Title

Identifying Excess Pavement: A Quantitative Analysis of Streets in the Dallas-Fort Worth Metroplex

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CAPSTONE PROJECT REPORT

UCLA Institute of Transportation Studies

Identifying Excess Pavement:

A Quantitative Analysis of Streets in the Dallas-Fort Worth Metroplex

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Client: North Central Texas Council of Governments (NCTCOG)

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16. Abstract

Despite significant focus from engineers and planners on the issue of traffic congestion, much less consideration has been given to the converse issue – at what point is too much land allocated to paved streets? This study was prompted by concerns about the negative fiscal, environmental, equity, and safety impacts of excess pavement in the Dallas-Fort Worth metroplex. For streets with low utilization relative to traffic volume, repurposing some of this public space could improve fiscal sustainability, environmental resiliency, and equity in transportation infrastructure, and reduce traffic violence. The analysis defines and identifies streets segments in the North Central Texas Council of Governments (NCTCOG) planning region with the lowest ratio of vehicle traffic to design capacity, categorizing the lowest decile as having excess pavement.

The most urban counties in the region (Dallas and Tarrant) have the highest share of excess pavement. Dallas County is particularly overrepresented, with 37% of the region's total excess lane-miles. Frontage roads and minor arterials are overrepresented in the subset of street segments with excess pavement (17% and 45.6% of excess pavement lane-miles vs. 4.9% and 38.9% of all lane-miles in the region, respectively). After incorporating street-level collision data, the majority of overbuilt and dangerous streets in the metroplex (for both fatal and non-fatal collisions) are located in Dallas County.

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The Institute of Transportation Studies at UCLA acknowledges the Gabrielino/Tongva peoples as the traditional land caretakers of Tovaangar (the Los Angeles basin and So. Channel Islands). As a land grant institution, we pay our respects to the Honuukvetam (Ancestors), 'Ahiihirom (Elders) and 'Eyoohiinkem (our relatives/relations) past, present and emerging.

Disclaimer

This report was prepared in partial fulfillment of the requirements for the Master in Urban and Regional Planning degree in the Department of Urban Planning at the University of California, Los Angeles. It was prepared at the direction of the Department and of the North Central Texas Council of Governments as a planning client. The views expressed herein are those of the authors and not necessarily those of the Department, the UCLA Luskin School of Public Affairs, UCLA as a whole, or the client.

Identifying Excess Pavement: A Quantitative Analysis of Streets in the Dallas Fort-Worth Metroplex

UCLA Institute of Transportation Studies

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Executive Summary

Despite significant focus from engineers and planners on the issue of traffic congestion (a result of too little roadway capacity relative to vehicle traffic), much less consideration has been given to the converse issue – at what point is too much land allocated to paved streets? More beneficial uses for this land could advance fiscal, safety, environmental, and equity goals. For streets in the transportation network with low utilization relative to traffic volume, repurposing some of this public space could improve environmental resiliency, fiscal sustainability, and equity in transportation infrastructure, and reduce traffic violence. This study defines and identifies excess pavement in the North Central Texas Council of Governments (NCTCOG) planning region.

The analysis identifies streets segments in the Dallas-Fort Worth metroplex with the lowest ratio of vehicle traffic to design capacity by ranking them by the ratio of traffic volume to roadway capacity, categorizing the lowest decile as having excess pavement. By this relative measure, the urban centers of Dallas and Tarrant counties have by far the most lane-miles of streets in the region with excess pavement. Dallas County in particular is overrepresented, with 37% of the region's total excess lane-miles. The plurality of all streets with excess pavement are classified as minor arterials (46%), followed by other principal arterials (28%) and frontage roads (17%). However, only frontage roads and minor arterials are overrepresented in the excess pavement subset compared to their share of lane-miles in the street network. The analysis then incorporates street-level collision data, which shows that the majority of overbuilt and dangerous streets in the metroplex (for both fatal and non-fatal collisions) are located in Dallas County, the most densely populated county in the NCTCOG planning region. These findings provide initial guidance to the NCTCOG in prioritizing interventions to repurpose pavement.

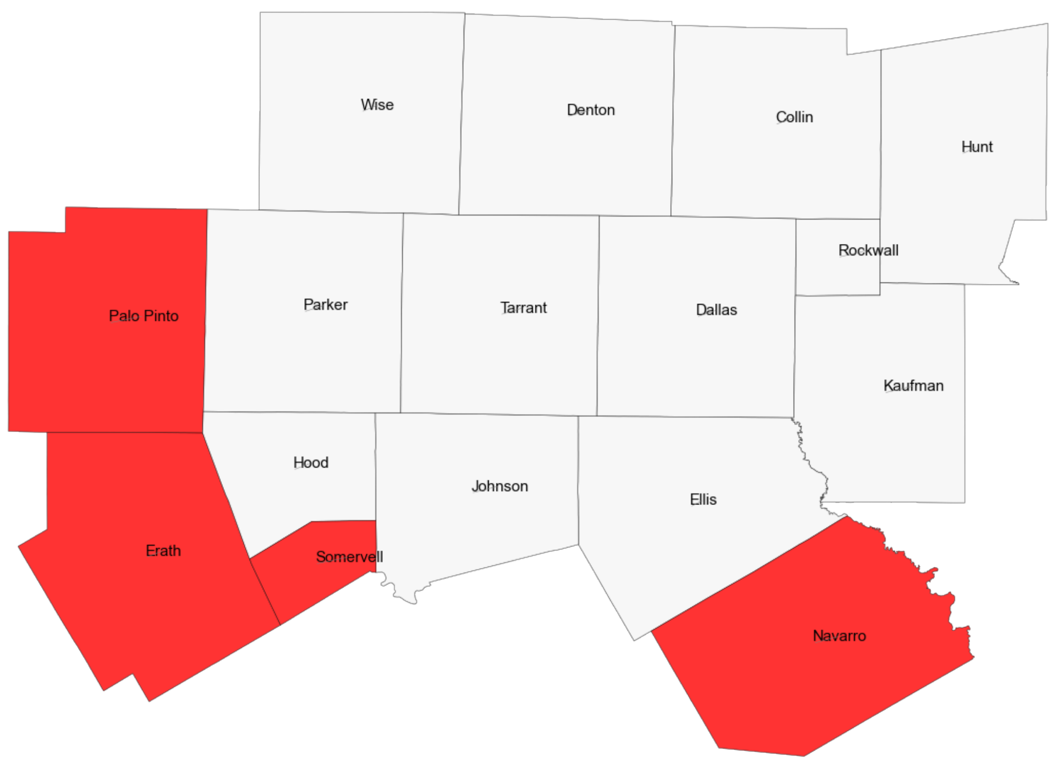
Four planning recommendations derive from these findings. First, the NCTCOG should study pavement repurposing options for different street typologies and land use contexts to understand where the benefits will be greatest relative to cost. I suggest focusing on minor arterials and frontage roads, as they are the two functional classifications overrepresented in the region's streets with excess pavements. Second, in selecting pilot sites for pavement repurposing, equity metrics and a community-driven process should complement this report's quantitative analysis to ensure both that the benefits do not flow exclusively to high-resource neighborhoods and that these findings are enhanced with local knowledge and needs. Third, jurisdictions in the region should also consider revising existing street design criteria. If current minimum right-of-way requirements produce streets with excess pavement, these requirements should be relaxed to allow for narrower streets. Finally, the NCTCOG should collect utilization data for on-street parking. Dedicated streetspace for parking that often sits vacant may present opportunities to reallocate this additional excess pavement without impacting traffic or congestion.

Introduction

This study of excess pavement in the Dallas-Fort Worth metroplex was prompted by concerns about the negative fiscal, traffic violence, environmental, and equity impacts of excess pavement. Streets are expensive to build, maintain, and repair, and much of that cost is borne by local governments. More lanes and wider streets encourage faster, more dangerous driving, and thus road diets (reducing the number of vehicle travel lanes) are a common prescription for corridors with dangerous street conditions. Land paved with impervious materials like asphalt and concrete contributes to the urban heat island effect, stormwater runoff issues, and particulate pollution from vehicle traffic. Across the U.S., low-income and communities of color disproportionately bear the negative externalities of our transportation systems.

The North Central Texas Council of Governments (NCTCOG) planning region includes 16 counties and 169 cities in the Dallas-Fort Worth metroplex (see **Figure 1**). The major cities in the planning region are Dallas, Fort Worth, Arlington, and Plano. The largest city, Dallas, makes up approximately 17% of the region's population. Because the NCTCOG Mobility 2045 travel demand model data does not include Erath, Navarro, Palo Pinto, or Somervell Counties (colored red in **Figure 1)**, they will be excluded from further analysis.

Figure 1. Counties in the NCTCOG Planning Region (excluded counties in red)



Like many urban regions in the Sunbelt, Dallas-Fort Worth has developed in a heavily car-centric manner, with few alternative transportation options beyond driving. The continual expansion of vehicle infrastructure has prompted concerns about the long-term fiscal liabilities of the street network. As one example, a lane widening and resurfacing project on a minor arterial in a major urbanized area costs approximately $3.8 million per lane-mile (see Street Context & Literature Review for more estimates). Some commentators have raised concerns that local infrastructural liabilities – primarily road maintenance – cannot be funded under current low tax rates without continual population growth (Herriges, 2018; Zhang, 2019). Although there is no indication of a looming fiscal crisis, of infrastructure maintenance costs are pertinent to many local governments. These expenses are particularly burdensome in low-density American suburbs, where the costs of public facilities are higher per capita than in more densely populated areas.

The problem of excess pavement is adjacent to many well-studied areas of urban planning and transportation engineering, from traffic congestion and multimodal road safety to the optimal allocation of space to various transportation modes and land uses. However, the core question of identifying excess or overbuilt street capacity is typically only considered in an ad-hoc manner while studying road diets on specific corridors with particularly high rates of traffic violence. LOS is a letter grade (A-F) assigned to streets based on congestion, which ultimately derives from this ratio. By turning the Level of Service (LOS) measure on its head, this study identifies the street segments in the NCTCOG street network with the lowest ratio of traffic volume relative to roadway capacity. After identifying these street segments with excess pavement, I propose a method to prioritize interventions based on rates of traffic violence.

Context & Literature Review

This section introduces the American street classification system and associated maintenance costs for several typologies, discusses approaches to measuring street networks and pavement coverage, and presents emerging policies to reduce or adapt existing pavement away from private vehicle use.

Street Typologies & Roadway Maintenance

The Federal Highway Administration (FHWA) defines functional classifications for streets. The street classifications in the NCTCOG travel demand model that this project analyzes include interstates, principal arterials (freeway), principal arterials (other), minor arterials, ramps, frontage roads, and HOV lanes. See Federal Highway Administration, 2013 for full descriptions of each functional classification and **Figure 2-4** for street-level examples from the region of several functional classifications.

Because minor arterials make up the largest share of lane-miles in Dallas-Fort Worth metroplex's street network and a near-majority of its excess pavement, additional detail is provided below. Generally, arterials provide a high level of mobility, local streets provide a high level of accessibility, and collectors provide a balance between the two. Minor arterials "provide service for trips of moderate length, serve geographic areas that are smaller than their higher Arterial counterparts and offer connectivity to the higher arterial system. In an urban context, they interconnect and augment the higher Arterial system, provide intra-community continuity and may carry local bus routes" (Federal Highway Administration, 2013). See **Table 1** for further detail on the characteristics of urban versus rural minor arterials and **Table 2** for estimates on the costs of roadway maintenance and widening in variety of roadway and density contexts.

Table 1. Urban and Rural Minor Arterials (Federal Highway Administration, 2013)

URBAN MINOR ARTERIALS	RURAL MINOR ARTERIALS
• Interconnect and augment the higher-level Arterials • Serve trips of moderate length at a somewhat lower level of travel mobility than Principal Arterials • Distribute traffic to smaller geographic areas than those served by higher-level Arterials • Provide more land access than Principal Arterials without penetrating identifiable neighborhoods • Provide urban connections for Rural Collectors	• Link cities and larger towns (and other major destinations such as resorts capable of attracting travel over long distances) and form an integrated network providing interstate and inter-county service • Be spaced at intervals, consistent with population density, so that all developed areas within the State are within a reasonable distance of an Arterial roadway • Provide service to corridors with trip lengths and travel density greater than those served by Rural Collectors and Local Roads and with relatively high travel speeds and minimum interference to through movement

Figure 2. Frontage Road: Interstate 30 WB Frontage Road in Aledo, TX (Google Street View)

Figure 3. Principal Arterial (Other): FM740 Ridge Road in Rockwall, TX (Google Street View)

Figure 4. Minor Arterial: Headquarters Dr in Plano, TX (Google Street View)

Table 2. Selected Costs per Lane-Mile for Roadway Maintenance and Improvement (Federal Highway Administration, 2019)

	Typical Costs (Thousands of 2014 Dollars per Lane-Mile)			
CATEGORY	**RECONSTRUCT AND WIDEN LANE**	**RECONSTRUCT EXISTING LANE**	**RESURFACE AND WIDEN LANE**	**RESURFACE EXISTING LANE**
Rural				
Interstate				
Flat	$1,993	$1,302	$1,128	$462
Rolling	$2,234	$1,335	$1,298	$492
Other Principal Arterial				
Flat	$1,556	$1,042	$941	$371
Rolling	$1,757	$1,071	$1,069	$413
Minor Arterial				
Flat	$1,423	$915	$877	$329
Rolling	$1,718	$1,013	$1,091	$354
Urban				
Freeway/ Expressway/ Interstate				
Small Urban	$3,356	$2,324	$2,645	$564
Small Urbanized	$3,608	$2,344	$2,736	$667
Large Urbanized	$5,754	$3,837	$4,238	$895
Major Urbanized	$11,509	$7,675	$8,224	$1,483
Other Principal Arterial				
Small Urban	$2,925	$1,974	$2,420	$473
Small Urbanized	$3,130	$1,998	$2,530	$559
Large Urbanized	$4,471	$2,929	$3,702	$703
Major Urbanized	$8,942	$5,857	$7,405	$1,135
Minor Arterial/Collector				
Small Urban	$2,155	$1,491	$1,831	$346
Small Urbanized	$2,258	$1,508	$1,848	$394
Large Urbanized	$3,040	$2,017	$2,527	$483
Major Urbanized	$6,080	$4,033	$3,822	$804

Measuring Excess Pavement

Neither transportation planning nor engineering literature define excess pavement. From an engineering perspective, more pavement (in the form of more and wider driving lanes) translates to a higher level of service (LOS), all else equal. Planners may examine land use in a more holistic manner, but outside of road diets for dangerous intersections or corridors and removal of on-street parking, few researchers – detailed below – have approached the problem of balancing space for vehicle travel with other urban needs or desires from a quantitative perspective.

Adam Millard-Ball's analysis of street widths and land values across the U.S. provides a methodology for assessing physical space dedicated to streets (2022). The study analyzed residential street widths across 20 American counties by calculating the distance between land parcels to determine the width of public ROW. This method has the benefit of speed and applicability to any jurisdiction with accessible parcel boundary data. The next step estimates the market value of the underlying land to illustrate the massive wealth stored in paved residential streets in urban and suburban areas that is likely not allocated to an optimal use. Both the City and County of Dallas require 50-foot minimum ROW for residential streets, and Millard-Ball's analysis finds that the median and mean residential street widths in Dallas County are 50 and 51.3 feet respectively. The highly modal distribution of street widths in Dallas suggest that minimum ROW widths artificially constrain determination of the necessary ROW width, and that developers or city planners would likely build narrower streets if they could. These residential streets make up 8.4% of Dallas County's land area, and all streets represent 19.1% of land in the county. Tarrant County, where Fort Worth is located, has nearly identical street features.

Arnold & Gibbons quantify impervious surface coverage and its environmental impacts, particularly on water resources and stormwater runoff (1996). They recommend aerial photographs or satellite imagery for measuring imperviousness over larger areas. Crossing jurisdictional boundaries to examine land use at the watershed level is an important step in their analysis, allowing for planners and environmental scientists to coordinate to balance development and sustainability. Gössling et al. carried out an analysis of public space devoted to various transportation modes in Freiburg, Germany (2016). They also used satellite imagery but manually categorized the land in the imagery according to its use (ex. roadway, on-street parking, sidewalk/crosswalk, bus stops/railway, bike paths). With this data, they calculated the ratio of land dedicated to each transportation mode compared to that mode's share of travel in the city. This approach has the advantage of producing a detailed breakdown of how public space is allocated. While it is difficult to replicate at scale, this method is useful for smaller cities or in cases where no relevant quantitative data is available.

To measure the equity impacts of vehicle infrastructure on health, Houston et al. pair Annual Average Daily Traffic (AADT) counts on freeways and major arterials in Southern California from Caltrans monitoring systems with a variety of demographic data to understand the characteristics of neighborhoods that suffer the brunt of the negative externalities of the transportation system (2004). They find that neighborhoods whose residents are predominantly low-income and people of color are exposed to twice the level of traffic density as the rest of the Southern California region and are thus at higher risk of negative health effects from exposure to vehicle-sourced air pollutants. The authors both estimate and extrapolate levels of pollution and its follow-on health effects because a more granular monitoring system does not exist. Analogously, paved surfaces (asphalt or concrete) contribute to the urban heat island effect, which poses significant public health risks. According to a 2017 study, the City of Dallas is the third fastest-heating city in the U.S. (Stone, 2017). Further, an NCTCOG-commissioned study projects a 5°F increase in average July temperature in Dallas and Tarrant Counties – home to the region's two major cities – between 1991-2000 and 2041-2050 (Winguth et al., 2015).

The concept of excess pavement – in the form of overly wide streets – also has ramifications for roadway safety and traffic violence. Despite a growing movement of planners calling for design and engineering changes to create safer streets, there is little rigorous research on how street width influences driver behavior and multimodal safety. However, one study of the relationship between lane width and safety drawing from Toronto and Tokyo finds a "sweet spot" between 2.8 and 3.2 meters (9.2 and 10.5 feet) for the best safety outcomes (Karim, 2015).

Repurposing Strategies

Building on his article quantifying the width and value of residential streets, Millard-Ball then proposed reallocating the valuable (and often unnecessary) width of that public ROW to either camper van parking or front-yard ADUs after returning some land to adjacent property owners (Millard-Ball, 2021). These proposals make sense in West Coast cities facing both spiraling land values and a housing crisis but are less applicable to urban areas in the Sunbelt, where density is significantly lower throughout, homelessness rates are much lower, and the political environment is very different. However, the paper offers a warning to these cities to right-size and reallocate streetspace before housing costs reach crisis levels.

Todd Litman is one of the few planners who has dedicated significant effort to considering how to convert paved land to better uses. His work has been a helpful starting point in the project, though it focuses primarily on underutilized land dedicated to parking and the land use factors that shape demand for road space. His "Pavement Busters Guide" provides a wealth of knowledge and sourcing on how the amount of impervious surface (i.e., pavement) varies across densities and land use types, and the many negative impacts of paved land (Litman, 2021). Though the Dallas-Fort Worth metroplex, like most urban areas in the U.S., almost certainly has an oversupply of parking, identifying excess paved parking facilities is beyond the scope of this project (see Recommendation 4).

Some efforts are underway in American cities to repurpose space previously reserved for private vehicles, including an expansion of bus-only lanes in New York City and Streets for All's 25x25 campaign to enlist the support of elected officials to turn 25% of LA's street space over to "the people" for non-vehicular uses by 2025 (New York City DOT, 2019; Streets for All, n.d.). Other cities outside the U.S. have more aggressively sought to reallocate public space away from private vehicles the public right-of-way. In Paris, Mayor Anne Hidalgo has implemented a suite of policies to redesign public rights-of-way. The Mayor's Climate Action Plan sets ambitious goals for park access, climate change resiliency, and urban forestry that necessitate repurposing vehicle space (Mayor of Paris, 2012). Hidalgo has aggressively expanded the city's bike network and reduced vehicle access to the central city, most notably through shutting down parts of a highway along the Right Bank of the Seine to create a park. These policies have certainly played a role in the decrease in car ownership from 60% of households in 2001 to only 35% in 2019 (Nossiter, 2019).

Methodology

This project synthesizes a variety of existing data sources from city and counties in the North Central Texas Council of Governments (NCTCOG) planning region as well as data collected by NCTCOG to answer a previously understudied question in the region. It sits at the nexus of major fiscal, safety, environmental, and equity issues that urban areas must address in the coming years. Additionally, the project provides an opportunity to contribute to the emerging understanding of “excess” pavement. Because the majority of the necessary data sources exist for urban areas around the country, this analysis is replicable for other locations The approach to measuring excess pavement outlined below relies on an engineering framework. However, other perspectives – economics, for example – might consider the value of the underlying land and the opportunity costs of using it to move and store private vehicles rather than for other purposes.

This project is limited by the fact that it examines a very large metropolitan area with many data sources as inputs. This analysis may overlook micro-level variations because incomplete or inaccurate data may produce erroneous analysis of excess pavement. However, the large-scale quantitative nature of the project avoids the ad-hoc and discretionary process of reallocating public ROW that often disproportionately benefit organized, wealthy communities with the resources and institutional influence to shape policy. With those caveats in mind, any plan to repurpose pavement identified with these methods should be validated with site visits, traffic counts, and a community process (see Recommendation 2). The findings from this project offer a range of streets potentially suitable for repurposing, to be considered in conjunction with community engagement as NCTCOG implements a program to address excess pavement.

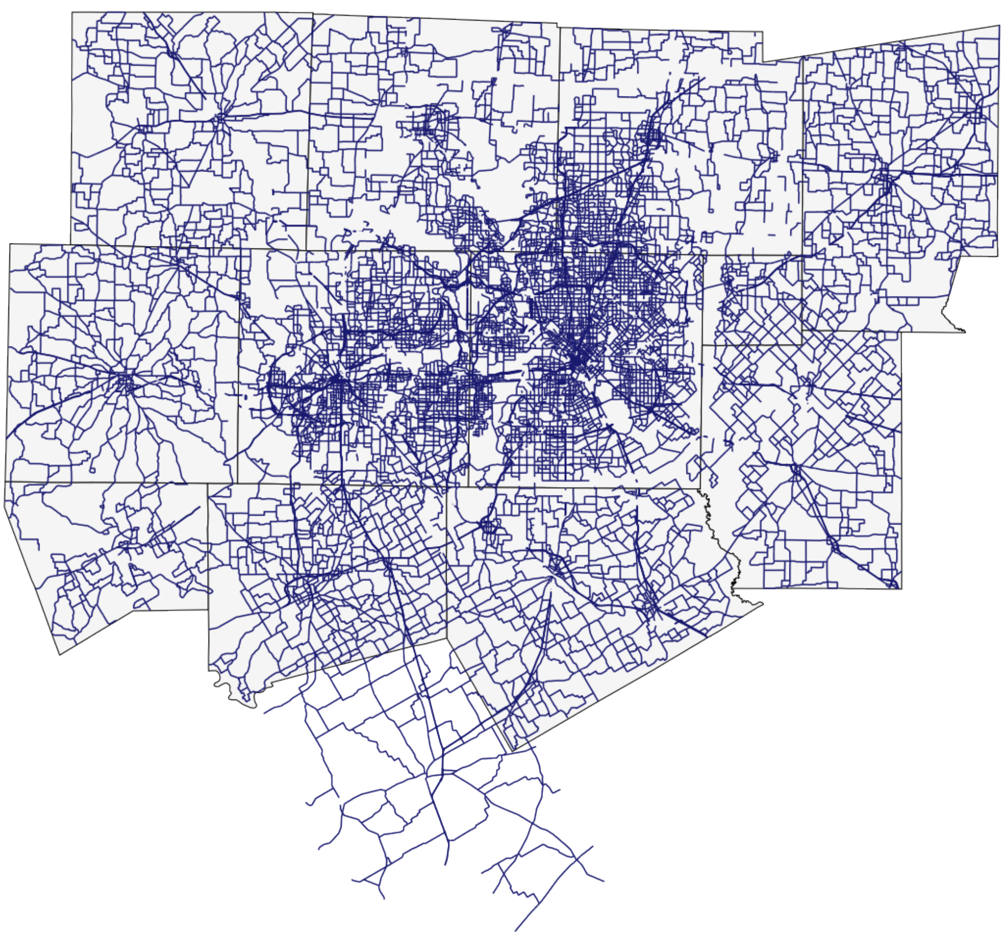
Data Overview & Sources

Demographic data – race/ethnicity, median household income, vehicle ownership, tenure (rent/own housing) – is from the Census 2019 American Community Survey 5-Year Estimates at the block group level. Street network and traffic data comes from the NCTCOG Mobility 2045 travel demand model (see **Figure 5** for a regionwide view of streets included in the model). Note that Erath, Navarro, Palo Pinto, and Somervell counties are not included in the travel demand model and are thus excluded from this analysis. I obtained geocoded collision incident data for the region between 2012 and 2020 from the TxDOT Crash Records Information System (CRIS) database. Administrative boundaries (cities and counties) are hosted on the NCTCOG data portal. See **Table 3** for all data sources used for analysis.

Table 3. Data Sources

DATA TYPE	SOURCE
Median Household Income; Race/Ethnicity; Vehicle Ownership; Tenure (Rent/Own)	U.S. Census American Community Survey, 2019 5-Year Estimate
Employment	U.S. Census Longitudinal Employer-Household Dynamics: Origin-Destination Employment Statistics (LODES), 2018
Mobility 2045 Travel Demand Model (regional street network)	NCTCOG
Administrative Boundaries	NCTCOG
Collision Data, 2011-2020	TxDOT CRIS

Figure 5. NCTCOG Street Network in Mobility 2045 Travel Demand Model



Defining Excess Pavement

To conduct this analysis, I assembled data on the street network, traffic volumes, collision locations, administrative boundaries, and demographics. I then used this data to identify the 10% of streets with the lowest traffic volumes relative to roadway capacity. Rather than set a precise level at which a street is considered to have excess pavement or be overbuilt, in this project streets will be graded relatively – from most to least excess pavement. This approach avoids creating an arbitrary definition that would generate controversy among engineers and planners, while offering a way for local or regional public agencies to prioritize and fund pilot projects to repurpose pavement/street space for other uses.

As noted above, the Mobility 2045 travel demand model data does not cover the street network in Erath, Navarro, Palo Pinto, and Somervell Counties. Neighborhood residential streets are also excluded from the model – though many residential streets in Dallas are significantly wider than necessary, and the same likely holds for other jurisdictions in the region (Millard-Ball, 2022). Additionally, data on the location and extent of on-street parking space (another use of pavement in the public ROW) is not included in this analysis but would complement my findings. Even without conducting a location-specific analysis, it is likely that underutilized on-street parking is a significant store of excess pavement in the NCTCOG region ripe for repurposing (see Recommendation 4). I adjusted for roadway size by calculating a lane-mile value for each street segment consisting of its length multiplied by the number of lanes. Finally, I exclude streets with less than two lanes in the given travel direction from the calculation of excess pavement, following guidance from the NCTCOG that local transportation planners are unlikely to eliminate the sole vehicle travel lane for a given street segment.

The Mobility 2045 dataset includes a calculated volume over capacity (VOC) ratio for each street segment, which is based on the volume of traffic on the street relative to the vehicle capacity it designed to carry. I define as excess street segments in the **lowest 10% of VOC**. This approach inverts the logic of Level of Service (LOS), which rates streets on an A-F scale based on congestion and traffic relative to capacity. I conducted separate analyses of the volume to capacity ratio for AM and PM peak periods for each street in the network for both directions where applicable. This methodology does not propose a specific ratio of traffic volume to roadway capacity at which a street segment has excess pavement; rather, it identifies the street segments with the lowest traffic volumes relative to capacity. Next, I examined the characteristics of the identified streets, including their geographic distribution, functional classification, and number of lanes in each direction.

For the sake of brevity and comprehensibility, this analysis is presented at the county level for the 12 counties included in the NCTCOG travel demand mode. City-level results are not included, though I tagged street segments by municipality where applicable and this analysis could be applied at the city level.

Equity & Traffic Violence

To incorporate a basic equity analysis of the NCTCOG planning region, I developed a measure classifying block groups into deciles (and assigned values from 1 to 10) based on the percentage of residents of color, median household income, percentage of zero-vehicle households, and percentage of renters. The first three metrics are drawn from LA Metro's Equity Focus Communities framework, to which I added housing rental/ownership status (Bonin et al., 2019). Block groups with higher percentages of residents of color, lower median household incomes, higher percentages of zero-vehicle households, and higher percentages of renters are assigned higher scores. The minimum score is 4 (bottom decile for each of the four indicators) and the maximum score is 40 (top decile for each indicator), with higher scores indicating higher equity need. The average index score is 22 for all block groups in the 12-county area considered in this study.

To match collision locations to streets in the travel demand model and identify street segments with high rates of traffic violence, I assigned each collision to the nearest street segment, excluding collision locations more than 50 meters from a street to account for erroneous coordinates. I then calculated the number of collisions per mile to account for street segment length and identified the top 10% of street segments with the highest number of collisions per mile as collision-prone. I performed a similar analysis using only the subset of collisions that resulted in at least one fatality to identify the top 10% of street segments with the highest number of fatal collisions per mile as fatality-prone.

Finally, I cross-referenced the streets identified as having excess pavement with collision locations and equity metrics to produce a priority list of streets for possible interventions. To do so, I matched the set of streets with excess pavement with my calculation of streets with the highest proportion of crashes. I then calculated whether streets with excess pavement are more or less likely to be located in areas of high equity need. The methodology outlined above takes a regional approach to identify streets with excess pavement, locate the most dangerous of these streets, and quantify the distribution of these streets from an equity lens.

Analysis & Findings

The code used to generate this analysis and csv files of street segments identified as excess are publicly accessible on Github at https://github.com/amjarnagin/Excess_Pavement.

The NCTCOG Street Network and Excess Pavement

NCTCOG's travel demand model includes the functional classification of each street. **Table 4** describes some characteristics of these streets and each functional classification's share of total lane-miles.

Table 4. Street Characteristics in the NCTCOG Region by Functional Classification

FUNCTIONAL CLASSIFICATION	% OF LANE-MILES IN STREET NETWORK	AVERAGE NUMBER OF LANES	AVERAGE SPEED LIMIT (MPH)
Interstate	8.5%	3.21	67
Principal Arterial (Fwy)	16.0%	3.82	46
Principal Arterial (Other)	29.5%	3.61	41
Minor Arterial	38.9%	2.37	34
Ramp	2.0%	1.2	45
Frontage Road	4.9%	2.43	41
HOV Lane	0.3%	1.59	70

Note: The travel demand model data categorizes each direction of some separated roadways (i.e., divided interstates) as different streets. The correct interpretation of average lanes for interstates, frontage roads, and other divided streets is the average lanes in each direction.

The percentage of lane-miles in each county's street network by Level of Service (LOS) is shown in **Figure 6**. The travel demand model data includes LOS grades of ABC, DE, or F. The majority of lane-miles in all counties are rated as ABC. The region's four most populous counties – Dallas, Tarrant, Collin, and Denton – have the highest shares of lane-miles ranked as DE or F. Only Collin and Denton Counties, the region's major suburban jurisdictions, have over 10% of lane-miles at LOS F (15% and 13%, respectively).

Figure 6: Level of Service (LOS) of Streets by County

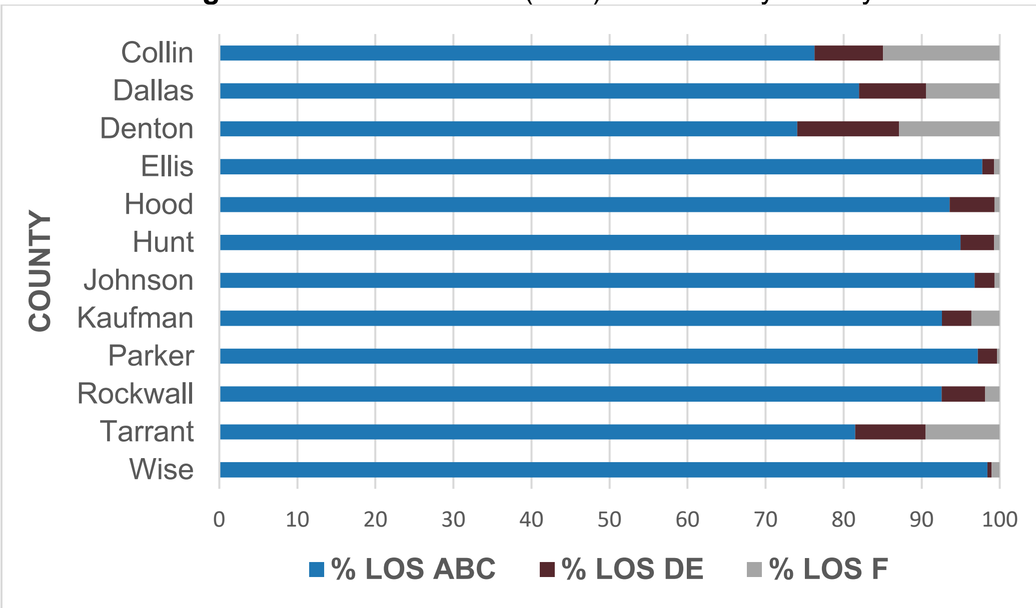


Figure 7 displays the distribution of AM peak period volume over capacity (VOC) ratios for all street segments in the travel demand model. The vertical red line at a VOC of 0.048219 is the lowest decile, below which I classify a street as having excess pavement for the AM peak period. Note that the actual number of street segments identified in this analysis as such is lower than what is displayed in the histogram after excluding streets with less than two lanes in the given direction (see Methodology for details). Perhaps intuitively, the 10% of street segments with the lowest VOC ratio all have an LOS classification of ABC, indicating that these street segments do not experience significant congestion.

Figure 7: Histogram of Street Segments by VOC Ratio for AM Peak Period
(cutoff for excess pavement calculation in red)

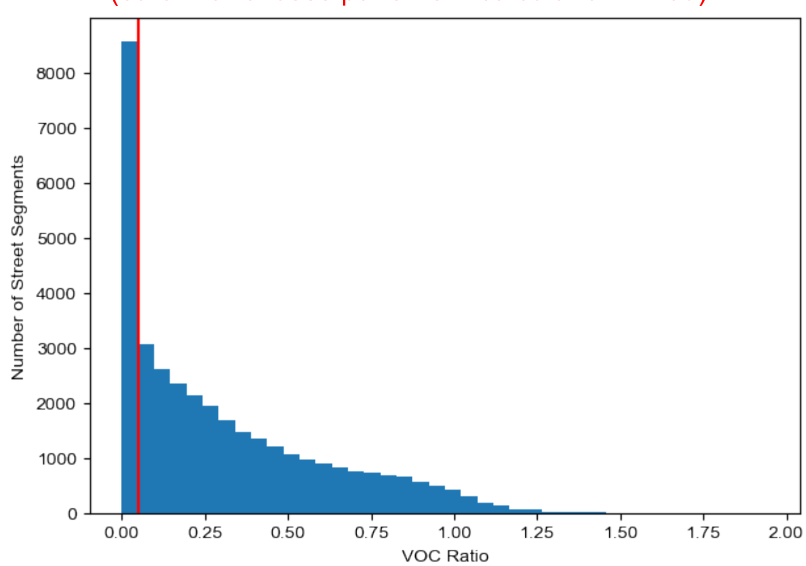


Figure 8 and **Table 5** show the distribution of excess pavement across counties in the NCTCOG travel demand model. Excess pavement in the AM and PM peak periods is relatively similar, and the most urban counties in the region (Dallas and Tarrant) have the highest share, followed by suburban counties (Collin, Denton, and Ellis), with exurban and rural counties at the lowest share.

Figure 8. Distribution of Excess Pavement in NCTCOG

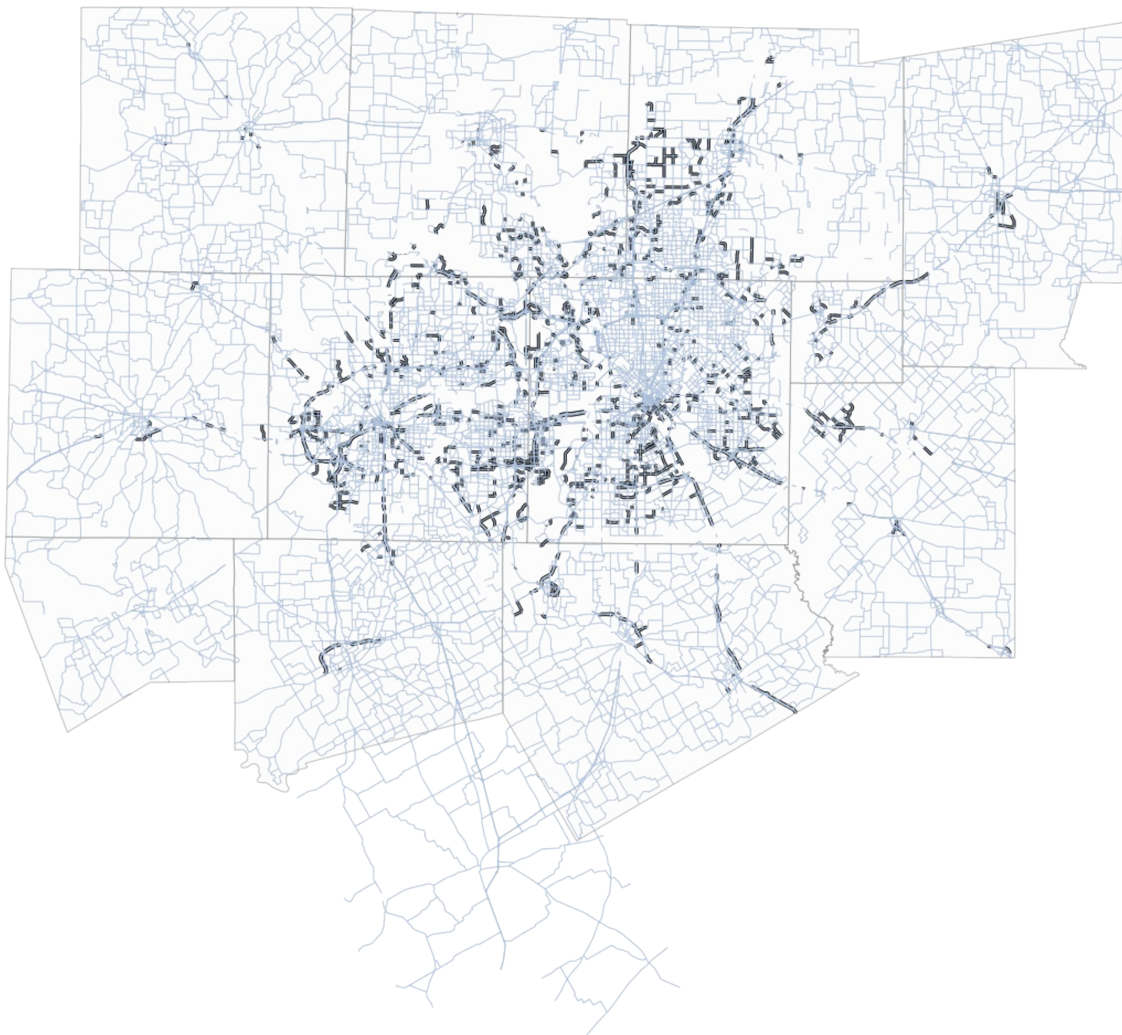


Table 5. Distribution of Top 10% of Streets with Excess Pavement at AM and PM Peak Periods by County

COUNTY	% TOTAL LANE-MILES	% EXCESS PAVEMENT LANE-MILES (AM)	% EXCESS PAVEMENT LANE-MILES (PM)
Dallas	33.7%	37.1%	35.2%
Tarrant	24.4%	24.9%	26.0%
Collin	13.8%	14.5%	14.9%
Denton	8.7%	11.1%	10.6%
Ellis	4.7%	3.6%	3.9%
Kaufman	2.7%	2.2%	2.8%
Hunt	2.2%	1.9%	1.9%
Hood	0.8%	1.9%	1.8%
Parker	2.2%	1.5%	1.6%
Johnson	3.9%	1.1%	1.2%
Wise	1.5%	0.3%	0.3%

According to my analysis, streets with excess pavement are most likely to be minor arterials, followed by principal arterials (other) and frontage roads (see **Table 6**). When compared to full street network in the region (**Table 4**), both frontage roads and minor arterials are overrepresented in the subset of street segments identified as having excess pavement (17% and 45.6% of excess pavement lane-miles vs. 4.9% and 38.9% of all lane-miles in the region, respectively).

Table 6. Distribution of Excess Pavement by Street Classification

FUNCTIONAL CLASSIFICATION	% OF TOTAL EXCESS PAVEMENT LANE-MILES
Interstate	3.1%
Principal Arterial (Fwy)	4.2%
Principal Arterial (Other)	28.2%
Minor Arterial	45.6%
Ramp	1.1%
Frontage Road	17.0%
HOV Lane	0.9%

Frontage roads typically run parallel to limited-access highways and provide access to the residential, commercial, or industrial land uses adjacent to the limited-access corridor. Since 2001, TxDOT policy has been to not construct new frontage roads in most circumstances (Texas Department of Transportation, 2002). Minor arterials tend to play a more connective role linking neighborhoods and small collector streets to major roadways. For a more detailed description of minor arterials, see **Table 1**.

As the FHWA classification indicates, bus routes are often located on these streets, so excess pavement could be reallocated to transit lanes. Their proximity to residential areas also suggests that active transportation infrastructure for people walking or biking could be beneficial. In areas with few public parks or greenspace, excess pavement along minor arterials could repurposed as urban greenways, parklets, or stormwater runoff infrastructure. A more immediate intervention could incorporate traffic calming, particularly along dangerous corridors (see below).

The land use context of frontage roads poses a different set of issues. Due to their location adjacent to freeways, frontage roads with excess pavement may offer opportunities to mitigate freeway traffic impacts with vegetation or sound barriers. However, there may be greater issues with addressing excess pavement in tensions between state and local transportation planning bodies, in addition to the fact that the area surrounding frontage roads is often unfriendly to non-driving transportation modes in general.

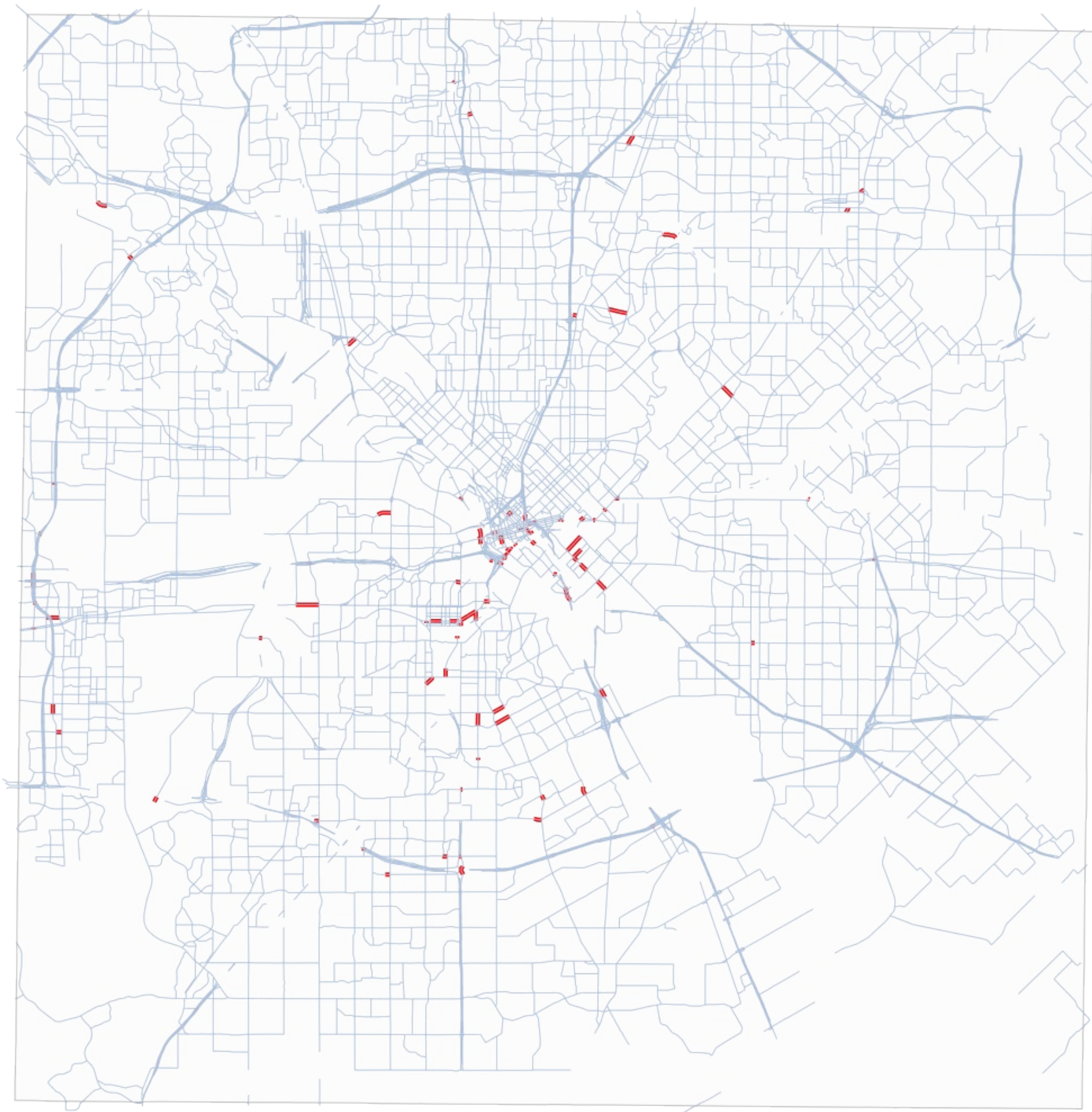
Matching Excess Pavement with Dangerous Streets

This section uses collision data to identify streets that have excess pavement (top decile) and are also in the top decile of crashes per lane-mile. In simpler terms, these are streets that are both overbuilt from a utilization perspective and disproportionately dangerous, and could be strong candidates for repurposing interventions. This analysis identifies 186 street segments that total 149 lane-miles, with an average segment length of 0.5 miles. See **Table 7** for the distribution of these streets across counties, and **Figure 9** for a map version zoomed in to Dallas County as an example. The region's densest, most urbanized counties (Dallas and Tarrant) are far ahead in overbuilt and dangerous streets. By this metric, NCTCOG should prioritize the Dallas-Arlington-Fort Worth area for the greatest impact on safety in the transportation network.

Table 7. Streets in Top 10% of Excess Pavement and Top 10% of Collisions

COUNTY	% OF REGIOWIDE EXCESS *AND* COLLISION-PRONE STREETS
Collin	5.8%
Denton	6.3%
Ellis	2.0%
Dallas	60.3%
Hood	0.0%
Hunt	4.9%
Johnson	0.7%
Kaufman	3.0%
Parker	0.3%
Rockwall	0.0%
Tarrant	16.5%
Wise	0.3%

Figure 9. Dallas County: Street Segments in Top 10% of Excess Pavement and Top 10% of with Most Collisions In Red



Conducting the same analysis to identify streets that have excess pavement (top decile) and are also in the top decile of *fatal* crashes per lane-mile yields 186 street segments over 448 lane-miles, with an average segment length of 2.1 miles. These streets are both underutilized from a traffic engineering perspective *and* have the highest rate of traffic fatalities, making them top priorities for design changes to repurpose excess pavement while improving safety. **Table 8** shows the results of this analysis of fatality-prone streets with excess pavement, with similar results to the collision-prone analysis: the region's most urbanized counties have the largest share of these streets. **Figure 10** shows these identified street segments in Dallas County as an example.

Table 8. Streets in Top 10% of Excess Pavement and Top 10% of Fatal Collisions

COUNTY	% OF REGIOWIDE EXCESS *AND* FATALITY-PRONE STREETS
Collin	7.8%
Denton	5.4%
Ellis	0.4%
Dallas	54.3%
Hood	0.0%
Hunt	4.8%
Johnson	0.2%
Kaufman	2.6%
Parker	1.7%
Rockwall	0.0%
Tarrant	22.8%
Wise	0.0%

Figure 10. Dallas County: Street Segments in Top 10% of Excess Pavement and Top 10% of with Most Fatal Collisions In Red

According to the analysis above, Dallas County bears the dubious distinction of having the majority of the region's street segment lane-miles that are classified as excess *and* collision-prone (60.3%) as well as the majority that are excess *and* fatality-prone (54.3%) These results are significantly higher than Dallas' share of all regional lane-miles (33.7%), all collision-prone lane-miles (48.5%), and all fatality-prone lane-miles (41.8%). Tarrant County is a distant second at 16.5% of the region's excess and collision-prone lane-miles and 22.8% of excess and fatality-prone lane-miles, though Tarrant is slightly underrepresented compared to its share of all regional lane-miles (24.4%), all collision-prone lane-miles (27.2%), and all fatality-prone lane-miles (25.0%). These results do not call for ignoring excess pavement and dangerous streets in

Tarrant County or any other NCTCOG jurisdiction, but demonstrate that at the county level, the scale of the problem is greatest in Dallas.

Equity and Excess Pavement

As noted in the literature review, the negative externalities of transportation infrastructure often disproportionately impact low-income communities and communities of color. Prior to conducting the analysis, I expected that street segments identified as having excess pavement would be located primarily in these communities, and that this finding would guide selection of sites to repurpose excess pavement. At the regional level, no clear trends emerge from a comparison of equity index scores for all block groups in the region to those where streets of excess pavement are located. However, in Dallas County, where the majority of excess pavement in the region is located, block groups with excess pavement as well as those with fatality-prone excess pavement have higher equity scores than the rest of the county. This finding also holds true in Ellis County. **Figure 11** shows a block group-level map of equity index scores. **Table 9** includes both county averages and scores for block groups that contain street segments with excess pavement. Index scores range from 4 to 40, with higher scores representing greater equity need. In the figure, dark blue indicates low scores and dark red indicates high scores (see the Methodology section for details on calculating the equity index).

Figure 11. Equity Index in NCTCOG

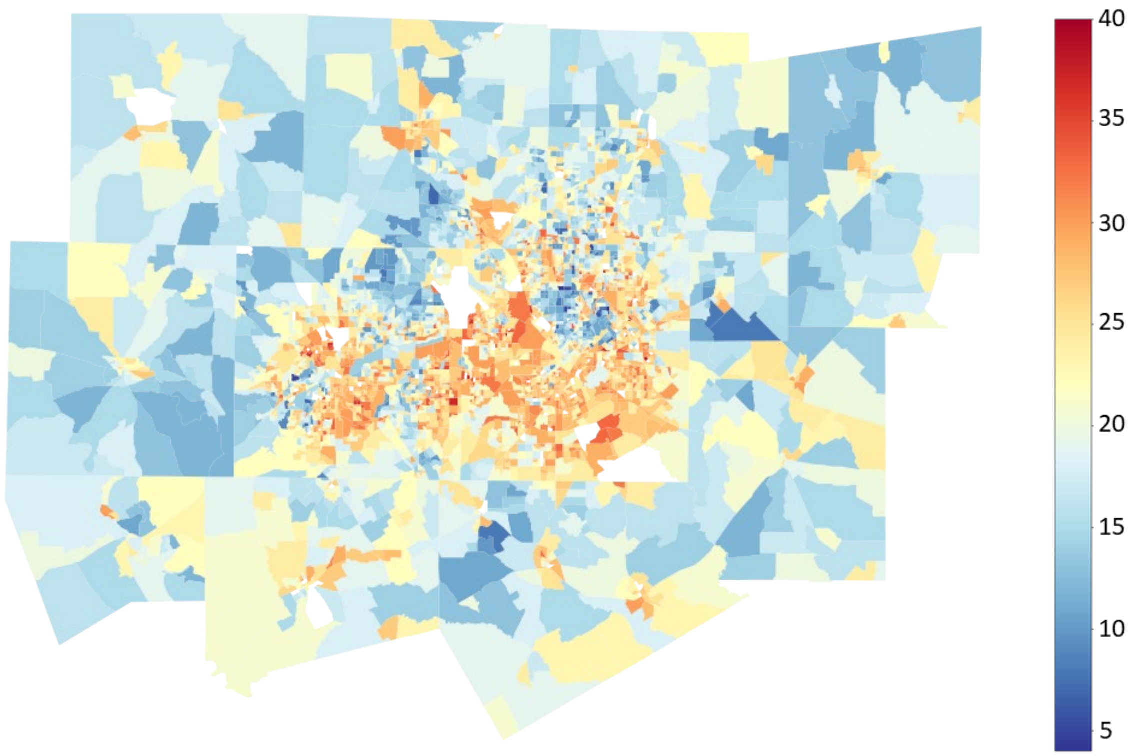


Table 9. Equity Index Values by County

COUNTY	AVERAGE EQUITY INDEX SCORE	AVERAGE EQUITY INDEX (BLOCK GROUPS CONTAINING EXCESS PAVEMENT)	AVERAGE EQUITY INDEX (BLOCK GROUPS CONTAINING EXCESS PAVEMENT *AND* FATALITY-PRONE STREETS)
Collin	19.21	19.65	18.89
Dallas	23.78	25.02	25.80
Denton	20.09	19.87	20.33
Ellis	20.46	21.22	23.00
Hood	18.70	N/A	N/A
Hunt	19.52	18.70	17.00
Johnson	20.78	24.32	20.50
Kaufman	19.88	18.64	20.33
Parker	17.27	15.24	14.00
Rockwall	17.17	18.50	N/A
Tarrant	22.27	22.26	23.99
Wise	18.64	18.87	N/A
Average	**19.82**	**20.21**	**20.43**

Counties with no street segment in a given subset have an "N/A" score.

Planning Recommendations

Recommendation 1: Study Different Street Typologies to Quantify the Relative Benefits of Pavement Repurposing

Due to the sheer quantity of excess pavement in the region, it is incumbent upon NCTCOG to develop an approach to prioritize pavement repurposing that efficiently mobilize its financial, engineering, and planning resources. To narrow down potential candidate streets, NCTCOG should conduct a general study to determine the benefits and costs of repurposing pavement in various street typologies. A better understanding of generalized characteristics of street typologies could also provide direction as to what type of repurposing intervention is most appropriate, from stormwater management features to parklets to active transportation infrastructure. As the two functional classifications overrepresented in the subset of NCTCOG streets with excess pavement, particular emphasis should be given to studying repurposing for minor arterials and frontage roads.

Recommendation 2: Use Equity Metrics and a Community-Driven Process for Pilot Site Selection

To help determine which streets should be selected for repurposing, the NCTCOG should conduct a community outreach process to determine residents' thoughts and experiences on the region's streets. However, existing structures for community participation in planning often benefit affluent and politically-connected residents and neighborhoods that have more resources – time, money, and institutional and political influence – to successfully advocate for their preferences. To rely solely on public input to identify excess pavement and carry out repurposing projects would almost surely lead to lopsided investments in neighborhoods that already receive disproportionate benefits from planning processes.

The City of Oakland's Measure KK-funded street paving plan – dubbed "The Great Pave" – is an example of integrating equity at the root of a data-driven capital improvements program. OakDOT gave equal weight to the share of local street miles in poor condition and the share of underserved populations in each planning area. See **Table 10** for OakDOT's funding distribution calculation. NCTCOG should consider using an equity metric like the one created for this project and a funding formula similar to OakDOT's to ensure that pilot sites for pavement repurposing prioritize communities disadvantaged by existing transportation infrastructure.

Table 10. OakDOT Local Streets Funding by Planning Area

PLANNING AREA	% OF LOCAL STREET MILES IN POOR CONDITION (A)	% OF CITYWIDE UNDERSERVED POPULATIONS (B)	FUNDING SHARE (A+B)/2	LOCAL STREETS FUNDING SHARE (MILLION $)	THREE YEAR PLAN LOCAL STREET MILES
Central/East Oakland	18%	29%	24%	$15.1	15.7
Coliseum/Airport	2%	1%	2%	$0.9	0.7
Downtown	2%	7%	5%	$2.8	1.7
East Oakland Hills	10%	6%	8%	$5.0	5.1
Eastlake/Fruitvale	17%	28%	23%	$14.5	14.6
Glenview/Redwood Heights	10%	4%	7%	$4.6	5.4
North Oakland Hills	16%	2%	9%	$5.7	5.6
North Oakland/Adams Point	19%	14%	17%	$10.7	10.6
West Oakland	6%	8%	7%	$4.6	3.0
Citywide				$63.8	62.5

Recommendation 3: Revise Street Design Criteria for New Construction

The problem of excess pavement ultimately derives from streets that were built too wide at the outset. Thus, the region would be well served by reducing the widths of planned new construction. While a comprehensive study of street design standards for every city and county in the NCTCOG planning region is beyond the scope of this project, a few examples are instructive. For neighborhood residential streets, both the City and County of Dallas require a minimum ROW width of 50 ft. (City of Dallas, 2019; Dallas County, 2017). For minor arterials, the City of Dallas requires a minimum of 60-75 ft and Tarrant County requires 60 ft. (City of Dallas, 2019; Tarrant County, 2012). As the population of the NCTCOG planning region continues to grow and new streets are planned for growing areas, cities and counties should consider reducing minimum ROW requirements or allocating less of the dedicated ROW to vehicle travel lanes.

Recommendation 4: Collect Parking Utilization Data to Identify Excess Pavement Dedicated to On-Street Parking

NCTCOG's Mobility 2045 travel demand model contains a wealth of data on the region's street networks. However, by only measuring travel lanes and their relative utilization, this study ignores the significant portion of paved land area devoted to on-street parking. The trend in planning research has shifted definitively against minimum off-street parking requirements as well as the provision of space for private vehicles on the public curb. Cheap and abundant on-street parking stimulates demand for driving and prevents adaptation of public ROW for uses that better reflect planning goals. Chester et al. find that 14% of land in Los Angeles County is devoted to parking - though this number also includes off-street parking (2015). Simply put, most U.S. cities have too much parking, and repurposing on-street parking lanes that sit largely vacant could be implemented with less inconvenience and public backlash than “road diets” that reduce travel lanes (Fraser et al., 2016).

Conclusion

Excess pavement as defined in this project is found throughout the Dallas-Fort Worth metroplex. However, Dallas County suffers disproportionately from this problem, particularly when taking into account the critical issue of traffic violence and roadway safety. Minor arterials and frontage roads are the street classifications that disproportionately have excess pavement, and each typology presents unique challenges and opportunities in finding new ways to use public space. Although the problem of excess pavement does not appear to disproportionately affect communities of equity concern, weight should still be given to local equity needs in selecting pilot sites for repurposing excess pavement.

While this report pairs its identification of streets with excess pavement to streets with high rates of collisions and fatalities to suggest portions of the road network that would most benefit from pavement repurposing, planners and local communities may select other criteria to prioritize projects. These other criteria could include prior designation of a street for active transportation infrastructure improvements, neighborhood access to parks and other greenspace, or a number of other factors. By soliciting proposals for ways to repurpose streetspace that has been identified as excess, NCTCOG can build a metropolitan region that is more environmentally and fiscally sustainable, safer for all travelers, and more equitable.

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