MIXED-USE DEVELOPMENT PILOT STUDY

Collin County, Texas

June 2025

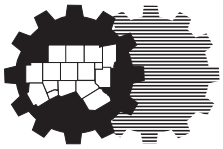
North Central Texas Council of Governments

What is NCTCOG?

The **North Central Texas Council of Governments** (NCTCOG) is a voluntary association of, by, and for **local governments** within the 16-county North Central Texas Region. The agency was established by state enabling legislation in 1966 to assist local governments in **planning** for common needs, **cooperating** for mutual benefit, and **coordinating** for sound regional development. Its purpose is to strengthen both the individual and collective power of local governments, and to help them recognize regional opportunities, resolve regional problems, eliminate unnecessary duplication, and make joint regional decisions – as well as to develop the means to implement those decisions.

North Central Texas is a 16-county **metropolitan region** centered around Dallas and Fort Worth. The region has a population of more than 7 million (which is larger than 38 states), and an area of approximately 12,800 square miles (which is larger than nine states). NCTCOG has 235 member governments, including all 16 counties, 170 cities, 20 independent school districts, and 29 special districts.

NCTCOG's **structure** is relatively simple. An elected or appointed public official from each member government makes up the **General Assembly** which annually elects NCTCOG's **Executive Board**. The Executive Board is composed of 17 locally elected officials and one ex-officio non-voting member of the legislature. The Executive Board is the policy-making body for all activities undertaken by NCTCOG, including program activities and decisions, regional plans, and fiscal and budgetary policies. The Board is supported by policy development, technical advisory and study **committees** – and a professional staff led by **R. Michael Eastland**, Executive Director.



NCTCOG's offices are located in Arlington in the Centerpoint Two Building at 616 Six Flags Drive (approximately one-half mile south of the main entrance to Six Flags Over Texas).

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NCTCOG's Department of Transportation

Since 1974 NCTCOG has served as the Metropolitan Planning Organization (MPO) for transportation for the Dallas-Fort Worth area. NCTCOG's Department of Transportation is responsible for the regional planning process for all modes of transportation. The department provides technical support and staff assistance to the Regional Transportation Council and its technical committees, which compose the MPO policy-making structure. In addition, the department provides technical assistance to the local governments of North Central Texas in planning, coordinating, and implementing transportation decisions.

Prepared in cooperation with the Federal Highway Administration, US Department of Transportation, and the Texas Department of Transportation.

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Executive Summary

The *Mixed-Use Development Pilot Study – Collin County, TX* was conducted by the North Central Texas Council of Governments (NCTCOG) Transportation Department in response to a request for assistance made by Collin County and the Cities of Frisco, Plano, Richardson, Allen, McKinney, Garland, and Wylie in December 2020. The study was incorporated into the Transportation Department's Fiscal Year 2022-2023 Unified Planning Work Program, and work began in Fiscal Year 2023.

The purpose of this study was to analyze the traffic impacts of mixed-use developments (MXDs) and provide findings and recommendations to be used as a resource for the organizations in the original request, as well as other communities in the region. This is a pilot study to explore baseline issues and methodologies prior to a potential regional MXD research study that would inventory and assess MXDs across the 12-county Metropolitan Planning Area.

Mixed-use development can be very nuanced and complicated in definition, development regulations, and impacts. This study includes some key discussion points to help guide conversations among stakeholders to ensure MXD outcomes that meet community goals. Key takeaways and recommendations were developed based on a detailed literature review and the results of a pilot analysis of trip generation comparing different types of MXDs and other development types in Collin County.

For cities planning for the best possible MXD outcomes, the key conclusions and recommendations of this study include:

1. The number of trips and vehicle miles traveled generated by a MXD is not explained solely by density or the mixed-use nature of the project, but also by various interacting factors. These may include development design factors, development size, types of land uses incorporated, whether the development is also a transit-oriented development (TOD), and other influences.
2. Education and messaging are crucial for community buy-in of MXD.
    a. Education should emphasize:
        i. Development design and land use policies/regulations are just as or more important than density in determining MXD outcomes.
        ii. Depending on the context, traffic congestion may be a beneficial tradeoff if the community desires a vibrant downtown or walkable places.

    b. Messaging should include emphasis on the economic benefits of MXD, such as attracting employers and workforce.
3. Adopting a clear definition of MXD and using it early on in conversations with developers may help define expectations and provide support for design modifications or rejecting permits for projects that don't meet the definition.
4. Reviewing and updating zoning codes and standards to emphasize design over mandated land uses are likely to provide a solid foundation for strong MXD outcomes.
5. Use economic development incentives and zoning to help promote a mix of uses that support the everyday needs of residents living in or near MXDs, which may be more likely to result in travel efficiencies.

Results of this pilot study are preliminary and require further study and data collection. These recommendations are meant to facilitate conversations with the public and developers, as well as set expectations and educate about MXD and how to make it work to meet specific community needs. Overall, the Collin County Mixed-Use Development Study will be used as a basis for further study of this topic in the Dallas-Fort Worth region in the future.

Introduction and Background

The *Mixed-Use Development Pilot Study – Collin County, TX* was conducted by the North Central Texas Council of Governments (NCTCOG) Transportation Department in response to a request for assistance made by Collin County and the Cities of Frisco, Plano, Richardson, Allen, McKinney, Garland, and Wylie in December 2020. The study was incorporated into the Transportation Department's Fiscal Year 2022-2023 Unified Planning Work Program, and work began in Fiscal Year 2023.

The study area encompasses each of the cities included in the request and the greater Collin County area, including the Cities of Garland and Richardson which are located in both Collin County and Dallas County.

The goals of this study were to:

- Develop and test a potential methodology for assessing whether MXDs produce less congestion than conventional (segregated or low density) development
- Serve as a pilot study for a larger, regional MXD analysis
- Provide local governments with recommendations for:
    - Advancing desired MXD outcomes, and
    - Facilitating discussion of MXDs with the public, elected officials, and developers

The study included a literature review covering various topics related to the impacts, characteristics, outcomes, and benefits of MXDs. The study also incorporated an inventory of MXDs, a data collection effort, and an analysis of MXDs using the Environmental Protection Agency's (EPA's) Mixed-use Developments Trip Generation Tool (EPA MXD Tool).[1] Finally, recommendations and considerations for implementing MXDs are discussed. These are general suggestions and observations that were developed out of the literature review and trip generation analysis. This study can serve as a resource for local government staff to facilitate conversations with various stakeholders about MXDs in their communities.

Defining Mixed-Use Development

Capturing the many nuances and contexts of MXDs required a review of many definitions used in literature and previous NCTCOG initiatives involving MXD. The literature pointed to varying elements that make up a MXD. Factors like number of uses, proportions of different uses, and the scale of buildings were common, defining themes. Additionally, the degree of internal connectivity and/or internal trip capture, bicycle/pedestrian linkages, and revenue production were also some key elements of MXD definitions identified in the literature review.

[1] https://www.epa.gov/smartgrowth/mixed-use-trip-generation-model

In addition to definitions from the literature, the definition of MXD from NCTCOG's Sustainable Development Funding Program was another starting point for defining MXD for the purposes of this study.[2]

From this review, it was determined that general characteristics of MXDs that would be considered for this study would include:

- A mix of residential and office and/or retail uses
- The mix of uses can be vertical or horizontal in arrangement
- Residential use should be within a quarter mile of the commercial use if horizontally-oriented
- Inclusion of pedestrian linkages to different land uses within the development
- Exclusion of industrial uses
- Exclusion of areas with mostly single-family detached residential development
- Exclusion of standalone/single land use types
- Exclusion of parking garage structures

Overall, a typology describing broad development types including the general variations of MXD observed in Collin County was the best approach to defining MXD for the purposes of this project to facilitate conversations and define units of analysis. The typology features five development types, including three types of mixed-use development. These types range from denser, smaller-scale developments with vertically-integrated uses to less-dense, larger-scale developments without integration of uses. More details about the typology and the development process are discussed in the following sections.

Literature Review

A two-part literature review was conducted. The first was to explore methodologies for assessing MXD traffic impacts and the best tools and data to use in this assessment. All sources cited in this study are included in the reference list. Appendix 1 contains additional sources that were reviewed but not cited in this report.

Methods for Assessing MXD Traffic Impacts

Institute of Transportation Engineers Trip Generation Manual

Much of the literature discussed the conventional way of estimating trip generation of proposed developments, which is done using the Institute of Transportation Engineers (ITE) Trip Generation Manual. The literature reviewed was generally critical of the use of the ITE Trip Generation Manual method (ITE method) for assessing MXD traffic impacts. A major finding was that the ITE method is based on only three "multi-use" sites in Florida and doesn't consider the scale of development, land use context, possibility for mode shift,

[2] www.nctcog.org/sdcfp

length of external single-occupancy vehicle trips, or other factors that may influence the number of trips generated from a MXD. The ITE method is thus unable to capture the nuances that exist within MXDs that may result in reduced vehicle miles traveled (VMT), such as internal trip capture, which is a portion of calculated trips that remain within the development (Bochner & Sperry, 2010) due to design and other factors of MXDs. Over-reliance on the ITE method has historically led to an overestimation of trips generated from MXDs and an underestimation of the benefits these areas can have. When relying on the ITE method to assess MXD trip generation, engineers have historically not used reliable tools for quantifying how internal trip capture may reduce VMT generated. Therefore, the tendency is to estimate internal trip capture more conservatively, or not at all, to avoid the possibility of liability resulting from too-low estimates which could mean that future road capacities were not appropriately planned for (Ewing et al., 2011; Tian et al., 2019).

MXD Trip Generation Tool

The literature indicated another tool that was developed to capture the many features of mixed use not considered in the ITE method. The ITE and the EPA developed the Mixed-Use Developments Trip Generation Tool (EPA MXD Tool). This tool assumes that travel to and from MXDs is the result of choices dependent on the "D Variables" of urban development described in Figure 1. The variables listed were also the focus of validation studies for application of the EPA MXD Tool (Ewing et al., 2011; Tian et al., 2019).

Figure 1: D Variables of Urban Development

D Variable	Description
Density	Population and jobs within an MXD site
Diversity	Jobs and housing balance within site and jobs availability within 1 mile of site
Design	Intersection density and street connectivity
Destination Accessibility	Employment and daily amenities available within 20-minute car trip or 30-minute transit trip
Distance to Transit	Proximity to rail station or existence of bus stops within a quarter mile
Demographics	Household size and vehicle ownership
Development Scale	Size of development in acres

Source: Ewing et al., 2011; Tian et al., 2019

To more realistically reflect traffic generated from MXDs, the EPA MXD Tool incorporates factors such as types of land use, the level of land use mix, the context of the site, employment, development size, etc. that represent the D Variables.

The EPA MXD Tool is intended to provide a relatively simple method by which developers, planners, engineers, or other stakeholders can estimate the internal capture of trips that occur from MXDs. Outputs generated include VMT and number of trips generated from the MXD, and comparison of the results to what would have been obtained using the ITE method. The EPA MXD Tool reduces the ITE method model by the number of trips that the EPA MXD Tool estimates would be captured internally, as well as by estimated external walking and transit trips. The EPA MXD Tool has been validated against trips generated in various case studies across the country, largely used by government staff, consultants, and developers (Ewing et al., 2011; Tian et al., 2019). The tool has been used in California, Washington, and New Mexico, and was adopted statewide by the Virginia Department of Transportation. More discussion about how the EPA MXD Tool was used for this project is featured in the following sections.

MXD+ Trip Generation Tool

While the EPA MXD Tool is considered a major improvement over the ITE method for estimating traffic impact from MXD, another method called MXD+ subsequently evolved and was later recalibrated (Bochner et al., 2011; Gard & Bell, 2020). MXD+ combines the EPA MXD Tool approach with the method of internal trip capture estimation described in the National Cooperative Highway Research Program Report 684, "Enhancing Internal Trip Capture Estimation for Mixed-Use Developments" (Bochner et al., 2011). This combined approach is considered to optimize the respective strengths and weaknesses of the two approaches that had previously been used separately. While this approach was not used in this preliminary study due to the data requirements, it may be a useful and comprehensive approach to consider when assessing traffic impacts of MXD.

Benefits and Effects of MXDs

The second phase of the literature review was focused on the potential benefits and effects of MXDs. This included the best zoning for MXD, internalization of trips (internal trip capture), trip and/or VMT reduction, trip trends in more conventional developments, economic incentives to support MXD, and the impacts from specific mixes of uses. Staff found the following trends from this literature review:

1. Internalization of trips: Trips can be captured inside MXDs, and larger mixed-use areas can reduce trips outside due to the proximity of land uses. These captured trips may be good for activated, vibrant downtowns/activity centers, even though congestion in the specific area may be higher.
2. Mode switch: Increases in population density, employment density, and/or land use mix may result in increases in transit/walking, decreases in single-occupancy vehicle usage, and decreases in VMT.
3. Trip length: With increase in population density, employment density, and/or land use mix, trip lengths may decrease.

Overall, the literature suggested that MXD *can* result in reduced VMT – but it's complicated. Factors include:

Context and Scale

The effects of MXD on traffic and other factors are context- and scale-dependent. Ewing (2011) found that an increase of nearby jobs and related supporting services decrease trip lengths. Mixed-use development connected to other MXD, transit/transit-oriented development, and bike/pedestrian infrastructure are more likely reduce VMT than stand-alone MXDs (Hamidi et al., 2014; Cervero et al., 2008). More isolated developments can mean more trip capture (Tian et al., 2019). However, making MXDs a "destination" can result in more trips from the region to an area (Sperry et al., 2011).

Built Form

More land use mix can equate to reduced VMT and/or vehicle ownership (ADOT, 2012; Litman, 2008). A few of the strongest influences on external walking trip generation include intersection density and concentration of jobs within one mile of MXD. Similar factors were also found to influence transit use (Ewing, 2011; Litman, 2008). To reduce VMT and increase shifts to bicycle and pedestrian modes, MXDs need density, connected internal streets, and transit (Tian et al., 2019). The most important D Variables for MXD are featured in Figure 1.

Land Use Policy

Land use and development policy can also play a role. The literature suggested that MXD is most effective if implemented with other travel demand management strategies (Litman, 2008). Major takeaways from the literature with regard to policy are that land use and development characteristics like development size, factors related to walkability, and density play a major role in VMT reduction within MXD sites. These factors are also more effective if one or more are present within a site. Jurisdictions can promote these design factors with design standards, form-based codes, and other tools. These are discussed further in the Recommendations for MXD Outcomes section.

Many individual studies (Frank & Pivo, 1994; Kockelman,1997; Ewing et al., 2011), as well as a comprehensive review of various other built environment travel studies (Ewing & Cervero, 2011), found that the closer a given area was to having an ideal balance of different land uses, the lower household VMT tended to be. McConville et al. (2010) discuss that land uses that meet residents' daily needs or are frequently visited showed an increase in non-motorized transportation trips, specifically walking. Land uses that had the most positive impact on walking trips were places such as grocery stores, banks, transit, and restaurants (McConville et al., 2010). Further, the Ewing & Cervero (2011) study also found that the reduction to VMT from land use balance could be compounded by other characteristics, such as density and accessibility. Two studies did not find significant correlation between land use balance and household VMT generally (Vance & Hedel, 2007; Choi & Zhang, 2011),

although one of these studies found that land use balance decreased VMT specifically in MXDs (Choi & Zhang, 2011). In studies where trips were broken down by VMT generated from different trip types (work, non-work, shopping), VMT decreased as the balance of land uses and irrelevant uses (office/industrial in the case of non-work VMT) increased (Kockelman, 1997; Cervero & Duncan, 2006). Jurisdictions can encourage a more ideal balance of uses for non-motorized modes and MXD with economic development, form-based codes, and other tools. These are discussed further in the Recommendations for MXD Outcomes section.

Travel Behaviors and Mode Choice

A recurring topic in many of these studies is self-selection, where residents that prefer a given transportation mode (driving, walking, transit) will choose to live in locations that accommodate that preference, which could bias findings regarding the impact of the physical characteristics of neighborhoods on VMT. Numerous studies acknowledge the potential of self-selection to bias their findings, but few attempt to account for it. One study analyzing the impact of self-selection found that it can lead to misestimation of the impact of the built environment on travel behavior, but that the overall impact is modest and unlikely to render findings statistically insignificant (Chatman, 2009).

Site characteristics within MXDs can affect trip generation and travel behaviors. For internal trip capture, which can result in decreased VMT generation, the most important characteristics cited in the literature were the land area of the MXD, intersection density, and employment (Ewing et al., 2011; Tian et al., 2019).

Collin County MXD Inventory and Typology

To assess developments using the EPA MXD Tool, an inventory of MXDs in the study area was completed. The foundation for this inventory was a previously completed analysis of Walkable Places in the NCTCOG region. Criteria for those sites included pedestrian-friendly building form, orientation, and density; a mix of uses; and a sidewalks/street transportation context. For this study, special generators (such as hospitals or stadiums), downtowns that are primarily commercial, and cities not included in this request were removed from the Walkable Places inventory.

In addition, a desktop analysis of Collin County was conducted to determine if any sites needed to be added to the inventory, and stakeholder feedback was solicited. This process resulted in the addition of several sites to the existing inventory. An interactive map detailing the inventory and details about each site can be accessed here: Collin County Mixed Use Developments Study (nctcog.org).[3] A map and list of developments included in the inventory

[3] https://geospatial.nctcog.org/portal/apps/mapviewer/index.html?webmap=3cde1588a3d348e2a32231f14a1927ce

is available in Appendix 2. As mentioned in the introduction, defining MXD is a challenge because what people refer to as MXD may vary a great deal based on geographic location, size, mix of uses, site characteristics, etc. Overall, the goal for defining MXD for this study was to identify broad types of MXD across a spectrum, capture all possibilities of what could be called MXD, and clarify the units of analysis. As a result, this study created and used a typology of development types considered in this study, rather than a single definition of MXD.

Figure 2 provides an overview of how the typology was constructed to capture the common types of development that exist in Collin County, including different types of MXD. Figure 3 illustrates the spectrum of the types from smaller, denser areas with uses vertically-integrated in single buildings; to generally larger, less-dense areas, with uses contained in separate buildings across the area. In this typology, "buildings" refer to standalone developments, while "areas" include larger clusters of buildings/developments. Vacant lots, parking garages and lots, and sites containing special traffic generators (e.g., hospitals, colleges, universities, stadiums, etc.) were generally excluded from this study to prevent skewed trip generation results when using the EPA MXD tool.

Figure 2: Overview of Criteria for Development Typology

Type 1 MXD: Vertically-Integrated Buildings

- Smaller developments with 1-3 buildings
- Vertically-oriented mixed use with two or more uses in the building

Type 2 MXD: Vertically- or Horizontally-Integrated Developments

- Larger, more self-contained development with vertically- or horizontally-integrated uses
- Incorporates internal connectivity of different uses, such as internal walkways, streets, and parking
- Mix of uses can be vertical and/or adjacent horizontal
- Single development/developer

Type 3 MXD: Vertically-Integrated Mixed-use Area

- Clusters of Type 1's or Type 2's
- Geographic areas that contain a mix of uses within a walkable distance of each other

Type 4: Conventional Small Downtown Area

- Mix of residential and commercial (office/retail/restaurant) uses with each use in separate single-use buildings
- Geographic areas that contain a mix of uses within a walkable distance of each other

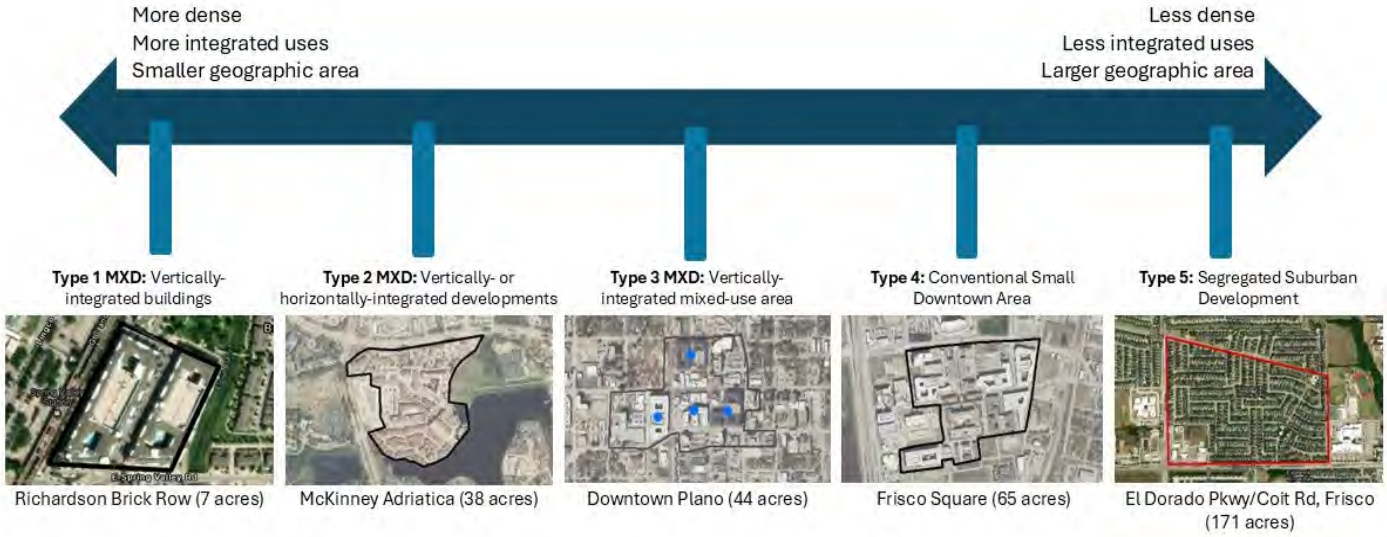
Type 5: Segregated Suburban Development

- Large area with generally isolated uses or bounded by roadways
- Not walkable or mostly auto-oriented

Site Characteristics

A total of 14 mixed-use buildings and/or areas were identified during the inventory for cities included in the original study request. Two segregated suburban developments (Type 5) were identified as comparison sites. There were 17 mixed-use buildings (Type 1) identified that fell within mixed-use areas (Type 3). Also, six sites were TODs. The inventory was categorized into the typologies seen in Figure 2, with most sites falling into the Type 2 or Type 3 categories. Site acreage ranged from approximately six acres to 261 acres. Appendix 3 features site characteristic data for all developments included in the pilot study, which is discussed in the Trip Generation Testing and Results section.

Figure 3: Development Typology



Trip Generation Testing and Results

The EPA MXD Tool was used to model predicted trips from a subset of MXDs included in the inventory. Staff first completed a test run ("Test") of three MXDs to determine data availability and data collection/analysis feasibility. The data collected for tool inputs included: development size household characteristics, land use breakouts, and VMT inputs. See Appendix 3 for a summary of all data inputs.

After the initial Test, a pilot analysis ("Pilot") was conducted that involved expanding the EPA MXD Tool modeling to nine of the sites from the inventory. The Pilot consisted of representatives of both TOD and non-TOD sites and the three original Test locations. Finally, two suburban developments (Type 5) were integrated into the Pilot analysis for comparison.

After reviewing preliminary data from the Test and discussing comparison sites with the study stakeholders, it was determined that Type 4 (originally called "Horizontally-integrated Mixed-use Area"), would not be considered a MXD type for purposes of the analysis. This was

due to Type 4's characteristic as a more conventional small downtown area, with relatively low density and horizontal integration of uses, which would not be expected to result in significant trip capture that would impact VMT or that the stakeholders would recognize as "mixed use." Type 4 was therefore renamed "Conventional Small Downtown Area" and both Type 4 and Type 5 (Segregated Suburban Development) were used to compare to the MXD types.

During the Pilot, it was also determined that Type 1, as standalone mixed-use buildings/very small developments, were also unlikely to generate enough internal trip capture to make their inclusion in the analysis meaningful, largely due to their very small size and isolation from other MXDs. Therefore, Type 1 sites were excluded from the Pilot. Other criteria used to select projects from the inventory for inclusion in the Pilot included excluding sites with special generators (stadium, hospital) or other unusual site characteristics, and including a site from each of the major cities in Collin County.

In summary, the Pilot focused on MXD Types 2 and 3 and compared those to Types 4 (Conventional Small Downtown Area) and 5 (Segregated Suburban Development). Staff conducted a high-level analysis of the results to arrive at preliminary conclusions and recommendations.

Retail Uses Analysis

To supplement the more aggregated land use data that was required for the EPA MXD Tool, staff conducted a desktop review of retail land uses at each of the Type 2-4 sites in the Pilot. Google Street View™ was used to inventory and categorize retail land uses into "everyday" uses versus "boutique" uses to roughly assess the potential impacts to VMT or internal capture that the balance of those uses have. Everyday uses include grocery stores, pharmacies, gyms, etc. Boutique uses are those that are not necessarily required for everyday life (e.g., gift shops, galleries, clothing stores, or other miscellaneous commercial uses) and may generate more vehicle trips from outside the MXD and the region because they have more of a special-use case. The "everyday" uses may support more internal capture as residents would be less likely to need to travel outside of the development for their daily needs, as discussed above.

Methods Considerations

There were a few considerations when using the EPA MXD Tool for this type of analysis. The first challenge was finding and compiling necessary data using existing data available to NCTCOG without further data purchases and with the use of existing staff capacity. More refined land use data as well as traffic counts could be helpful to better assess MXD impacts at a more micro-level. Due to the robust data requirements of the EPA MXD Tool and available staff capacity, this study used a small sample size, which means that any conclusions are very preliminary and need to be confirmed and expanded on with further study using a much larger sample size.

In addition, the study application of the EPA MXD Tool was a modification of the original intention of the tool. The EPA MXD Tool was created mainly for developers to show potential project impacts prior to the construction of an MXD. Conversely, the projects included in this study were already constructed and the purpose of using the tool was to assess impacts after the fact. Further, two non-mixed-use or "suburban" developments were included in the tool analysis. These were used to compare the tool outputs from the MXDs included in the inventory. Given the robust data requirements for the tool, in theory, the tool may be expected to function satisfactorily with non-MXDs. However, this was also not the original intent of the EPA MXD Tool.

Additional data collection and analysis using a much larger sample of MXDs is needed to better understand the mode shifts and internal trip capture patterns that may occur within MXDs due to the various D Variable factors that may impact them (see Figure 1).

Findings and Recommendations

The primary goals of this report were to test a potential methodology for assessing the traffic impacts of MXD, provide a resource for local governments to facilitate conversations about the various definitions and factors of MXDs, and to provide guidance for implementing desired MXD outcomes. This is a complex topic, and developments can vary in impact based on demographics, building forms, land uses, adjacent transportation facilities, and more. The following are general findings, considerations, and recommendations compiled as a result of this study.

EPA MXD Trip Generation Tool Results

As discussed in the Methods Considerations section, results from the use of the EPA trip generation tool are very preliminary due to the small sample size that was used. The focus in reviewing the results was to arrive at some preliminary conclusions that could be the focus of a Phase 2 study that would look at these and other questions on a regional scale.

Figure 4 summarizes characteristics of the MXDs included in the Pilot and the VMT and number of trips modeled for each using the EPA MXD Tool.

Figure 4: Characteristics and EPA MXD Tool Results for Developments Included in Pilot

Site	City	Type	Acres	Dwelling Unit/ Acre	Population	Pop/ Acre	Modeled VMT	VMT per Population	Total # Daily Trips
Adriatica	McKinney	2	38	11	483	13	89,065	184	10,161
CityLine	Richardson	2	105	29	4,148	40	272,630	66	44,389
Legacy Commons	Frisco	2	26	24	879	34	233,892	266	34,556
Legacy Town Center	Plano	2	261	18	6,435	25	528,290	82	89,247
Watters Creek	Allen	2	28	8	531	19	139,716	263	16,246
Downtown Plano	Plano	3	44	32	1,100	25	179,381	163	29,317
Downtown Garland	Garland	4	81	6	741	9	133,182	180	18,093
Coit Rd & El Dorado Pkwy	Frisco	5	172	3	2,004	12	185,422	93	18,960
Teel Pkwy & Main St	Frisco	5	209	3	1,759	8	495,990	282	43,777

Population data source: 2020 Census

Figure 5 plots the VMT per population modeled for each development by its population density (population per acre). The development with the highest VMT per population generated was a Type 5 development, Teel Parkway & Main Street. The developments showing the lowest VMT generated are Legacy Town Center and CityLine, both Type 2 developments with relatively high densities.

The Type 2 developments are the second most dense in the development typology (see Figure 1); Coit & El Dorado, a Type 5 segregated suburban development, is a close third for lowest VMT. The difference between Coit & El Dorado and Teel & Main may be explained by the fact that Teel & Main is a large commercial node, while Coit & El Dorado has only a few commercial uses and is more characterized by single family homes.

Figure 5: Modeled VMT per Population and Population per Acre

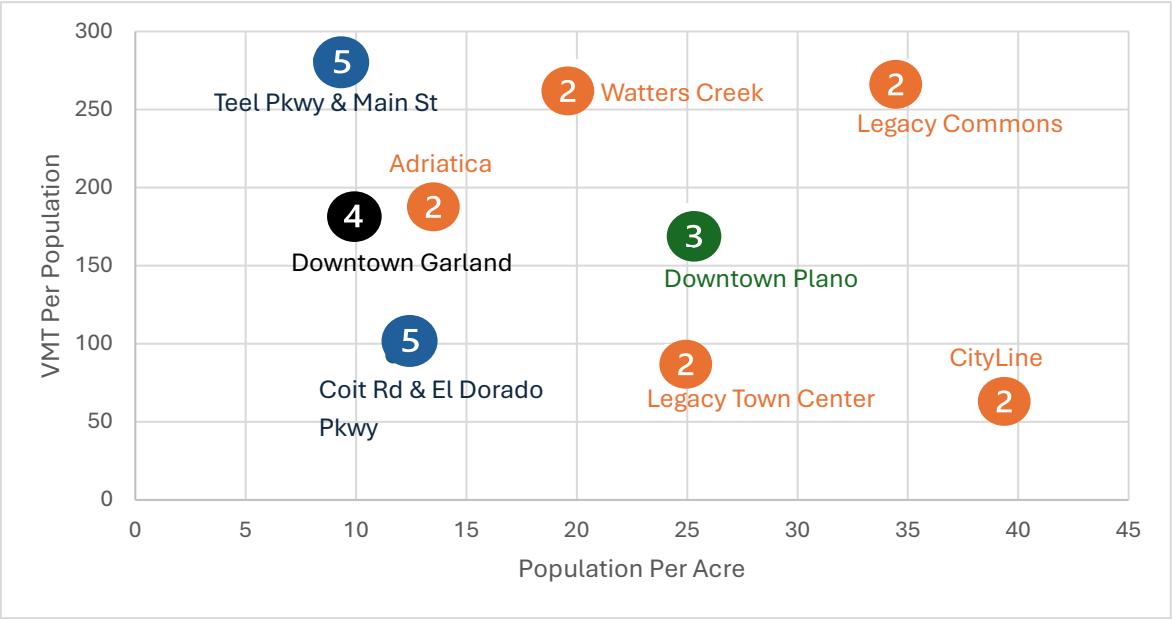


Figure 6 plots the VMT per population modeled for each development by a different density measure, dwelling units per acre, with similar results as far as the overall pattern of modeled VMT.

Figure 6: Modeled VMT per Population and Dwelling Units per Acre

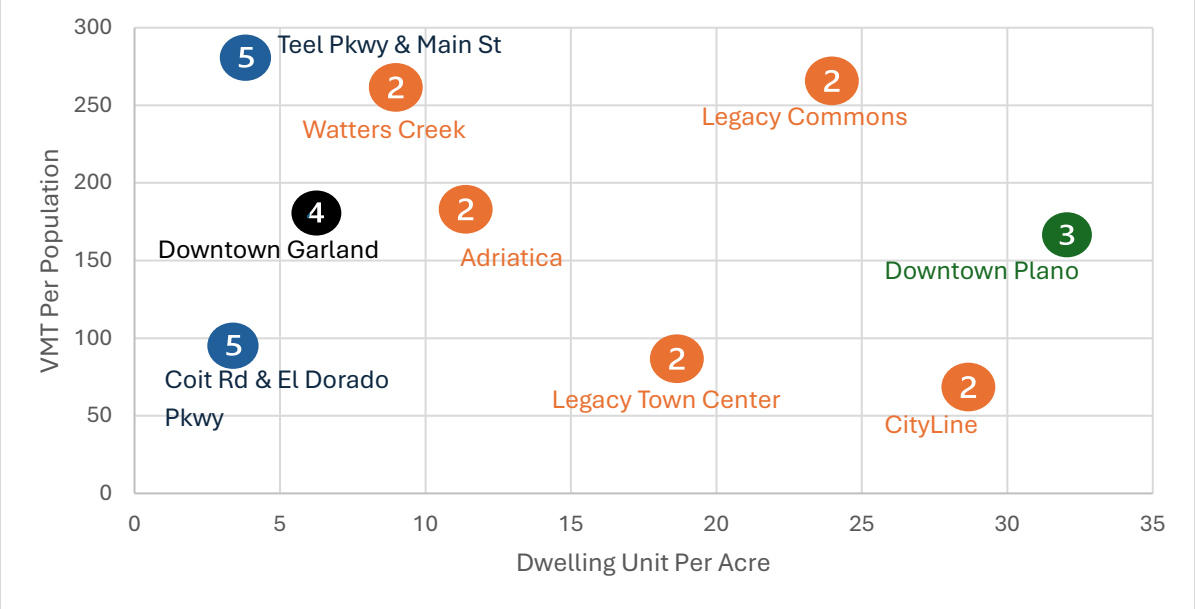


Figure 7 shows that the average VMT for Types 2 and 3 together is lower than Types 4 and 5. For each type individually, Types 2 and 3 had the lowest VMT while Types 4 and 5 had the highest and nearly equal VMTs between the two types (Figure 8). The average VMT is also lower for TOD projects vs non-TOD projects (Figure 9).

Figure 7: Average VMT per Population by Development Type (Grouped)

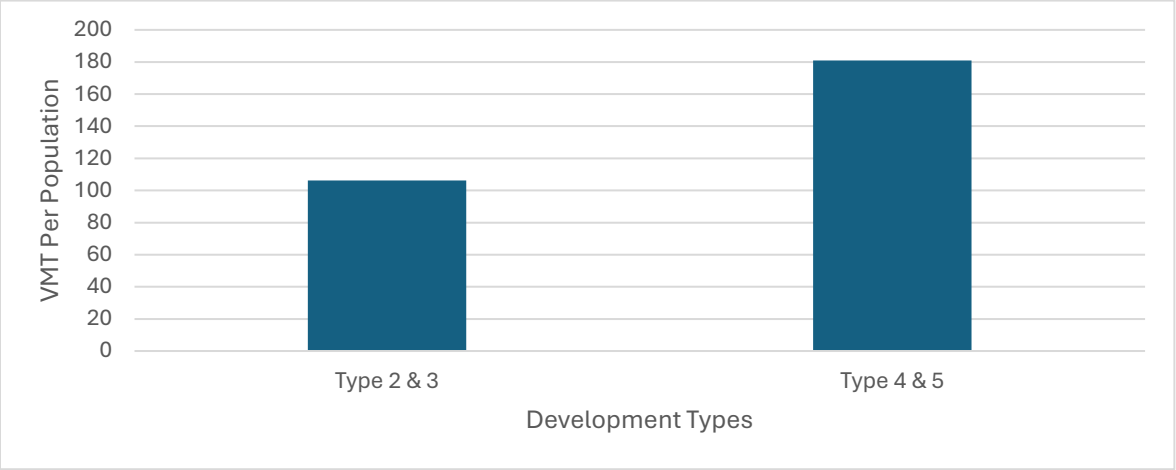


Figure 8: Average VMT per Population by Development Type (Breakout)

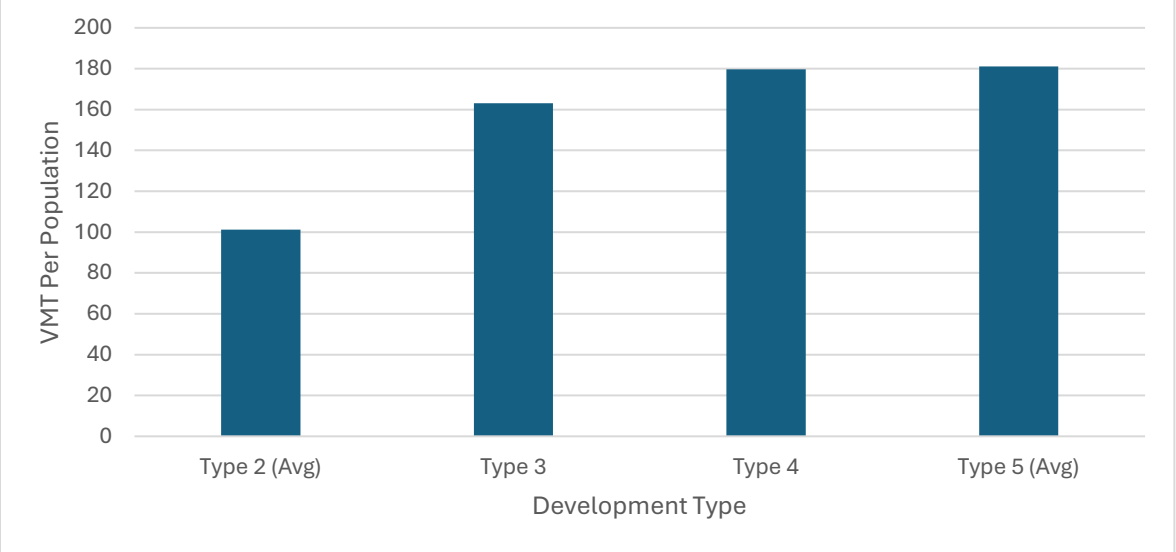
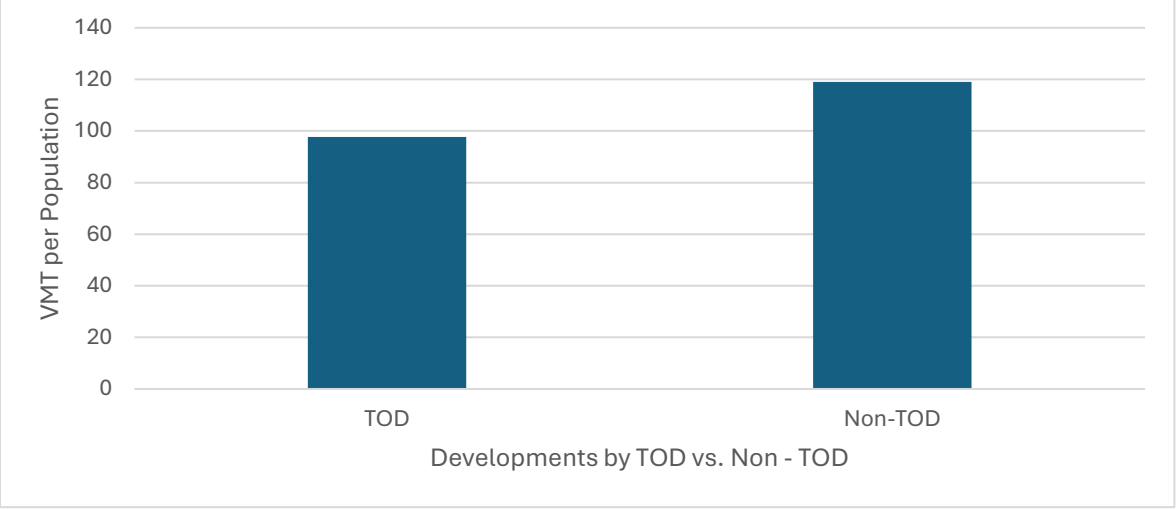


Figure 9. Average VMT per Population by TOD vs non-TOD



In addition, as shown in Figure 10, Type 3 had more "everyday" and fewer "boutique" retail uses than Types 2 or 4, while TOD projects had more "everyday" retail uses and fewer "boutique" uses, as well as a near-equal balance between "everyday" and "boutique" retail uses, when compared to non-TOD (Figure 11). As discussed previously, Type 3 and non-TOD projects also had relatively low VMT compared to Types 4 and 5 and non-TOD sites.

Figure 10. Categories of Retail by Development Type

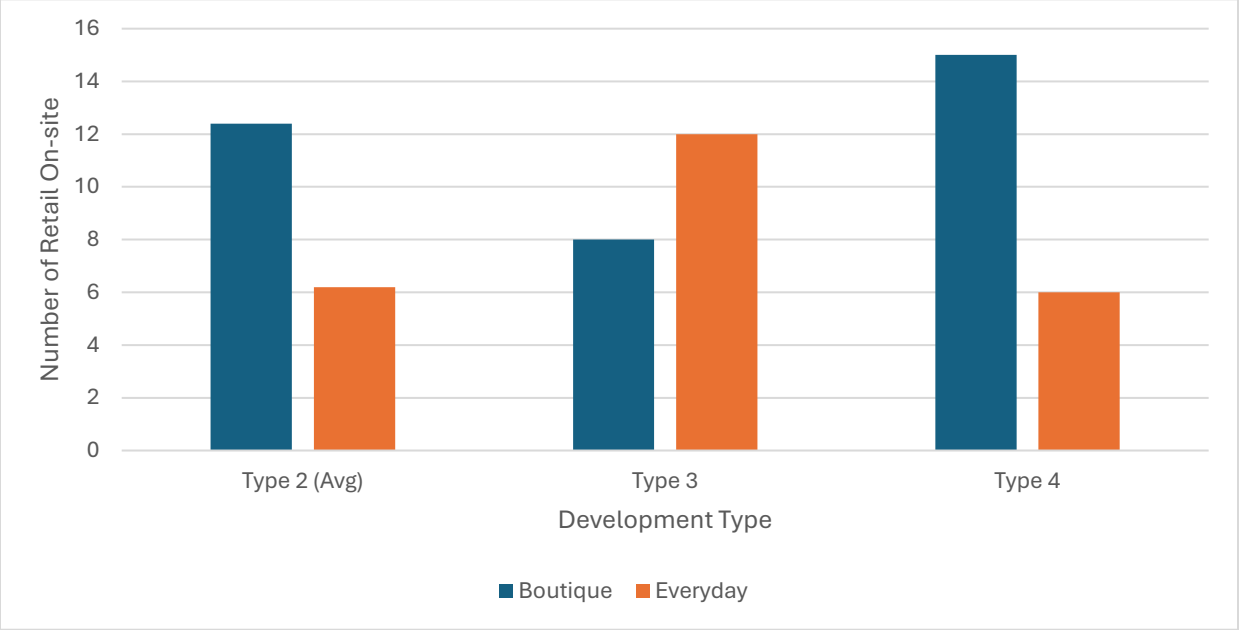


Figure 11. Categories of Retail by TOD vs. Non-TOD Development

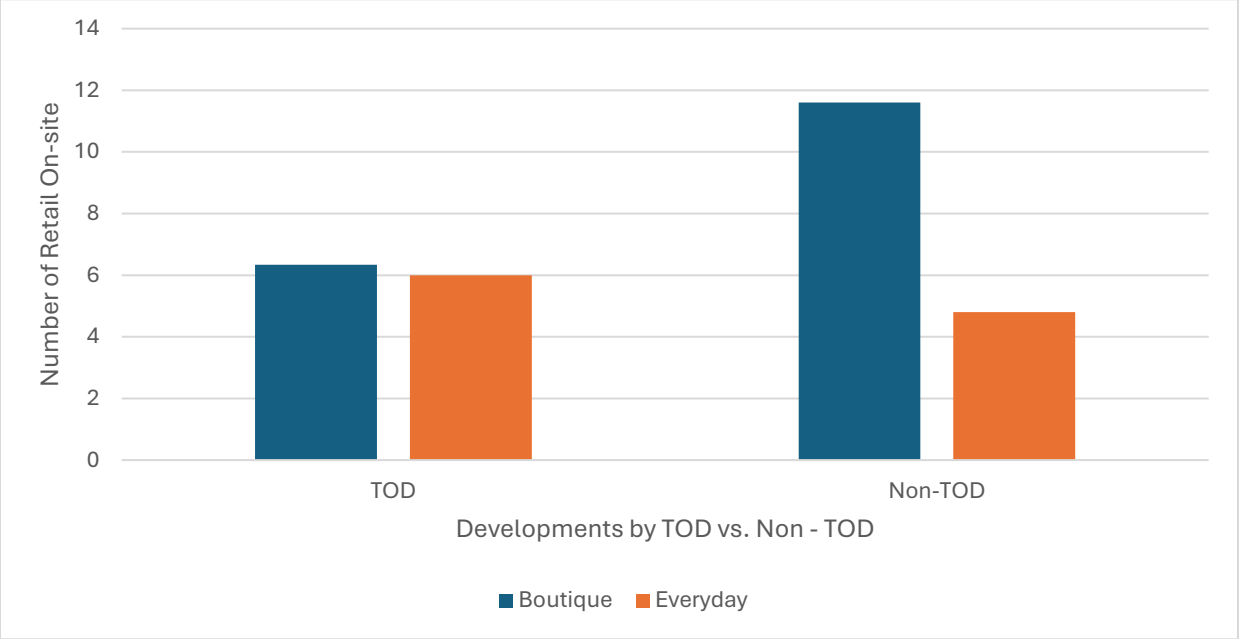
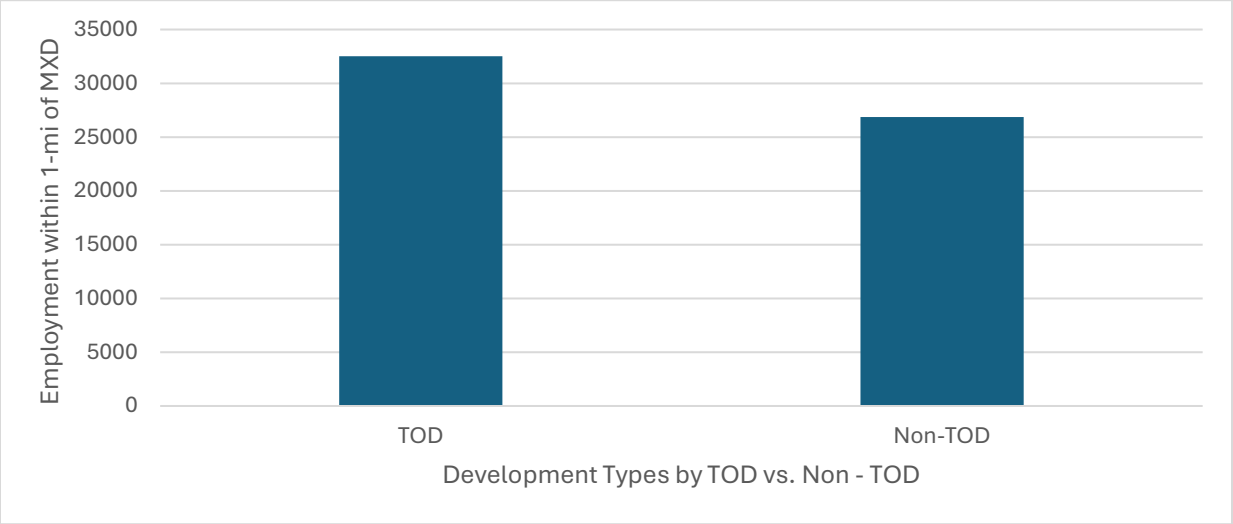


Figure 12 illustrates that TOD sites had higher amounts of employment within one mile of the MXD than non-TOD sites.

Figure 12. Employment within One Mile of TOD vs. Non-TOD Development



The model also provided the number of external daily trips for each site and followed a similar pattern as the VMT discussed previously. As shown in Figure 13, the number of external daily trips was lower for Types 2 and 3 than for Types 4 and 5.

Figure 13. Number of External Daily Vehicle Trips by Development Types (Grouped)

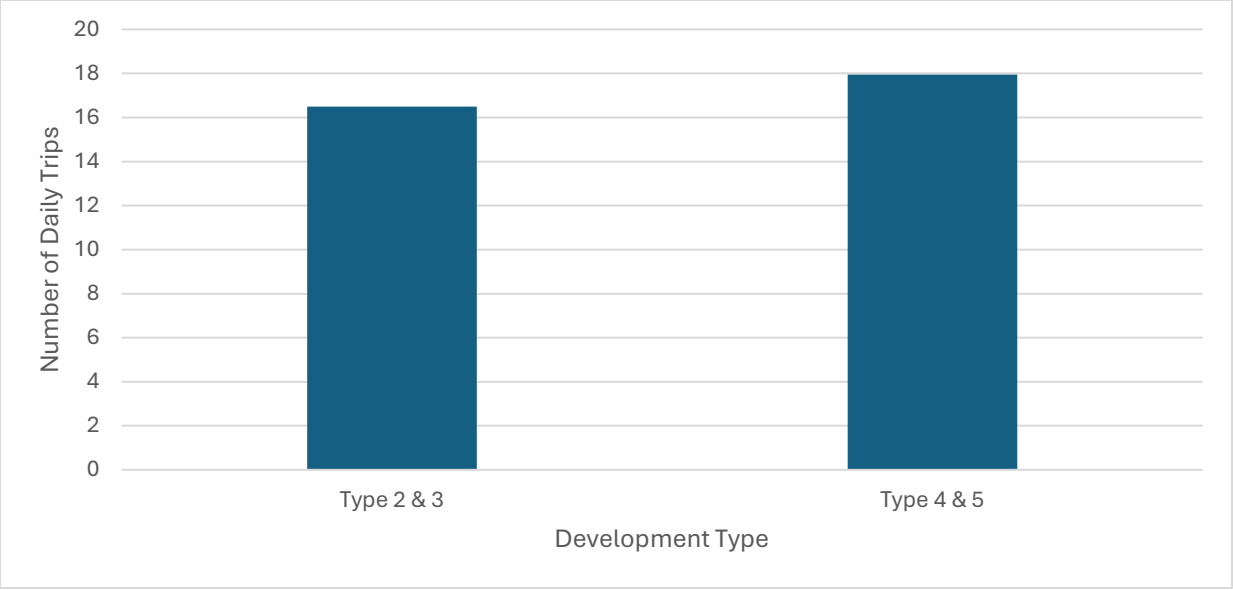
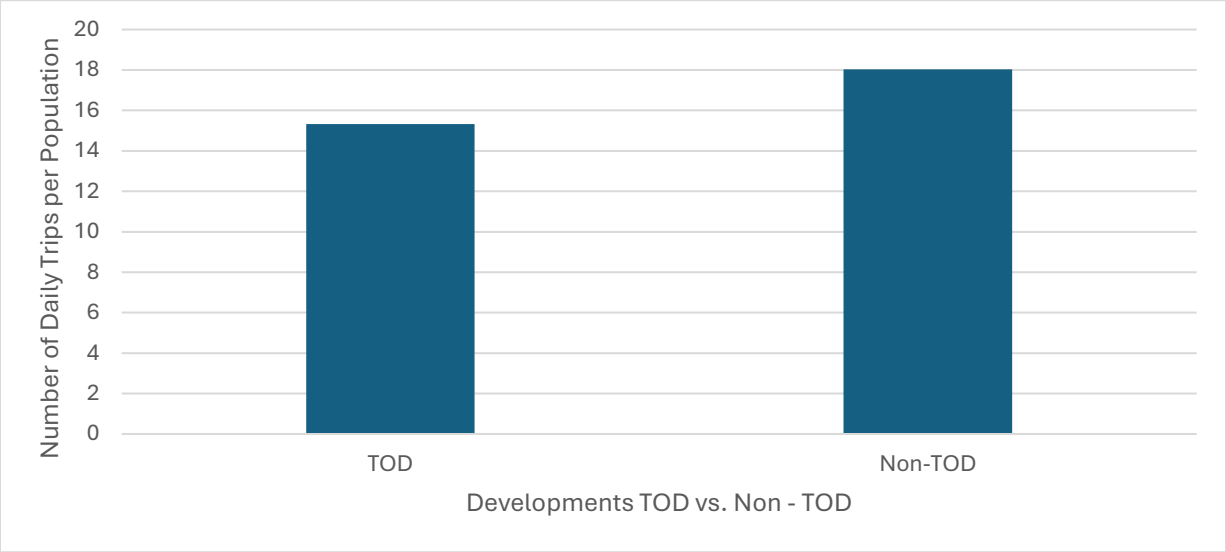


Figure 14 illustrates that the number of external daily trips was lower for TOD vs. non-TOD sites.

Figure 14. Number of External Daily Vehicle Trips by TOD vs. non-TOD Development



These results suggest that 1) further study is warranted to confirm whether Types 2 and 3, and TOD MXDs may be the most effective of the types studied at producing lower VMT and number of trips, 2) whether Types 2 and 3 can result in travel efficiencies compared to non-MXD types, 3) whether the type of retail included in the development and nearby employment play a role in travel efficiencies of MXDs, and 4) whether MXDs that are also TODs demonstrate more travel efficiencies than MXDs that are not also TODs.

Summary of EPA Trip Generation Tool Pilot Conclusions

- The number of trips and VMT generated by a MXD is not explained solely by density, but also by various interacting factors. These may include development design factors, development size, land use mix, whether the development is also a TOD, and other influences.
- The mix of uses, types of retail, and employment within one mile of an MXD may play a role in reducing VMT generated.
- Further study with a larger sample size and additional data is needed to determine final conclusions.

Recommendations for MXD Outcomes

As discussed, the literature review and preliminary analysis suggest that MXD may or may not result in travel efficiencies and reduced number of trips or vehicle miles traveled. Much of the outcome depends on contextual factors. In cases where MXD does not result in travel efficiencies, it can still have other benefits, such as positive economic impacts, and travel efficiencies may still be realized once the mix of uses in the development has been realized,

or after single developments are added to in the future to result in a larger mixed-use area and more diverse land-use mix. If MXD does not result in travel efficiencies, it may not be simply because it is mixed use, but because the specific MXD does not have the characteristics needed to capture travel efficiencies.

The recommendations below are intended to provide guidance for local governments to consider when planning and implementing MXD to maximize the likelihood of achieving the desired outcomes.

Encouraging MXD in Your Community

Perceptions of MXD use impacts can sometimes be negative, thus resulting in pushback from communities on projects. Education, transparency, and messaging with these types of projects is crucial for public engagement and buy-in. It is crucial to clearly state the long-term vision of why this type of development was chosen over others (e.g., VMT reduction, walkability, market drivers, etc.). It is not uncommon to see the general public opposing denser developments due to potential traffic increases, but is traffic always bad? Planners and local governments could use this opportunity to hone their messaging to convey to the public the benefits of congestion if they want a vibrant downtown or walkable places and the tradeoffs of implementing MXD.

Local comprehensive plans can help with this messaging if there are goals included in the plans that support MXD and/or infill development. It will be important to emphasize that the benefits of MXDs may occur much later, either because market forces will need to be aligned with fulfilling the available non-residential space, or because a larger mixed-use area may be needed to realize travel efficiencies. Again, clearly stating those benefits and possibly estimating when the development could start producing such benefits may help build a more positive perception from the public.

Adopting a definition of what MXD is and what it looks like for your community may help by allowing the city to promote certain types of development and to have a standard to refer to when communicating with developers. The definition could be a typology like the one included in this study or another illustrative reference that can support more transparent conversations with the general public and developers. Providing timelines and communicating specific expectations for the development will also allow for more transparency and education for all stakeholders. For example, explicitly defining what is meant by MXD in developer meetings and during the permitting phase will reduce confusion on the back end or the mislabeling of projects (e.g., multi-family complex with office space for the property owners). This can help to create a clearer development process, set expectations early, and foster good working relationships with the developers.

Density and Design Considerations

Because MXDs are generally denser than conventional residential or commercial developments, there is often a perception that this density creates traffic congestion. To assess the benefits of MXD, which could include reduced VMT, increased walkability, increased economic development opportunities and more, density and design must be emphasized.

An outcome of this study is that MXDs and density are likely not inherently causing more traffic congestion. Specific to the North Texas region, congestion and increased traffic from MXDs may be more of a result of the design of the MXD, the mix of uses, and how isolated single developments are. Isolated islands of MXD do not necessarily encourage mode shifts because they do not have the built environment and the mix of uses that will enable trip capture, especially in non-TOD cases. Overall, there are always tradeoffs in development, so planners could consider emphasizing the community goals and growth plans identified in long-range plans to facilitate this conversation.

The D Variables of urban development, as shown in Figure 1, should be considered in land use policy and design standards to produce effective MXD. This is especially true for elements such as intersection density and land use mix which can increase walkability and internal trip capture. Design standards can be a regulatory tool local governments can implement to encourage pedestrian-sensitive designs in MXDs. More tools related to land use and zoning are discussed in the following section.

Land Use and Zoning Considerations

Land use and zoning play a huge role in the built form and access to MXDs. Having proper zoning in place to support MXD can serve as a tool for local governments when working with developers on these types of projects. Further, having the proper zoning and land use in place can help developers navigate the development process and understand expectations upfront. The literature reviewed for this study pointed to different zoning tools and strategies for supporting MXDs. Mixed use zoning, form-based codes, and other design-oriented or district-based zoning strategies were the most common types identified. Design guidelines and form-based codes that include consideration of the D Variables of development (Figure 1) set the tone for the built environment and consider the form and function of the development.

Tools and resources like the NCTCOG Sustainable Zoning Guidebook can help local governments garner support for these developments by emphasizing design over mandating the type of use, allowing for the market for different uses to express the will of the community. Overlay districts are another tool that both regulates and provides an outline of development standards, which again provides the city with regulatory mechanisms and guidance for developers on what they can build and where. Overall, enabling supportive zoning and focusing more on form-based codes rather than regulating specific uses can

further support MXD as it allows the market to function more naturally and allows for diverse uses. Characteristics of zoning strategies that support MXD as observed in the literature are featured in Figure 15.

Figure 15: Zoning Elements that Support Mixed Use

Getting the "Right" Land Use Mix

The literature indicates getting the "right" land use mix is a crucial element of internal capture and the overall success of MXDs. Encouraging the "right" mix can be determined by the market and zoning regulations. To capture the actual benefits that MXD can have, the correct mixture of land use is needed to support the daily needs of residents who live in or near an MXD.

The needs of residents must be met through the commercial or other uses implemented to capture the benefit of reduced VMT and increased internal capture. As discussed previously, McConville et al. (2010) found that proximity to fast food, grocery stores, recreational facilities, restaurants, social uses, and sports facilities was associated with a higher likelihood of walking for transport, up to 150 minutes/week. Proximity to banks, physical activity uses, and social uses were also associated with a higher likelihood of walking.

Further, the more densely clustered the development is to other MXDs, the more vehicle travel is reduced and there is an increased opportunity or need to connect these spaces via multi-modal transportation. Per the McConville et al., (2010) study, a greater number of grocery stores, offices, and retail stores within a half mile and quarter-mile buffer was associated with a higher likelihood of walking for transport, with the effect being stronger within the quarter-mile buffer. A higher land use mix within a half mile and a quarter-mile buffer was associated with a higher likelihood of walking for transport, with the effect being stronger within the quarter-mile buffer.

Local governments can use land use and zoning tools alongside economic development incentives and public input to assess and encourage the "right" mix for a specific development. Ultimately the goal is to incentivize more everyday uses with the goal of increasing internal capture rate and other benefits of MXD.

Economic Development Considerations

Mixed-use development can be used as a tool for economic development as it can support or spur opportunities for live-work-play communities. Promoting walkable places can be an economic development tool used to attract employers and workforces. Economic development opportunities, in addition to the long-term financial benefits MXDs can have, are an important part of the conversation surrounding MXDs. Including economic development as a potential benefit in messaging around MXD projects may help change negative perceptions from the public and leadership.

A prevalent strategy to encourage MXDs is a streamlined/ "fast-tracked" approval process for such developments. A survey of U.S. developers found that the most-cited obstacle to alternative developments (including MXDs) was local regulation. The same survey found that of those that had attempted to develop alternative developments, nearly half had the mixed-use character of the development reduced during negotiations for approval (Levine, 2004). Simplifying approval may also encourage outside investment, making the entire financing process easier for the developer (Parzen, 2004).

Key Takeaways for Cities Planning MXD

As emphasized throughout this study, the mixed use picture is complicated and there are many factors to consider. The takeaways below summarize key points from the previous discussions for cities to consider when planning for MXD and to help ensure the best possible MXD outcomes.

1. The number of trips and VMT generated by a MXD is not explained solely by density, but also by various interacting factors. These may include development design factors, development size, land use mix, whether the development is also a TOD, and other influences.
2. Education and messaging are crucial for community buy-in of MXD.
    a. Education should emphasize:
        i. Development design and land use policies/regulations are just as or more important than density in determining MXD outcomes.
        ii. Depending on the context, traffic congestion may be a beneficial tradeoff if the community desires a vibrant downtown or walkable places.
    b. Messaging should include emphasis on the economic benefits of MXD, such as attracting employers and the workforce.
3. Adopting a clear definition of MXD and using it early on in conversations with developers may help define expectations and provide support for design modifications or rejecting permits for projects that don't meet the definition.
4. Reviewing and updating zoning codes and standards to emphasize design over mandated land uses are likely to provide a solid foundation for strong MXD outcomes.
5. Economic development incentives and zoning can help to promote a mix of uses that support everyday needs of residents living in or near MXDs and may be more likely to result in travel efficiencies.

Next Steps

This analysis was intended to be a pilot study to analyze MXD patterns and impacts in the Collin County area. The process of developing a pilot methodology and collecting data has highlighted the need for additional data sources and a larger, more comprehensive review of MXDs in the region. Thus, one of the key next steps for this study is to consider conducting a regional analysis and inventory of mixed-use development patterns within North Texas. Additional data sources would be needed to support more in-depth reviews of MXD traffic patterns and rates of internal capture.

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