIF designation is lower than the rate for properties in the TIF after the designation and for properties adjacent to the TIF after the designation. In other words, the TIF designation resulted in higher property values compared to the period before the creation of the TIF.

# 2 Approach

To determine the viability of implementing a transportation reinvestment zone to capture returns to land development, assessed land values and land development trends must be analyzed. In an area with little to no land development, the lack of development would not generate enough revenue to provide adequate leverage to finance transportation infrastructure improvements. The approach to determining the amount of money available to be leveraged by land development surrounding transportation infrastructure in the Dallas-Fort Worth area required analyzing property values for Collin County, Tarrant County, and parts of Dallas County to provide a hypothetical picture of past changes in development and appraisal values from 2004 to 2008. This time frame provided a picture of development that carried both the peak in real estate development (2004-2006) as well as part of the decline (2006-2008). Moreover, there were several issues with data in each county before 2003, and data for 2009 and 2010 are incomplete or still being revised. The 2004 to 2008 framework provided the best benchmark for comparison of values in the region. In addition to the property value analysis, several case studies were analyzed to highlight localized development patterns around transportation infrastructure throughout the Dallas-Fort Worth metropolitan area.

The main goal of this research is to determine whether property value appreciation between 2004 and 2008 may be correlated with the transportation linkage based on returns to land development. If transportation reinvestment zones are implemented, the value generated from the TRZ has to be worth the initial administrative hurdles to leverage current maintenance costs as well as future construction and maintenance costs. If there is no extensive appreciation of these properties over time and/or no new development in areas proximate to transportation infrastructure, then the likelihood of a TRZ as being a feasible alternative to existing leveraging mechanisms is greatly reduced.

For this research, property parcel maps were acquired from the Collin County Central Appraisal District, Dallas County Central Appraisal District, and Tarrant County Central Appraisal District. Due to a lack of existing appraisal data electronically available before 2007, Denton County was not included in the study. In addition to the parcel maps, certified assessed property values were also acquired from Collin, Dallas, and Tarrant Counties. These data were largely in the form in multiple, fixed-length .txt files. Geographic information files for the Texas Highway System and Texas rail line data were used from the Department of Geography at Texas A&M University. The geographic information files for the tollway data were downloaded from the North Texas Tollway Authority. Census block maps and 2000 population data from the U.S. Census were used in building the geographic information system database. Finally, road maps for Collin, Dallas, and Tarrant Counties were downloaded from the Texas Natural Resources Information System.

# 3 Methodology

The data collection aspect of this project has been extensive given the limited data available through several entities. The reason for studying assessed property values from 2004 to 2008 is twofold. First, since the transportation reinvestment zones are essentially a form of TIF, the reliance on appraised values is necessary because appraised values form the basis for the increment that will be invested in transportation. Second, 2004 is the earliest year with data available for the study area, and 2008 is the most recent year that has certified appraisal values that are reconciled and corrected. The data for 2009, while certified, are largely incomplete for all counties. While it is apparent that there has largely been an increase in property values between 2004 and 2008 for the counties under analysis, data limitations are abundant and have caused the front end of this project to be far more time consuming than originally proposed. Complete data for Collin and Tarrant Counties have been obtained, along with the city of Dallas (not the entire county), and 2008 data have been obtained for Denton County. The 2004 and 2008 data for the city of Dallas are in the process of being converted into a usable format, while the 2004 data from Denton County are still being compiled.

For each geographic area, the land use code may have one of 56 different possible classifications. Collin, Denton, and Tarrant Counties all use the codes provided by the State of Texas Office of the Comptroller, allowing for uniformity and comparison as well as ease of filing between the county and state agencies. Dallas County, unfortunately, uses a different land use codes that are currently undergoing transformation to be compatible with the codes of the other counties for joining into one database. While there are 56 different land use codes, these codes can be broken down into a handful of groups. Classifications that begin with the letter "A" are residential and include single-family mobile homes where the land is owned, condominiums, townhomes, or residential improvements. Classifications in the "B" group are multifamily units that are for rent such as apartments, duplexes, triplexes, quadplexes, and multifamily improvements. The "C" category includes vacant lots under 5 acres and includes all uses (residential, commercial, and industrial). The "D" category relates to undeveloped land, inactive cropland, and inactive pastures. Farms and ranches fall into a separate "E" category that includes cropland and pastures. The "EX" category includes all exempt uses such as government buildings, churches, cemeteries, and non-profits. Another exempt category is "M" and includes miscellaneous exemptions not necessarily owned by the government but exempt for unspecified reasons unrelated to ownership. The "F" category includes all commercial and industrial uses, while the "J" category includes all utility-related uses.

On average, it took a few months to carefully and properly convert the appraisal data into a format that could then be combined with the parcel dataset using geographic information systems (GIS). This process required writing a computer program that converts the appraisal data from one file format into a file format that is compatible with GIS files for spatial projection. Once the appraisal data were combined with the spatial data, they were projected in GIS. Transportation files compatible with GIS were then incorporated, and buffers were calculated for distances of 0.25 mile, 0.25 to 0.5 mile, 0.5 to 0.75 mile, and 0.75 to 1 mile. Properties were then subtracted to ensure that they were not double-counted. Creating a dummy variable ensured that a property was included only once as being within 0.25 mile, between 0.25 mile and 0.5 mile, between 0.5 mile and 0.75 mile, and between 0.75 mile and 1 mile. The resulting dataset provided an accurate picture of how much properties appreciated in value between 2004 and 2008 proximate to transportation infrastructure in nominal terms.

To calculate appreciation rates for converting 2004 appraisal values into 2008 values, several different data sources were consulted to formulate an index that accurately depicted the property values. Using national-level data, especially given the current economic downturn, would fail to adequately measure the growth that Texas has undergone despite the economy. Moreover, the study conducted on TRZs in El Paso used data from the Office of Federal Housing Enterprise Oversight, data from the Texas State Comptroller's Office, and undocumented case studies on a few developments throughout El Paso. The future average annual property appreciation estimates for properties around major transportation improvements range from

2 percent to 4 percent, and estimates for properties not located around major transportation improvements range from 1.5 percent to 2.5 percent.

## 3.1 Study Area

This study chose Collin County, Tarrant County, and a portion of Dallas County as study areas. They are the most populous counties in the Dallas-Fort Worth Metroplex (Figure 1).

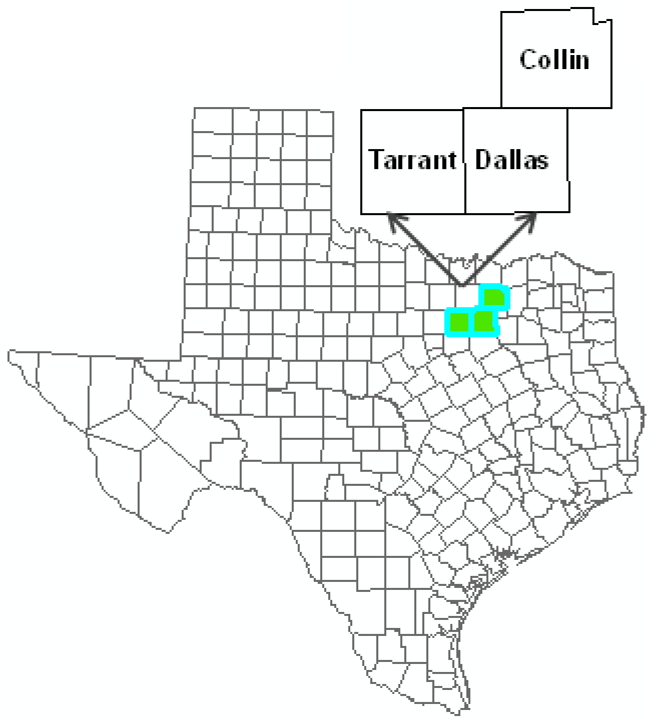


**Figure 1: Map of Collin County, Dallas County, and Tarrant County**

Collin County, Tarrant County, and Dallas County have been experiencing extensive growth in the past 10 years. This metropolitan area has consistently ranked as the area with the largest increase in population in the United States for the last five years. Table 1 indicates these three counties are home to some of the largest populations in Texas. Despite Harris County being the most populous county in Texas, Collin County, Dallas County, and Tarrant County all ranked in the top six most populous counties. Dallas was the second largest with 2,451,730 people, Tarrant County ranked third with 1,789,900 people, and Collin County ranked sixth with 791,631 people. Moreover, Collin County continues to be one of the fastest-growing counties in the United States. Collin County's population increased 58.3 percent from 2000 to 2009. Dallas County had a population increase of 10.2 percent, and Tarrant County had a population increase rate of 23.1 percent between 2001 and 2009 (U.S. Census Bureau, 2010; Texas State Data Center, 2010). These data reveal that there is an influx of people into this metropolitan area, yet the population growth is outpacing the transportation growth.

**Table 1: Current and Estimated Population in Collin, Dallas, and Tarrant Counties**

| County | 2000 Census Population | July 1, 2009, Estimate | January 1, 2010, Estimate | Change 2000-2009 | Change 2000-2010 | Percent Change, 2000-2009 | Percent Change, 2000-2010 |
|---|---|---|---|---|---|---|---|
| Collin | 491,675 | 785,314 | 798,033 | 293,639 | 306,358 | 59.7 | 62.3 |
| Dallas | 2,218,899 | 2,429,276 | 2,449,612 | 210,377 | 230,713 | 9.5 | 10.4 |
| Tarrant | 1,446,219 | 1,779,396 | 1,798,838 | 333,177 | 352,619 | 23 | 24.4 |

(Source: Texas State Data Center: U.S. Census)

Perhaps even more important is that the population growth is exceeded by vehicle miles traveled. This issue is not unique only to the Dallas-Fort Worth area but is exhibited by all major metropolitan areas throughout Texas. Between 1990 and 2005, the population in the Dallas-Fort Worth area increased 37 percent, but the vehicle miles traveled increased 61 percent. Despite the overall increases in population and vehicle miles traveled, the construction of new lane miles only increased 22 percent (Texas 2030 Committee, 2009). As Texas and its metropolitan areas continue to grow in population and vehicle miles traveled, the rate of construction of new lanes and use of non-automobile forms of transportation lag far behind. The main problem is not just that congested roadways, but that existing financing mechanisms for transportation construction cannot meet the fast rate of growth.

Figures 2, 3, and 4 display the overall pattern of population density maps by census block by using a 30-by-30-foot raster for Collin County, Dallas County, and Tarrant County. These population maps at the block level cannot explain the relationship between population and transportation link accessibility very well, but they provide a general geographic illustration of population density for each county. Darker areas denote higher population densities in each of the counties. Areas that are white denote either man-made or natural areas where there is no population. Examples of man-made infrastructure include highways, tollways, streets, light rail, freight rail, industrial uses, and commercial uses. Natural areas include lakes, rivers, parks, and related uses without a human population.

Compared to Dallas and Tarrant Counties, Collin County is still growing, with the majority of population density in the southwest quadrant of the county. It is important to recall that these population density maps document where people live and not necessarily where people work. The purpose of including these population density maps is to show areas that may have high value from a residential standpoint from which to capture value for infrastructure improvements.

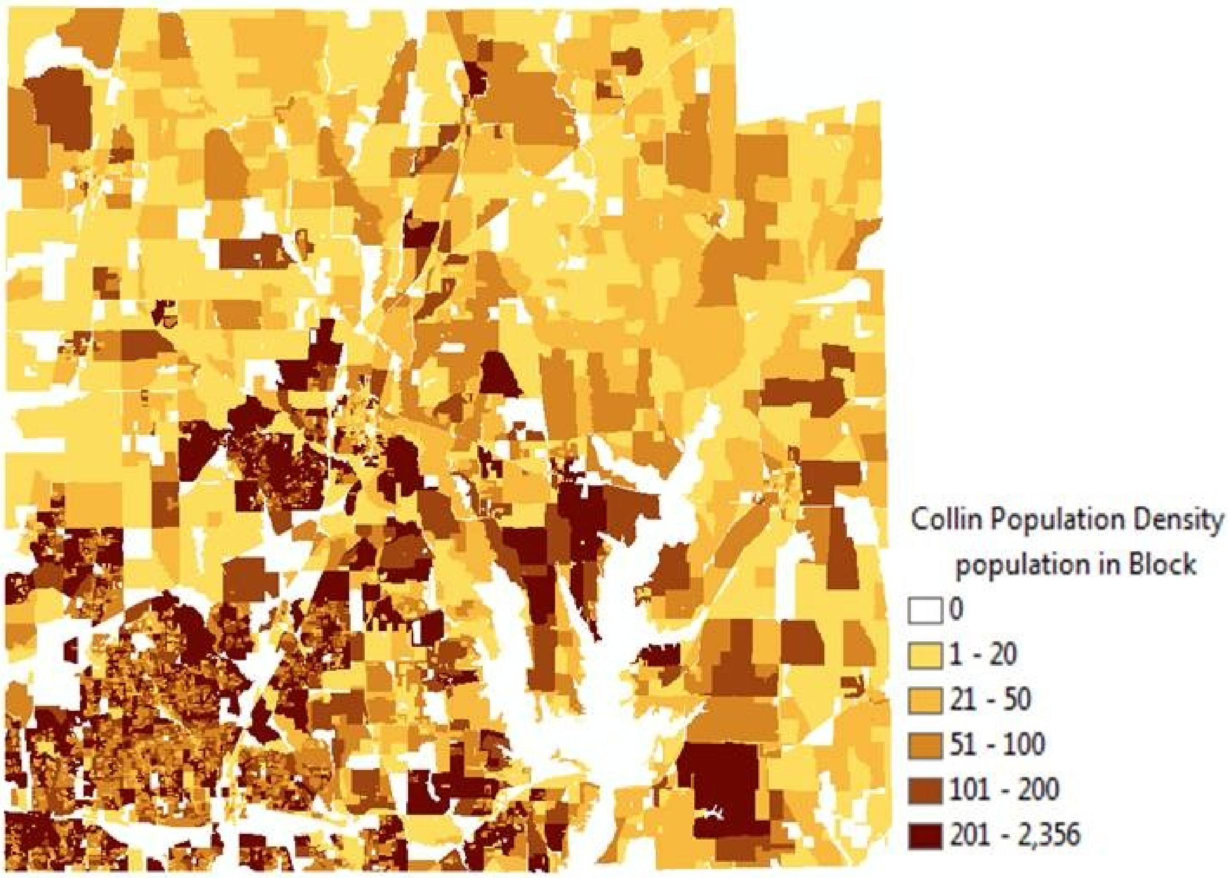


**Figure 2: Collin County Population Density in Census Block**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).


**Figure 3: Dallas County Population Density in Census Block**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

Unlike Collin County, population densities in Dallas County are somewhat scattered, although higher-density areas exist in every direction from the downtown central business district. The reason for this pattern is that there is a large concentration of office uses in the downtown area, with a few high-density residential uses interspersed around the downtown area but not really concentrated in any single downtown area. The southeastern part of Dallas County is largely undeveloped, but the general growth pattern of the county has largely been toward the north into Collin County and toward the northwest into Denton and Tarrant Counties.

Similar to Dallas County, Tarrant County has also had a majority of recent growth to the north toward Denton County and to the northeast toward Collin County. The northwestern and southwestern sections of Tarrant County have lower population densities due to sprawling developments and/or a lack of residential development. Similar to Dallas County, Tarrant County, with Fort Worth as the center of the county, exhibits the same pattern of lower population density in the central business district due to the prevalence of commercial and industrial uses.

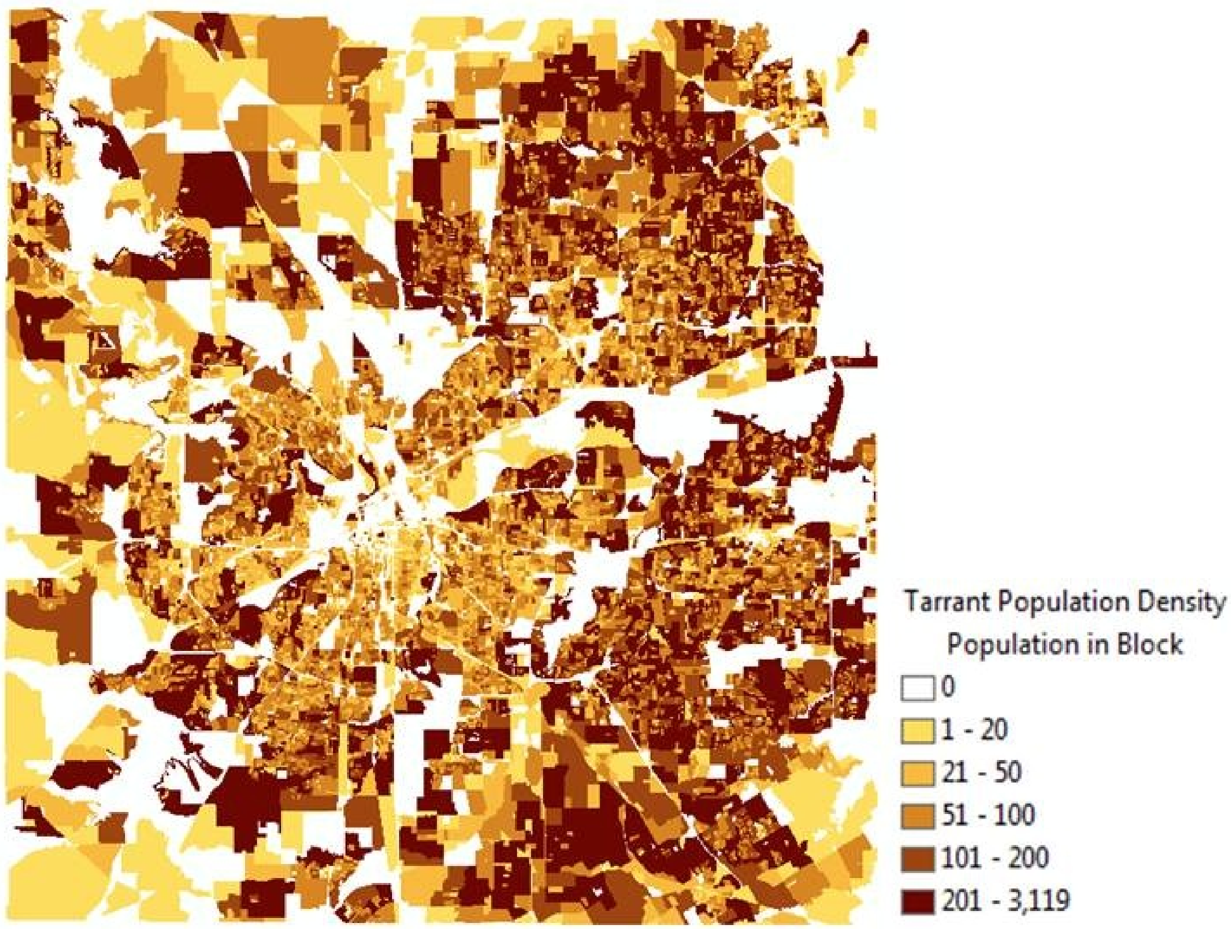


**Figure 4: Tarrant County Population Density in Census Block**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

Given the density of population, using geographic information systems enables the analysis of residential values in relation to existing transportation infrastructure to determine whether residential uses near transportation infrastructure command a higher value on average than residential uses further away from this infrastructure.

## 3.2 Geographic Information Systems Methodology

The geographic information system database required several steps to create the overall database used for analyzing the property values and total amount of value to be captured based on proximity to the transportation infrastructure network. The first step required splitting the rail database into two distinct files, with one file consisting solely of freight rail lines and the other file containing Dallas Area Rapid Transit (DART) and Trinity Railway Express (TRE). The main purpose for this step is that light-rail transit may have a positive effect on property value and oftentimes acts as a central development point for transit-oriented development. Additionally, real estate literature consistently demonstrates that freight rail has either a neutral or negative impact on property values. Failing to account for these different types of rail may cause the increases in property values proximate to light rail (a positive amenity) to be offset by decreases in property values proximate to freight rail (a negative amenity). Moreover, the number of freight rails in the Dallas-Fort Worth Metroplex are unlikely to expand, whereas several plans are under study, being implemented, or under construction for the expansion of DART and TRE to alleviate existing congestion issues.

The second step created variables for the property value inflation rate between 2004 and 2008. Rather than using the U.S. Consumer Price Index or other national-level inflation index, values at the local and county levels were used to determine a more localized appreciation rate index. An underlying reason for this approach is that the Dallas-Fort Worth area did not experience the high levels of unsubstantiated property value speculation and the ensuing crash in property values that occurred from 2004 to 2008. Using local indicators provides a conservative estimation of the big picture. The conservative approach also signifies that the results created from the ensuing research act as more of a floor than a ceiling in determining the basic level of value to be captured by the implementation of an RMA and/or a TRZ. For retail and commercial values, CoStar's Analytics proprietary database was used to access market reports, property price trends, and related factors. Using data from the National Association of Homebuilders, the National Association of Realtors, the U.S. Census, and related government sources provided a general benchmark for residential property value appreciation. The resulting index showed the average change in value from the inflation figure for Collin County from 2004 to 2008 is 16.47 percent, for Dallas is 10.00 percent, and for Tarrant County is 17.28 percent. After the inflation of the property values, the property parcel shapefiles for Collin County, Tarrant County, and Dallas County were converted to raster by the change in value from 2004 to 2008 with a set cell size of 30 by 30 feet.

Once the files were converted to a raster format, buffers were created for properties that were 0.25 mile away, 0.25 mile to 0.5 mile away, 0.5 mile away to 0.75 mile away, and 0.75 mile away to 1 mile away from light rail, freight rail, tollways, and highways. These buffer intervals correspond to several of the studies in the peer-reviewed literature regarding property valuation effects due to transportation network proximity. Additionally, these intervals also match various segments of the transportation reinvestment zone currently established for El Paso, Texas. After creating the buffers, dummy variables for properties within each interval were added. The dummy variable was coded, with 1 denoting properties within 0.25 mile, 2 denoting properties within 0.25 mile to 0.5 mile, 3 denoting properties within 0.5 to 0.75 mile, 4 denoting properties within 0.75 mile to 1 mile, and 5 denoting all other properties beyond 1 mile away from each type of transportation infrastructure.

The next step in the process was the development of the population density map. In order to accomplish this task, the aim is to distribute the population living in each census block to the roads contained within that census block. An underlying assumption is that most roads are built where the people live, with a higher density of roads indicating higher population densities. Using zonal statistics, the number of roads in each census block was calculated with each road cell size set at 30 by 30 feet before calculating the population in each cell. Once this step was completed, each cell was aggregated to a 0.5-mile grid to produce the population density map.

## 3.3 Data Analysis

After processing the GIS steps described in previous sections, there are several findings that merit discussion. Using the data available in Tables 2, 3, and 4 for each geographic area under analysis some broad observations merit mention. The mean value for appraised property in Collin County for 2004 is $190,183, and for 2008 is $264,160. After considering the 16.47 percent inflation figure, the change of mean value for appraised property from 2004 to 2008 is approximately $42,654 per parcel in Collin County. This is an increase in value of 19.3 percent when controlling for the effect of inflation, which is a considerable increase despite the current financial crisis and subprime mortgage collapse. For Dallas, the mean value for appraised property is $236,710 in 2004 and $303,964 in 2008 for a total of 428,528 parcels. Without any inflation, there is a 28.4 percent value increase from 2004 to 2008. When the appraised values are recalculated using the 10 percent inflation figure, the real change in value is $43,583, resulting in an overall increase in real value of 16.7 percent for Dallas. For Tarrant County, the mean value for appraised property is $164,550 in 2004 and $192,749 in 2008. There is a 17.1 percent increase in value from 2004 to 2008 without accounting for inflation. When inflation is included in the property value, the 17.28 percent inflation figure results in a minimal overall change in mean real value for appraised property of only $728.

The next step explores the connection among these valuation changes, including population density and the relationship of property value compared to the distance to transportation links.

**Table 2: Collin County Change in Appraised Property Values, 2004-2008**

| Collin County Parcel Proximity to: | Number of Properties | 2004 Appraisal | 2004 Appraisal (in 2008$) with Inflation | 2008 Appraisal | 2004-2008 Percent Change without Inflation | 2004-2008 Percent Change with Inflation | 2004-2008 Value Change with Inflation | 2004-2008 Aggregate Value Change with Inflation |
|---|---|---|---|---|---|---|---|---|
| Light Rail—0.25 mile | 999 | $513,241 | $597,772 | $709,134 | 38.2% | 18.6% | $111,362 | $111,250,724 |
| Light Rail—0.250.25-0.5 mile | 1,413 | $461,388 | $537,379 | $501,362 | 8.7% | −6.7% | $(36,017) | $(50,892,019) |
| Light Rail—0.5-0.75 mile | 2,371 | $258,755 | $301,372 | $420,256 | 62.4% | 39.4% | $118,883 | $281,871,934 |
| Light Rail—0.75-1 mile | 2,283 | $230,407 | $268,355 | $270,708 | 17.5% | 0.9% | $2,353 | $5,370,761 |
| Freight Rail—0.25 mile | 15,536 | $237,331 | $276,419 | $352,812 | 48.7% | 27.6% | $76,393 | $1,186,845,425 |
| Freight Rail—0.25-0.5 mile | 16,825 | $197,124 | $229,590 | $261,494 | 32.7% | 13.9% | $31,904 | $536,781,136 |
| Freight Rail—0.5-0.75 mile | 19,152 | $190,005 | $221,299 | $251,691 | 32.5% | 13.7% | $30,393 | $582,077,269 |
| Freight Rail—0.75-1 mile | 18,247 | $217,861 | $253,743 | $292,545 | 34.3% | 15.3% | $38,802 | $708,022,429 |
| Tollway—0.25 mile | 6,865 | $731,987 | $852,545 | $1,220,535 | 66.7% | 43.2% | $367,990 | $2,526,249,906 |
| Tollway—0.25-0.5 mile | 12,955 | $339,874 | $395,852 | $459,346 | 35.2% | 16.0% | $63,494 | $822,567,294 |
| Tollway—0.5-0.75 mile | 14,824 | $305,436 | $355,742 | $413,880 | 35.5% | 16.3% | $58,138 | $861,835,531 |
| Tollway—0.75-1 mile | 13,238 | $274,257 | $319,428 | $382,637 | 39.5% | 19.8% | $63,209 | $836,763,160 |
| Highway—0.25 mile | 141,694 | $230,197 | $268,111 | $305,163 | 32.6% | 13.8% | $37,052 | $5,250,094,185 |
| Highway—0.25-0.5 mile | 65,971 | $170,899 | $199,046 | $230,858 | 35.1% | 16.0% | $31,812 | $2,098,685,622 |
| Highway—0.5-0.75 mile | 28,775 | $138,987 | $161,879 | $225,540 | 62.3% | 39.3% | $63,662 | $1,831,864,914 |
| Highway—0.75-1 mile | 14,223 | $126,957 | $147,867 | $218,760 | 72.3% | 47.9% | $70,893 | $1,008,316,181 |
| **TOTAL OR AVERAGE** | **272,182** | **$190,183** | **$221,506** | **$264,160** | **38.9%** | **19.3%** | **$42,654** | |

**Table 3: Dallas County Change in Appraised Property Values, 2004-2008**

| Dallas Parcel Proximity to: | Number of Properties | 2004 Appraisal | 2004 Appraisal (in 2008$) with Inflation | 2008 Appraisal | 2004-2008 Percent Change without Inflation | 2004-2008 Percent Change with Inflation | 2004-2008 Value Change with Inflation | 2004-2008 Aggregate Value Change with Inflation |
|---|---|---|---|---|---|---|---|---|
| Light Rail—0.25 mile | 23,192 | $576,046 | $633,651 | $778,327 | 35.1% | 22.8% | $144,676 | $3,355,324,500 |
| Light Rail—0.25-0.5 mile | 25,157 | $333,705 | $367,075 | $451,031 | 35.2% | 22.9% | $83,955 | $2,112,063,424 |
| Light Rail—0.5-0.75 mile | 25,434 | $268,125 | $294,938 | $358,512 | 33.7% | 21.6% | $63,575 | $1,616,954,605 |
| Light Rail—0.75-1 mile | 23,877 | $240,677 | $264,745 | $304,619 | 26.6% | 15.1% | $39,874 | $952,073,255 |
| Freight Rail—0.25 mile | 41,850 | $314,542 | $345,996 | $415,869 | 32.2% | 20.2% | $69,873 | $2,924,183,022 |
| Freight Rail—0.25-0.5 mile | 46,380 | $203,586 | $223,944 | $254,123 | 24.8% | 13.5% | $30,179 | $1,399,707,818 |
| Freight Rail—0.5-0.75 mile | 44,482 | $214,201 | $235,621 | $279,539 | 30.5% | 18.6% | $43,918 | $1,953,547,575 |
| Freight Rail—0.75-1 mile | 41,554 | $209,087 | $229,996 | $254,907 | 21.9% | 10.8% | $24,912 | $1,035,181,006 |
| Tollway—0.25 mile | 12,548 | $684,719 | $753,191 | $942,195 | 37.6% | 25.1% | $189,004 | $2,371,626,221 |
| Tollway—0.25-0.5 mile | 15,347 | $472,115 | $519,326 | $644,451 | 36.5% | 24.1% | $125,124 | $1,920,285,357 |
| Tollway—0.5-0.75 mile | 16,689 | $426,187 | $468,806 | $612,167 | 43.6% | 30.6% | $143,361 | $2,392,557,589 |
| Tollway—0.75-1 mile | 17,933 | $418,904 | $460,794 | $616,133 | 47.1% | 33.7% | $155,339 | $2,785,687,775 |
| Highway—0.25 mile | 134,687 | $370,260 | $407,286 | $498,692 | 34.7% | 22.4% | $91,405 | $12,311,072,054 |
| Highway—0.25-0.5 mile | 111,051 | $191,413 | $210,554 | $241,106 | 26.0% | 14.5% | $30,551 | $3,392,758,779 |
| Highway—0.5-0.75 mile | 75,069 | $174,100 | $191,510 | $214,050 | 22.9% | 11.8% | $22,540 | $1,692,081,674 |
| Highway—0.75-1 mile | 46,184 | $177,723 | $195,496 | $210,686 | 18.5% | 7.8% | $15,190 | $701,529,591 |
| **TOTAL OR AVERAGE** | **428,528** | **$236,710** | **$260,380** | **$303,964** | **28.4%** | **16.7%** | **$43,583** | |

Note: The number of parcels for Dallas County only includes the city of Dallas, which covers 85 percent of Dallas County.

**Table 4: Tarrant County Change in Appraised Property Values, 2004-2008**

| Tarrant County Parcel Proximity to: | Number of Properties | 2004 Appraisal | 2004 Appraisal (in 2008$) with Inflation | 2008 Appraisal | 2004-2008 Percent Change without Inflation | 2004-2008 Percent Change with Inflation | 2004-2008 Value Change with Inflation | 2004-2008 Aggregate Value Change with Inflation |
|---|---|---|---|---|---|---|---|---|
| Light Rail—0.25 mile | 11,745 | $294,794 | $345,734 | $356,708 | 21.0% | 3.2% | $10,974 | $128,883,362 |
| Light Rail—0.25-0.5 mile | 16,271 | $192,570 | $225,846 | $236,107 | 22.6% | 4.5% | $10,262 | $166,969,565 |
| Light Rail—0.5-0.75 mile | 17,260 | $180,814 | $212,059 | $202,582 | 12.0% | −4.5% | $(9,476) | $(163,564,754) |
| Light Rail—0.75-1 mile | 17,340 | $187,352 | $219,726 | $204,713 | 9.3% | −6.8% | $(8,424) | $(146,068,192) |
| Freight Rail—0.25 mile | 54,847 | $162,673 | $190,783 | $191,136 | 17.5% | 0.2% | $353 | $19,349,742 |
| Freight Rail—0.25-0.5 mile | 53,095 | $130,824 | $153,431 | $154,047 | 17.8% | 0.4% | $616 | $32,698,316 |
| Freight Rail—0.5-0.75 mile | 44,027 | $131,765 | $154,534 | $170,501 | 29.4% | 10.3% | $15,967 | $702,974,685 |
| Freight Rail—0.75-1 mile | 38,494 | $133,874 | $157,008 | $156,491 | 16.9% | −0.3% | $(516) | $(19,879,542) |
| Tollway—0.25 mile | 4,952 | $357,030 | $418,725 | $383,973 | 7.5% | −8.3% | $(34,752) | $(172,093,772) |
| Tollway—0.25-0.5 mile | 9,222 | $246,930 | $289,600 | $285,449 | 15.6% | −1.4% | $(4,151) | $(38,280,370) |
| Tollway—0.5-0.75 mile | 12,086 | $189,171 | $221,859 | $235,472 | 24.5% | 6.1% | $13,613 | $164,520,756 |
| Tollway—0.75-1 mile | 13,245 | $202,271 | $237,224 | $248,634 | 22.9% | 4.8% | $11,411 | $151,134,010 |
| Highway—0.25 mile | 345,815 | $177,736 | $208,448 | $203,452 | 14.5% | −2.4% | $(3,506) | $(1,212,269,083) |
| Highway—0.25-0.5 mile | 129,817 | $131,262 | $153,944 | $156,572 | 19.3% | 1.7% | $2,628 | $341,214,384 |
| Highway—0.5-0.75 mile | 33,604 | $158,230 | $185,572 | $197,630 | 24.9% | 6.5% | $12,058 | $405,194,670 |
| Highway—0.75-1 mile | 12,997 | $174,063 | $204,141 | $233,727 | 34.3% | 14.5% | $29,586 | $384,533,099 |
| **TOTAL OR AVERAGE** | **535,671** | **$164,550** | **$192,984** | **$192,749** | **17.1%** | **−0.1%** | **$728** | |

Figures 5 and 6 are the maps for appraised property value change and population density distributing to roads in Collin County, respectively. Both maps display a strong connection from appraised property values and population density to transportation links based on a geographic representation of the information from the previous tables on property value changes between 2004 and 2008. In Figure 5, darker parcels represent areas of the greatest positive change in property value between 2004 and 2008, whereas lighter parcels represent areas of zero or negative property value change since 2004. For a majority of the parcels showing significant positive changes in value, these parcels are largely adjacent to one or more transportation infrastructure routes in Collin County. Moreover, Figure 6 demonstrates that the greatest population densities are similarly concentrated in the same area of the county. Collin County's existing transportation infrastructure is mainly concentrated in the southwestern part of the county, with the north, northeastern, and eastern parts of the county still largely agricultural and/or undeveloped. Multiple studies and plans exist for extending several of the existing transportation routes further into the county to accommodate future development. Additional funding for current and future infrastructure development and maintenance via a transportation reinvestment zone around new transportation infrastructure provides another source of funding to leverage additional funding such as tollway revenue.

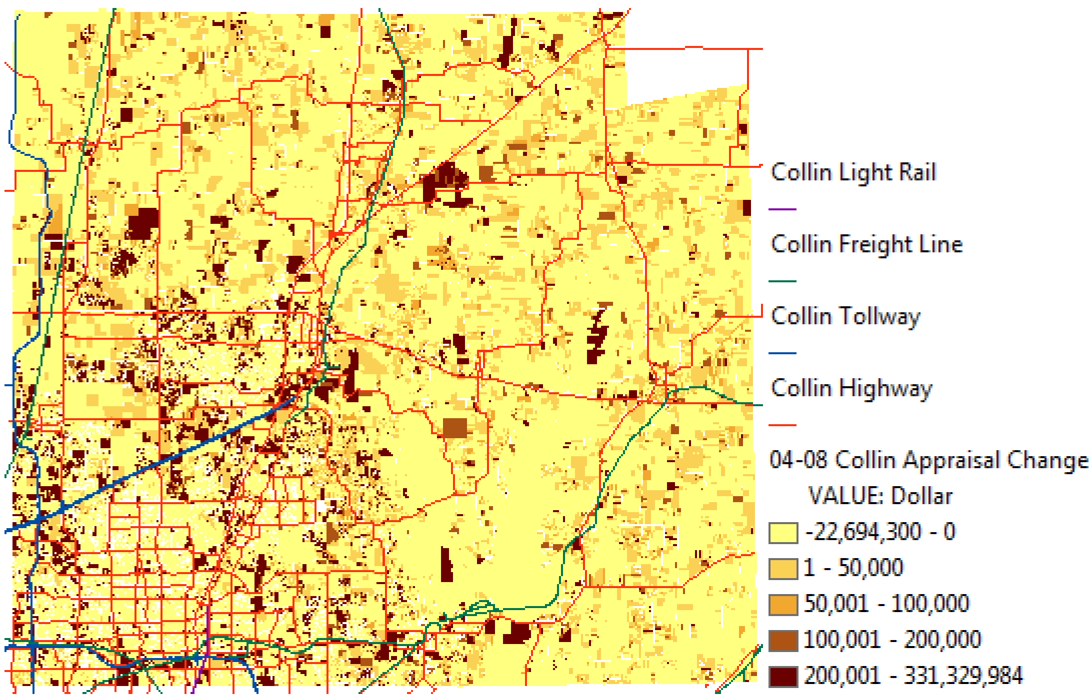


**Figure 5: 2004-2008 Appraised Property Value Change in Collin County**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

It is important to note the concept of population validation before discussing Figure 6. Population density for each of the three areas under study used 0.5-mile grids based on the smallest population density area consisting of census blocks. By creating a raster model, the model assumed that people will not live where there are no roads. Population distribution was based on the roads each block contains. Due to the fact that some people may live where there are no roads, the population validation error accounts for this discrepancy by calculating the percentage error from converting the data into a raster format. In the case of Collin County, the percentage error is 0.105 percent, indicating that the model accounts for approximately 99.895 percent of the population.

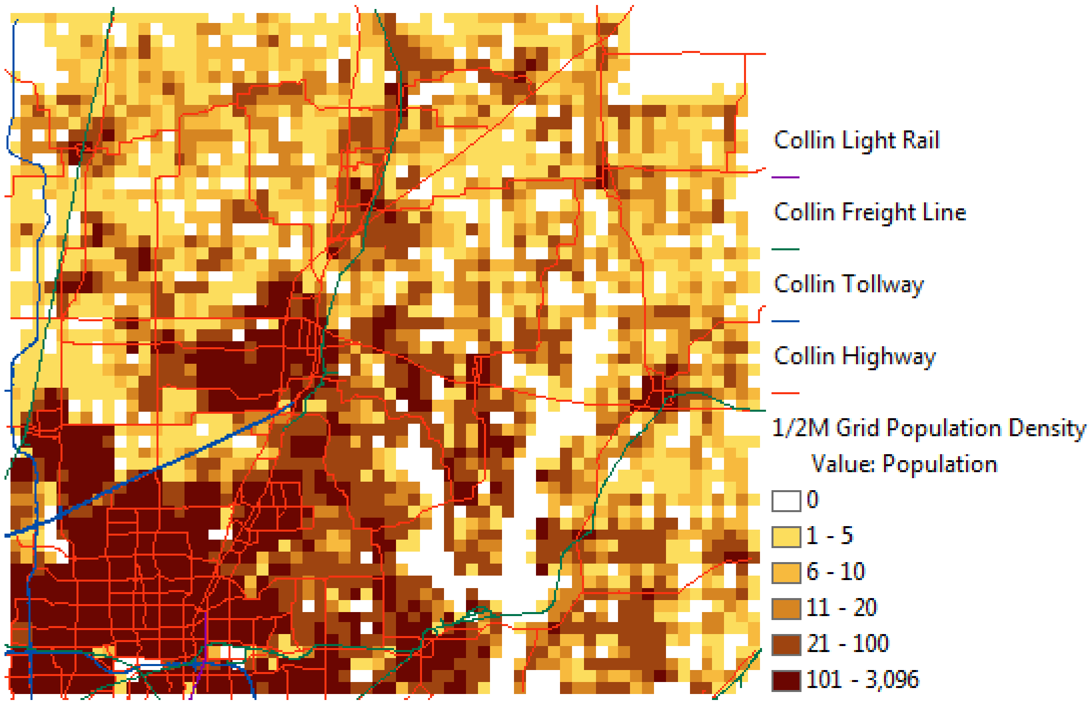


**Figure 6: Collin County Population Density Map with Transportation Infrastructure**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

Population Validation: % Error = [(492,192 – 491,675) / 491,675] * 100 = 0.105%

Figures 7 and 8 for Dallas and Figures 9 and 10 for Tarrant County exhibit characteristics similar to Collin County in the patterns of density and appreciation in appraised value in relation to proximity to transportation infrastructure.

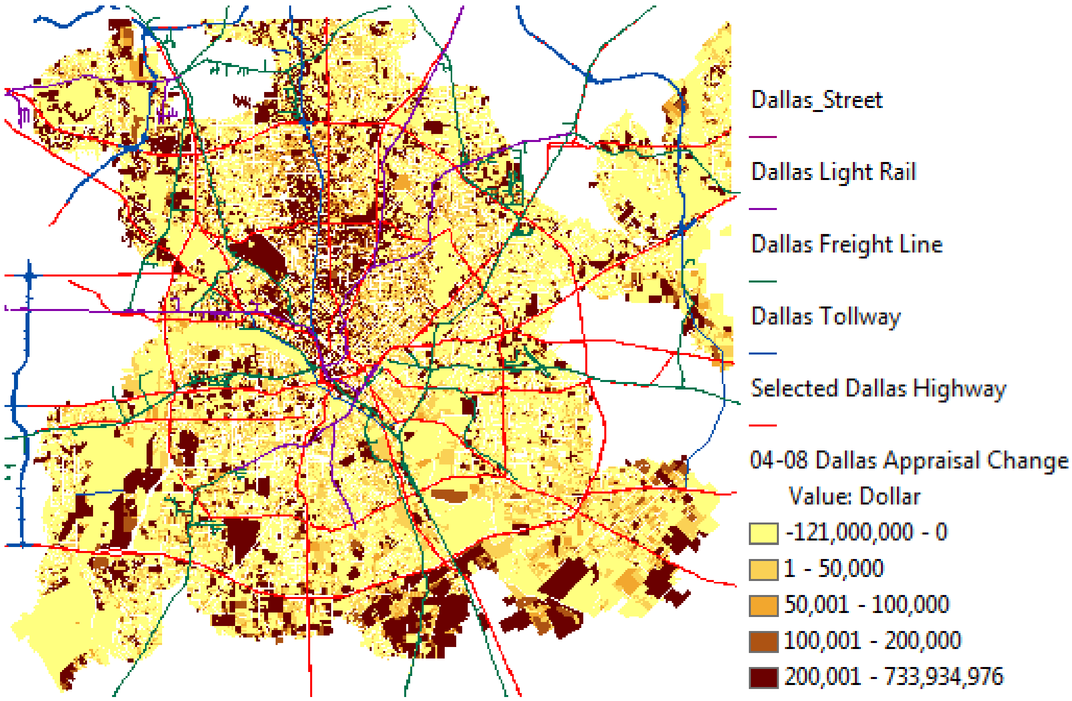


**Figure 7: 2004-2008 Appraised Property Value Change for the City of Dallas**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

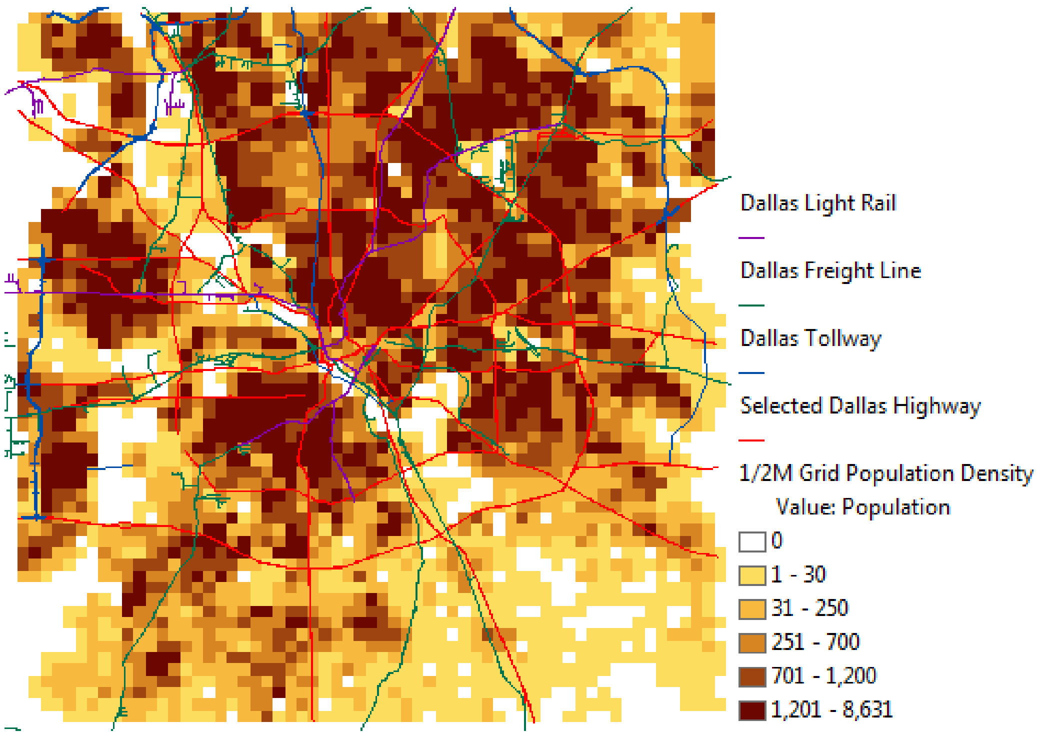


**Figure 8: Dallas County Population Density Map with Major Transportation Infrastructure**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

Population Validation: % Error = [(2,217,586 – 2,218,899) / 2,218,899] * 100 = 0.059%

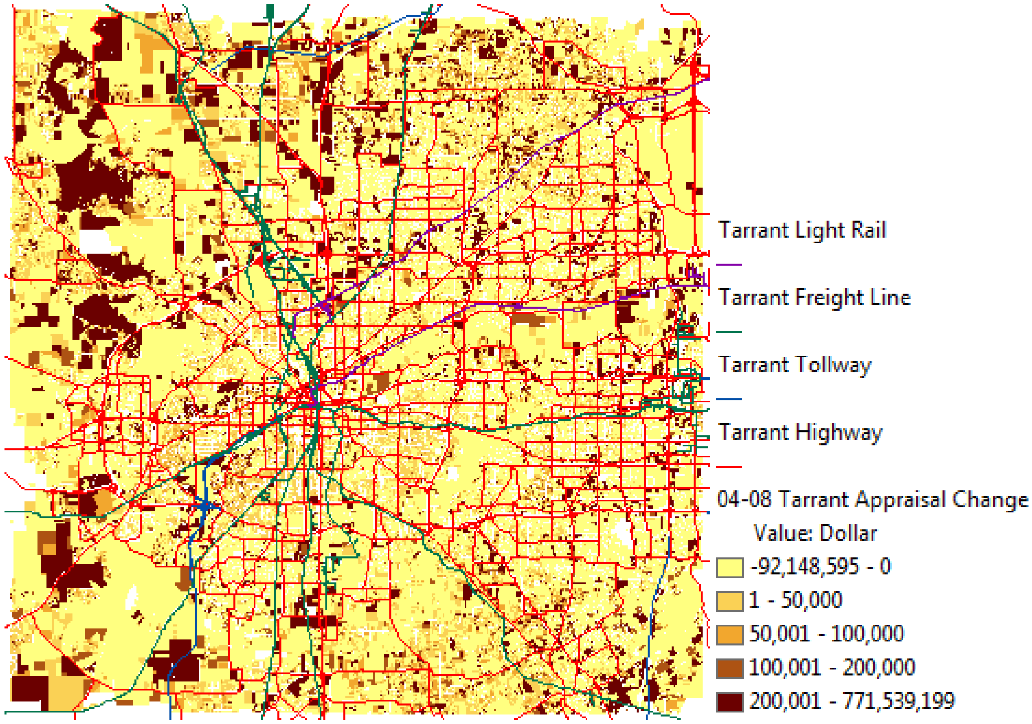


**Figure 9: 2004-2008 Appraised Property Value Change for Tarrant County**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

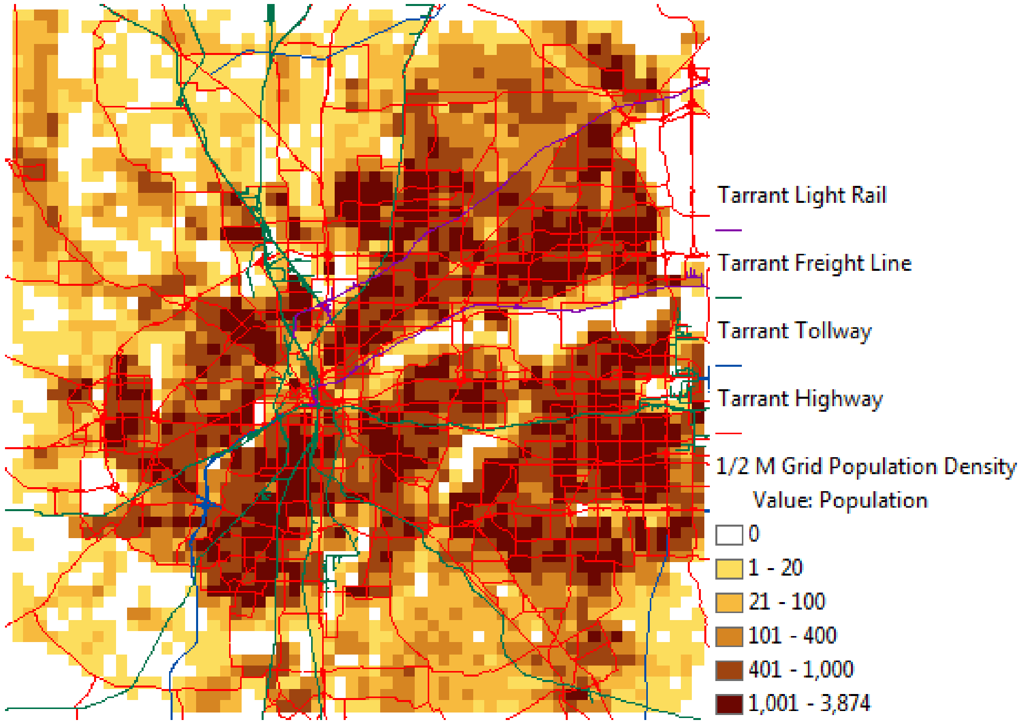


**Figure 10: Tarrant County Population Density Map with Major Transportation Infrastructure**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

Population Validation: % Error = [(1,443,960 – 1,446,219) / 1,446,219] * 100 = 0.156%

The previous series of maps served the purpose to show that greater population densities are located near major transportation infrastructure. Additionally, many of the largest changes in appreciation in appraisal value are also located near the same infrastructure. The purpose of this section was to provide a foundation of the overall layout for each geographic area in the study area. Essentially, it sets the stage for a more rigorous analysis by demonstrating that people do live near transportation and that positive changes in value exist near transportation, but this section does not determine whether these changes are significant given all the property values in each area. In other words, it is not enough to explore the connection from the GIS maps, despite the simplicity the maps provide in showing the basic big picture. Using statistical methods, these simple maps gain greater meaning in determining whether a tax-increment finance district created under the powers of a regional mobility authority is worth pursuing as a regional solution to the transportation funding issue facing the Dallas-Fort Worth Metroplex. The next section applies hot-spot analysis to determine whether the property values proximate to transportation infrastructure increased at a statistically significant amount between 2004 and 2008.

## 3.4 Spatial Autocorrelation

Spatial autocorrelation needed to be tested on the data first before applying hot spot analysis. This tool helps to determine the distance for the spatial processes that highlight where spatial clustering in change in values is most pronounced. Spatial autocorrelation (Global Moran's I) is a global statistics tool to indentify the overall patterns or trends of spatial data. Spatial autocorrelation is nothing more than a way to ensure that the model is properly calibrated for the analysis of the real estate values. It works by comparing the feature locations or attributes to a theoretical random distribution in order to determine if they have statistically significant clustering or dispersion (ESRI, 2006).

Global Moran's I can identify two distinct patterns simultaneously in a dataset. The first pattern shows whether features are generally clustered or not clustered. The second pattern, and the pattern most important for the present analysis, identifies where features with similar attribute values cluster spatially together. Using Global Moran's I indicates clustering or positive spatial autocorrelation if high values cluster together, and/or if low values cluster together, but it cannot distinguish between these situations. The General G statistic distinguishes between hot spots and cold spots. It identifies spatial concentrations. The General G statistic is interpreted relative to its expected value, which means if it has a larger than expected value compared to the overall area, it would be a potential "hot spot" and if it has a smaller than expected value, it would be potential "cold spot". The Z test statistic is used to test the expected value if the difference is sufficient to be statistically significant. If the Z test statistic is significant and positive (above 1.96) and these values can be mapped, the patterns between these clusters and nearby transportation infrastructures can be examined.

For Collin County, there are 3,547 commercial parcels and 1,301 industrial parcels. Thus the sample size is 4,848. Spatial autocorrelation was run multiple times to get the exact fitness of the Z score. For the input field, the change of appraised property values was the input variable. The fixed distance band was used to conceptualize the spatial relationships, and Euclidean distance was used as the measurement. The last parameter is the distance band, which is the distance that defines the range of spatial interaction among the geographic features. To determine the maximum distance requires running the spatial autocorrelation analysis multiple times.

Using a distance of 0.25 mile, the Z score is 4.13; for 0.5 mile, the Z score increases to 4.22; for 0.75 mile, the Z score is 5.37; for 1 mile, it increases to 5.81; for 1.25 miles, the Z score is 6.39 and reaches its peak; for 1.5 miles, it begins to decrease, and its value is 6.36. The chosen distance band, then, is set at 1.25 miles for the hot-spot analysis. Figure 11 shows the output for the final chosen distance band for Collin County.

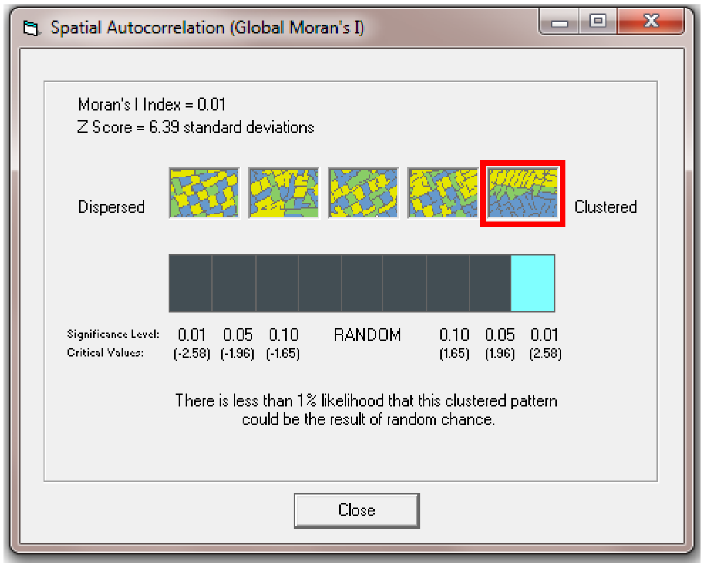


**Figure 11: Result of Spatial Autocorrelation for Commercial and Industrial Uses in Collin County** (Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

From the results, there is definitely significant clustering based on the changes of appraised properties for commercial and industrial parcels in Collin County. The Z score is 6.39 standard deviations with a level of statistical significant at the 0.01 level, the distance band is 10.25 miles, and the Moran's I Index is 0.01. What this output signifies is that the peaks and valleys in the change in appreciation values between 2004 and 2008 are not random but cluster around similar appreciation values. Moreover, these values are based only on the change in appreciation values and not on their proximity to existing transportation infrastructure.

The same spatial autocorrelation process was followed for Dallas County. Figure 12 shows the results for the spatial autocorrelation process for Dallas County. The maximized Z score for Dallas County is 17.24 at a 0.01 level of significance, with a distance band of 1 mile, and Moran's I Index is 0.01. The sample size is 24,761.

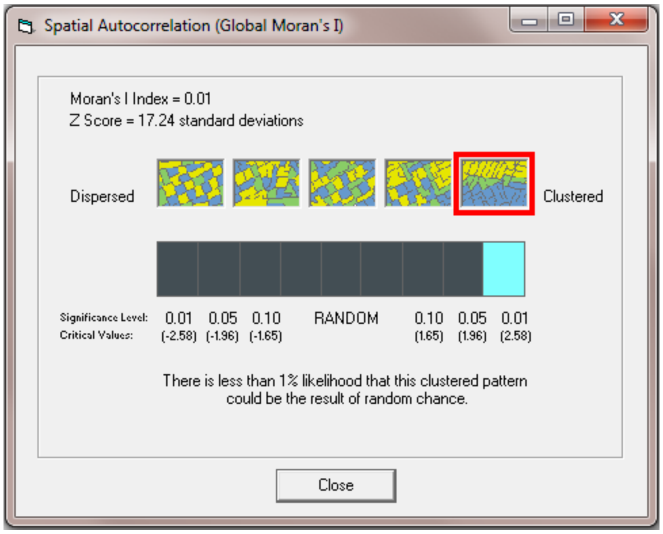


**Figure 12: Result of Spatial Autocorrelation for Commercial and Industrial Uses in Dallas County**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

Using the same process for Collin and Dallas Counties, Figure 13 shows the maximized Z score for Tarrant County is 16.54 at a 0.01 level of significance, with a distance band of 0.5 mile, and Moran's I Index is 0.01. The sample size is 25,818.

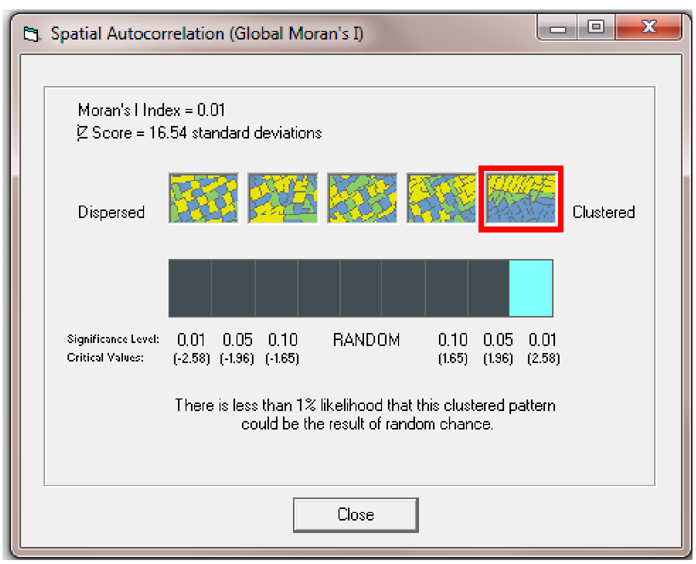


**Figure 13: Result of Spatial Autocorrelation for Commercial and Industrial Uses in Tarrant County**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

The next sections use the distance bands from the spatial autocorrelation tool to apply hot-spot analysis to commercial and industrial properties as well as residential properties.

## 3.5 Hot-Spot Analysis for Commercial and Industrial Development

The previous section examined the general question of whether there is significant clustering of property value change for commercial and industrial properties. Hot-spot analysis provides a method to determine where there are clusters of significant changes in property value, either positive or negative. To accomplish this task requires focusing on commercial and industrial properties separately from residential properties to see whether features with similar attribute values cluster spatially together.

This section uses the Hot Spot Analysis Getis Ord Gi* tool to further test the change of appraised property values for commercial and industrial properties. It can be used to delineate clusters of features with values significantly higher or lower than the overall study area's mean or average value (ESRI, 2006). The input field is the change in appraised property values between 2004 and 2008. The distance band enables a comparison and conceptualization of spatial relationships, and for the distance method, Euclidean distance was used. For the distance band, 1.25 miles was used as derived from the methods in the previous section. Figure 14 is the hot-spot outcome map for Collin County based exclusively on commercial and industrial properties with the major transportation infrastructure linkages included.

A Z score is simply a measure of standard deviation. For example, if the property has a Z score of 2.5, this is interpreted as 2.5 standard deviations. A Z score is a reference value that is associated with a standard normal distribution. Therefore, a very high or very low Z score would be found in the tails of the normal distributions. For these pattern analysis tools, a very high or a very low Z score highlights a spatial pattern that deviates significantly from a hypothetical random pattern. Generally, the critical values for Z scores using a 95 percent confidence interval are −1.96 and 1.96 standard deviations. So if the Z score is between −1.96 and 1.96, it means that there is no observed pattern or relationship between the change in property value and the proximity to transportation infrastructure. When the Z score falls outside that range, for example, a very high or very low score such as −2.58 or +6.39, the pattern is not random, signifying that the pattern is either clustered for a high Z score or dispersed for a low, negative Z score.

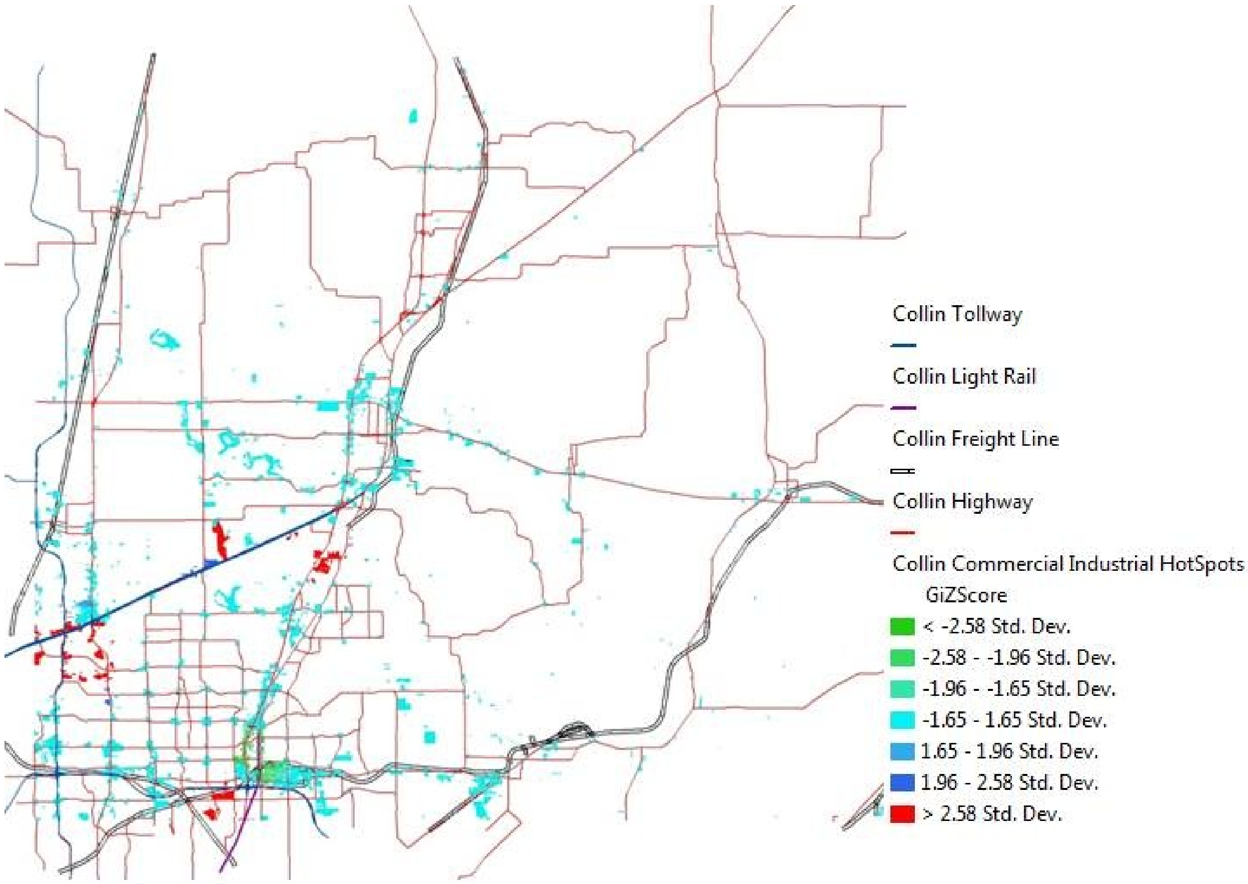


**Figure 14: Hot-Spot Analysis Map for Commercial and Industrial Properties in Collin County**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

From Figure 14, although the hot-spot clusters are not distinct due to the level of detail, a majority of property value hot spots appear close to the major transportation links. Because there are only 4,848 properties of commercial and industrial parcels in Collin County, the hot-spot areas are relatively small but cluster around the existing transportation infrastructure. This outcome provides support that commercial and industrial property values located proximate to transportation linkages largely appreciated at a rate significantly greater than properties located further away from transportation networks. Given that Collin County is still a growing county with transportation infrastructure expanding to accommodate current and future growth, it is likely that future infrastructure expansion will follow a similar pattern, with commercial and industrial uses concentrated around future transportation improvements.

Next, the hot-spot tool tested commercial and industrial parcels in the city of Dallas and Tarrant County. Figure 15 is the hot-spot map for commercial and industrial parcels in Dallas County using 1 mile as the distance band. Most commercial and industrial hot spots are located along the existing major transportation infrastructure. This observation is most noticeable in the red areas that are in a corridor from downtown to the north.

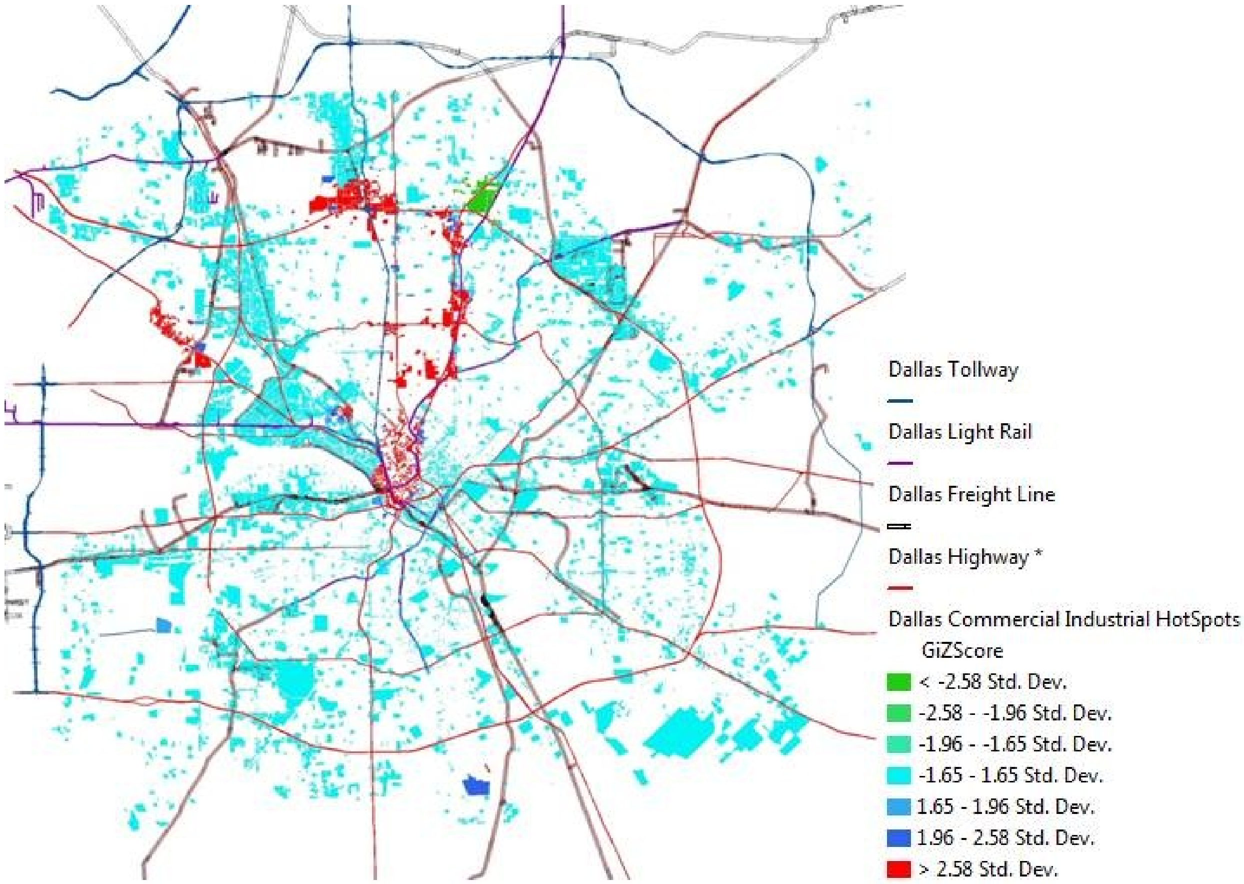


**Figure 15: Hot-Spot Analysis Map for Commercial and Industrial Properties in the City of Dallas**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

Due to the density of property development in Tarrant County, a distance band of 0.5 mile was used. Similar to the results for Collin County, the hot-spot results for commercial and industrial parcels are small and discrete, as shown throughout the map in Figure 16. Unlike Collin County, there are more clusters that had negative property appreciation between 2004 and 2008. A major reason for this is the generally low average appraised property value increase in comparison to the city of Dallas and Collin County. Despite the 17.28 percent inflation figure, there are several properties that have a negative value change in appraisal. This observation suggests that despite the inflation figure, development in the county is uneven, with some areas showing disinvestment or abandonment.

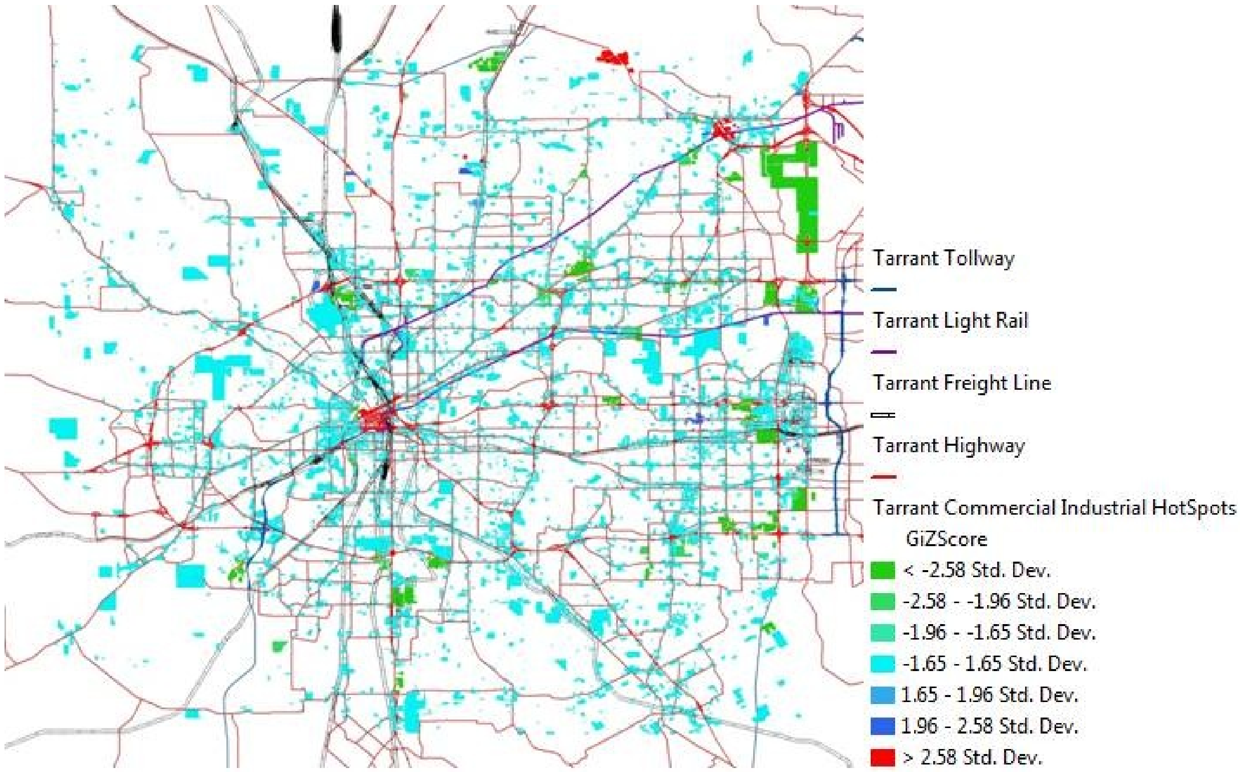


**Figure 16: Hot-Spot Analysis Map for Commercial and Industrial Properties in Tarrant County**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

Comparing the three counties, Dallas County has the most significant hot-spot pattern in change of appraisal value of commercial and industrial properties from 2004 to 2008. Thus, the hot-spot analysis supports the concept that a majority of commercial and industrial properties located within 1 mile of transportation infrastructure have increased positively and significantly in property value compared to properties located further away from transportation infrastructure. In other words, looking at assessed property values shows change, but the hot-spot analysis shows that a strong pattern exists between positive change in assessed value and location to major transportation infrastructure. More importantly, the results provide evidence that a tax-increment finance strategy implemented under a regional mobility authority may provide enough of a tax increment to maintain and enhance the nearby major transportation infrastructure.

## 3.6 Hot-Spot Analysis for Residential Single-Family Development

Residential single-family properties constitute the largest use of developed property in the three counties. Based on land use coverage, each county has more than 80 percent of its parcels classified as single-family residential uses. Examining the spatial pattern of single-family housing provides insight into whether residential usage patterns reflect the commercial and industrial patterns in relation to transportation infrastructure.

Unlike spatial analysis for commercial and industrial properties in the previous sections, the number of residential single-family properties for all three counties was too large to directly apply the exact same spatial analysis used for the commercial and industrial hot-spot analysis. In order to conduct spatial autocorrelation and hot-spot analysis for residential single-family uses, it was necessary to complete two steps before the analysis. The first step converted parcel polygons to points, and the second step added in a spatial weights matrix. Both steps enabled accurate calculation without compromising the outcomes of spatial autocorrelation and hot-spot analysis.

## Collin County

For Collin County, the following steps were taken to convert the file:

1. Convert Collin County residential single-family parcels from polygon to point.
2. Construct a spatial weights matrix using k-nearest neighbors and 60 as the value of nearest neighbors.
3. Run spatial autocorrelation (Moran's I) with a spatial weights matrix by selecting "Get Spatial Weights from File" as a spatial relationship, and use the result created in step 2.
4. Check the output of Local Moran I. The sample size is 201,568. The Z score is 1,453.56 standard deviations, which is large enough for statistical validity. The Moran's Index is 0.57. The significance level is 0.01, which means that the pattern is very clustered, as shown in Figure 17.

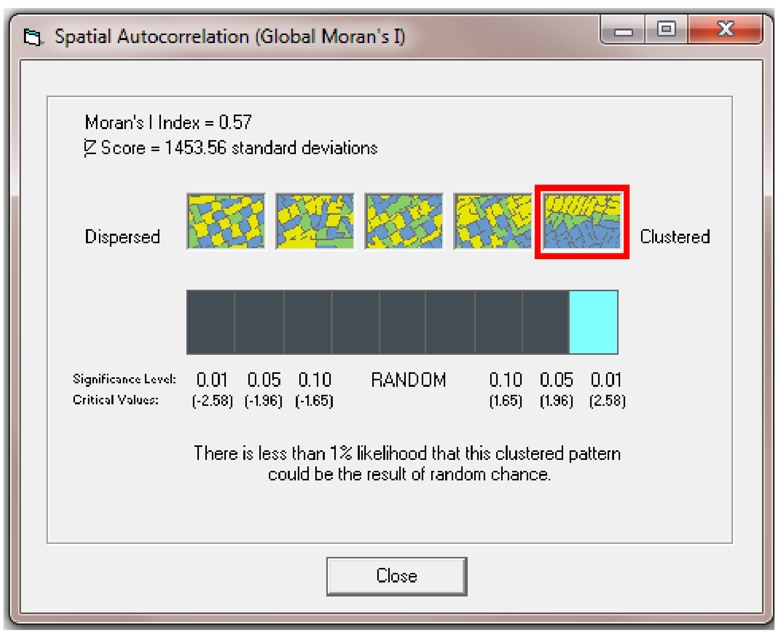


**Figure 17: Spatial Autocorrelation Output for Residential Single-Family Properties in Collin County** (Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

5. Run hot-spot analysis using the same spatial weights matrix, and get the final hot-spot map for residential single-family analysis in Collin County. The input field used in the above steps is the change of appraised value from 2004 to 2008. Using the appraised value as the input field means that the clusters will represent areas where properties appreciated at a high rate between 2004 and 2008 or depreciated at a high rate.

From the hot-spot pattern in Figure 18, the largest increases in appraised value in residential single-family residential land uses were located near several existing transportation links throughout Collin County. These results appear in the red areas throughout the county.

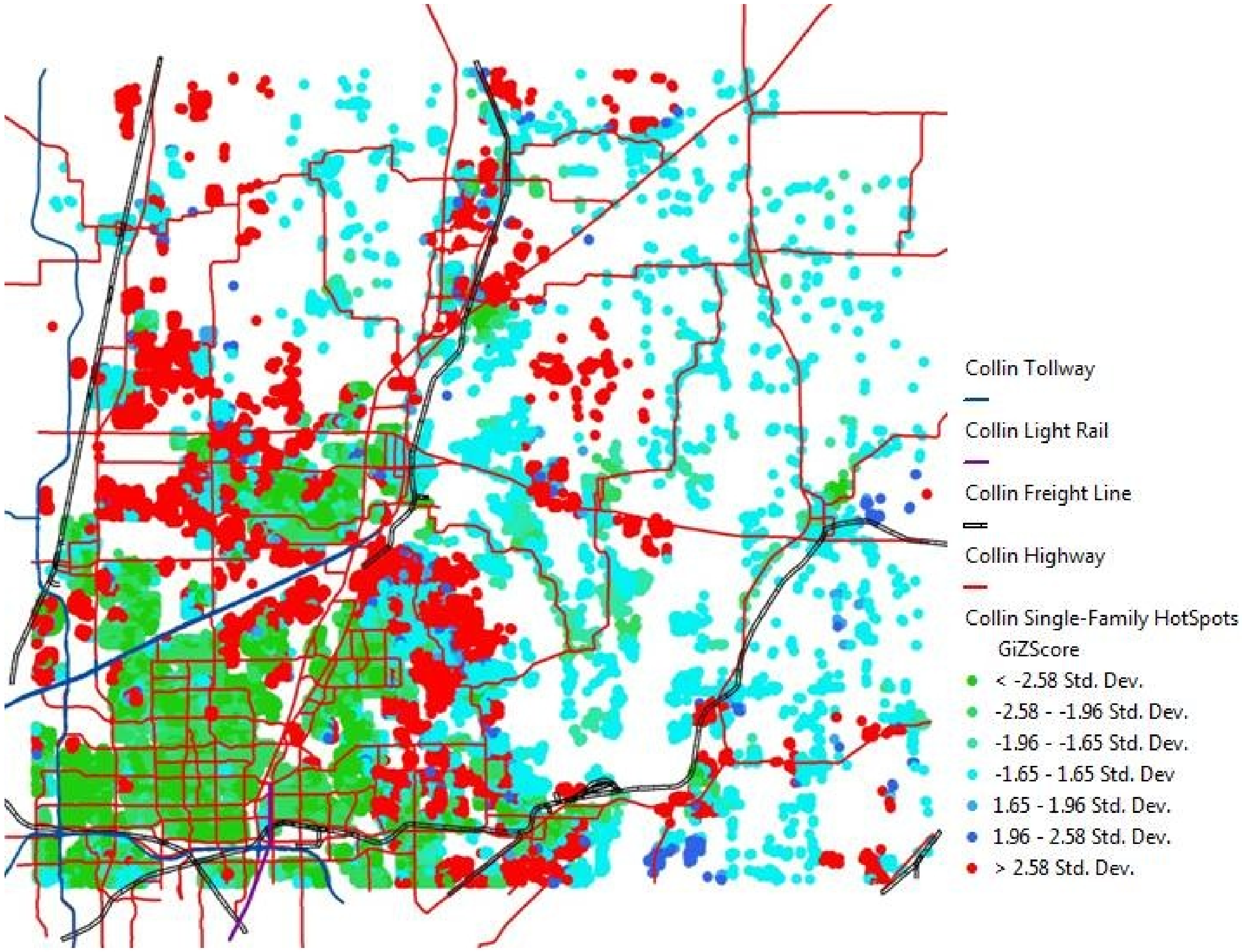


**Figure 18: Residential Hot-Spot Analysis for Collin County**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

## Dallas County

The process was repeated for Dallas County using the data for the city of Dallas:

1. Convert Dallas County residential single-family parcels from polygon to point.
2. Construct a spatial weights matrix using k-nearest neighbors and 60 as the value of nearest neighbors.
3. Run spatial autocorrelation (Local Moran's I) with a spatial weights matrix by selecting "Get Spatial Weights from File" as a spatial relationship, and use the result created in step 2.
4. Check the output of Local Moran's I. The sample size is 317,268. The Z score is 759.85 standard deviations, which is large enough. The Moran's I is 0.21. The significance level is 0.01, meaning that the pattern is clustered and not random, as shown in Figure 19.

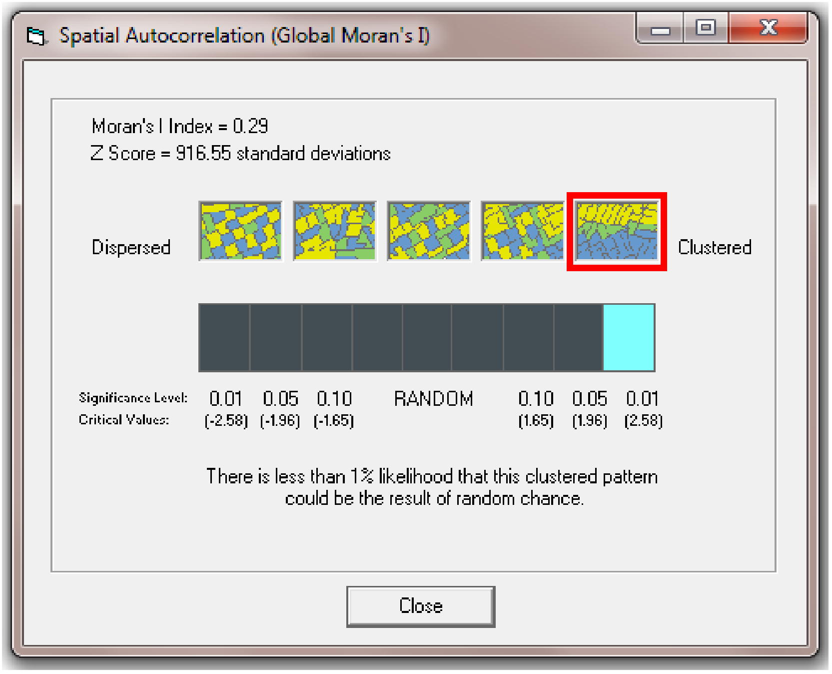


**Figure 19: Spatial Autocorrelation Output for Residential Single-Family Properties in Dallas County** (Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

5. Run hot-spot analysis using the same spatial weights matrix, and get the final hot-spot map for residential single-family uses in the city of Dallas. Figure 20 indicates a significant cluster of high property value appreciation in the central to north Dallas area, which denotes a high increase in overall property value compared to surrounding values. These property values also correspond to a high-value corridor along the Highway 75/DART light-rail line corridor north into Collin County.
6. The asterisk next to Dallas Highway in Figure 20 denotes the fact that only major highways were included in the map to better indicate the location of hot spots.

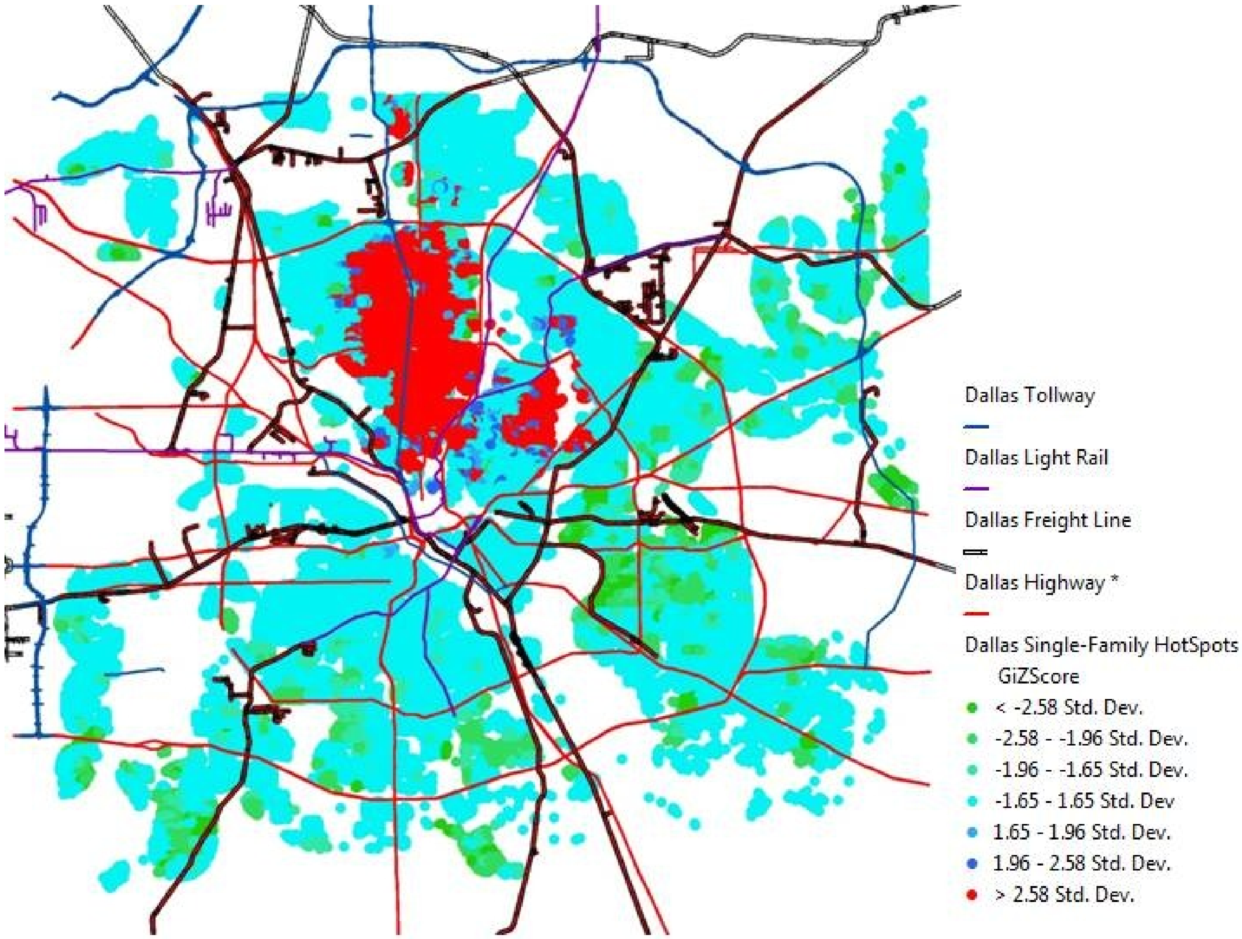


**Figure 20: Residential Hot-Spot Analysis for Dallas County**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

## Tarrant County

For Tarrant County, the same steps were followed as for Collin and Dallas Counties:

1. Convert Tarrant County residential single-family parcels from polygon to point.
2. Construct a spatial weights matrix using k-nearest neighbors and 60 as the value of nearest neighbors.
3. Run spatial autocorrelation (Local Moran's I) with a spatial weights matrix by selecting "Get Spatial Weights from File" as a spatial relationship, and use the result created in step 2.
4. Check the output of Local Moran's I. The sample size is 402,493. The Z score is 759.85 standard deviations, which is large enough to run the data. Moran's Index is 0.21. The significance level is 0.01, meaning that the appreciation value pattern is clustered. These results are shown in Figure 21.

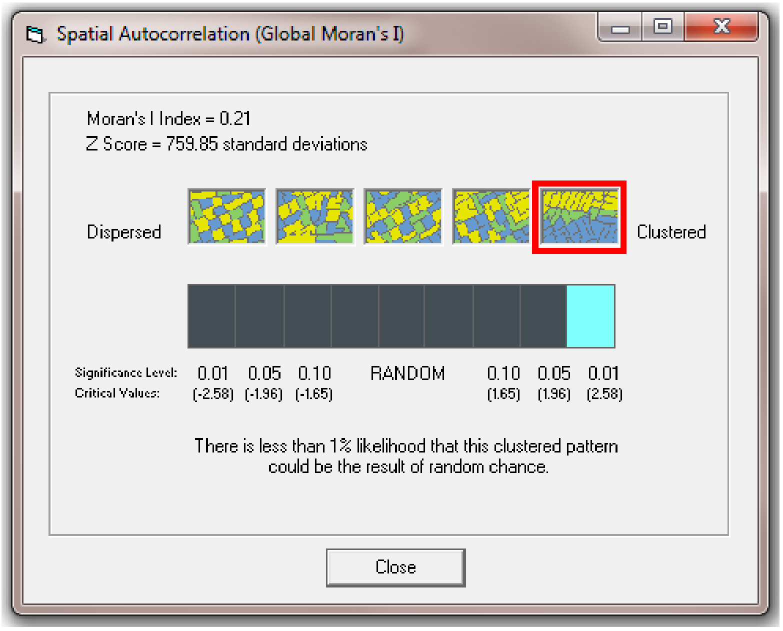


**Figure 21: Spatial Autocorrelation Output for Residential Single-Family Properties in Tarrant County** (Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

5. Run hot-spot analysis using the same spatial weights matrix, and get the final hot-spot map for residential single-family uses in Tarrant County.

From Figure 22, most of the points have standard deviations ranging from −1.65 to 1.66. Considering the 17.28 percent inflation rate from 2004 to 2008, there is a small fluctuation in the appraised value change for most of the residential single-family housing. While the appreciation rates are clustered, there is no significant appreciation trend in hot spots and cold spots. This result means that residential property values in Tarrant County have appreciated at a constant rate compared to the median appreciation rate. Additionally, while the spatial autocorrelation indicates that the values are clustered, there is little significant change in values across the county. The outcome of this analysis for Tarrant County is essentially that residential property values gradually change throughout the county, but there is no statistical evidence that peaks and valleys exist in relation to appreciation rates between 2004 and 2008.

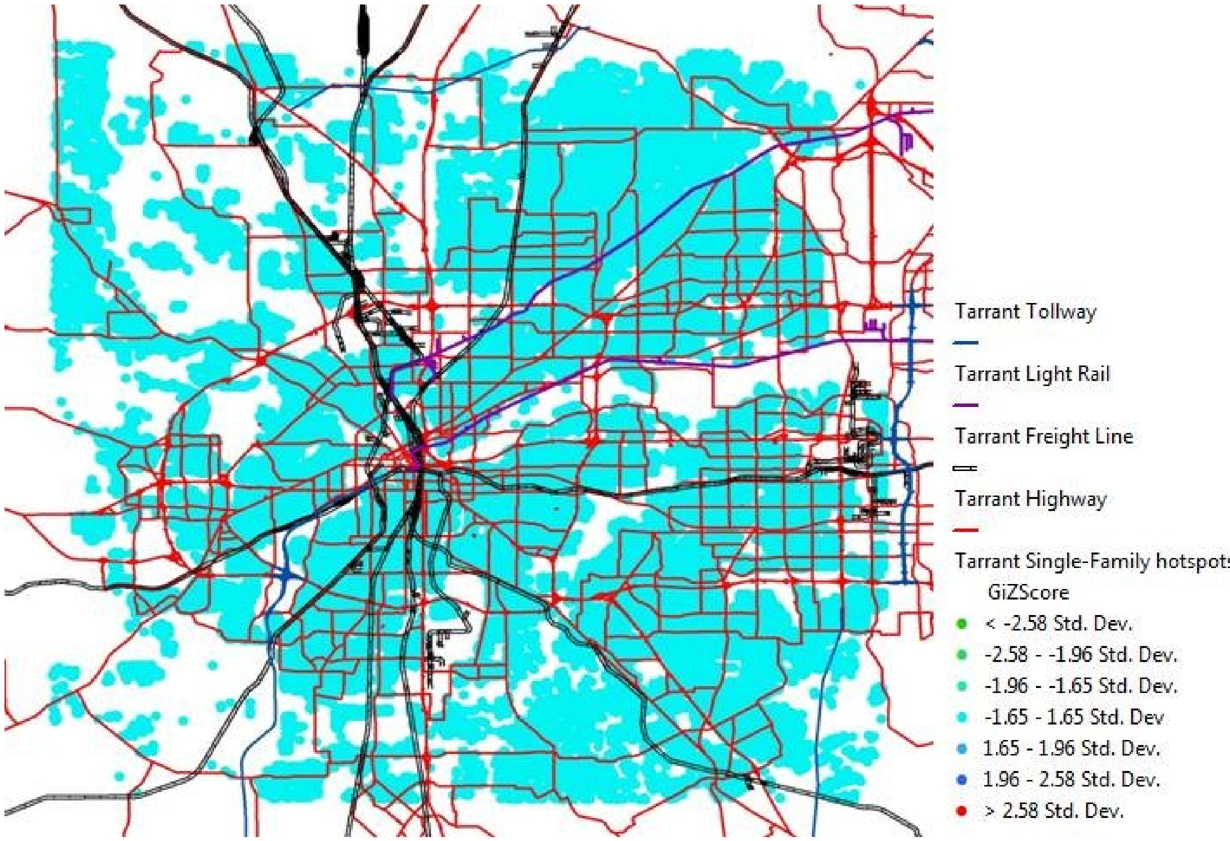


**Figure 22: Residential Hot-Spot Analysis for Tarrant County**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

## 3.7 Conclusions

The purpose of this section served to show the big picture regarding real estate values in relation to proximity to transportation infrastructure. Hot-spot analysis focused on determining whether there were significant changes in property value for commercial, industrial, and residential uses proximate to existing transportation infrastructure. The next section provides case studies that look at specific projects adjacent to existing transportation infrastructure undertaken by tax-increment finance projects. These projects are illustrative of many similar projects being undertaken that take advantage of existing major transportation infrastructure without paying for additional wear and tear to that infrastructure.

## 4 Case Studies

The case studies are included as illustrative examples of development around transportation nodes versus similar areas that underwent large-scale infrastructure improvements between 2004 and 2008. Whereas the hot-spot analysis looks at the big picture regarding individual property appreciation rates, looking at case studies provides examples of the types of developments that create higher property values around transportation nodes. Many of these examples utilize tax-increment finance for the infrastructure improvements with transit-oriented development as the focal point. These case studies will be compared to other recent developments that also use tax-increment finance but do not necessarily use existing transportation nodes. The reason for focusing on tax-increment finance zones underlies the use of their application to large-scale infrastructure improvements on a regional level via regional mobility authorities. Additionally, cities use tax-increment finance to improve access to transportation on a micro level, whereas regional mobility authorities would likely use tax-increment finance on a macro level to fund regional solutions for existing and planned transportation infrastructure improvements.

A brief outline of each case study by tax-increment reinvestment zone is included in Table 5. These projects were selected on the basis of the scale of improvements. All of these districts benefit from their relative locations to highways, tollways, and/or light-rail lines, yet the tax increment generated by these new developments that take advantage of these forms of transportation does not go beyond the transportation infrastructure exclusive to the new developments within each district. Despite attempts to find large-scale land improvements for comparison that were not located near major transportation infrastructure, no significant, major projects were found. Part of this issue stems from the proliferation of state highways throughout the study area, and the other part of the issue is the lack of large-scale improvements, possibly due to the economic downtown.

**Table 5: Brief Overview of Case Studies**

| Tax-increment Reinvestment Zone | Project Name | Location | County | Projects |
|---|---|---|---|---|
| TIRZ #1 | Garden District | Allen | Collin | Streetscape improvements and public parking |
| TIRZ #2 | Cityplace | Dallas | Dallas | Retail, commercial, and multifamily uses |
| TIRZ #7 | Sports Arena | Dallas | Dallas | Infrastructure replacement and enhancement for a sports arena |
| TIRZ #11 | Downtown Connection | Dallas | Dallas | Streetscape improvements, redevelopment of underutilized buildings, linkages with DART, historic preservation |
| TIRZ #14 | Skillman Corridor | Dallas | Dallas | Pedestrian infrastructure improvements, basic infrastructure, linkages to DART, encouragement of residential and retail development |
| TIRZ #3 | Downtown | Fort Worth | Tarrant | Residential, commercial, and retail uses; asbestos abatement and streetscape improvements |
| TIRZ #7 | North Tarrant Parkway | Fort Worth | Tarrant | Street and pedestrian infrastructure improvements |
| TIRZ #12 | East Berry Renaissance | Fort Worth | Tarrant | Street and pedestrian infrastructure improvements |
| TIRZ #2 | HomeTown | North Richland Hills | Tarrant | Improvements to a 42-acre tract of commercial land |
| TIRZ #2 | Historic Downtown | Plano | Collin | Performing arts center, parking, downtown redevelopment, land assembly, DART station |
| TIRZ #1 | Centennial Park | Richardson | Dallas | Pedestrian infrastructure improvements, basic infrastructure, link to future DART stations, residential and retail development |
| TIRZ #1 | Southlake Town Square | Southlake | Tarrant | Infrastructure, streetscape, and pedestrian improvements related to commercial, residential, and retail development |

## 4.1 Garden District, Allen, Collin County

The Garden District TIF Zone (City of Allen, TIRZ #1) was created to provide infrastructure funding for mixed-use development on an undeveloped site that was formerly Montgomery Farm. The mixed-use structures on this site consist of restaurants and retail on the ground floor with apartments and office space on the floors above. Figure 23 provides an overview of the density of development intertwined with open space and interconnected with pedestrian areas (Hammeke, 2009). The zone supplies a source of funding for infrastructure improvements until 2025 via a 20-year term for tax-increment reinvestment. The majority of these funds have been used for streetscape improvements and public parking. At the time of the zone's inception, there were no sales-tax-producing activities. Within three years of the zone's creation, there was over 181,000 square feet of leased retail and restaurant space generating $260,446 in sales tax revenue (City of Allen, 2009).

**Figure 23: Garden District Site Plan**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

From a transportation perspective, this development is located next to U.S. Highway 75 at the Bethany Drive exit. Collin County's tax contribution financed exit ramp improvements, traffic signals, and a bridge, and subsidized many of the new streets for the development. The city of Allen's tax increment is partially funding construction for three parking structures comprising 1,410 parking spaces (City of Allen, 2009). Despite not being on a DART line, the development provides a good example of medium-density, mixed-use infill development at the intersection of a highway and major road to at least minimize the transportation impact of areas further away from the highway. Moreover, several of the new structures are environmentally sustainable. Finally, the development is not just automobile friendly but also pedestrian friendly with several green, open areas, and the development is interconnected with sidewalks.

## 4.2 Cityplace, Dallas, Dallas County

West Village is a walkable residential, retail, and entertainment development within the Cityplace and Uptown area of Dallas created with infrastructure funded by the Cityplace Area TIF District. Interestingly, this area is also part of the red clustered area indicating higher-than-average property value increases from the hot-spot analysis north of downtown Dallas. The original goals of the district focused on overhauling outdated infrastructure and suggesting medium-density residential development in areas away from high-traffic areas and high-rise commercial and residential uses along areas near the freeway. Improvements to infrastructure included the construction of several new streets and extensions of existing streets into the site, putting infrastructure underground to improve the streetscape and pedestrian areas. For pedestrians, the zone provided improvements to the existing trail system and parks as well as several well-landscaped public open areas. Figure 24 provides a cross-section of typical streetscape and pedestrian uses with open space and landscaping throughout the area (City of Dallas, *Cityplace Area TIF District FY 2009 Annual Report,* 2009).

**Figure 24: Example of Pedestrian and Car Thoroughfare in the Cityplace TIF District**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

From a transportation perspective, the location of this zone provides multiple ways to take advantage of existing transportation networks. There are two separate DART rail lines (Red Line and Blue Line) that have stops at Cityplace Station, which is located under Cityplace under U.S. Highway 75. Additionally, aboveground, the McKinney Avenue Transit Authority's streetcar runs a circular route from downtown Dallas to Cityplace Station and throughout the West Village. Several bus stops are also scattered throughout the development. These advantageous transportation nodes intertwine with the surrounding commercial and residential uses. There are several mixed-use developments with ground-floor retail under several floors of residential apartments. Between the mixed-use and single-use residential projects, over 17 of the new developments contain some residential component. Unlike many tax-increment reinvestment zones, the amount of taxes generated in this zone led to its early termination once all infrastructure improvements were funded. The zone's termination was set for the end of 2012, but the completion of all infrastructure improvements occurred by the end of 2008 (City of Dallas, *Cityplace Area TIF District FY 2009 Annual Report,* 2009).

## 4.3 Sports Arena District, Dallas, Dallas County

The purpose of the Sports Arena District was to subsidize infrastructure improvements to areas including and surrounding American Airlines Center. Included in this development program were several hundred condominiums, at least one high-end hotel, and additional office space. All of these infrastructure improvements were reimbursed by the tax increment generated from over $800 million of new development in Victory Park. The focal point of new development (which also accounted for nearly 50 percent of that $800 million in new development) included American Airlines Center. Surrounding developments included a mix of retail, condominiums, apartments, hotel, and office space. The W Dallas Victory Hotel and Residences provided a high-end hotel near the arena. All of the residential developments contain a ground-floor retail component in keeping with the nature of most downtown buildings. Victory Plaza Buildings and One Victory Park provide the office component to the master plan as well as additional space. Figure 25 is a site plan of Victory Park, with the American Airlines Center to the left, the DART light rail line and Victory DART stop are near the bottom left, and the W Dallas Victory Hotel is in the W Hotel Block outlined in the purple box (Stein Planning and Management, 1999).

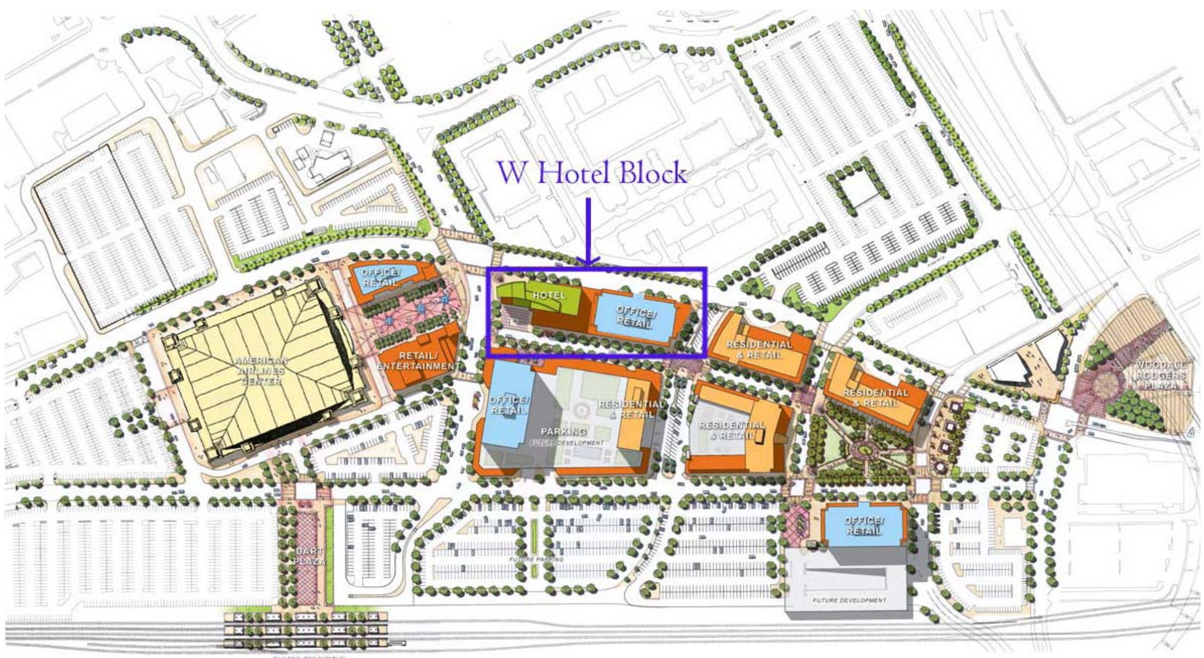


**Figure 25: Victory Park Site Plan**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

This area is better known as Victory Park based on the master plan and new developments. It abuts the North Dallas Tollway as well as light-rail stations for DART and TRE. A portion of the funds generated from the TIF were used to build the Victory DART stop. Many of the infrastructure improvements focused on better connections from a pedestrian and automobile perspective in intertwining American Airlines Center with the existing street network. Other infrastructure improvements include landscape and streetscape improvements, drainage improvements, traffic signals, relocation of some utilities, construction of the Continental Bridge, and improvements to Woodall Rodgers Plaza to enhance the pedestrian aspects of the new developments (City of Dallas Sports Arena Tax Increment Financing District, 2009).

## 4.4 Downtown Connection, Dallas, Dallas County

The Downtown Connection TIF District provided a mechanism for targeting certain parcels for redevelopment while also interweaving this redevelopment within existing downtown development. The tax-increment reinvestment zone specifically covers only a few blocks of the downtown area that are underutilized. In some cases, due to the ages of the buildings in the zone, financing for environmental remediation was included as an acceptable cost to offset expenses related to the removal of asbestos. The redevelopment of buildings within this area should conform to the existing buildings in the area given the historic character in this part of downtown Dallas. The redevelopment of the LTV Building as the Grand Ricchi Dallas provides an example of renovating an existing, underutilized 32-story building into an updated use more conducive to the downtown area. At its completion in late 2011, the Grand Ricchi will be home to a mix of retail and office space on its first several floors with a hotel above those uses. Figure 26 demonstrates the site-specific nature of the Downtown Connection TIF District to focus on redeveloping specific blocks in the downtown area (City of Dallas Downtown Connection TIF, 2009).

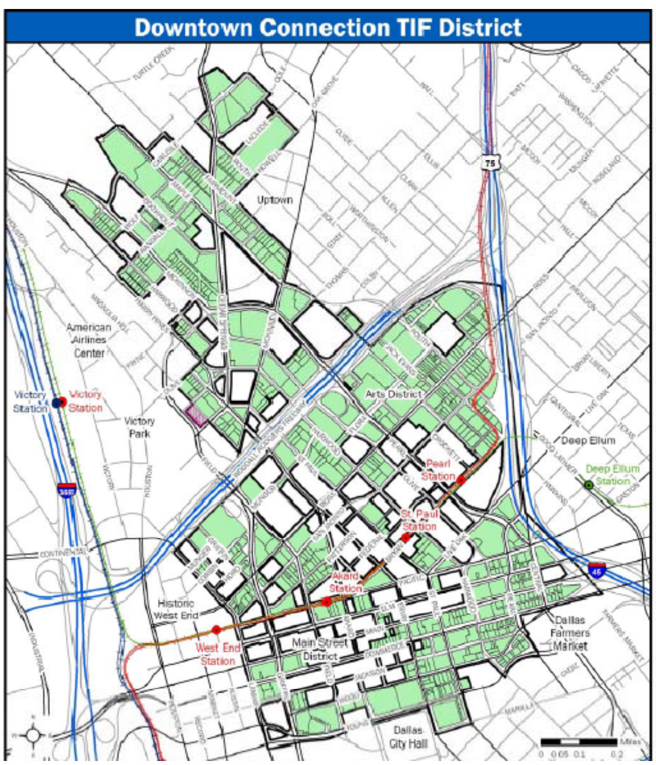


**Figure 26: Downtown Connection Tax-Increment Finance District**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

Infrastructure improvements for this zone revolve around improving the pedestrian-level streetscape for added comfort and safety. Improvements include additional lighting around streets and sidewalks. Perhaps more importantly, the Akard DART Light Rail Station is only a few blocks away. Three different light-rail routes serve this stop on a regular basis, with a fourth route providing limited service during morning and evening rush hours on weekdays. The pedestrian improvements associated with this zone focus largely on increased connectivity to this light-rail stop. Below ground, any new developments should link into the downtown pedestrian tunnel system. Secondary goals related to increasing the level of pedestrian use in this area focus on redeveloping ground-floor retail areas that are vacant as well as converting current underutilized office space into residential uses. There is little mention or discussion of any plan to increase parking for cars, perhaps due to the existence of several parking areas within walking distance of this zone (City of Dallas Downtown Connection TIF, 2009).

## 4.5 Skillman Corridor, Dallas, Dallas County

The Skillman Corridor TIF District encompasses an older residential area primed for redevelopment due to its location near an existing DART rail stop and Highway 635. Additionally, proposals exist for another DART rail station in an area ripe for transit-oriented development with a significant residential component. This zone focuses on an older area of Dallas that contains several older structures with their only viable use being lower-end rental apartments. The proposed plan provides for infrastructure to update and upgrade the current large proportion of rental units into a mix of renter-occupied and owner-occupied residential structures throughout the zone. Despite being located within City of Dallas boundaries, this zone is part of the Richardson School District, making the zone unique because the school district is working with the city to adapt to the changes based on the residential redevelopment of this area (City of Dallas Skillman Corridor Tax Increment Financing District Project Plan and Reinvestment Zone, 2006). Figure 27 highlights the pedestrian-friendly trail aspect of the redevelopment as a focal point within the higher-density residential mixed-use development corridor (City of Dallas Skillman Corridor TIF District, 2009).

**Figure 27: Skillman Corridor TIF Park and Hike-and-Bike Trail Site Plan**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

This zone has only been in existence since 2006, and in that short amount of time, over $500 million in new investment occurred. The biggest project contributing to this added value is the Lake Highlands Town Center, valued at $350 million and containing office, residential, and retail space. Other projects include new homes or the renovation of existing residential and retail uses. The zone partially financed much of the infrastructure necessary to accommodate these higher-intensity uses. The new DART rail line stop, mentioned in the previous paragraph, is the center of studies analyzing how to maximize the transit-oriented development potential of this site by creating the optimal mix of residential, retail, and office uses. Other infrastructure enhancements include a bridge over Jackson Creek, collector streets, traffic and median improvements, and pedestrian access and related improvements. Park space and open space on both sides of Jackson Creek are slated for improved hike-and-bike trails to connect with existing trails on both sides of the zone (City of Dallas Skillman Corridor TIF District, 2009).

## 4.6 Downtown Fort Worth, Fort Worth, Tarrant County

The Fort Worth Rail Market is the result of a public-private project partnership stemming from the Downtown Fort Worth Tax-Increment Finance District (TIRZ #3) and Downtown Fort Worth, Inc. This district's main purpose is to carry out the goals of the 1993 Downtown Plan to overhaul and upgrade the downtown district. The project utilizes the principles of adaptive re-use of a historic structure in addition to its location to major transportation linkages in the downtown Fort Worth area. As an example of redevelopment, the Santa Fe Freight House was redeveloped as a 40,000-square-foot, European-style market. The structure houses a combination of retail space for independent merchants and commercial office space, and also includes a civic component, a community meeting room. The Downtown Fort Worth Tax-Increment Finance District was created in December of 1995 to promote the redevelopment of downtown Fort Worth. As part of the goals of the TIF, asbestos abatement of historic structures was included along with comprehensive streetscape improvements.

Over 400 acres of downtown Fort Worth are included in the district, and it includes the central business district. The eastern border of this district abuts Highway 35 West, and the southern border abuts Highway 30. Moreover, this area is home to two light-rail stops on the Trinity Railway Express and four bus routes, although one of those bus routes only operates on Saturdays (City of Fort Worth, 2009). Despite the location of several transportation nodes, there is little to no mention of transit-oriented development. Infrastructure upgrades are obviously needed to accommodate and stimulate higher-density redevelopment due to this area's historic nature. Accompanying this goal of redevelopment are street improvements, landscaping improvements, and pedestrian improvements. The goal is to make this area vibrant, not just through higher occupancy rates of the surrounding buildings, but also by making it pedestrian friendly with better sidewalks beautified with a landscape element.

## 4.7 North Tarrant Parkway, Fort Worth, Tarrant County

The North Tarrant Parkway Reinvestment Zone covers an area of 2,008 acres, is split nearly down the center of the zone by Interstate 35 West, and is bordered by Highway 287 to the south. It is worth mentioning the size of the site because much of the site was originally undeveloped agricultural land with some commercial uses on it. Given the size of the site and the financially intensive nature of infrastructure improvements to make this site ready for development, the current economic downturn has taken a massive toll on this site's redevelopment. The first large-scale, non-residential portion of the site is being developed as Alliance Town Center and a site plan for the center is in Figure 28. As of the 2010 tax-increment report, the financial projections for the redevelopment of this site were off by nearly $150 million (City of Fort Worth, 2010). Part of the problem is that it took almost four years for the completion of basic infrastructure before the site was ready for development.


**Figure 28: North Tarrant Parkway TIF: Alliance Town Center Site Plan**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

Infrastructure improvements also included the construction of interchange ramps for North Tarrant Parkway from Interstate 35 West, frontage roads, and connectors to the existing street network. All of these improvements are in conjunction with Alliance Town Center, part of a larger, 17,000-acre development. The ultimate development goal is a mix of over 2 million square feet of retail, office, and residential uses throughout the entire development. While pedestrian-friendly environments are mentioned, there is no explicit plan for pedestrian improvements. While the area is close to two highly traveled highways, there is no light-rail stop in this development, and despite the economic downturn, it is in a high-growth area in north Tarrant County.

## 4.8 East Berry Renaissance, Fort Worth, Tarrant County

The goal of this zone is to improve the street network, sidewalks, and landscaping in this area that is a mix of residential and commercial uses. The area has Interstate 35 West as a border on the west side, with Highway 287 as the border on the east side. East Berry Street runs the length of this corridor from east to west and is the focal point of improvements to this area (City of Fort Worth, 2010). Similar to the North Tarrant Parkway TIF, this zone was created in 2006 and suffers from poor timing due to the recession. Despite the economic issues, Renaissance Square was completed as a new shopping center in Fort Worth. It is home to at least 30 retail stores, a mid-sized grocery store, a department store, and several other complementary uses.

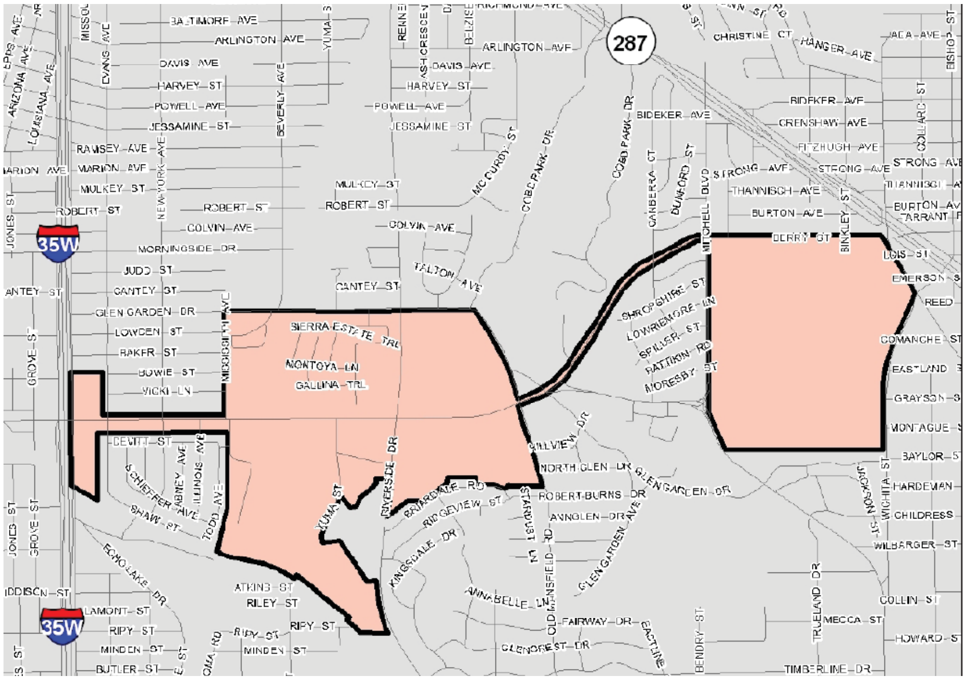

**Figure 29: Map of East Berry Renaissance TIF District**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

The main infrastructure improvements thus far in the redevelopment include improved access at the intersection of Berry Street and Highway 287. The site plan for Renaissance Square has outlot parcels for restaurant uses, a centralized surface parking lot, and anchor stores on the other side of the parking lot. Again, due to the economic downturn, other developments may be in the works, but these developments are on hold until the economy improves.

## 4.9 HomeTown, North Richland Hills, Tarrant County

HomeTown is a residential development that consists of over 400 homes incorporated around a 25-acre park system. The Town Center regulations were approved in 1999 as a master-planned, mixed-use community. The final plan included a development that would be unique not only to North Richland Hills but to this entire region of Texas. This plan included mixing commercial, retail, and office uses along with single-family homes, townhomes, and apartments in a format more similar to a dense urban area than the typical sprawling suburban developments found in most other suburban communities. Two of the key concepts behind this "new urban" project were increased density of the built environment and being a pedestrian-friendly community (URS Transit Urban Design Studio, 2009). Another key component of this type of project is the provision of public green space and park amenities. In fact, one of the goals of this type of development is to get people out of their houses and individual yards to exercise and socialize with their neighbors. The existing HomeTown neighborhood is very popular in spite of the fact that it is roughly twice as dense as most other developments in North Richland Hills.

What makes this development unique is that it was originally the location of a 300-acre municipal airport that was decommissioned. The creation of the zone in 1999 originated with the completion of a master plan in 1998. Originally, this site had two existing arterial roads with speed limits of 60 MPH. One of the earlier streetscape improvements involved reducing the width of the streets by incorporating medians and widening sidewalks while also lowering the speed limit. More recent proposals for infrastructure improvements include the likelihood of two light-rail stops, but these stops are on the periphery of the development (Miller, 2004).

## 4.10 Historic Downtown Plano, Plano, Collin County

In 1999, the City of Plano, the Plano Independent School District, Collin County, and Collin County Community College created a tax-increment finance district to encourage economic reinvestment along the DART light-rail corridor. The master plan for the district was to create a transit-oriented, pedestrian-friendly urban village of three- and four-story buildings consisting of almost 500 apartment units and 45,000 square feet of shops, offices, and restaurants (JD Wilson and Associates, 1999; Turner, 2003). Historic commercial and civic buildings are also being restored, including the adaptive reuse of the city's first school gymnasium into a performing arts theater. DART rail service to downtown Plano began in 2002 and Plano is currently served by the Red and Orange lines. Figure 30 is an example of the low- to medium-density historic buildings in the background with the DART stop in the foreground.


**Figure 30: DART Light-Rail Stop Adjacent to Historic Downtown Plano**
(Color figure may be viewed at http://utcm.tamu.edu/publications/final_reports.stm#sagi41).

The Eastside TIF extends along the DART rail corridor from the southern city limit to approximately 0.5 mile north of Parker Road. At the time the TIF was created, the total appraised value of property within the district was $313 million. Five years later, the total appraised value has grown to nearly $413 million, yielding $6.2 million in revenue to date. The infrastructure improvements included updated signage and better landscaping, coupled with public parking and required right-of-way clearance for public improvements. Multiple infrastructure improvements led to the redevelopment of this area, resulting in a medium-density, pedestrian-friendly environment centered on the historic downtown area and taking advantage of the light-rail stop.

## 4.11 Centennial Park, Richardson, Dallas County

Despite the creation of this zone in 2006 as the economy began its downturn, the Centennial Park TIF District has been successful in developing a 1,217-acre parcel of land in Richardson north of Dallas. This area was also part of the hot-spot analysis that showed up in red, which makes sense due to the large-scale development and added value. One example of a successful development in this district is the medium-density, transit-oriented development exemplified by Brick Row. Brick Row abuts the Spring Valley DART station and the development contains a residential mix of upscale apartments, townhomes, and condominiums as well as ground-floor retail and office uses (City of Richardson Department of Finance, 2010).

This district encompasses Highway 75 from the exit at Spring Valley Road in the south to the Campbell Road exit in the north. The funds generated by this district provided partial financing for infrastructure improvements throughout the area. More importantly, the new developments are situated to take advantage of Spring Valley and Arapaho Center Station DART rail stops. In this district, given the transit-oriented nature of development, an emphasis has been placed on making the area pedestrian friendly by incorporating landscaping and lighting into the development plan. In some cases, funding for environmental remediation and demolition was provided to prepare the land for residential development. The higher-density uses also required improvements to storm drainage, water and waste infrastructure, and relocation of aboveground utilities underground to stimulate development. Emphasis was placed not just on residential and retail uses but also on good design principles to provide a coherent approach to development.

## 4.12 Southlake Town Square, Southlake, Tarrant County

The city of Southlake has one active tax-increment finance district. Southlake Town Square is a 130-acre, mixed-use development comprising retail, office, restaurant, entertainment, residential, and governmental uses. Southlake Town Square has become the downtown for the city of Southlake in northeast Tarrant County. It opened in March 1999 and currently encompasses 10 city blocks covering about 140 acres, which is roughly 33 percent of the entire district. The district was established to provide a financing mechanism to facilitate high-quality development in the southeast area of the city between State Highway 114 and Southlake Boulevard. Figure 31 shows the TIF district in purple, with the northern border of the TIF adjacent to State Highway 114 to the north. The narrow purple boundaries to the south take advantage of drawing the TIF district around major thoroughfares for pedestrian and streetscape improvements (City of Southlake, 1997; City of Southlake, 1999).

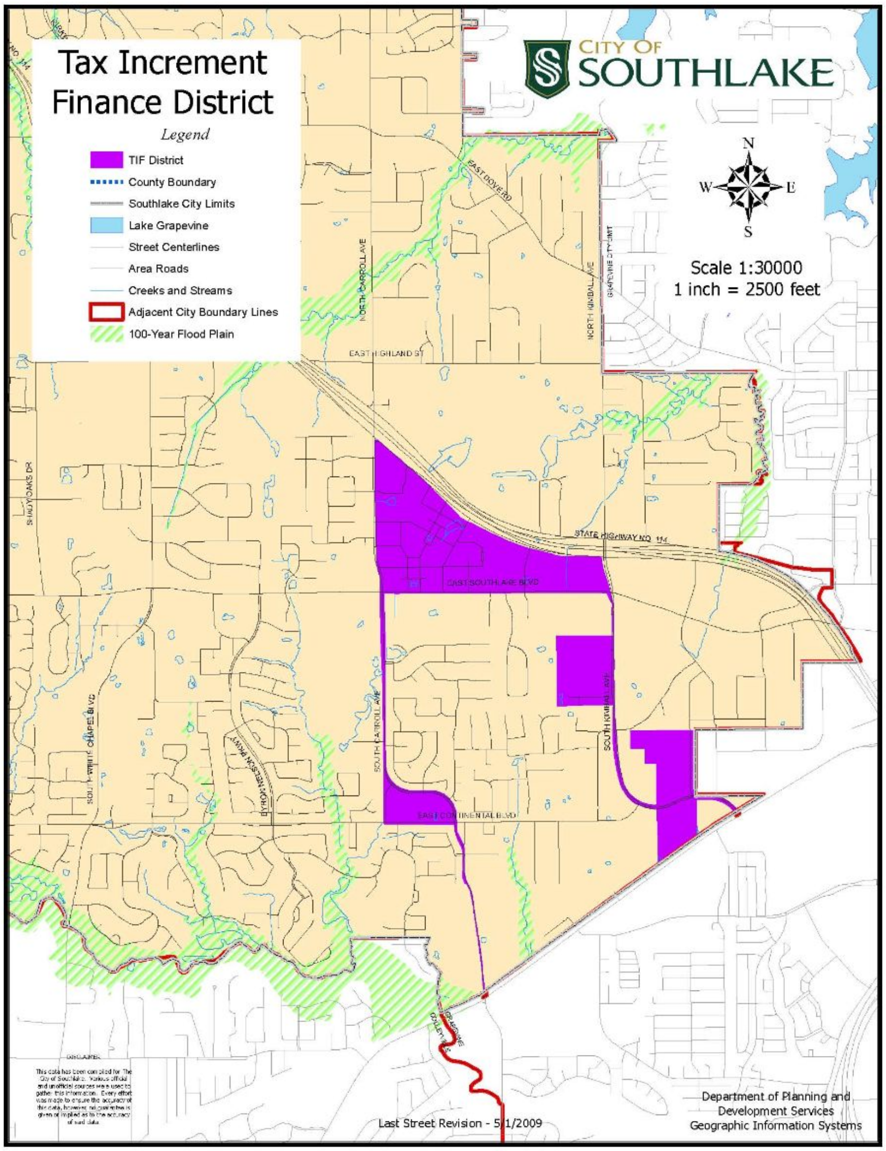


**Figure 31: City of Southlake Tax-Increment Finance District Map**
(Color figure may be viewed at [http://utcm.tamu.edu/publications/final_reports.stm#sagi41](http://utcm.tamu.edu/publications/final_reports.stm#sagi41)).

Infrastructure improvements in this district include landscaping throughout the site along with connector streets and general public infrastructure such as parking. The developer was reimbursed at 40 percent of the costs for these infrastructure components but was fully reimbursed for any costs for the public parks throughout the development. In addition to the retail and residential aspects of this district, a city/county building opened in 2000, and additional parking uses were bought by the city upon construction completion in 2008.

## 4.13 Summary of Case Studies

Each of the case studies represents the use of tax-increment financing to fund infrastructure improvements. In each of these cases, there is some inclusion of transportation infrastructure improvements in each plan, although at drastically different scales. Tax-increment finance districts in fully developed areas like the ones for Dallas and Fort Worth mostly focus on making enhancements to the existing street network due to the lack of space for planning significant transportation improvements. Most of the Dallas and Fort Worth plans do attempt to better connect areas undergoing revitalization to DART and/or TRE light-rail stops or bus stops and provide for pedestrian improvements rather than automobile-oriented improvements. The suburban tax-increment finance districts differ greatly depending on their proximity to various transportation networks. Throughout the examples, several districts are situated along high-traffic highways that are not near light-rail stations. For these districts, the infrastructure improvements often entail collector streets, feeder roads, and interchanges to connect into the existing highway. On the one hand, these types of development take advantage of utilizing undeveloped or underdeveloped property along existing transportation infrastructure for infill development, but these developments contribute nothing directly to the maintenance of that section of highway. While the higher-intensity development benefits the taxing jurisdictions, the cost of the additional wear and tear on the highway is left to other entities.

Table 6 illustrates just how much the appraised values of the properties in these districts have increased due to the new land improvements. For the 12 projects discussed in this section, their overall base value at the inception of the TIF district was slightly over $2 billion. In 2008, the appraised value was nearly $5.4 billion (Combs, 2004; Combs, 2006; Combs, 2008; Combs, 2010). Granted, many of these TIFs were established before 2004, with the earliest TIF being Cityplace in 1992, but these values provide some benchmark for the long-term viability of TIFs to finance major infrastructure projects by capturing the returns to land development proximate to this major infrastructure. Table 6 provides evidence that tax-increment districts do appreciate in value, indicating that the use of tax-increment finance districts centered on transportation infrastructure and implemented by regional mobility authorities could generate adequate revenue to maintain and expand existing, planned, and future transportation infrastructure improvements. Moreover, all of these projects are within 1 mile of existing and/or proposed major transportation infrastructure such as highways, light rail, and toll roads, yet none of them contribute directly to improvement of the central transportation infrastructure.

**Table 6: Case Studies with Base Values and 2008 Appraised Values**

| Tax-increment Reinvestment Zone | Project Name or District | Location | Base Year | Base Value | 2008 Appraised Value | 2008 Captured Appraised Value |
|---|---|---|---|---|---|---|
| TIRZ #1 | Garden District | Allen | 2005 | $2,424,098 | $67,608,590 | $65,184,492 |
| TIRZ #2 | Cityplace | Dallas | 1992 | $45,065,342 | $481,468,434 | $436,403,092 |
| TIRZ #7 | Sports Arena | Dallas | 1998 | $16,423,773 | $574,257,867 | $557,834,094 |
| TIRZ #11 | Downtown Connection | Dallas | 2005 | $562,696,137 | $1,541,454,353 | $979,758,216 |
| TIRZ #14 | Skillman Corridor | Dallas | 2005 | $335,957,311 | $440,650,892 | $104,693,581 |
| TIRZ #3 | Downtown | Fort Worth | 1995 | $217,893,395 | $768,979,334 | $551,085,939 |
| TIRZ #7 | North Tarrant Parkway | Fort Worth | 2003 | $1,283,324 | $74,743,324 | $73,460,256 |
| TIRZ #12 | East Berry Renaissance | Fort Worth | 2006 | $29,176,323 | $39,412,113 | $10,235,790 |
| TIRZ #2 | HomeTown | North Richland | 1999 | $40,577,462 | $262,704,354 | $222,126,892 |
| TIRZ #2 | Historic Downtown | Plano | 1999 | $317,040,980 | $519,308,906 | $227,558,731 |
| TIRZ #1 | Centennial Park | Richardson | 2006 | $430,377,678 | $476,631,877 | $46,254,199 |
| TIRZ #1 | Southlake Town Square | Southlake | 1997 | $23,475,366 | $149,443,969 | $125,968,603 |
| **Total** | | | | **$2,022,391,189** | **$5,396,664,013** | **$3,400,563,885** |

Based on the information from the change in appraised values, the hot-spot analysis, and change in value of properties in existing TIF districts, the following section provides insight into the level of increment that could be captured from a large-scale TIF district implemented by a regional mobility authority created to oversee infrastructure improvements.

# 5 Findings from the Value Capture Analysis

The goal of this report so far has been to discuss the real estate values surrounding major transportation infrastructure in the Dallas-Fort Worth Metroplex to determine if real estate located near major transportation infrastructure has appreciated at a higher rate than real estate further away from transportation infrastructure. The previous section highlighted several tax-increment finance districts that were located near major transportation infrastructure and that contributed directly to the maintenance of that infrastructure. This section focuses on how much value could have been captured with the timely creation of a regional mobility authority that implemented tax-increment finance districts around key transportation infrastructure to finance the maintenance and expansion of the existing transportation infrastructure. Forecasting the amount of tax-increment value that could be captured in the future is a difficult task. That being said, the 2004 to 2008 timeline provides a frame of reference to determine the possible tax increment that could have been captured between 2004 and 2008 through a regional mobility authority.

For this section, several caveats to the financial analysis merit mention. First, the assumptions are fairly conservative in terms of which governmental entities would be foregoing their tax increment. Most of the cases mentioned in the previous section had the city, county, special districts, and in some cases school districts participate to some degree in contributing their tax increment to the district. The value capture analysis here only assumes that the county increment will be contributed to the tax-increment finance district, as opposed to cities, schools, and special districts. In other words, given the fiscal climate facing cities and schools, assuming that these governmental entities would forego their tax increment is not realistic.

Table 7 highlights the contribution of various taxing entities in relation to the tax-increment finance districts discussed in the case study section (Combs, 2004; Combs, 2006; Combs, 2008; Combs, 2010). For the most part, the city government portion of the increment has the greatest tax contribution to the project. The county matched the local contribution in terms of the percentage contributed to the district. Other entities such as school districts, community college districts, county hospital districts, and regional water districts contributed at varying rates. The contributions in Table 7 make sense since all of these projects focus on local impacts, not regional impacts, which provide a benefit to the tax-increment district and surrounding areas.

**Table 7: Percent of Tax-Increment Contribution to Tax-Increment Finance District by Governmental Entity**

| Tax-increment Reinvestment Zone | Project Name | City | County | School District | Community College District | County Hospital District | Regional Water District |
|---|---|---|---|---|---|---|---|
| TIRZ #1 | Garden District | 50% | 50% | | | | |
| TIRZ #2 | Cityplace | 100% | 100% | 100% | 100% | 100% | |
| TIRZ #7 | Sports Arena | 100% | 100% | 100% | | 100% | |
| TIRZ #11 | Downtown Connection | 90% | 55% | | | | |
| TIRZ #14 | Skillman Corridor | 85% | 55% | 16% | | | |
| TIRZ #3 | Downtown | 100% | 100% | 100% | 100% | 100% | 100% |
| TIRZ #7 | North Tarrant Parkway | 80% | 80% | | | 80% | 80% |
| TIRZ #12 | East Berry Renaissance | 100% | 100% | | 50% | 100% | 100% |
| TIRZ #2 | HomeTown | 100% | 100% | | 100% | 100% | |
| TIRZ #2 | Historic Downtown | 100% | 80% | 100% | 50% | | |
| TIRZ #1 | Centennial Park | 100% | 65% | | | | |
| TIRZ #1 | Southlake Town Square | 100% | 100% | 100% | 100% | 100% | |

To some extent, some people may argue that assuming the county will forego its increment is not realistic, but counties are also the largest geographic unit to participate in regional solutions to the current transportation problems in the Dallas-Fort Worth area. Additionally, this analysis assumes that the regional mobility authority would encompass Collin County, the city of Dallas, and Tarrant County. These are the three areas where complete appraisal data for 2004 and 2008 were available. A regional mobility authority would ideally encompass additional counties in the area, most notably Denton County due to its growth, which would likely increase the amount of tax increment available for bond issuance.

For the purpose of calculating the amount of value captured, the county tax rates per $100 of valuation in 2008 were used. This figure was 0.2281 for Collin County, 0.7479 for the city of Dallas, and 0.2640 for Tarrant County. The percentage of the tax increment available for bond issuance is 90 percent. Other relevant assumptions include an interest rate of 4 percent, an issuance cost of 2 percent, and a cash reserve of 15 percent. In the case studies, the tax-increment district term ranged from 15 to 30 years with an average of 22 years. For this exercise, 20 years is set as the term of the district. Based on these assumptions, the annual incremental revenue based on 2008 tax rates for each area of study is shown in Table 8.

**Table 8: Annual Incremental Revenue (Based on 2008 Tax Rates)**

| Type of Transportation Infrastructure and Proximity | Total Amount Based on Proximity | Total Amount Based on Proximity—Aggregated |
|---|---|---|
| Light Rail—0.25 Mile | $23,119,638 | $23,119,638 |
| Light Rail—0.25-0.5 Mile | $14,613,230 | $37,628,392 |
| Light Rail—0.5-0.75 Mile | $11,462,538 | $48,702,300 |
| Light Rail—0.75-1 Mile | $6,419,526 | $54,807,509 |
| Freight Rail—0.25 Mile | $22,165,418 | $22,165,418 |
| Freight Rail—0.25-0.5 Mile | $10,601,222 | $32,766,641 |
| Freight Rail—0.5-0.75 Mile | $16,014,738 | $48,781,379 |
| Freight Rail—0.75-1 Mile | $8,421,406 | $57,155,551 |
| Tollway—0.25 Mile | $21,149,792 | $21,149,792 |
| Tollway—0.25-0.5 Mile | $14,614,281 | $35,764,073 |
| Tollway—0.5-0.75 Mile | $18,264,708 | $53,637,879 |
| Tollway—0.75-1 Mile | $20,827,628 | $74,356,560 |
| Highway—0.25 Mile | $93,644,975 | $93,644,975 |
| Highway—0.25-0.5 Mile | $27,956,116 | $120,790,366 |
| Highway—0.5-0.75 Mile | $16,112,949 | $135,940,572 |
| Highway—0.75-1 Mile | $7,705,689 | $142,732,610 |

The column titled "Total Amount Based on Proximity" lists the taxable value based on the property values that fall within that distance to the major transportation infrastructure. This amount is the value of the tax increment in 2008 based on property values. For instance, in 2008, based on all appraised property values that were located between 0.25 mile and 0.5 mile from light rail, the total increment was $14,613,230. For this column, based on proximity, the lowest total is for properties located between 0.75 mile and 1 mile from light rail, while the highest total is for properties located with 0.25 mile of a highway. Given these two extremes, some explanation is necessary. Highways and freight rails are the oldest major transportation infrastructure types. Most of the existing high-value, high-density commercial and residential developments surround existing highways. Light rail and tollways are both newer forms of transportation infrastructure in the Dallas-Fort Worth area. These newer forms of transportation infrastructure are also not as prevalent or as well networked as highways are throughout the area. So, while light rail and tollways exist, the ability of these transportation forms to provide circulation throughout the Metroplex is still greatly limited. Most, if not all, new highways are toll roads, while light rail is still evolving and expanding.

The column titled "Total Amount Based on Proximity—Aggregated" contains the aggregated amounts of the tax increment up to that proximity basis. In other words, the aggregate value of the tax increment for appraised property values located between 0.25 mile and 0.5 mile from light rail is $37,628,392 because this amount contains the total aggregate increment value of all properties within 0.5 mile from light rail. For the aggregated column, the highest values for the incremental revenue are for properties within 1 mile of a highway. The lesson to take away from this study is that the regional mobility authority must take some care in determining which boundaries to use to maximize the total amount of the tax increment to reinvest in transportation infrastructure. It might make sense to make the tax-increment district around highways in older, more developed areas and make the tax-increment district around tollways in newer, growing areas.

Table 9 shows the maximum amount of debt service available after cash reserve requirements are met. Similar to Table 8, Table 9 is also based on the 2008 tax rates. Moreover, also similar to Table 8 are the figures that have the highest maximum amount of debt service available after the reserve requirement is met. This observation is no surprise, given that the increment is based on the total incremental amount of revenue. Again, the largest total amount of debt service available is the aggregated amount for properties located within 1 mile of a highway at $121,322,719.

**Table 9: Maximum Amount of Debt Service after 15 Percent Reserve Requirement**

| Transportation Infrastructure and Proximity | Total Amount Based on Proximity | Total Amount—Aggregate |
|---|---|---|
| Light Rail—0.25 Mile | $19,651,692 | $19,651,692 |
| Light Rail—0.25-0.5 Mile | $12,421,245 | $31,984,133 |
| Light Rail—0.5-0.75 Mile | $9,743,157 | $41,396,955 |
| Light Rail—0.75-1 Mile | $5,456,597 | $46,586,383 |
| Freight Rail—0.25 Mile | $18,840,606 | $18,840,606 |
| Freight Rail—0.25-0.5 Mile | $9,011,039 | $27,851,645 |
| Freight Rail—0.5-0.75 Mile | $13,612,528 | $41,464,172 |
| Freight Rail—0.75-1 Mile | $7,158,195 | $48,582,219 |
| Tollway—0.25 Mile | $17,977,323 | $17,977,323 |
| Tollway—0.25-0.5 Mile | $12,422,139 | $30,399,462 |
| Tollway—0.5-0.75 Mile | $15,525,002 | $45,592,197 |
| Tollway—0.75-1 Mile | $17,703,484 | $63,203,076 |
| Highway—0.25 Mile | $79,598,229 | $79,598,229 |
| Highway—0.25-0.5 Mile | $23,762,698 | $102,671,811 |
| Highway—0.5-0.75 Mile | $13,696,007 | $115,549,486 |
| Highway—0.75-1 Mile | $6,549,835 | $121,322,719 |

Making the assumptions of implementing a 20-year term for the tax-increment finance district and the 4 percent interest rate, the gross maximum amount of bond issuance after the reserve requirement is met can be calculated. These calculations appear in Table 10. To interpret the table, if the tax-increment district is drawn to include all properties within 1 mile of freight rail, the gross amount of bonds that could be issued is $594,223,387.

**Table 10: Gross Maximum Amount of Bond Issue**

| Transportation Infrastructure and Proximity | Total Amount Based on Proximity | Total Amount—Aggregate |
|---|---|---|
| Light Rail—0.25 Mile | $240,365,623 | $240,365,623 |
| Light Rail—0.25-0.5 Mile | $151,927,900 | $391,207,325 |
| Light Rail—0.5-0.75 Mile | $119,171,419 | $506,338,315 |
| Light Rail—0.75-1 Mile | $66,741,241 | $569,811,731 |
| Freight Rail—0.25 Mile | $230,444,980 | $230,444,980 |
| Freight Rail—0.25-0.5 Mile | $110,216,666 | $340,661,646 |
| Freight Rail—0.5-0.75 Mile | $166,498,823 | $507,160,470 |
| Freight Rail—0.75-1 Mile | $87,553,988 | $594,223,387 |
| Tollway—0.25 Mile | $219,885,917 | $219,885,917 |
| Tollway—0.25-0.5 Mile | $151,938,830 | $371,824,747 |
| Tollway—0.5-0.75 Mile | $189,890,855 | $557,651,558 |
| Tollway—0.75-1 Mile | $216,536,515 | $773,055,388 |
| Highway—0.25 Mile | $973,589,319 | $973,589,319 |
| Highway—0.25-0.5 Mile | $290,648,543 | $1,255,809,075 |
| Highway—0.5-0.75 Mile | $167,519,880 | $1,413,319,706 |
| Highway—0.75-1 Mile | $80,112,961 | $1,483,933,807 |

For this example, and consistent with the previous tables, the gross maximum amount of bonds that could be issued revolves around all properties within 1 mile of a highway at approximately $1.5 billion. But, even reducing the width of the tax-increment district to properties within 0.25 mile of highways would still garner a gross maximum amount of nearly $1 billion.

Finally, Table 11 provides the final table for discussion in relation to the maximum net bond issuance. The only difference between Table 11 and Table 10 is the fact that Table 11 includes the 2 percent cost to finance the bond issuance. While the differences between the two tables may be somewhat negligible, Table 11 is perhaps the most important because this table serves as the most likely maximum amount of bond issuance available to finance transportation infrastructure improvements.

**Table 11: Net Maximum Amount of Bond Issue**

| Transportation Infrastructure and Proximity | Total Amount Based on Proximity | Total Amount—Aggregate |
|---|---|---|
| Light Rail—0.25 Mile | $235,558,310 | $235,558,310 |
| Light Rail—0.25-0.5 Mile | $148,889,342 | $383,383,179 |
| Light Rail—0.5-0.75 Mile | $116,787,991 | $496,211,549 |
| Light Rail—0.75-1 Mile | $65,406,416 | $558,415,497 |
| Freight Rail—0.25 Mile | $225,836,081 | $225,836,081 |
| Freight Rail—0.25-0.5 Mile | $108,012,333 | $333,848,413 |
| Freight Rail—0.5-0.75 Mile | $163,168,847 | $497,017,260 |
| Freight Rail—0.75-1 Mile | $85,802,908 | $582,338,919 |
| Tollway—0.25 Mile | $215,488,199 | $215,488,199 |
| Tollway—0.25-0.5 Mile | $148,900,054 | $364,388,252 |
| Tollway—0.5-0.75 Mile | $186,093,038 | $546,498,527 |
| Tollway—0.75-1 Mile | $212,205,785 | $757,594,281 |
| Highway—0.25 Mile | $954,117,533 | $954,117,533 |
| Highway—0.25-0.5 Mile | $284,835,572 | $1,230,692,894 |
| Highway—0.5-0.75 Mile | $164,169,482 | $1,385,053,312 |
| Highway—0.75-1 Mile | $78,510,702 | $1,454,255,131 |

In this table, the largest amount of bond issuance possible based on proximity is the segment with all properties within 0.25 mile of a highway. This one segment could account for approximately $954 million in bond issuance. This amount is greater than the entire bond value for properties located within 1 mile of tollways. For the aggregate amount, properties within 1 mile of a highway exhibit the distance where the greatest net amount of bond issuance is possible.

This section illustrated the possibilities that value capture of land development returns can provide for funding current infrastructure improvements and better planning of future infrastructure improvements. Moreover, these land development returns establish a new source of funding for these types of projects.

# 6 Conclusions and Recommendations

The current funding scenarios for funding transportation infrastructure are dire. As vehicles become more fuel efficient, the decrease in gas-tax revenue becomes more challenging to rely on as a source for funding transportation infrastructure improvements. As federal and state funding for transportation improvements becomes scarce, local and regional strategies must arise to fill in the funding gaps for transportation. The use of tollways does not fully address the issue as long as highways exist as an alternative for cost avoidance. Light rail may reduce the amount of automobile congestion to some extent, but light rail is limited based on the availability and cost of land for light-rail expansion. The focus of transportation has often been on the transportation network itself and financing transportation infrastructure based on user fees, government handouts, and gas-tax revenue. None of these forms of finance are reliable, nor are they sustainable. Creating a more sustainable transportation infrastructure funding stream requires the creation of additional sources of funding based on capturing the returns from land development. Assessed property values have increased proximate to various types of transportation infrastructure at a higher rate than property values further away from transportation infrastructure. Existing tax-increment finance districts take advantage of their proximity to highways, tollways, and light rail without directly contributing financially to the major transportation infrastructure. The issue is that plans exist for transportation infrastructure improvements not just in the Dallas-Fort Worth area studied here, but throughout the state; yet these plans suffer from unreliable funding sources, a lack of diversity in funding sources, or a combination of both problems.

The major recommendations from this report require legislators, transportation planners, city planners, and regional agencies to look beyond traditional transportation financing mechanisms given the uncertain future of funding for existing transportation finance tools. User fees may be acceptable for toll roads, but what about all the other forms of existing transportation infrastructure? This report attempts to scratch the surface of a current funding issue for transportation that will continue to be an issue based on current funding trends and population growth. Moreover, with the decline in funding for transportation at the state and federal government levels, and the realization that investment in major transportation improvements are more expensive than local governments can afford, the only current viable solutions exists at the regional level.

One major recommendation is to look beyond transportation itself to property values in relation to transportation in the transportation planning process. The fact that transportation finance must be strictly transportation-related is a shortcoming in many existing transportation finance policies. This report examines the manner in which properties benefit financially based on proximity to transportation infrastructure, but a more important questions may be whether transportation infrastructure benefits based on proximity to properties? This question has never truly been answered, although this report attempts to work toward an answer by looking at the interaction of property values and major transportation infrastructure networks. The implementation of regional mobility authorities provides a possible answer that transportation infrastructure could benefit from proximity to properties if a mechanism such as tax-increment finance can capture and leverage the returns to land development.

Another recommendation is to look at real estate development and transportation infrastructure planning from a comprehensive network standpoint at the regional level. To some extent, transit-oriented development aims to accomplish this goal, but transit-oriented development focuses on nodes, not networks, much as is the case exhibited in the transit-oriented tax-increment finance examples discussed in an earlier section. To a greater extent, transit neighborhood development gets closer to the network idea, but it still has its limitations. Transportation improvements require regional approaches. A regional mobility authority with the power to implement tax-increment finance with transportation as the focal point rather than a local development project is the best way to maximize the funding potential from capturing the returns to land development.

Transportation funding is at a crossroads. The amount of land available for development of property and/or transportation is fixed. More land cannot be created, but better use of existing land can create better solutions and better funding options for transportation infrastructure improvements. As the population in the Dallas-Fort Worth area and throughout Texas continues to grow, the issue of transportation infrastructure will also continue to grow. The failure of the Trans-Texas Corridor means that the likelihood of a similar statewide solution is greatly diminished. Regionally, organizations already exist to address transportation issues and plan for the future, but the toolbox used to address and plan for transportation issues needs new tools to solve old and new problems. A regional mobility authority is nothing more than a new tool that can use an old tool such as tax-increment finance to resolve current and future transportation infrastructure issues. Until regional solutions are in place, there may be minor victories and advances in transportation infrastructure improvements that may help some areas in some ways, but the net benefit will be localized, and that benefit may come at the cost of adjacent areas.

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