Freight Land Use Compatibility Analysis

A Freight North Texas Study

April 2022

A Product of the Transportation Department Freight Team

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What is NCTCOG?

The North Central Texas Council of Governments is a voluntary association of cities, counties, school districts, and special districts which was established in January 1966 to assist local governments in **planning** for common needs, **cooperating** for mutual benefit, and **coordinating** for sound regional development.

It serves a 16-county metropolitan region centered around the two urban centers of Dallas and Fort Worth. Currently the Council has **236 members**, including 16 counties, 168 cities, 24 independent school districts, and 28 special districts. The area of the region is approximately **12,800 square miles**, which is larger than nine states, and the population of the region is about **7 million** which is larger than 38 states.

NCTCOG's structure is relatively simple; each member government appoints a voting representative from the governing body. These voting representatives make up the **General Assembly** which annually elects a 17-member Executive Board. The **Executive Board** is supported by policy development, technical advisory, and study committees, as well as a professional staff of 350.

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.

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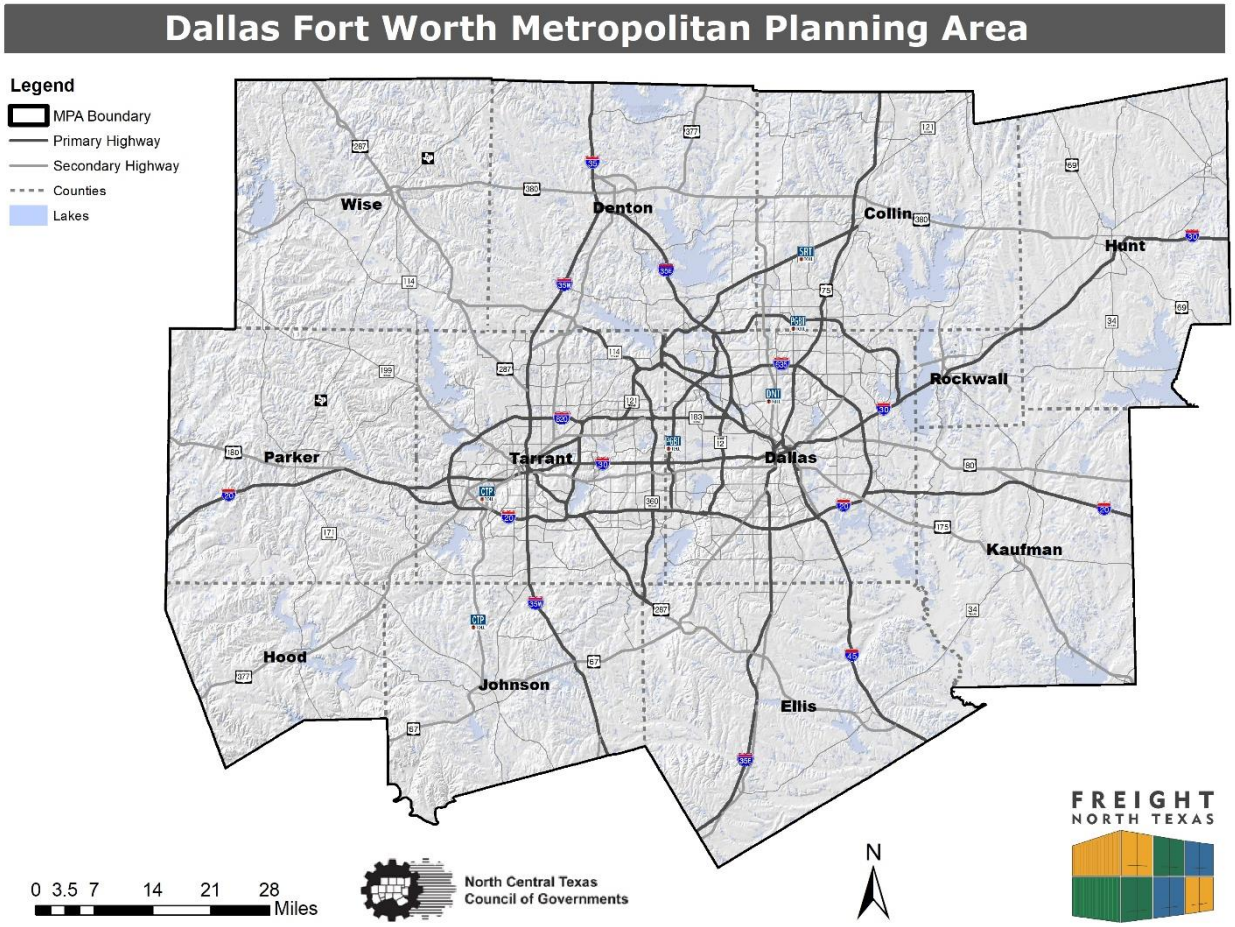
1.0 Introduction

Since 1974, the North Central Texas Council of Governments (NCTCOG) and the Regional Transportation Council have served as the Metropolitan Planning Organization for the Dallas-Fort Worth area. NCTCOG oversees freight system planning in the NCTCOG 12-county Metropolitan Planning Area. Figure 1 shows the Freight Land Use Study Area.

Figure 1: Metropolitan Planning Area Boundary



1.1 The Importance of Freight Land Use

Throughout the United States, city and county governments are increasingly establishing dedicated plans for the movement of goods, services, and people throughout their jurisdictions. Such activities have historically been informed by a growing body of academic and institutional publications that focus specifically on urban and rural transportation issues, while being strongly influenced by various policies and initiatives at the state and federal level. Ever-increasing levels of urbanization and globalization have forced decision makers at all levels to consider seriously the implications of transportation planning activities, especially regarding both the environment and the economy.

Similarly, land use decisions concerning the further development of urban areas have also received much attention. The influence of New Urbanism and Smart Growth initiatives have become more prevalent in urban districts, promoting pedestrian and bicycle-friendly built environments and modern site plans that leave less square footage for the accommodation of vehicles and more for the installation of green spaces, water features, and other sense-of-place enhancements. As the impact of such development has become more understood, several transportation-related conflicts have been identified in the interaction of land use planning and goods movement.

Logistics operations have far-reaching impacts in nearly every major commercial, institutional, and industrial sector. As such, the infrastructure that facilitates goods movement plays a vital role in sustaining and developing the economy. Therefore, broad spectrum land use policies that do not consider the needs of the freight industry are both environmentally and economically detrimental. This study seeks to present a comprehensive analysis of freight land uses in the North Central Texas region and provide a toolkit to municipal governments as an aid in refining and updating current land use policies. Ensuring that freight industry needs are accounted for in municipal and county codes maximizes the economic benefit of freight activity while minimizing any environmental and quality-of-life externalities that result from logistical operations.

1.2 Freight North Texas

Regional transportation planning is built around the Metropolitan Transportation Plan (MTP). The MTP is the central mechanism for selecting investments to develop the metropolitan transportation system. It is also a long-term plan for how the infrastructure will be built and serves as a "blueprint" for transportation systems and services aimed at meeting the mobility needs of the Dallas-Fort Worth Metropolitan Area through the next 20+ years. The current MTP is the Mobility 2045 Update (2022), available online at https://www.nctcog.org/trans/plan/mtp/2045.

The Freight North Texas Program is key in defining successful regional freight and goods movement planning processes outlined in the MTP. Goods, services, and people movement planning involves an array of programs, one of which is Freight North Texas. Policies, programs, and projects have been developed to assess, understand, and improve upon regional freight movements to, through, and within the region. The Freight section, in the Mobility Options chapter in the MTP, includes the region's projects, goals, policies, and programs as they pertain to goods movement and freight planning. It also provides an overview of regional freight planning and the role it plays in the everyday lives of North Texas residents.

The goal of the Freight North Texas Program is to enhance the safety, mobility, efficiency, and air quality associated with freight movements within the Dallas-Fort Worth area.

The implementation of policies and programs to facilitate more efficient freight improvements requires the use of freight performance measures. Freight performance measures are an important part of the planning process and an effective means to evaluate transportation system resiliency. For a complete

list of the performance measures included for the Freight Program see Appendix E of the Mobility 2045 Update.

Freight planning has always been a priority at NCTCOG and there have been multiple freight planning studies completed over the past few decades. Significant studies include the *Hazardous Material Routing Study Phase 1* and *Phase 2* completed in 1985, *Regional Trucking Issues* completed in 1996, and *Truck Lane Restriction Study* completed in 2006. These studies underscore the commitment to freight planning and the safe, efficient movement of goods.

Other notable related programs and projects designed to improve freight movements are the Railroad Crossing Reliability Partnership Program, implementation of Truck Lane Restrictions, Railroad Crossing Banking Program, and Tower 55 upgrades that increased capacity and improved air quality, safety, and mobility.

All these studies, programs, and projects were precursors to the development of the Freight North Texas planning program; a comprehensive approach to evaluating regional freight system needs. This initiative began with an expansive inventory of the existing freight system.

The North Central Texas Regional Freight System Inventory

In 2013, NCTCOG completed the North Central Texas Regional Freight System Inventory. The plan is currently being updated and it will be completed by the end of 2022. This report assessed the freight network capacity, concerns, and opportunities, as well as the need for future programs and studies. Completion of this inventory was the first step in a continuous planning process. As more data is collected and additional studies are conducted, the Freight North Texas Program will continue to develop and improve the North Central Texas transportation system.

The 2022 update includes a comprehensive plan of all the follow-up studies from the first North Central Texas Regional Freight System Inventory, including the Truck Parking Study, Freight Congestion and Delay Study, and Land Use Analysis Study. The update will also include an update on any concerns or opportunities in regard to future studies.

Elements of the Freight North Texas Study

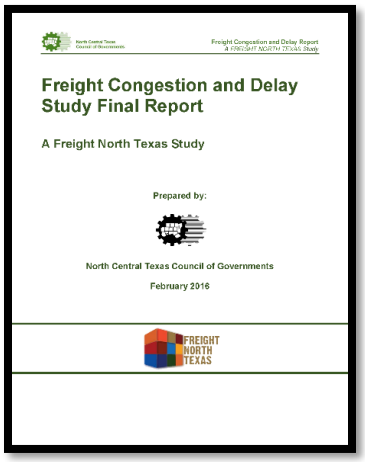
Overview of Freight in North Central Texas – This section identifies the elements that create the freight system. This includes freight modes (trucks, rail, pipelines, air cargo, and intermodal), the importance of freight to the region, foreign trade zones, and key infrastructure issues.

The Regional Freight System – Outlined in this section are the Regional Freight Network; freight system concerns; freight facility locations; city, county, and regional economic information; regional rail and truck initiatives; truck routes; key infrastructure points; key freight groups; air quality mitigation strategies; and environmental justice concerns.

Current System Issues – This section reviews the freight system challenges related to land use, truck traffic and volume, infrastructure strategies for the future regional freight system, future federal and regional policies impacting freight, and performance measures.

Freight North Texas Recommended Follow-Up Studies

Freight Congestion and Delay Study (Completed 2016)



The study primarily examines congestion in four areas that represent diversity in regional freight facilities. The result of the study was recommended policies and programs that can be applied regionally and "low cost" projects for each focus area. Implementing the recommendations is intended to improve mobility within the "first/last" mile of a freight trip in the focus areas. The report can be found on the Freight North Texas web page at www.nctcog.org/FNT.

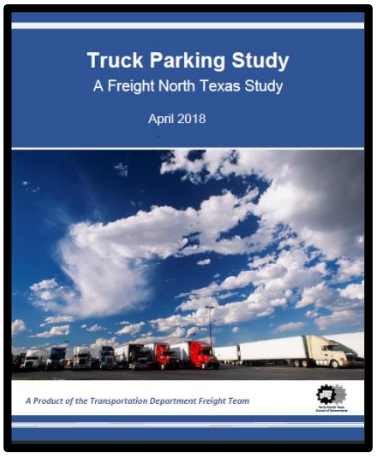
Economic Impact of Freight on the Region

A study will be conducted to determine the freight industry's economic impact to the region. The freight industry is a multibillion-dollar industry nationwide and an important factor of economic growth. This study will consider all aspects of the freight system in the North Central Texas region. It will track the economic impact of freight in real dollars and demonstrate the importance of freight to the region as an economic force.

Freight Project Evaluation System (Completed 2021)

Criteria for prioritizing freight projects based on safety, mobility, and air quality has been developed. The projects are ranked on a point system that includes cost estimates/thresholds, available funding, regional significance, time sensitivity, and location in relation to the freight corridors identified in Freight North Texas. The Freight Project Evaluation System has been developed and various sources of funding and implementation strategies have been identified. Also, a timeline was developed to determine potential funding sources for the freight improvements recommended in Freight North Texas. This study was completed in 2021.

Regional Truck Parking Study (Completed 2018)



The Regional Truck Parking Study was conducted to determine the locations and adequacy of both short-term and long-term truck parking within the region. The study defines areas or corridors where current parking needs are not being met and develops possible solutions to regional truck parking concerns. The study assesses the overnight and temporary truck parking needs in the North Central Texas region. The study includes review of existing information from previous truck parking studies, results of data collection, results of driver surveys, analysis of regional Corridors of Concern, and recommendations for possible solutions for the Dallas-Fort Worth area.

The Regional Freight Advisory Committee

As part of the process to create the inventory, in September 2011, NCTCOG staff convened the Regional Freight Advisory Committee, consisting of knowledgeable freight professionals who have direct experience with goods movement. The Regional Freight Advisory Committee provides guidance to NCTCOG staff and regional policy makers regarding freight activities and input on strategic product and project review. The Committee meets two times per year.

1.3 Land Use Analysis

With its central location within the country and its expanding economy, freight and goods movement will continue to be critical to the Dallas-Fort Worth region. It is very important the facilities that support goods movement be integrated into the urban environment. This analysis defines areas or corridors in which there are land use conflicts and includes possible solutions to mitigate these conflicts. The results will help reduce land use conflicts and alleviate the locations that have these concerns in the North Central Texas region.

Study Needs and Background

The timely and efficient movement of goods is vital to the national, state, and regional economy. According to Version 4 of the Freight Analysis Framework, the combined value of all freight moved across all modes in the United States was $18.8 trillion, **which represents 92 percent of the entire national Gross Domestic Product for that same year.**[1] Since the North Central Texas region is a major logistical nexus for the national and state freight systems, continued systematic efforts to maintain and improve critical freight assets are necessary for the public benefit.

As stated earlier, this study was conducted based on the recommendation of the Freight North Texas Inventory. The Inventory identified the need to better understand the land uses that comprise regional freight infrastructure, as well as the impact it has on the surrounding communities. Freight facilities vary greatly in the functions they perform and, when adjacent to incompatible land uses, can have negative effects on residences, businesses, schools, and parks. In order to prevent such conflicts from occurring, NCTCOG determined that defining, inventorying, analyzing, and mitigating these conflicts through thoughtful policy solutions at the municipal level was essential for economic growth and maintaining a high quality of life in the region.

Key Terms

Key Terms provide details to help understand important concepts within this study.

Land Use Conflict – Occurs when adjacent land uses disrupt or degrade the social, economic, or environmental conditions in the vicinity of the identified properties resulting from interference with the different land use functions. Potential impacts include pollution (air, water, waste, noise, vibration, light, etc.), roadway or railroad congestion, safety risks, reduced quality of life, and decreased economic productivity.

[1] Current-dollar US GDP in 2018 was $20.5 trillion according to the Bureau of Economic Analysis. More information about the Freight Analysis Framework can be found at https://ops.fhwa.dot.gov/freight/freight_analysis/faf/.

Environmental Justice – The Environmental Protection Agency defines environmental justice as, "…the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."[2]

Intermodal Facility – Most frequently refers to a transfer yard between truck and rail modes; however, it can also refer to any land, air, or maritime terminal at which goods are transferred from one mode of shipping into another.

Freight-Oriented Development – An area where manufacturing, warehousing, distribution, and freight forwarding operations are consolidated with ready access to a multimodal transportation network.

Good Neighbor Strategies – Operational or physical characteristics that aim to integrate freight facilities into their surrounding land uses, with a focus on preventing or remediating land use conflicts.

Context-Sensitive Solutions – An approach to the design of transportation infrastructure that attempts to conform roadway features to the scale, functionality, and community identity of the surrounding built environment.

Data Collection

The following data sets were collected for the study:

Freight Land Use Typology – Description of the five different freight-related land uses that can be found in the North Central Texas region.

Regional Overview – Classification of the freight infrastructure in the region, major freight facilities, and freight-oriented development

Literature Review – The Literature Review portion consisted of identifying and reviewing key reports, documents, and studies from multiple sources about freight and land use. Key ideas and overarching themes from each work were recorded and summarized.

Site Visits – Site visits were conducted in freight-oriented developments across the region to better identify issues and concerns specific to those areas.

Local Land Use Policies and Ordinances – Data was also collected on existing regional land use policies and ordinances, with special attention given to regulations on truck parking, lighting, noise, and vibration emissions.

Freight Facility Condition – A review of freight facility by age, dispersion, and concentration by type.

Internal and External Stakeholder Outreach – Freight stakeholders (both public and private) conducted public outreach for the purpose of aligning community goals with the goals of freight facility operators.

Land Use Conflicts – Focuses on the localized impacts that freight land use conflicts generate, and will present a regional scoring methodology, an analysis of conflict types, and a description of findings from the scoring process.

[2] https://www.epa.gov/environmentaljustice

Data was collected from site visits, literature review, local land use policies and ordinances, and internal and external outreach. The collected data will be used in the analysis to help determine any land use conflicts within the region.

Analysis

This analysis was conducted to determine areas that have land use conflicts and disparities within the North Central Texas region. Portions of the analysis include a freight land use preservation phase which explains environmental justice and freight land use conflict areas.

Compatibility Concerns and Best Practices – Identified compatibility concerns unique to each type of freight-oriented development, along with land use planning factors and tools for use in the mitigation and prevention of conflicts with respect to land use type.

Freight Land Use Preservation – The Freight Land Use Preservation phase included a more wide-area analysis of historic and current trends in freight facility location, age, size, and type. Included was a review of the frequency with which freight facilities were developed outside of the urbanized area, as well as the proximity of existing facilities to the urban core.

Freight Land Use Conflict Analysis – Freight-oriented development analysis targeted major regional freight districts and corridors. Facilities were analyzed to determine the presence of land use conflicts, and the efficacy of measures taken to address them (if any).

Environmental Justice and Freight Land Use Analysis – Identified locations in the region where there is a potential for disproportionate negative impacts to occur because of freight land use or land developments near populations protected by environmental justice laws and policies.

Based on the aforementioned analysis, NCTCOG includes the following list of key findings and recommendations.

Key Findings and Recommendations

After reviewing the data collection and completing analysis, several recommendations and land use strategies have been identified. The recommendations are to encourage positive changes and make freight a good neighbor.

Freight Land Use Planning Toolkit – Helps identify key policies and strategies for municipalities when seeking to improve the quality of freight land uses within their jurisdiction. It is a four-step process and includes a rating tool to help evaluate potential policies.

Policy Recommendations – NCTCOG recommends areas of emphasis in freight infrastructure plans such as school proximity to freight facilities, historical, social, and cultural assets, and proximity to nearby ecological features.

Good Neighbor Strategies – Enables municipalities to leverage freight infrastructure development as an economic revitalization tool to help mitigate land use conflicts.

Site Design – Communities contemplate the characteristics of specific sites, facilities, and plots of land, rather than focusing on broad geographical subdivisions of the city. Many of the Good Neighbor Strategies can be implemented during the site design phase.

The key findings and recommendations include freight land use compatibility preservation strategies, freight land use planning toolkit, policy recommendations, Good Neighbor Strategies, and site designs to provide various solutions to some of the challenges the region faces regarding land use preservation.

Summary

This study includes valuable data, an analysis, and recommendations that foster better understanding of the land uses that comprise regional freight infrastructure, as well as the impact it has on the surrounding communities. The policy toolkit will be a guide for freight land use planning across the region. It is hoped that it results in the preservation of key freight land uses, while making freight a good neighbor.

2.0 Regional Overview

The existing conditions, data sets, and information sources outlined in the following sections provide a current overview of freight driven land use within the region.

2.1 Literature Review

Multiple technical documents and guides were consulted which helped to form the foundation of this study. While a full enumeration of the documents reviewed may be found below, some of the materials that contributed most significantly to this study were:

- The *Freight and Land Use Handbook* produced by the Federal Highway Administration
- *Integrating Freight Facilities and Operations with Community Goals* produced by the Transportation Research Board

These documents are comprehensive in their approach and highlight key freight land use issues, as well as provide a wide range of case studies and best practices. Many strategies aimed at mitigating and/or preventing freight land use conflicts are presented, along with contexts in which they are most likely to be effective. The recommendations in this report are based on these, while being tailored specifically for the types of land uses and regulatory context most prevalent in North Central Texas.

Mobility 2045 Update

North Central Texas Council of Governments (2022)

Description: The Mobility 2045 Update is the current Metropolitan Transportation Plan for the NCTCOG 12-county Metropolitan Planning Area. It serves as the primary planning document for transportation within the region; it establishes transportation policy, guides capital project selection, and presents a comprehensive regional mobility vision. The Freight section (Chapter 6) of this plan identifies numerous policies that NCTCOG pursues in support of freight infrastructure and economic development. The most directly relevant and prominent of these policies are listed below:

AQ3-006: Adopt and implement an idling restriction ordinance, or any other idling restriction measure, to reduce idling within local government jurisdictions as consistent with Regional Transportation Council Resolution R21-06.

ER3-001: Enhance quality of life by protecting, retaining, restoring/mitigating, or enhancing the region's environmental quality during planning and implementation of transportation programs and projects.

FP3-001: Foster regional economic activity through safe, efficient, reliable freight movement while educating elected officials and the public regarding freight's role in the Dallas-Fort Worth region's economy.

FP3-004: Enhance intermodal freight activity through innovation, facility development, and improved connections to the freight network by requiring local governments to create a dedicated and recurring funding source for projects that enhance freight mobility.

FP3-005: Enhance freight-oriented land-use sustainability by requiring local governments to adopt compatible zoning requirements and address environmental justice pertaining to freight-oriented development land uses.

FP3-007: Improve efficiency by promoting safety, mobility, and accessibility on the freight networks.

FP3-009: Incorporate freight analysis and involve the freight community in the planning process of all transportation projects.

FP3-011: Improve railroad safety through public education, innovation, and partnering with local governments to address railroad crossing safety improvements.

FT3-008: Encourage the early preservation of right-of-way in recommended roadway corridors.

FT3-010: Corridor-specific design and operational characteristics for recommended roadways will be determined through the project development process.

FT3-011: Support advanced planning activities such as thoroughfare planning and subarea studies to aid in strategic decision making regarding Metropolitan Transportation Plan and project development.

TSSF3-001: Implementation of safety strategies in work zones consistent with industry best practices.

PI3-005: Provide education to the public and encourage input and engagement from all residents on the transportation system and the transportation decision-making process.

EJ3-001: Evaluate the benefits and burdens of transportation policies, programs, and plans to prevent disparate impacts and improve the decision-making process, resulting in a more equitable system.

The Freight Planning Program at NCTCOG operates in support of these and all other Mobility 2045 Update objectives.

Atlanta Regional Freight Mobility Plan Update

Atlanta Regional Council – May 2016

Description: The Atlanta Regional Freight Mobility Plan Update covers all elements of the Atlanta region's freight network and is very detailed. As it relates to land use analysis, Chapter 5.0, Assessment of Performance Measures, Opportunities, and Needs is most relevant. The chapter explores their major freight activity clusters. These are areas of major freight activity such as manufacturing and warehousing. These clusters are where the freight traffic volume is created and moved through. This chapter includes tables and maps to help show the analysis they have done on freight land use. The chapter and report build on the data sets and create usable performance measures that will then feed into their regional mobility plan.

The report's key findings include:

- Maps that highlight the freight activity clusters.
- Tables that discuss the type of land uses within each freight activity cluster.
- Statistics about freight activity clusters, including Global Positioning System data received from the state.
- Performance analysis focused on freight traffic to and from this region.

The applicable recommendations include:

- The plan identifies six major categories for freight performance measures – Usage, Reliability, Accessibility, Safety, and Environment
- The plan recommends several site-specific plans for the freight activity clusters, including Fulton Industrial Boulevard Long-Term Capacity and Use Study, County Freight Cluster and County Subarea Freight Plans, and South Fulton Community Improvement District Master Plan

Guide for Integrating Goods and Services Movement by Commercial Vehicles in Smart Growth Environments

Transportation Research Board – 2016

Description: The Guide for Integrating Goods and Services Movement by Commercial Vehicles in Smart Growth Environments provides planners with the information needed to integrate goods and services movement in the design of smart growth environments. The guide is to help the different groups involved to work together to create land uses that help to benefit all groups while accommodating freight movement. Specifically reviewed were the sections that discuss transitioning from different land uses to freight focused ones and ways to mitigate the impact of freight movements on the built environment.

The report's key findings include:

- Freight-focused areas can be found in almost all zones of development, meaning proper inclusion of them is important to smart growth environments.
- The areas most likely for housing and freight-focused activities are in urban and suburban environments.

- Transitioning industrial areas can have several issues associated with them, including pollution and land use shifts from industrial to others such as housing.
- When considering land use changes, the concerns of existing and potential future freight generators must be weighed.
- Planners must integrate freight activities into the communities and not ignore them. If freight is excluded from form-based codes or traditional zoning, companies will look elsewhere.
- Issues caused by land use conflicts include truck noise, lack of buffering near housing, street design, and commercial vehicle access.
- Best practices to help mitigate these issues include better capacity, air quality regulations, and ongoing monitoring
- There is a lack of consensus about Complete Streets and freight movement.

The applicable recommendations include:

- Needs identification process. Understand the community and its needs and issues as they pertain to freight.
- Consider potential obstacles. What are the obstacles to a better land use plan and how do we overcome them?
- Strategies to including freight in smart growth include setting the stage. This includes elements like employment, freight compatible development, reuse of brownfields for freight, and promote freight-oriented development around rail hubs.
- Create buffers with setbacks and/or landscaping.
- Designate truck routes.
- Invest in technology to aid freight operators.
- Participate in national discussions on freight best practices.

Federal Highway Administration Freight and Land Use Handbook

Federal Highway Administration – April 2012

Description: The Freight and Land Use handbook provides transportation and land use planners with the tools and resources to properly assess the impacts of land use decisions on freight movements, as well as the impacts of freight development and growth on land use planning goals. The handbook reviews freight related land use issues and possible solutions to those issues. There are both urban and rural examples; for this study, the focus is on the more urbanized areas.

The report's key findings include:

- Freight should be a good neighbor. Appropriate and coordinated land use policies will help create an approach that can better integrate freight. The Metropolitan Planning Organization should be included in the planning process to help create a regional vision.
- Effective transportation systems and services means to complete the first/last mile of the freight network.
- All are accountable for good planning for freight; local, regional, and state agencies should all be actively involved.

- Public critical freight and land use issues include potential negative effects of freight and industrial land uses that public-sector agencies may need to address, but there are potential positive effects of freight and industrial land uses that may provide justification for their inclusion in the planning discussion.
- Private-sector critical freight and land use issues include issues that may impact the economic viability and functioning of freight land uses.
- Regional level strategies, such as scenario planning, could be used to create better policies and practices.
- Promote time-of-day distribution of truck traffic and off-peak delivery times.
- Freight development should be sustainable. Poorly planned freight hubs and systems create congestion, causing delays and increasing costs for fuel and time. In addition, poorly planned freight systems impact other users of the transportation system, increasing delays, fuel use, and costs.

The applicable recommendations include:

- Tax relief programs to preserve freight-dependent land uses.
- Creating buffers or separation between industrial land uses and other land uses. This includes adding walls and berms around freight facilities. Include buffer zones around freight sites and create safe pedestrian paths around freight areas.
- Preserve and maintain existing industrial land uses.
- Promote context-sensitive solutions such as establish staging areas for freight delivery and reduce light spillage from freight facilities.
- Replace at-grade rail crossings with grade-separated ones when possible.
- Stakeholder engagement. Go out and talk to the people that are being affected by the freight focused development.

Integrating Freight Facilities and Operations with Community Goals

Transportation Research Board – 2003

Description: The Integrating Freight Facilities and Operations with Community Goals is to identify the successful efforts in the location and operation of freight transportation facilities and to compile information on practices that enable freight facilities and operations to be good neighbors within their communities. The study also identifies areas that are examples of freight planning conflict and focuses on practices to find solutions.

The report's key findings include:

- There is a growing need to apply best practices to freight planning. The US is growing, and the amount of freight traffic is increasing. This means there will be conflicts of development.
- Key community issues include communication, traffic flow and congestion, safety and security, economic development, air quality, noise and vibrations, and land uses and values.
- Rail freight issues include facility closings or rail line abandonment, noise and vibrations, and lack of a buffer zone around the rail yards.
- Trucking related issues include congestion, hazardous materials spills, accidents involving trucks, and truck parking.

- Land use and value concerns because of freight activities play a large role in how people view freight focused land use.
- Air cargo concerns include hours of operation and noise, truck traffic on access roads, theft, and security.

The recommendations include:

- Be a good corporate neighbor; work with the surrounding community to balance needs.
- Replace at-grade rail crossings with grade-separated crossings.
- Develop truck-only access routes.
- Require developers to make necessary highway access improvements for trucks.
- Undertake integrated freight/economic development programs.
- Create walls/pedestrian paths to reduce trespassing.
- Require staging areas for trucks at buildings.

2.2 Freight Land Use Typology

The purpose of this section is to provide a breakdown of five different freight-related land uses that can be found in the North Central Texas region. Notably included in these categories are land uses that do not specifically involve the commercial shipment and delivery of goods, namely Land Use Type 4 (Pipeline and Public Works). Public works facilities are included because of the operational and physical similarities they have to other freight-oriented developments; however, they are not the primary focus of this study. For this analysis, the categories and definitions utilized by the North American Industry Classification System were used as a guide to the typology.

Land Use Type 1: Warehousing and Distribution

This is the most prominent type of freight-focused land use in the North Central Texas region and will be the primary focus of this study. Warehousing and Distribution facilities most often fall under the "Industrial" or "Light Industrial" category in municipal zoning and land use classifications. An example can be seen in **Image 1**. In general, these facilities provide a large amount of indoor square footage to be used for the temporary storage of goods before they are distributed to the various sites or customers that will either sell the product or consume it in the course of another activity (i.e., manufacturing). Although warehousing and distribution activities are often co-located, the two terms are not synonymous. Distribution can be distinguished from Warehousing in that the former involves the receiving, repackaging, breaking down, and shipping of products, while the latter refers specifically to the organized and temporary storage of goods for later use.

Image 1: Warehousing in North Central Texas

Source: NCTCOG

Land Use Type 2: Freight Rail Transportation

Land uses that fall into this category are characterized by the presence of railroads that provide service to freight trains, including main lines, spurs, and sidings. This land use also includes other miscellaneous rail operations, including intermodal yards and engine service facilities. This category does not include passenger or transit rail emplacements, although they operate largely on the same network of railways.

The two most common types of development that take place in this land use type are the construction of railroads (tracks), and rail yards/intermodal yards. The land that railroads are constructed on, as well as the land on either side to a limited extent, are the right-of-way, usually owned by the agency or company that operates the rail on that line. There are signaling equipment, entry gates, utilities, audible warning devices, and electrical equipment along certain portions of tracks, especially at railroad crossings. Rail yards consist of multiple sets of tracks constructed adjacent to one another in a concentrated area, usually for the purpose of storing cars and engines, loading/unloading railcars, switching trains, and building trains. Intermodal yards are similar to rail yards with the exception of the ability to transfer cargo from railcars directly onto trucks or trailers for transport via roadway.

Land Use Type 3: Air Cargo Transportation

This land use category encompasses land uses that facilitate the scheduled and unscheduled transportation of goods via aircraft. Freight airports possess similar types of infrastructure that one would expect to see at a conventional passenger airport; namely, runways, hangars, terminals, and a variety of technical facilities that accommodate the maintenance, refueling, loading, and unloading of aircraft. Freight airports differ from passenger airports in that they are, to a greater extent, collocated with various other types of freight facilities (usually those found in Land Use Type 1 and, occasionally, Type 2) and provide increased access to the nearby freight transportation network.

Land Use Type 4: Pipelines and Public Works

Included in this category are various types of pipelines, including transmission and gathering lines for petrochemical harvesting and refinery operations. Also included are those containing high voltage electrical lines and natural gas lines for residential and commercial use.

Land Use Type 5: Manufacturing and Processing

Included in this land use type are manufacturing and logistics facilities that require an influx of large amounts of raw goods in order to operate or maintain production. Such facilities include petrochemical processing, fabrication yards, refineries, heavy manufacturing, natural resource harvesting operations (logging, quarrying, mining, etc.), large-scale food and beverage production, mineral or metal processing plants, chemical production, and machining. Not included in this category are types of light manufacturing that fall under Land Use Type 1: Warehousing and Distribution; these include activities such as embroidery, printing, small-batch production of specialty goods, and low-volume pharmaceutical production.

Land Use Type 6: Intermodal Facilities

Intermodal facilities, or yards, involve a blending of multiple land use types mentioned in the preceding text and, as such, will be considered separately from them in this study. At its most basic level, an intermodal facility is a terminal where cargo is transferred from one mode to another (i.e., airports and seaports); however, the term more frequently refers specifically to a rail yard where cargo is transferred from truck to rail and vice versa. Intermodal facilities enable mode shifts to take place, which gives customers and freight operators alike additional mode options when selecting the most cost-effective and efficient mode to use for a particular shipment. Weight, size, and packing efficiency of cargo can dramatically affect which mode of transportation it is most suited to. High weight and low value per-pound items are generally better suited to transport by rail, for example, whereas low weight and high value per-pound items more often constitute air cargo shipments (transportation by truck is used for most items that fall in between these two ends of the spectrum). Air quality and congestion concerns merit consideration when discussing mode shift from truck to rail, and research indicates that increases in freight system productivity due to mode shift can result in lower prices for consumers.[3] Other studies have shown that "whether customer (final destination) has a railhead is a big factor in which mode is used."[4] Thus, the availability of intermodal facilities and their placement along key shipping routes is an important aspect of regional goods movement networks.

2.3 Regional Freight Conditions Overview

2.3.2 Freight Conditions Overview

The North Central Texas region is a major logistics hub with trucks constantly moving through, within, to, and from the region. It is critical that these freight-oriented development areas meet the demands for safe and efficient movement of freight. There are four major Interstate Highways that run through

[3] For further reading: *Economic Benefits of Productivity Increases through Truck-to-Rail Mode Shift in Freight Transport*, National University Rail Center (NURail Center), 2016

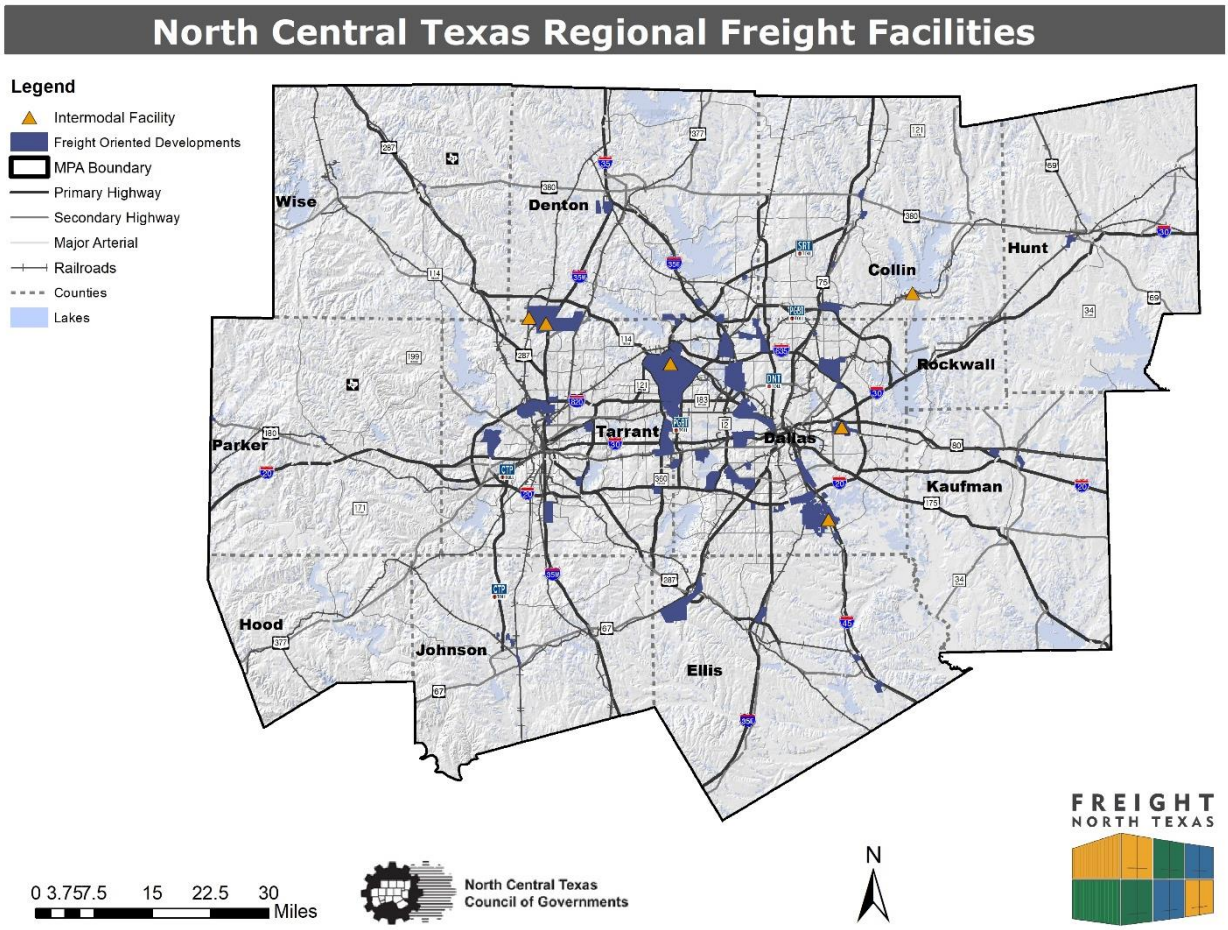
[4] *Analysis of Freight Movement Mode Choice Factors*, Center for Urban Transportation Research at the University of South Florida, 2003, pg. 58

the region: IH 20, IH 30, IH 45, and IH 35 (including IH 35E and IH 35W branch routes). Interstate Highways provide safe and efficient routes for trucks and, in many cases, accommodate their needs for bridge height and weight capacity in ways that other roads do not. This confluence of multiple major Interstate routes through the metroplex, in combination with significant commercial and industrial activity, makes for large amounts of truck traffic traveling in and through the region. In addition to being a crossroads of major Interstates, the region has three Class 1 railroads with operations spanning the Dallas-Fort Worth area. These include Kansas City Southern (KCS), Union Pacific Railroad (UPRR), and Burlington Northern Santa Fe (BNSF).

UPRR also has intermodal operations in two locations in the southeast portion of the region with the Dallas Intermodal Facility located off IH 45 near IH 20 and the Mesquite Intermodal Facility located off US 80 near IH 635. BNSF has an intermodal yard in the northwest part of the region located off US 80 near IH 635. BNSF has an intermodal yard in the northwest part of the region located off IH 35W and SH 170 in Alliance. KCS recently opened an intermodal yard in Wylie in the northeast portion of the region off SH 78. Intermodal facility operations are significant to roadway freight movements due to the truck trips they generate. These facilities also affect how the location and nearby areas are being used. Since the domestic and international freight demand continues to grow, the ability of infrastructure and appropriate land use to meet that demand is crucial to the region's economy, mobility, and to the safety of its residents.

North Central Texas is also home to two major freight airport operations: Dallas Fort Worth International Airport (DFWIA) located in the center of the region and Fort Worth Alliance Airport in the northwest part of the region. DFWIA has the 11th largest air cargo operation of any airport in North America and Alliance is a freight-focused airport. Similar to intermodal facilities, airports generate a significant amount of freight activities which require warehousing and distribution centers located in the immediate vicinity of the airport.

Figure 2: Regional Freight Facilities



2.3.2 Inventory of Freight-Oriented Developments

For this study, freight-oriented developments were tracked and analyzed. A freight-oriented development (FOD) is defined as an area where manufacturing, warehousing, distribution, and freight forwarding operations are consolidated with ready access to a multimodal transportation network. Since the Dallas-Fort Worth region is a major logistical hub, there are many FODs within the region. **Table 1** shows the major FODs within the region as of the writing of this report. Because the region is active in the development of FODs, NCTCOG periodically updates the FOD inventory. The updated inventory can be found on NCTCOG's website at https://www.nctcog.org/home.

Table 1: Major Freight-Oriented Developments in the North Central Texas Region

Name	City Primary	County
Alliance Area	Fort Worth	Denton
Meacham Area	Fort Worth	Tarrant
Joint Reserve Base	Fort Worth	Tarrant
Carter Industrial Park	Fort Worth	Tarrant
820 East/Lake Arlington	Fort Worth	Tarrant
Riverbend	Fort Worth	Tarrant
Centreport	Fort Worth	Tarrant
Midlothian Industries	Midlothian	Ellis
Dallas Ecopark	Dallas	Dallas
Dallas Southport	Dallas	Dallas
Dallas Eastpoint Business Center	Dallas	Dallas
Dallas Hensley Field	Dallas	Dallas
Dallas Mountain Creek Business Park	Dallas	Dallas
Dallas Pinnacle Park	Dallas	Dallas
Dallas Redbird Industrial Prop	Dallas	Dallas
Dallas Santa Fe Industrial Park	Dallas	Dallas
Dallas Stoneridge	Dallas	Dallas
Great Southwest Industrial District	Grand Prairie	Tarrant
Northgate Business Park	Garland	Dallas
Valwood Business Park	Carrollton	Dallas
Turnpike Distribution Center	Dallas	Dallas
Skyline Industrial	Mesquite	Dallas
Sunridge Business Park	Wilmer	Dallas
North Dallas	Dallas	Dallas
Addison	Addison	Dallas
Southwest Dallas	Dallas	Dallas
Trinity Freight-Oriented Development	Dallas	Dallas
Northeast Dallas	Dallas	Collin
Mesquite Intermodal Facility	Dallas	Dallas
Trinity Mills Business Park	Carrollton	Denton
Santa Fe Industrial Park	Dallas	Dallas
Dallas County Centerpoint	Irving	Dallas
Terrell Municipal Airport District	Terrell	Kaufman
North DFWIA Area	Irving	Dallas
North DFWIA Area	Irving	Tarrant
Casa Linda Industrial District	Dallas	Dallas
Trinity Mills Business Park	Carrollton	Dallas
Danieldale Road Lancaster	Lancaster	Dallas

2.3.3 Freight Facility Condition

As a major hub of logistics activities with national significance, the Dallas-Fort Worth metroplex and surrounding North Central Texas region contain a great diversity of freight land uses across rail, air, pipeline, and highway modes. The region is a nexus for freight movement along the IH 35, IH 20, IH 30, and IH 45 corridors, and three Class I railroads operate in the area, along with several short-line railroads. NCTCOG estimates that by 2045, the Dallas-Fort Worth population of 7,548,400 will grow to 11,246,246, an increase of 49 percent. This, combined with an increase in e-commerce and overall consumer demand, assures growth in the freight sector. Due to this growth, an intensifying strain will be placed on the region's freight transportation network. In order to retain the current level-of-service enjoyed by the region, freight land use patterns must be examined at the regional level, the result of which will enable a granular assessment of the region's freight network.

This assessment seeks to analyze the extent to which freight development has been preserved in the urbanized area, as well as regionwide trends in the placement of these facilities. In order to determine this, multiple points of analysis were considered:

- Distance from geographic center of both core cities – Dallas and Fort Worth
- Average distance from mean geographic center of all freight developments
- Year freight facility was constructed
- Type of freight facility (warehousing, distribution, manufacturing)
- Change in number of facilities
- Change in average distance from central business district/geographic center
- Average amount of freight facility square footage added per year

The locations of freight facilities and the associated metadata was collected, consolidated, and geographically rendered by NCTCOG.[5] A total of 2,422 freight facilities were identified in the NCTCOG region based on available records. This dataset was validated to ensure the facilities fit the parameters of this study. Although this dataset does not represent a completely exhaustive inventory of all freight facilities in the region, it does offer a significant sample size (with detailed metadata) from which to draw conclusions about regional freight land uses.

Historically, methods of analyzing freight facility dispersion have varied widely, with some studies utilizing a highly sub-regional approach, or using non-political boundaries as the unit of consideration. A commonly used method is to determine the distance of freight facilities to the geographic center of an urbanized area, as well as examine the concentration of freight development that lies within a specified buffer zone(s). The methodology employed in this assessment focuses on two levels of analysis:

- Wide-area geographic location
- Center points highlighting an infrastructural or political nexus (central business districts, Interstate corridors, city, county boundaries, etc.)

These elements are supplemented by an evaluation of average distances to mean geographic centers of various features, as well non-geographical metrics (overall number of facilities, percent change, etc.).

[5] For more information on the precise methods of collection, see page 1 of the NCTCOG Development Monitoring Program Overview document: https://rdc.dfwmaps.com/MethodologyDocs/NCTCOG%20Development%20Monitoring%20Program%20Overview.pdf

For some portions of the analysis, regional freight facilities were classified into five decade-long time bands going back to 1970. This was done to more closely group warehouses and distribution centers by their physical characteristics and changes in design standards, as well as to capture trends in industrial real estate development patterns. The types of facilities used for this study include those categorized as their primary business being manufacturing, distribution, and warehousing services; the definitions for these categories are as follows:

- Distribution – Facilities that have higher flow velocities than warehouses and offer services such as packaging and cross docking.
- Warehousing – Facilities whose primary purpose is the storage of raw materials, intermediate goods, or finished goods.
- Manufacturing – Facilities wherein goods are produced or assembled.

2.3.4 Summary of Findings

The Dallas-Fort Worth metroplex is unique in that its mean geographic center does not accurately represent the central business district (CBD) of the urbanized area. Rather, the metroplex is duo centric – having two separate primary CBDs; the city of Fort Worth has the CBD to the west and Dallas has the CBD to the east. Furthermore, the space between these two urban centers – the "mid-cities" area – contains a multitude of smaller municipalities, many of which have their own smaller scale CBDs or otherwise significantly developed areas. An example of this is the city of Arlington's CBD and Entertainment District, both of which are situated south of the metropolitan mean center. This translates to the need for varying types of analysis other than conventional monocentric methods in order to accurately measure the presence of decentralization. This was accomplished through the use of polycentric geospatial analysis and the balancing of subregional studies with patterns observed in the wide-area investigations.

Regional Trends – The majority of freight-oriented development is situated in the urbanized areas of Dallas-Fort Worth-Arlington, McKinney, and Denton-Lewisville. These districts represent the most highly developed portions of the region interwoven by multiple high-volume Interstate and intraregional corridors, however there are several clusters of freight facilities in the rural portions of the region as well. Warehousing makes up the majority of all freight facilities in the region, comprising 52.60 percent of the total count. Distribution and Manufacturing facilities make up 19.41 percent and 27.99 percent, respectively.

Facility Age – In order to determine location trends over time in the region, an analysis of freight facilities was conducted based on the year construction was completed. This was done in two phases. The first phase was to determine the locations and types of all freight facilities in the dataset (**Figure 3**, **Figure 4**). These facilities were then placed into multiple time band categories on the basis of the decade in which they were constructed, going back 50 years to 1970; all facilities constructed prior to this were either omitted from the analysis or placed into a single wide-ranging time band. This analysis revealed the average freight facility in the North Central Texas region is 30 years old, having been constructed in or around 1990. This number is perhaps pulled downward more than is warranted due to the inclusion of some exceptionally old facilities in the dataset (the oldest of which was constructed in 1908).

Therefore, a better measure of central tendency would be the median, which is a slightly more recent year of 1993.

Figure 3: Freight Facility Locations

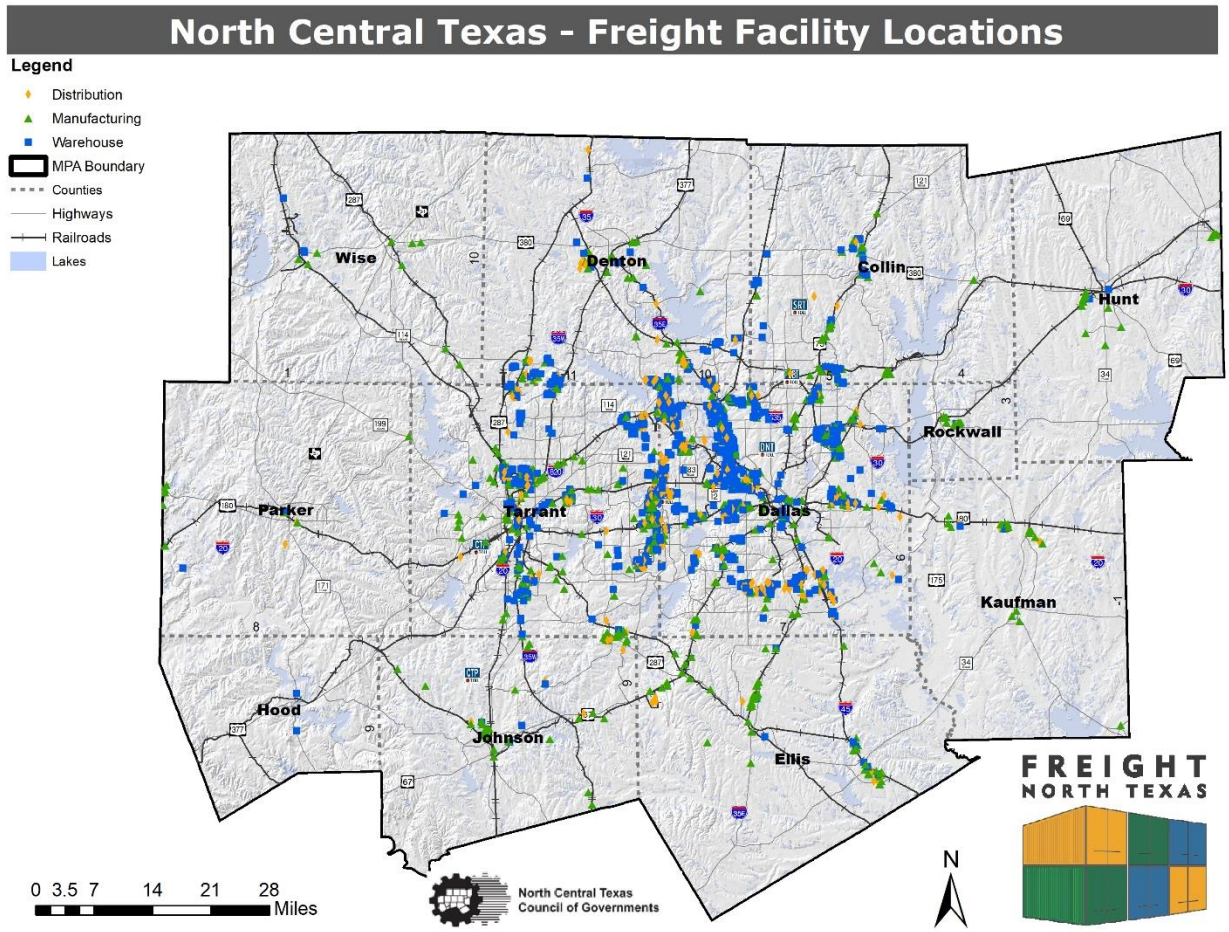
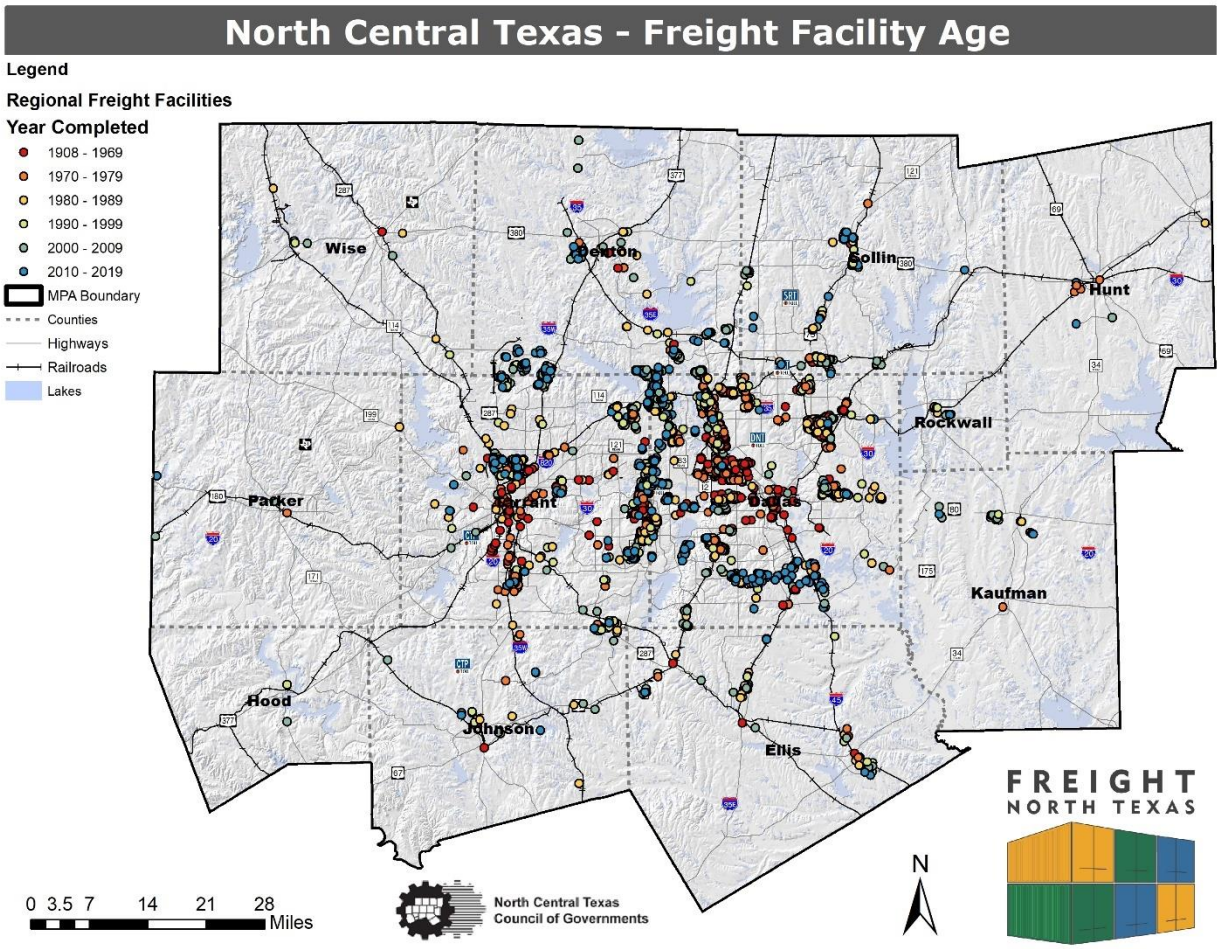
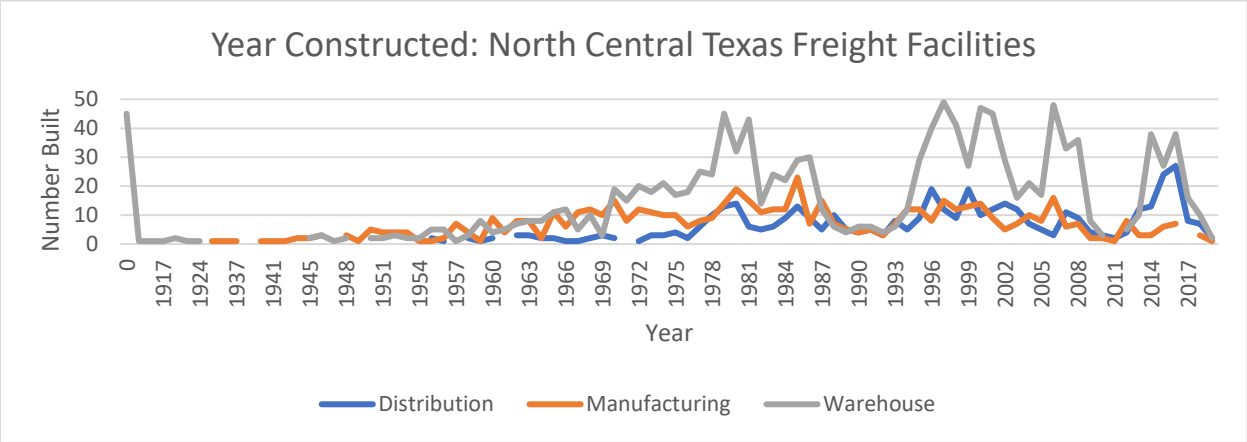


Figure 4: Freight Facility Age



An average of 25 new freight facilities (across all three types) are constructed every year in the region. Warehouses are built at a rate that is roughly double that of Manufacturing and Distribution facilities, with the exception of a significant uptick in Distribution construction after 2012 (**Figure 5**). This is likely due to reformation of the supply chain in order to accommodate increasing e-commerce activities.

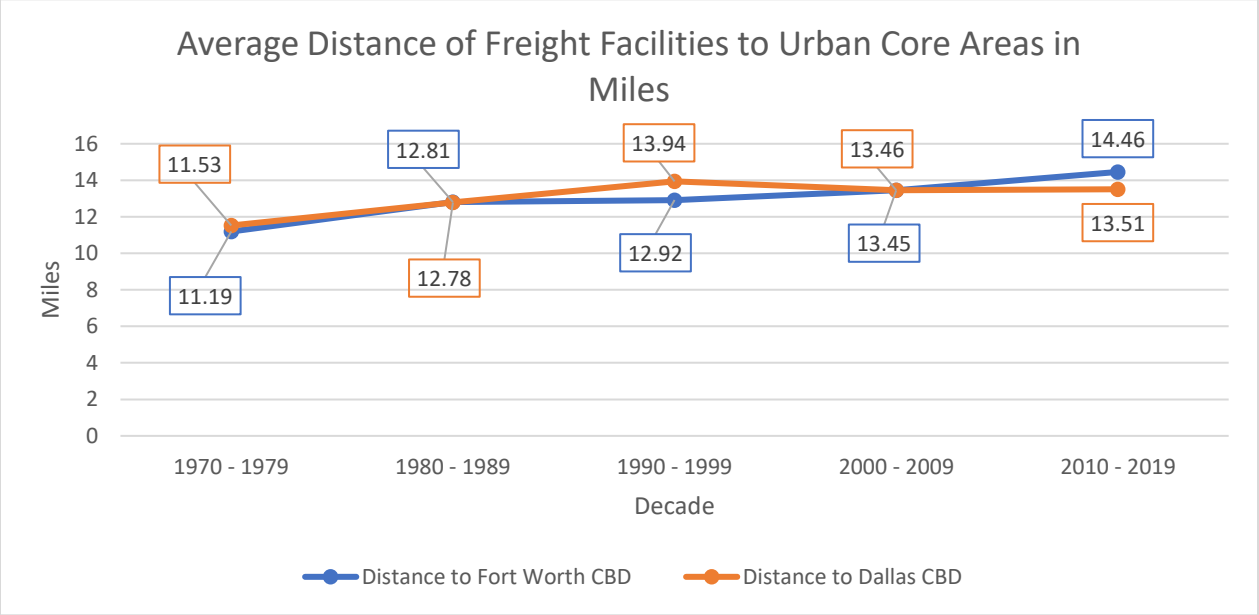
Figure 5: Year Constructed: North Central Texas



Dispersion Analysis

Section 3.2 of this report discusses the phenomenon of freight sprawl – also referred to as *freight facility dispersion.* This analysis serves as a supplement for the observations in that section. In the past two decades, new construction of freight facilities shifted significantly closer to (or beyond) a 10-mile radius from the CBD of both Dallas and Fort Worth. This new construction is mostly concentrated in both the central and upper mid-cities area. It can be observed that freight sprawl in the Dallas-Fort Worth metropolitan area is occurring in one sense, yet not occurring in another. In terms of average distance from urban FODs to CBD, the region has experienced an increase over the past decades; this can be seen in **Figure 6**.

Figure 6: Average Distance of Freight Facilities to Urban Core Areas in Miles



The average distance from urban freight facilities[6] to the Fort Worth CBD increased by a substantial 29 percent over the past 50 years, whereas an increase of 17 percent was noted for the Dallas CBD during the same period. This metric is usually a weighty indicator of whether or not freight sprawl is occurring; however, it must also be tempered with other metrics, namely percent of facilities that remain in the urbanized area. As can be seen in **Table 2**, the vast majority (92 percent) of regional manufacturing, distribution, and warehousing facilities remain located within the urbanized area.

[6] *Urban freight facilities* here refer to those within 20 miles of the central business district, thus omitting FODs located outside the urbanized area.

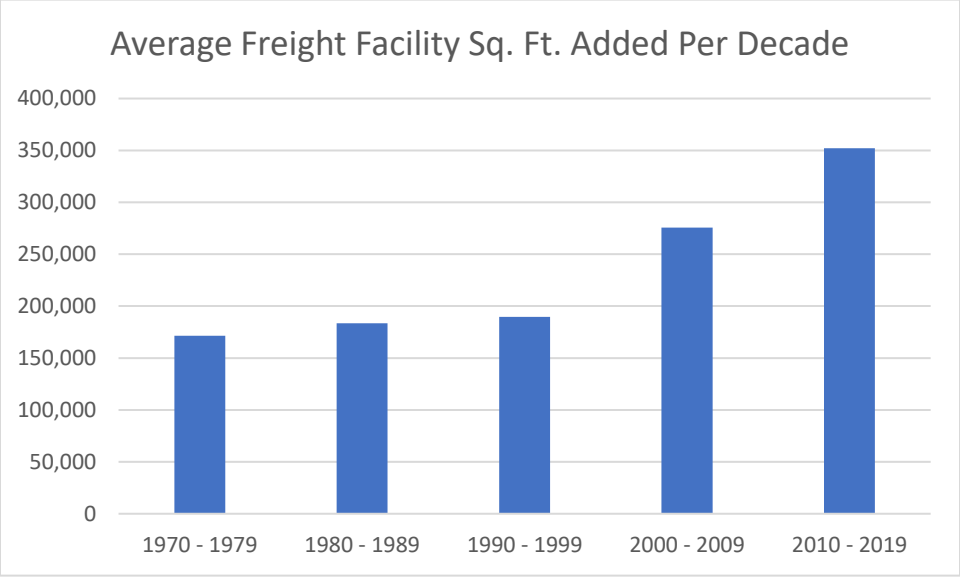
Table 2: North Central Texas Freight Facility Location Proportions

	Count	Percent of Total
Total Regional Freight Facilities	2422	100%
Facilities within 20 miles of Dallas CBD	1483	61%
Facilities within 20 miles of Fort Worth CBD	750	31%
Facilities Outside Urban Core	189	8%

It should also be noted that more recent freight land development tends to occur in cities in close proximity to DFWIA, as well as in two major planned industrial districts: Alliance Texas (North Fort Worth/Haslet/Roanoke) and the International Inland Port of Dallas (South Dallas/Lancaster/Hutchins). These districts may have the effect of inducing freight land development – that would have otherwise occurred closer to a CBD – further out along the periphery of the urbanized area.

A shift in freight-oriented land development can be observed as the annual number of facilities added to the region decline, yet average square footage of new facilities continues to increase over time *(***Figure 5**, **Figure 7***).* This is likely due to a transportation industry shift to much larger, more capable distribution centers and warehouses. This trend will likely continue to increase as urban shopping centers are converted to act as neighborhood fulfillment centers in service of e-commerce generated shipping demand.

Figure 7: Average Freight Facility Square Feet Added Per Decade



Although, on average, freight facilities are moving further away from established CBDs, the vast majority of both new and old development remain in the urbanized area. Geographic analysis indicates that new construction or redevelopment of freight facilities is more likely to occur further away from a CBD than their older counterparts.

The North Central Texas region appears to demonstrate some level of resiliency against freight sprawl, as evidenced by the high degree of FOD retention in the urbanized area. However, as newer facilities are

constructed or redeveloped, it is important that cities take measures to preserve freight land in the urban core, especially as the supply of developable land decreases and demand for goods movement services increases.

2.4 Site Visits

Multiple site visits were conducted to FODs throughout the region. These FODs were of interest because of their areas with high concentrations of freight land uses. A better understanding of the land uses in and near the FODs was a critical step in understanding development patterns in each area. NCTCOG staff observed all the FODs listed in **Section 2.2.2**. Observations made in the FODs included:

- Land uses and surrounding land uses
- Road conditions and street design
- Site design of freight land uses
- Potential land use conflict

These details were then used in the analysis of site-specific land use conflict that is part of **Section 3** of this report.

2.5 Local Land Use Policies and Ordinances

Local Comprehensive Plans

Local comprehensive plans were reviewed to examine how cities within the region with largest FODs plan for freight focused facilities. The cities chosen for this analysis are Fort Worth, Arlington, Grand Prairie, and Dallas. These plans were examined for how they impacted freight land use development, as well as regulated freight transportation infrastructure and operations.

2021 Comprehensive Plan

City of Fort Worth – March 2021

In the Land Use section of their comprehensive plan, the city of Fort Worth identifies the following policies aimed at preventing land use conflicts:

- Locate large industrial uses along freight rail lines, highways, or airports within industrial growth centers and other appropriate locations.
- Separate incompatible land uses with buffers or transitional uses. Some land uses have attributes such as height, proportion, scale, operational characteristics, traffic generated, or appearance that may not be compatible with the attributes of other uses.
- Identify and designate on future land use maps new industrial growth centers in rapidly developing areas, based on proximity to existing infrastructure, particularly in the central city.
- Coordinate future land uses and development types and intensity with the Complete Streets policy, Master Thoroughfare Plan, Active Transportation Plan, and Transit-Oriented Development Plans.

The city has identified the following as Industrial Growth Centers:

- Alliance Airport
- Alliance Gateway
- Carter Industrial Park
- Centreport
- Meacham Airport
- Loop 820 East/Lake Arlington
- Naval Air Station Joint Reserve Base/Lockheed-Martin
- Riverbend

In enumerating both freight-intensive clusters of development and Good Neighbor Strategies to guide their site design and infrastructure decisions, Fort Worth has appropriately considered freight in the planning process.

99 Square Miles

City of Arlington – March 2015

The city of Arlington's plan makes note of the large role freight plays in both its traffic and land use within the city. The city's Thoroughfare Plan (adopted in 2011) advocates for Complete Streets that are "designed to fit within its physical setting, taking into account urban form, the environment, historic preservation, safety, and mobility." This context-sensitive approach to street design should include appropriate transportation infrastructure for FODs as well. Overall, the plan recognizes the importance of freight for the local economy and advocates for integrating freight into the urban environment. The plan discusses several freight related issues:

- Implementing truck lane restrictions on key Interstate corridors to reduce congestion, improve safety, and mitigate congestion.
- Addressing safety concerns regarding at-grade rail crossings and proposing grade separation as funding is available for high-traffic corridors.
- Advocating for the implementation of quiet zones on freight rail lines.
- Addressing chronic vacancies and aging infrastructure in the Great Southwest Industrial District.

The Strategies and Action section include the following:

- Maintain active relationships with brokers, developers, and site selectors to communicate vision and incentives.
- Employ guidelines for evaluating redevelopment and infill development applications to ensure that new structures are compatible with the surrounding neighborhood.
- Support regional efforts towards a safe, reliable, and efficient rail system for passenger and freight movement.
- Implement an updated Airport Master Plan.
- Provide additional grade-separated crossings at the Union Pacific rail line in the downtown and Entertainment District areas.

The city of Arlington's Mater Plan addresses freight activity and identifies strategies and improvements that could be undertaken to improve the quality of freight land uses throughout the city.

2018 Comprehensive Plan

City of Grand Prairie – December 2018

The city of Grand Prairie divides their plan into two parts regarding industrial uses – Light Industrial and Heavy Industrial.

Light Industrial:

- Light Industrial areas should be located along arterial thoroughfares, in proximity to freeways, rail lines, and/or areas with access to airports and other transportation outlets.
- These areas should be screened and buffered from residential uses using a major roadway, commercial/retail/office use, or floodplain/natural area.
- They should serve as a buffer and transition between Heavy Industrial and lower intensity uses.

Heavy Industrial:

- Heavy Industrial areas located along arterial thoroughfares and in proximity to freeways should be heavily screened from public roadways.
- Heavy Industrial areas should not be located in close proximity to residential or commercial/ retail/office areas.

This outlines the requirements a freight focused development must complete to help with conflicting land use in the city of Grand Prairie.

forward Dallas! Comprehensive Plan

City of Dallas – June 2006

in their plan, the city of Dallas focuses on making a better experience on a human level. They have policies of design that work to help make land use more compatible. None of these policies directly impact freight focused land use but have the elements of what helps to lessen the conflicts of land uses.

The policies are below. *Please note only the relevant portions of policies are shown.*

Policy 5.1.3 – Encourage complementary building height, scale, design, and character. By encouraging development of buildings, structures, and landscapes that complement the character and scale of their setting and relate to the human scale, a more defined sense of place is created.

New development should be appropriate to the context of its location in density, intensity, and size, particularly when adjacent to existing residential areas, historic, or conservation districts.

Buildings should be designed to be compatible in height, scale, bulk, and massing to the urban context and established character of the surrounding area.

The impact of parking lots and structures on adjacent areas should be given careful consideration. Location, configuration, access points, and screening should be designed to minimize spillover and mitigate any negative effects.

All parking lots and structures must be designed and screened to eliminate visual intrusion or incompatibility with the adjacent residential neighborhoods, historic, or conservation districts.

Policy 5.1.3.2 – Amend the Dallas zoning regulations to establish urban design standards that reflect quality design and good land use principles through regulations which address height, scale, bulk, and massing of new development. Standards will also address the impact of parking lots and structures to minimize spillover to adjacent neighborhoods, mitigate any negative effects, and eliminate visual intrusion or incompatibility with the adjacent residential neighborhoods, historic, or conservation districts.

Policy 5.2.4 – Enhance retail, industrial, and business operations. By encouraging better design quality and convenience in retail centers, business parks, and industrial parks, the city takes on a more notable look.

- Mechanical equipment and open storage should be screened.
- Exterior lighting should be directed downward to avoid skyward light pollution.

Implementation Measures:

5.2.4.1 – Develop design standards for retail centers, business parks, and industrial parks.

5.2.4.2 – Enact new design standards for retail centers and industrial and business parks, where appropriate, through Area Plans.

5.2.4.3 – Establish cooperative relationships with private and civic organizations to improve urban design, landscaping, and other amenities. These amenities will, in turn, enhance commercial areas throughout the city.

Overall, the city of Dallas has included significant and specific guidance with regard to FODs and the transportation infrastructure that supports them.

2.6 Internal and External Stakeholder Outreach

To gain better insight into land use conflicts and to understand the surrounding issues, NCTCOG sought input from various cities to ask questions and provide feedback. Freight stakeholders (both public and private) conducted public outreach like soliciting public feedback through the Regional Freight Advisory Committee, newsletters, and one on one outreach. Internally, communication among interdepartmental teams included:

- Air Quality
- Safety
- Environmental Justice
- Sustainable Development
- Roadway Planning
- Transportation Technology and Innovation

Collaboration within the agency provided multidiscipline insights to the freight land use issues and opportunity and helped guide the analysis in this report.

Through the collection of research, areas of FODs were located and observed, along with the age of these freight facilities. The Local Comprehensive Plan of four cities (Arlington, Fort Worth, Dallas, and Grand Prairie) gave different perspectives on ways their cities are mitigating land use conflicts. All of the collected data, Literature Review, and Regional Conditions provide information and data to begin the land use analysis.

3.0 Freight Land Use Analysis

This section will provide an in depth focus on the five different types of land uses, Freight Land Use Preservation, Freight Land Use Analysis, and Environmental Justice Land Use Analysis.

3.1 Compatibility Concerns and Best Practices

The following discussion will consist of the compatibility concerns unique to each type of freight-oriented development, along with land use planning factors and tools for use in the mitigation and prevention of conflicts with respect to land use types.

Land Use Type 1: Warehousing and Distribution

Warehouse and distribution center collocation with residential and commercial land uses is relatively commonplace and tends to have the lightest impact on other land uses when compared to other industrial facilities. Much can be provided in the way of flexibility on the part of the freight operator, and many strategies – both in design and procedure – are available to lessen any negative impacts to adjacent properties. For example, noise emissions from distribution centers are usually limited to the sound of trucks entering or departing the property, as well as those that result from the activities that occur during loading and unloading (metal banging, backup signals, air brakes, etc.). Facilities with railroad access will produce sounds related to freight train operation, heavy crane operation, and possibly vibrations in the ground as well. Good Neighbor Strategies abound in this category as sound walls, careful placement of vegetation, earthen berms, and high-quality fences do much in the way of bringing noise output down to tolerable levels for neighboring residential and commercial districts.

Truck traffic is a continuous concern. As previously stated, trucks (and occasionally railcars) are constantly making their way in and out of facilities, usually during business hours. This can coincide with peak travel times of non-commercial traffic, resulting in severe delays for the freight operator, as well as contribute to congestion on already over-capacity streets. These factors result in a complicated obstacle that requires nuance on the part of both municipalities and businesses to successfully navigate. In some situations, the most readily available solution to this issue is the development of designated truck routes and driveway reconfiguration; these force trucks to enter and exit facilities via only approved avenues of approach, and route commercial traffic away from private automobile traffic. A consequence of this method is that safety is improved, since research has shown that segregating trucks from other types of traffic reduces the severity of accidents.[7] This approach, however, requires collaboration with local governments to codify truck routes in local ordinances. Coordination of design and funding between cities and freight businesses must take place in order to emplace new roads, reconfigure facility

[7] https://mobility.tamu.edu/mip/strategies-pdfs/traffic-management/executive-summary/truck-lane-restrictions-1-pg.pdf

entrances, and install additional and/or improved signage. Improved traffic flow reduces the negative effects that freight bottlenecks have on shippers.

Image 2: Warehouse with Improved Façade

Source: Getty Images

Older Type 1 facilities may also present aesthetic challenges for communities. The presentation of a light industrial site has a significant impact on perception by community members in nearby neighborhoods and offices, which is especially relevant for freight facilities in a highly urbanized context. With some land uses, such as those found in Type 2 and Type 4, form is closely related to the function of such facilities, and there is very little leeway that can be given to architects and engineers to improve the way a facility appears to the outside observer. With Type 1 land uses, however, many external, low-cost treatments can be leveraged to improve visual appearance. Landscaping and greenspace are effective yet inexpensive additions to Type 1 facilities that yield significant visual improvement while also contribute to noise reduction and urban greenspace. A more costly alternative is exterior renovation with the installation of a more appropriate façade, buffer zones, or amenities such as water features and dedicated greenspace. Lighting improvements contribute to land use compatibility as well; light pollution is often generated by facilities that continue to operate late at night and early in the morning and can be remediated by installing fixtures that direct light down towards the ground or onto the facility and away from nearby properties. As has been observed in the North Central Texas region, older and smaller freight facilities tend to lack these amenities, in addition to geometrically truck-friendly driveways, short-term staging areas for multiple simultaneous deliveries, truck parking, and high-quality fencing. These qualities improve aesthetics, as well as provide operational benefits. Ultimately, a site

that makes passers-by or residents of nearby homes feel like the area is run down, dirty, or unsafe will make preserving freight land uses in urban areas more difficult and is therefore to be avoided if reasonably possible.

Land Use Type 2: Freight Rail Transportation

Freight rail operations present several challenges to successful integration into the urbanized area. Because rail operations require the use of heavy and fast-moving equipment, they pose an obvious danger to pedestrians, bicyclists, and motorists alike. To counteract this, railroads are required to emplace warning devices and safety equipment to prevent accidents and warn people nearby of approaching train traffic. One of the most prominent concerns faced by municipalities and rail operators are the issues that arise due to at-grade railroad and highway intersections, known more commonly as at-grade crossings. The (sometimes lengthy) discontinuation of motor vehicle traffic crossing while trains occupy the track space over the intersection is a frequent source of delay. The traffic congestion that occurs as a result can have significant quality-of-life impacts for nearby residents. Additionally, trains are required to blow their horns as they approach crossings, creating a large amount of unwanted noise. Even in areas where quiet zones have been implemented, the noise associated with the train engines and cars rolling over the track can disturb the inhabitants of nearby homes and businesses. This, in consort with vibrations from heavy train movements, create difficult land use conflicts.

Most challenges stemming from the development of freight rail infrastructure have to do with at-grade crossings, which affect safety, noise, and traffic flow. The most noticeable is the danger that locomotives pose to automobiles, bicyclists, and pedestrians at these crossings, since trains have little, if any, ability to stop should an object or person occupy space on the railway during a crossing event. Because of these hazards, safety equipment such as gates, bells, alarms, and flashing lights are required to be installed on most urban at-grade crossings, in addition to the train whistles installed on every locomotive. These, in turn, affect nearby properties by generating large amounts of noise. Some low-cost strategies that can be undertaken to mitigate these effects include no whistle zones (or “Quiet Zones”), sound wall construction, and the emplacement of urban forestation (which helps to absorb sound). The more permanent and ideal solution, however, is to grade separate a railroad crossing, which entails constructing either an underpass or bridge to isolate traffic, remediating crossing delays, and improving safety. Grade separating railroad crossings, however, can be prohibitively expensive and should be considered in very high-traffic corridors or crossings with a history of safety concerns. Grade separation projects should also be a part of transportation system planning to draw in outside investment and maximize both safety and public investment.

Another significant concern with freight rail transportation infrastructure is the movement of hazardous cargo through heavily populated and/or environmentally sensitive areas. Trains are frequently used to ship high volumes of substances such as chlorine, petroleum products, radioactive materials, and explosives. Although they are rare, it is important to consider the minimum safe distance from nearby inhabited buildings in the event of a derailment or spill and ensure that rail planning efforts are underway to route hazardous cargo away from heavily populated areas. In the event this is not possible, placing extra distance between rail lines and residential or commercial development can somewhat mitigate the risks associated with hazardous cargo through routes while simultaneously addressing noise and vibration.

Freight rail spurs that are constructed to provide trains direct access to industrial facilities increase mobility and efficiency by removing the need for an intermodal connector to get products and goods to their recipient. However, high rates of turnover for businesses in some industrial parks and the loss of industrial land in urbanized districts causes many of these rail spurs to fall out of use, and eventually into disrepair. Once no longer active, rail siding inhibits redevelopment and poses a challenge to municipalities that cannot afford to remove the derelict track with public dollars, since some degree of environmental mitigation is usually required. An increasingly popular and cost-effective method of remediation is what is known as the "Rails-to-Trails" initiative, wherein abandoned railways are converted into nature preserves, and the tracks filled in or paved over to make them navigable by pedestrians and bicyclists and thereby adding community value to former industrial sites.

Land Use Type 3: Air Cargo Transportation

One of the most obvious land use impacts associated with any type of airplane operation is noise pollution. Aircraft engines produce large amounts of noise while in flight, especially during takeoff and landing. Because of the amount of space required for airport operations, there is usually a significant offset from other nearby land uses; however, this is seldom enough to completely obstruct airplane noise. This affects nearby development and can drive down the price of land. This, in consort with a high degree of freight network connectivity and generally low building heights, makes land adjacent to an airport a prime location for fright land development. Additional considerations include the quality and designation of the airspace above the airport, the height of surrounding structures, amount of air traffic congestion, and access to Interstate Highways or other corridors that connect to the same.

Land Use Type 4: Manufacturing and Processing

Manufacturing facilities, depending on the type, can affect nearby developments significantly due to their operational requirements. The intensity and frequency of truck traffic that will be induced onto nearby roadways should be considered during the permitting and zoning process. Much modern industrial development occurs in greenfield or exurban areas; therefore, it is likely that trucks will need to traverse several low-capacity roads in their first/last mile movements. It is important to forecast how much truck traffic will increase and consider whether widening existing roads, making geometric improvements, or building new roads will be necessary. Safety and security concerns usually result in Type 5 facilities being well lit at all hours, which can disturb nearby residences during non-business hours, as can the noise that comes from the operation of heavy machinery and vehicles. The type of manufacturing or processing is important for land use planners to consider prior to new facility development, as there may be other land use compatibility impacts unique to the facility (e.g., foul odor emissions, vibration emissions from heavy rail or machine operation, surface pollution, etc.)

Cities may consider the designation of *planned industrial districts*,[8] which collocate industrial land uses and allow for deliberate planning efforts to segregate incompatible land uses and emplace the needed Good Neighbor Strategies along the periphery of the district or where interaction with Sensitive Land Uses is anticipated. Planned industrial district development also enables transportation infrastructure

[8] Planned industrial districts are more fully discussed in *Policy 2-6: Planned Industrial District Designation* under **Section 4.0** of this report.

modifications to be made in a preemptive and systematic manner to accommodate the requisite types of freight vehicles and modes.

3.2 Freight Land Use Preservation

Freight Land Use Preservation Issues

Typically, the act of "preserving" a specific land use is discussed in the context of historical or environmental resources in a community. Indeed, when the question of how to increase quality of life, foster economic development, and expand the tax base for a city is asked, you will likely hear strategies such as catering to tourist populations, inducing additional residential development, and attracting high-end commercial businesses to the area. These are all effective ways to grow a city, but as time goes on, the consistent prioritization of other land uses over freight mobility results in a variety of negative effects that degrade quality of life, increase cost of living, decrease air quality, and cause additional roadway congestion. This occurs because the infrastructure that facilitates the timely movement of goods is pushed further and further into the periphery of the urbanized area, or alternatively, is gradually repurposed into an alternative use, thus making deliveries in the urban core increasingly difficult and expensive. The former of these phenomena is known as *freight sprawl,* or *freight facility dispersion*. As freight facilities decentralize, truck trip origin points begin further and further away from destinations in the urban core, which exacerbates the costly effect of congestion and delay on major highways in urban areas, and which are the most severe in the state of Texas.[9] Additionally, as warehouses and distribution centers become more geographically dispersed, longer trips are required, resulting in higher truck vehicle miles traveled and correspondingly negative effects on air quality. One of the primary causes of freight sprawl is the loss of FOD in higher density urbanized areas, which is a primary topic of this report.

Freight facility encroachment occurs when longstanding or regionally significant logistics centers are converted into other uses or are forced to relocate to exurban or rural zones. This often takes the form of developing incompatible land uses immediately adjacent to freight facilities; however, it also includes the demolition of obsolete or vacant warehousing space with the aim of repurposing the land for non-freight uses. There are several factors that contribute to encroachment:

- Real estate cycles (changes in land valuation)
- Surrounding land uses
- Facility obsoletion
- Municipal land development policies
- Customer locations
- Mega-regional/national shifts in supply chain

Although many of these issues reflect happenings in private sector markets, municipalities can greatly impact (either directly or indirectly) the extent to which they affect the local and regional freight

[9] The American Transportation Research Institute estimates that congestion on the nation's major highways resulted in the addition of $74.5 billion in operational costs to the trucking industry in 2016 as a result of commercial trucks being stuck in traffic for 1.2 billion hours. – American Transportation Research Institute, *Cost of Congestion to the Trucking Industry: 2018 Update*, pg. 6 (2018)

mobility infrastructure through land use planning/permitting, industrial district designation, and communication with industrial land developers.

The Need to Preserve Freight Land

Multiple transportation and industry professionals have endeavored to study freight land use patterns, and this report draws on the definitions and methodologies they used. In highlighting the importance of freight land use preservation, the National Cooperative Freight Research Program noted that "Given the critical role of freight transportation in the economy, preservation of freight facilities and corridors is extremely important. The loss of freight facilities, yards, and other ancillary facilities that may serve the network can create bottlenecks, increase costs, and potentially affect consumers through increased prices."[10] Additionally, goods movement is an increasingly vital component of national, regional, and local economies; the trend towards greater globalization of the supply chain for most businesses is one of the drivers of this. The rise of e-commerce and decentralization of business operations has also contributed greatly to reliance upon freight transportation networks: "From 2014 to 2018, US e-commerce increased by 69 percent, from $298 billion to $505 billion, and is expected to increase another 39 percent by 2022, to $706 billion. Since 2016, Amazon has built 20 new distribution centers in the US and continues to expand its logistics system domestically and globally, including the development of truck, aircraft, and shipping fleets."[11] It is not difficult to infer from these data that the demand for goods movement in US cities will increase; correspondingly, a city's ability to leverage freight assets for economic, workforce, and transportation development will become an increasingly vital aspect of the city's ability to compete for business, attract residents, and improve quality of life.

Barriers to Freight Land Preservation

Barrier 1 – Public Perception and Regulatory Environment. Many cities do not consider logistics developments to satisfy the condition of the "highest and best use" for land in their jurisdiction. This stems from a largely antiquated view of warehousing and distribution infrastructure; it is commonly believed these facilities pollute heavily, reduce property values, destroy roads, and are unsafe. However, with modern site designs, construction methods, and proper planning, these facilities can contribute greatly to the function and form of the urban landscape and further sustainable development goals.[12] Nevertheless, some cities may have ordinances that restrict the development and operation of freight facilities. This could include zoning and permitting prohibitions, as well as regulations on the movement, routing, parking, and loading/unloading of commercial vehicles.

Barrier 2 – Freight Transportation System Condition. The effect of roadway congestion and delays on logistics operations can force freight businesses to relocate. It may not be cost effective for freight operators to remain in their present locations given increasing transportation network inefficiencies. Although a universally applicable solution to systemic roadway congestion is not currently available, cities can take steps to prevent and/or mitigate what are known as *freight bottlenecks*. These occur when freight operators experience significant amounts of non-recurring or unpredictable delay in their shipments due to irregular or volatile traffic patterns. The primary metric to consider in determining

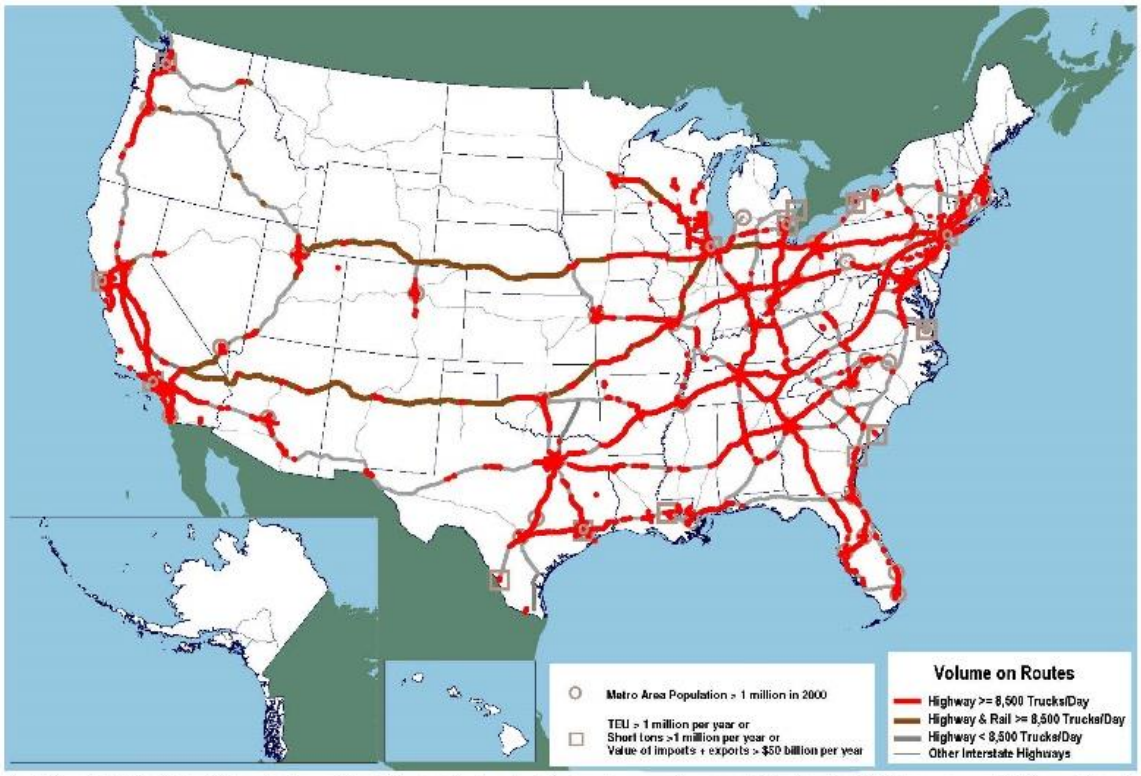
[10] NCFRP, *Report 16: Preserving and Protecting Freight Infrastructure and Routes*, pg. 30 (2012)
[11] TRIP, *America's Rolling Warehouses: Opportunities and Challenges with the Nation's Freight Delivery System*, pg.2 (2019)
[12] For specific examples, see NCFRP Report 13: *Freight Facility Location Selection: A Guide For Public Officials*, ch. 2 (2011)

whether or not a freight bottleneck is present is *travel time reliability* – shippers need to be able to anticipate how much delay will occur before a trip begins, so they can set adjust their departure and arrival times to factor in known delays due to traffic patterns. If the level of delay is too unpredictable, freight operations will suffer, which, in turn, increase the likelihood that shippers in the affected area will relocate. This matter is especially important in our modern context of just-in-time shipping practices, wherein the punctuality of deliveries has the potential to dramatically affect business operations of the receiving firms. A related barrier to freight-oriented development is the condition of/access to Interstate Highways, railroads, airports, and intermodal facilities. If major freight network nodes have moved too far away or are generally inaccessible by shippers, certain freight-oriented businesses may seek to house their operations outside of existing logistics districts in the urbanized area. This causes FODs to transition to non-freight uses in a piecemeal fashion.

Barrier 3 – Inadequate Freight Planning. "Planning is the first and most important step in creating effective processes and opportunities to achieve freight-compatible development, reduce community-freight conflicts, and preserve critical freight corridors and facilities."[13] **Figure 8** shows the major freight corridors within the country. Although the State of Texas and Metropolitan Planning Organizations officially include freight in their planning process, municipalities very rarely do so. This largely has to do with there being no statutory requirement for freight planning at the city and county level, while the regional and state bodies have federally mandated freight performance measures. Oftentimes, for reasons mentioned in the discussion on *Barrier 1*, sub-regional economic development and planning efforts do not focus on freight and its accompanying infrastructure. The result is that cities largely lack coordinated and informed efforts to reduce freight-related land use conflicts and preserve FODs in critical areas. Similarly, cities may lack awareness of goods movement issues and how they impact the built environment. Freight mobility is frequently sacrificed in favor of development initiatives that call for increased residential/commercial density and corresponding alterations in road alignments that are prohibitive for commercial vehicles. Although strategies such as mixed-use zoning and truck routing have proven benefits, they must be balanced with the needs of freight stakeholders and implemented in areas that do not encroach upon critical urban freight corridors.

[13] NCFRP, *Report 16: Preserving and Protecting Freight Infrastructure and Routes*, pg. 35 (2012)

Figure 8: Major Freight Corridors



Note: Highway & Rail is additional highway mileage with daily truck payload equivalents based on annual average daily truck traffic (2011) plus average daily intermodal service on parallel railroads. Average daily intermodal service is the annual tonnage moved by container-on-flatcar and trailer-on-flatcar service divided by 365 days per year and 18 tons per average truck payload.
Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, 2013

Retention of Freight Land Use: Overcoming the Obstacles

Each of the barriers mentioned in the previous section have at least one – although in most cases, several – strategies that allow public officials and private freight stakeholders to prevent or remediate freight sprawl. The following discussion provides recommendations for addressing these common barriers to freight land use preservation. It should be noted that neither the listed barriers nor the proposed solutions in this document are comprehensive. Many additional factors contribute to logistics district and property preservation, many of which are derived from the unique economic, geographic, and regulatory contexts of each city. Furthermore, these solutions do not necessarily include the utilization of resources that Councils of Government, Metropolitan Planning Organizations, and state agencies may provide to their member cities and counties; engaging in continuous conversation with these entities on matters of freight land use is an important aspect of effective freight planning at the county and municipal level.

Barrier 1 – Public Perception and Regulatory Environment. In order to effectively develop and maintain a robust freight network, municipalities must frequently evaluate the current regulatory atmosphere concerning freight infrastructure in order to remove or modify any previously enacted stipulations that inhibit freight land preservation in the urbanized area. Additionally, freight stakeholders (both public and private) may also wish to conduct public outreach for the purpose of aligning community goals with the goals of freight facility operators. An opportune time for this to occur is when soliciting public

feedback for a comprehensive plan or hosting charrettes and community workshops. It may be fitting for freight businesses to establish positive relationships with local community groups and business associations to distribute educational materials or disseminate information on the benefits of freight land development. Likewise, governing bodies and their staff must identify what problems resulting from FODs are being perceived by residents and work with the private sector to remediate these issues whenever possible. Public officials must also know the extent to which the freight industry impacts the local area, and be aware of the benefits and assets the industry provides such as additional jobs, larger tax base, lower prices on consumer goods, etc. Perhaps the strongest opportunity to develop positive community relationships and promote public awareness of logistics issues is through the employees of local freight businesses. Hosting events and communicating directly to goods movement professionals in the local area is a viable strategy for uniting the common interests of municipalities, communities, logistics businesses, and transportation agencies. Key tools for use in overcoming public perception and regulatory barriers to freight land use preservation include public outreach and awareness campaigns, hosting workshops and charrettes, industry outreach, and the creation of a freight quality partnership.

Barrier 2 – Freight Transportation System Condition. Strategic and well-placed improvements to freight network infrastructure can go a long way towards alleviating freight bottlenecks. However, the cost of such improvements, especially along mainline railways and Interstate Highways, place such projects well out of financial reach for many local governmental bodies. Thus, it is important to develop partnerships with the affected public and private stakeholders; this also includes transportation agencies whose jurisdiction overlaps the targeted area or project extent. This allows for the development of innovative funding strategies, cost-sharing measures, and the coordination of operational improvements when feasible. Consider the following example of a hypothetical freight bottleneck alleviation effort:

A freight bottleneck results from an unusually steep grade on a heavily traveled urban Interstate Highway. The steep grade forces heavy commercial vehicles to slow dramatically and results in long recurring delays, as well as increased non-recurring delays (traffic accidents) due to more private motorists rear-ending trucks as they reduce speed. The resulting bottleneck affects freight shipments regionwide. Reconstruction and leveling of this portion of roadway may be in the best interest of multiple organizations: local and national freight operators, the state Department of Transportation (DOT), residents of the city, and the Metropolitan Planning Organization (MPO). The city initiates a partnership with the MPO and DOT to solicit federal funding for improvements to the Interstate Highway System in support of regional, state, and national freight goals, and establishes a Freight Corridor Task Force for the area, of which the private freight stakeholders are a part. As a result of multiple meetings and proposals deliberated by the Task Force, the city, MPO, and a private consortium of shippers decide to invest in preliminary engineering and environmental work on the reconstruction project, which the state DOT and its consultants then carry out. Because of this work, the Task Force ultimately applies for and wins a discretionary infrastructure grant for most of the cost of the project. The city monitors and reports on the progress of the project to its citizens, while the MPO and state DOT partner to administer the project. As construction is completed, private freight shippers see increased profits from reduced delays, and operating costs decrease due to less idling and fewer truck-involved accidents; this also measurably improves air quality and motor vehicle safety in the region. Commuters in the city benefit from higher average speeds and less congestion, and homeowners gradually see

increased property values.[14] The MPO sees improvement in their performance metrics, namely Truck Travel Time Reliability, Peak-Hour Excessive Delay, and On-Road Mobile Source Emissions Reductions. The state DOT uses the project as a case study in their State Freight Plan update. The Task Force continues to convene periodically to address other freight bottlenecks in the metroplex.

The preceding scenario encompasses multiple aspects of a healthy transportation improvement process, namely interagency collaboration, innovative funding strategies, private stakeholder involvement, and public awareness. It is important to note, however, that project delivery is only impactful in situations where project selection is done thoroughly, with opportunity costs weighed and the projects with maximum benefits per dollar spent identified. It is often the case that many good and needed projects exist within a city, and the decision to proceed with one project over another must be based on empirical data and input from technical experts on transportation planning and its various components (freight, roadway development, safety, air quality, sustainable development, environmental justice, etc.). Key tools for overcoming barriers related to financing freight system infrastructure improvements include public-private partnerships, utilizing federal freight improvement funding initiatives, creation of a Freight Advisory Committee, special assessment districts, in-kind/equity contributions to projects, private activity bonds, cost-sharing agreements, and revenue-sharing agreements.

Barrier 3 – Inadequate Freight Planning. As previously stated, the consideration of goods movement in the existing planning framework is the most impactful way to preserve freight land uses in the urban area. The successful integration of freight considerations into the land development and planning process depends on 1) awareness of freight issues, and 2) balancing the need for efficient goods movement with community goals.

Planning staff and public officials must be aware of what logistical requirements their cities and counties have. In some areas, the freight industry is a significant generator of revenue by itself and, in others, it is more of a platform or foundation upon which high-impact industrial activities operate. By way of example, a robust multimodal freight transportation system in the city of Houston, Texas across all modes (rail, truck, pipeline, marine, and air) allows for large scale petrochemical processing operations to take place in and around the metroplex. This would not be possible were freight development and infrastructure unable to keep up with business demand. In contrast, due to its location and status as a logistical hub for multiple industries across highway, air, and rail modes, the Dallas-Fort Worth metroplex features multiple planned logistics districts, wherein standalone goods movement is the primary business function. In both examples, the needs of citizens and the vision set forth by the comprehensive plan of cities interface with the goods movement industry in different ways, and matters of housing, commercial development, mass transit, and greenspace management are all affected. Seeing the implications urban growth and/or infill strategies have on goods movement is the first step in planning for freight.

The needs and desires of the freight industry may be in conflict with those of the community; this is frequently expressed in the urban landscape by the formation of land use conflicts within and around FODs. Since goods movement is vital to the economy and quality of life, the elimination of fright development is not feasible. If freight development proliferates in incompatible zones, it can threaten

[14] Huang, W. *The Effects of Transportation Infrastructure on Nearby Property Values: A Review of the Literature*; (1994)

the safety, sustainability, and quality of commercial and residential areas. Therefore, collaborative efforts must be made with freight businesses to determine where private and public sector goals align, as well as how to address or mitigate areas in which disagreement exists. Special attention should be given to the presence of freight-related land use conflicts, as well as the vitality of freight infrastructure. Key tools to use in these endeavors are truck routes, Good Neighbor Strategies, planned industrial districts, freight cluster development (freight villages), off-peak deliveries, and urban consolidation centers.

3.3 Freight Land Use Conflict Analysis

Freight infrastructure such as rail yards, warehouses, and airports are all critical links to global commercial markets and are part of a network of facilities that operates throughout the North Central Texas region. Because of market demands, such facilities are often located nearby or within communities, as opposed to being relegated to imposing business parks or industrial centers. Freight businesses and the infrastructure they operate provide necessary services and access to goods that improve quality of life, provide jobs, and reduce cost of living for residents. Despite their many benefits, however, some freight facilities are built on sites surrounded by land uses that are not compatible with the range of activities that occur in goods movement operations. Other times, residential development occurs in primarily freight areas, thereby reducing the regional stock of valuable freight land, as well as reducing the performance of the residential property – and with it – quality of life.

This section is focused on the localized impacts that freight land use conflicts generate, and will present a regional scoring methodology, an analysis of conflict types, and a description of findings from the scoring process.

3.3.1 Methodology

Reviewed Site Types Definition

- A *Land Use Conflict* occurs when adjacent land uses disrupt or degrade the social, economic, or environmental conditions in the vicinity of the identified properties resulting from interference with the different land use functions. Potential impacts include pollution (air, water, waste, noise, vibration, light, etc.), roadway or railroad congestion, safety risks, reduced quality of life, and decreased economic productivity.
- *Good Neighbor Sites* are areas that have operational or physical characteristics that aim to integrate freight facilities into their surrounding land uses, with a focus on preventing or remediating land use conflicts.
- *Areas of Concern* are areas where conflicts occur. These usually involve multiple facilities and a variety of contextual non-freight land uses. Areas of Concern can refer to those at a singular facility or a larger FOD identified to have an impact on a specific neighboring land use.
- *Mixed Freight Areas* are areas that have both non freight and freight land uses intermingled with one another. They can include any of the types identified above within them.

Scoring Criteria

This section defines the scoring criteria used to evaluate freight-related land use conflicts in the North Central Texas region. In **Appendix A** is a description of a scoring matrix with the weight assigned to each individual criterion, and an explanation of the rationale behind it. **Table 3** shows the different criteria described in this section.

Table 3: Freight Land Use Conflict Scoring Criteria

Good Neighbor Strategies	Railroad Infrastructure
Sidewalks & Bicycle/Pedestrian Paths	Median Barriers
Raised Berms	Quad Gates
Supplemental Vegetation	Quiet Zone
Sound Walls	Offset from Sensitive Land Use
High-Quality Fencing	Rail-Related Connectivity Issues
Buffer Zones	Buffers Between Sensitive Land Use & Railroads
Site Design	**Roadway Infrastructure**
Loading Docks	Loading & Unloading Zones
Lighting	Truck-Related Roadway Damage
Vegetation & Fencing	Access Via Non-Residential Road
Staging Areas	Adequate Truck Parking
Freight-Oriented Development	
FOD Encroachment	
Pipeline Setbacks	
Environmental Justice Concerns	

Good Neighbor Strategies

Sidewalks/Bike/Pedestrian Paths

This criterion evaluates the presence or absence of sidewalks, bicycle lanes, trails (either bicycle or pedestrian), and other active transportation infrastructure (micro-mobility access, “slow lanes,” etc.). Sidewalks are considered to be of good quality if they are able to accommodate both pedestrians and bicyclists and have a buffer between it and the road.

Raised Berms

This criterion evaluates the presence or absence of raised earthen barriers between freight facilities and sensitive land uses (SLUs). Berms are effective and of good quality if they act as barriers that block unappealing sightlines, light, and sound emissions.

Supplemental Vegetation

This criterion evaluates the presence or absence of shrubs, trees, and other landscaping features. Supplemental vegetation is of good quality if it mitigates the emission of light and noise pollution while adding aesthetic value to the property and contributing to tree canopy cover.

Sound Walls

This criterion evaluates the presence or absence of sound-absorbing barriers, fences, or walls. A sound wall is of good quality if it reduces noise emissions a minimum of 5 decibels and is at least 6 feet high. A sound wall may not be needed if supplemental vegetation, high-quality fencing, or sufficient offsets are in place.

High-Quality Fencing

This criterion evaluates the presence or absence of fencing along property lines. A fence is considered to be of good quality if it aids in blocking light and noise emissions, obscures unpleasant sightlines, and enhances safety by limiting access to the freight facility.

Buffer Zones

This criterion evaluates the presence or absence of buffer zones, or portions of terrain that spatially separate or insulate land uses via green space, forestation, landscaping, or changes in elevation. Buffer zones are of good quality if the sensitive land use is at least 200 feet away from the freight property line and includes landscaping features that reduce light and noise pollution (if measurable, reduces noise emissions by 9 or more decibels, and reduces light emissions by 50 percent or more).

Railroad Infrastructure

Median Barriers

This criterion evaluates the presence or absence of median barriers on or around at-grade railroad crossings. Median barriers are of good quality if they clearly delineate lanes of traffic approaching an at-grade crossing and highlight the presence of a crossing (posts or barrier is in good physical condition and is painted or marked).

Quad Gates

This criterion evaluates the presence or absence of quad crossing gates (a four-gate system). These gate systems prevent motorists from driving around the gate arms while they are down and are effectively used in consort with other supplemental safety measures.

Quiet Zones

This criterion evaluates the presence or absence of a quiet zone. Quiet zones ban trains from blowing their whistles while in the zone; however, they require the emplacement of supplemental safety measures in order to ensure motorists are aware of approaching train traffic.

Offset from Sensitive Land Use

This criterion evaluates whether the distance from the railroad (or rail infrastructure property) to the nearest SLU is sufficient. A distance of 200 feet is generally considered adequate; however, based on site conditions, that distance may vary. Vibrations can be detected from some longer freight trains in excess of 250 feet from the track, while shorter and lighter passenger trains produce detectable vibrations out to a much shorter distance. This criterion does not consider the presence nor the features of buffers.

Rail-Related Connectivity Issues

This criterion evaluates the presence or absence of connectivity, traffic flow, and accessibility issues on the roadway network caused by railroad infrastructure. These can take the form of reducing pedestrian or automotive access to nearby homes and businesses, rail-related delays in motor vehicle traffic, and blocked crossings resulting from crew changes or switching activities. High-quality rail infrastructure design blends well with other transportation modes in the area and does not restrict or inhibit pedestrians, cyclists, and motorists.

Buffers Between Sensitive Land Use and Railroads

This criterion evaluates the presence and quality of buffers between rail infrastructure and nearby sensitive land uses. Well-designed buffers utilize sound walls, vegetation, high-quality fencing, and changes in elevation to alleviate noise, light, and vibration pollution that may be emitted from railroads.

Site Design

Loading Docks

This criterion evaluates the orientation of loading docks, if present. Loading docks facing away from SLUs is considered best practice, since they generate a large portion of a freight facility's noise and light. Outward-facing loading bays also disrupt what might otherwise be a visually appealing façade and lessen both privacy and security of the business operation.

Lighting

This criterion evaluates the presence and quality of exterior lighting on freight facilities. Sites that score highly in this area feature floodlights and lighting fixtures that are oriented downward, away from nearby SLUs, thereby reducing light pollution.

Vegetation and Fencing

This criterion evaluates the presence and use of vegetation and fencing on the freight property, as opposed to the Buffers Zones criterion in the Good Neighbor Strategies category, which evaluates the interstitial space between freight and adjacent facilities. Examples of high-quality vegetation include arrays of planters, trees, and shrubs that complement the façade of the building or serve to block sightlines to loading and staging areas. High-quality fencing is defined here as the use of solid, opaque materials (wood, stucco, brick, etc.) of sufficient height to insulate adjacent properties from light and sound emissions in non-industrial areas (typically around 8 feet high). The use of vegetation and fencing in a unified manner along property lines is also considered best practice when near SLUs.

Staging Areas

This criterion evaluates the presence, absence, and quality of staging areas for vehicles and equipment on the freight-oriented property. Staging areas are of good quality if they allow trucks, material handling equipment, and trailers to be staged on the property prior to and immediately

after loading and unloading, preventing trucks from the need to queue and park on nearby roadways, shoulders, or otherwise off the property.

Roadway Infrastructure

Loading and Unloading Zones

This criterion evaluates the presence of dedicated short-term parking for freight vehicles in high-density or highly trafficked areas. These may include parking for full-size tractor-trailer combinations, or for smaller delivery vehicles (e.g., box trucks and vans) and must be available for use by commercial drivers conducting deliveries at the property in question. Loading zones are of good quality if they accommodate a variety of vehicle classes.

Truck-Related Roadway Damage

This criterion evaluates the presence and extent of physical damage caused to roadway and facility infrastructure because of geometry and design issues. This includes destruction or degradation of curbs, medians, and fencing, as well as potholes and pavement damage that typically result from heavy freight vehicle traffic.

Access Via Non-Residential Road

This criterion evaluates whether the freight facility is accessible via non-residential roads. Well-designed entrances provide a direct route to freight facilities, using roadway alignments or access ramps that eliminate the need for trucks to make use of neighborhood streets or connectors that are relied upon by private motorists for access to residential areas, schools, parks, and other SLUs. Regulations and signage that route trucks away from residential roads are considered a best practice.

Adequate Truck Parking

This criterion evaluates the presence and quality of truck parking at or nearby freight facilities. The designation of dedicated short-term or long-term truck parking areas on the freight property is a best practice, but truck parking areas outside of freight properties are also considered. Large amounts of illegal truck parking pose a safety threat and indicate the need for remediation.

Freight-Oriented Development

Freight-Oriented Development Encroachment

This criterion evaluates the presence, absence, and severity of encroachment by other land uses into an established FOD. Sites will score poorly if significant encroachment by other land uses is taking place, especially by SLUs.

Pipeline Setbacks

This criterion evaluates the proximity of pipeline infrastructure to SLUs, as well as other safety and quality of life considerations. Sites will be evaluated based on their compliance (or lack thereof) with city ordinances on minimum pipeline setback distances, if enacted. Well-executed pipeline planning

involves the establishment of a consultation zone or the emplacement of berms, walls, spill zones, or other additional safety features.

Environmental Justice Concerns

This criterion evaluates the presence or absence of environmental justice issues at the site. Sites will score well if they equitably distribute any negative externalities and benefits amongst all classes of citizens and will score poorly in the opposite case.

3.3.2 Regional Conflict Assessment

Identification of Conflicts

Freight land use conflicts were identified based on lessons learned from the literature review and from observations made on site visits, then as discussed in **Sections 3.1** and **3.2.** The site identified for scoring can be found in **Table 4** below.

Table 4: Identified Sites for Scoring

Location	City	Site Type
Conflans Road & SH 161	Irving	Good Neighbor Site
Arkansas Lane & Typhoon Drive	Grand Prairie	Good Neighbor Site
Cedardale Road and North Houston School Road	Lancaster	Good Neighbor Site
West Bardin Road & Meadow Green Drive	Arlington	Good Neighbor Site
South Coppell Road & Cooper Lane	Coppell	Good Neighbor Site
Centerport (Sovereign Road & Centerport Drive)	Fort Worth	Good Neighbor Site
Alliance District/Roanoke Town Center	Roanoke	Good Neighbor Site
Shiloh Road	Garland	Land Use Conflict
East Avenue K & 109th Street	Grand Prairie	Land Use Conflict
Duncan Perry Road	Grand Prairie	Land Use Conflict
Simonton Road & Dallas Parkway/Inwood Road	Farmers Branch	Land Use Conflict
East Pioneer Drive & English Street	Irving	Land Use Conflict
Heinz Way & Holland Street	Grand Prairie	Land Use Conflict
Sherman Street & Trailerdell Street	Grand Prairie	Land Use Conflict
Gerault Road & Old Gerault Road	Flower Mound	Land Use Conflict
North Border Street & BNSF Cleburne Yard	Cleburne	Land Use Conflict
Wintergreen Court & Gannon Lane	DeSoto	Land Use Conflict
Miller Ferry Road & West Pleasant Run Road	Wilmer	Land Use Conflict
Samuell Blvd. & Mesquite Business Center	Mesquite	Land Use Conflict
Decatur Avenue & Norman Street	Fort Worth	Land Use Conflict
Terminal Road & Zwolle Street	Fort Worth	Land Use Conflict
January Lane & SH 161	Grand Prairie	Area of Concern
Minters Chapel Road & East Dallas Road	Grapevine	Area of Concern
SH 12 & Buckner Baptist Chld Home Drive	Dallas	Area of Concern
Empire Central Drive & Concord Avenue	Dallas	Area of Concern

Location	City	Site Type
East Union Bower Road & River Hill Road	Irving	Area of Concern
South Great Southwest Parkway & Osler Drive	Grand Prairie	Area of Concern
Susan Drive & Pinewood Drive	Arlington	Area of Concern
113th Street & UPRR (Great Southwest North Substation)	Grand Prairie	Area of Concern
Fountain Parkway & Great Southwest Parkway	Grand Prairie	Area of Concern
North Wilhite Street & Gray Place Road	Cleburne	Area of Concern
Chattanooga Place & Mesa Circle	Dallas	Area of Concern
Oak Grove Road & Enon Avenue	Fort Worth	Area of Concern
NE Main Street & UPRR (Ennis Substation)	Ennis	Area of Concern

Figures 9 through **13** show the locations of the different types of sites identified in this assessment. **Figure 9** shows an overview of all the types of conflict. **Figure 10** shows the freight land use conflicts in the region. **Figure 11** shows the Areas of Concern. **Figure 12** displays Good Neighbors Sites, and finally, **Figure 13** shows Mixed Freight Areas.

Figure 9: Regional Assessment Overview

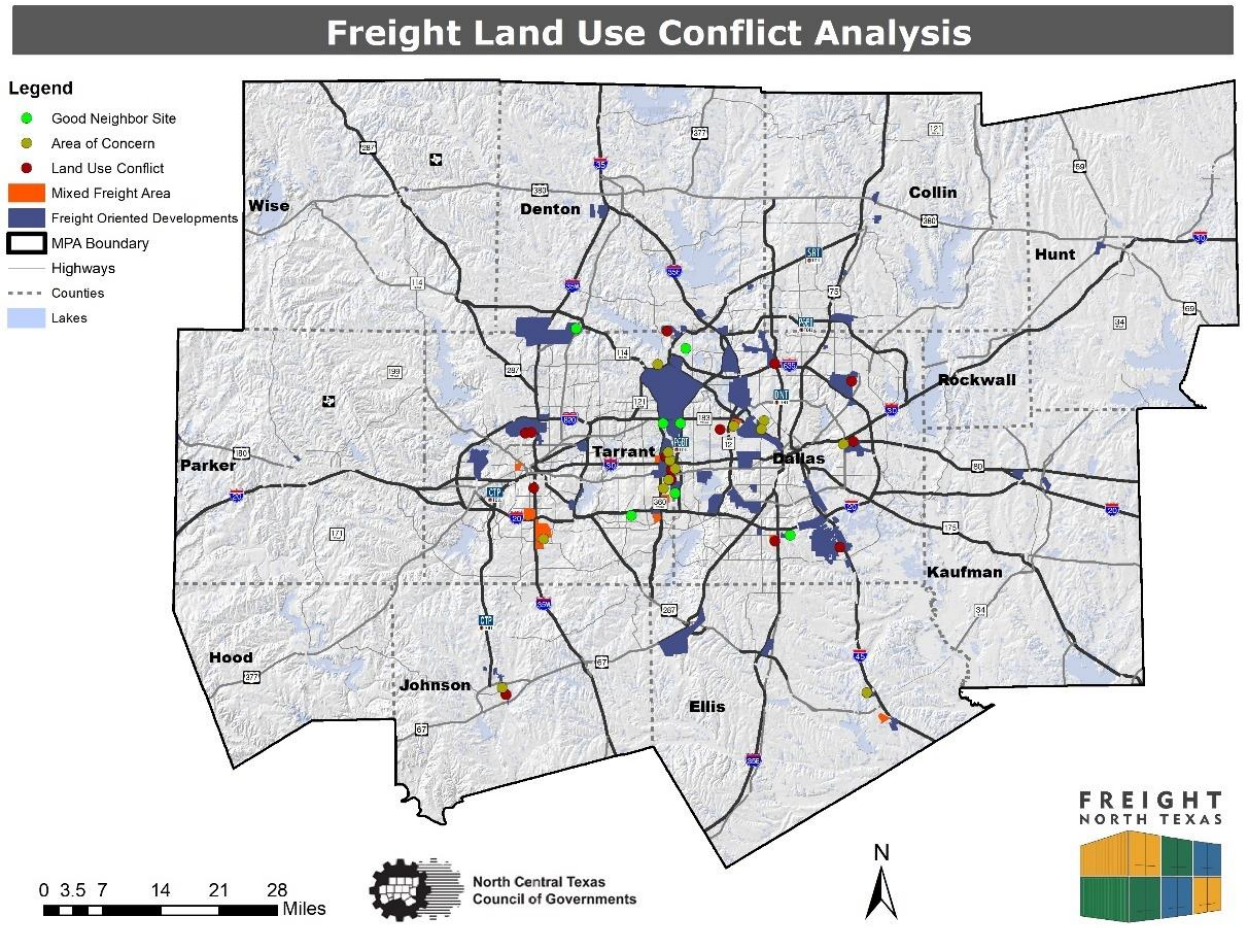


Figure 10: Freight Land Use Conflicts

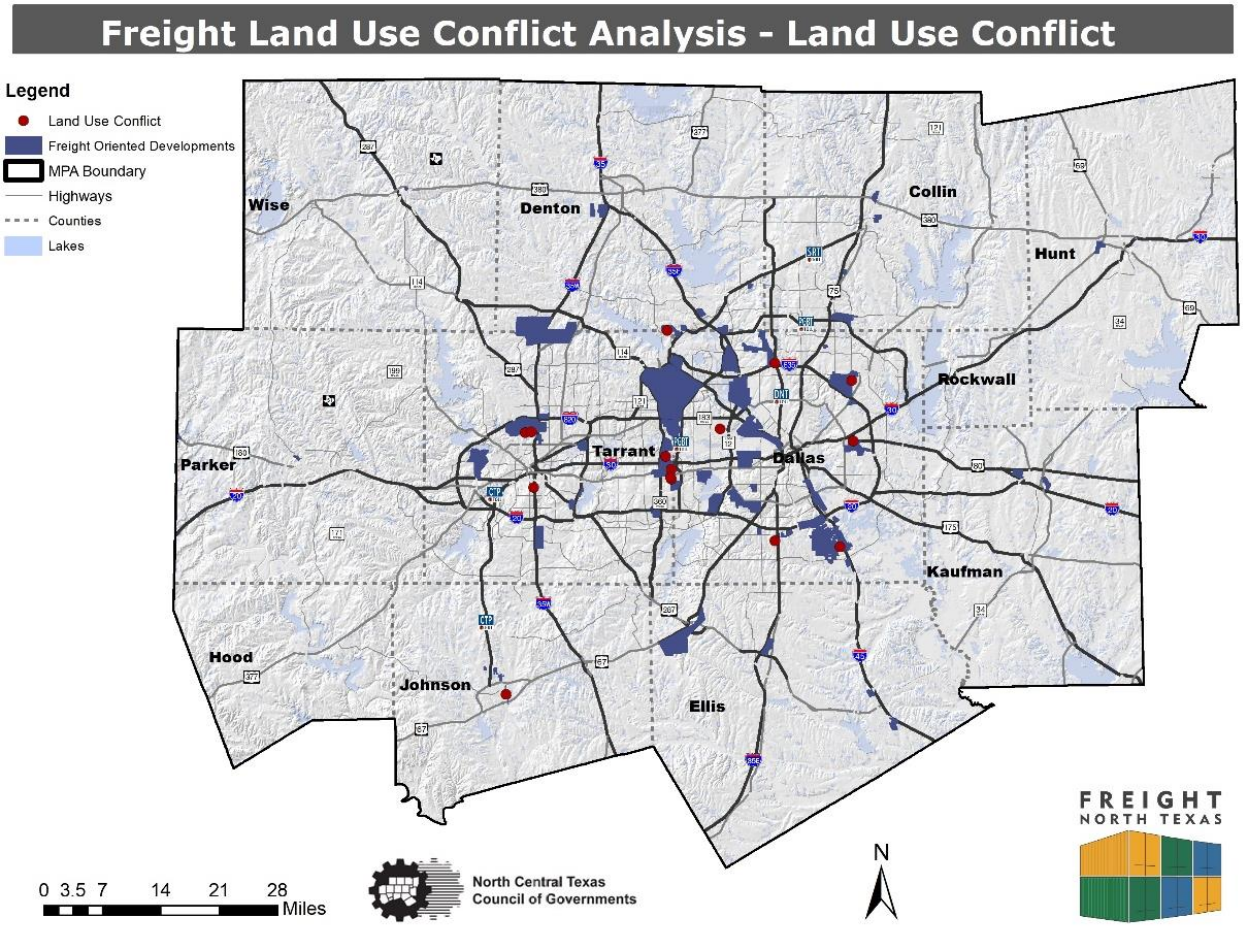


Figure 11: Areas of Concern

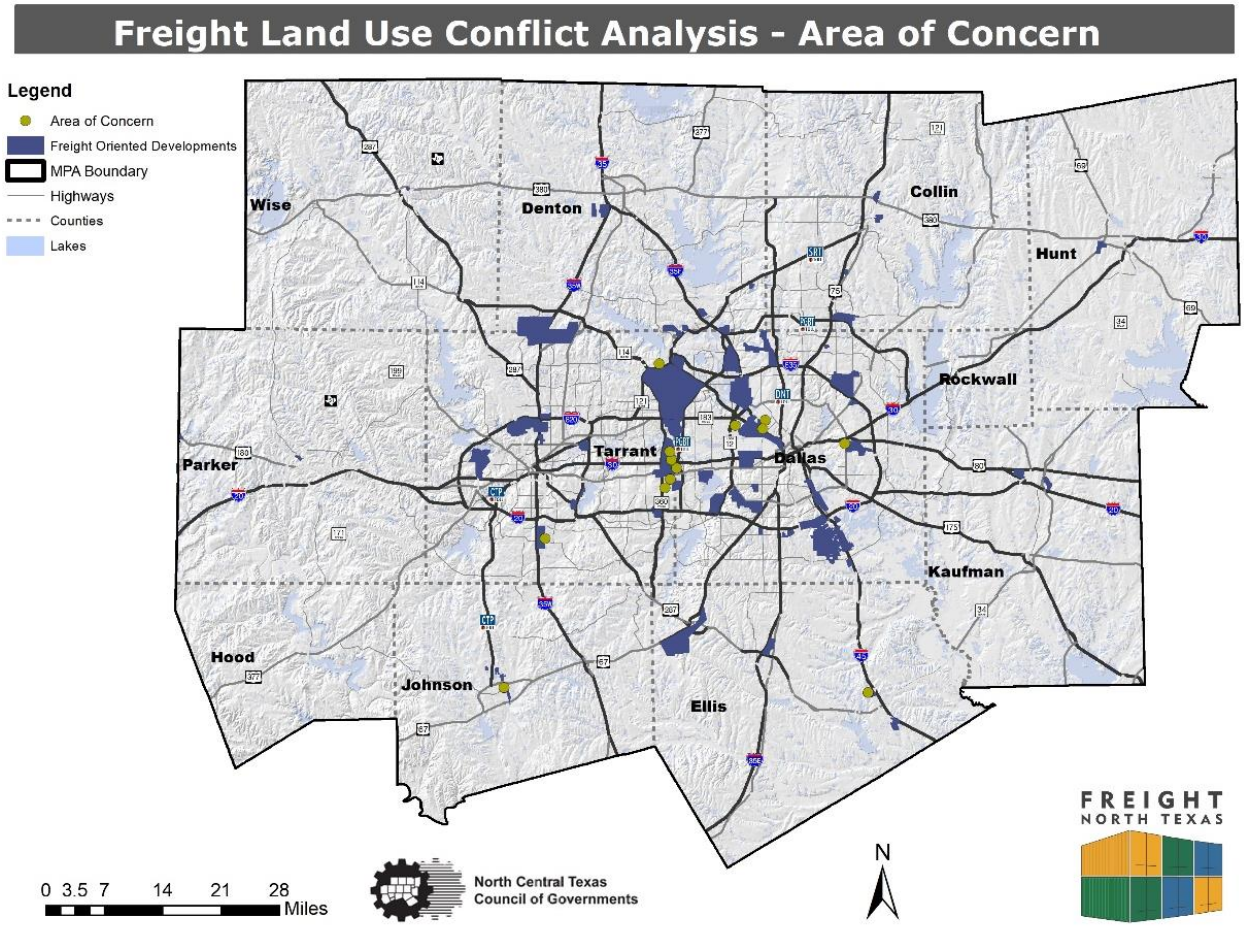


Figure 12: Good Neighbor Sites

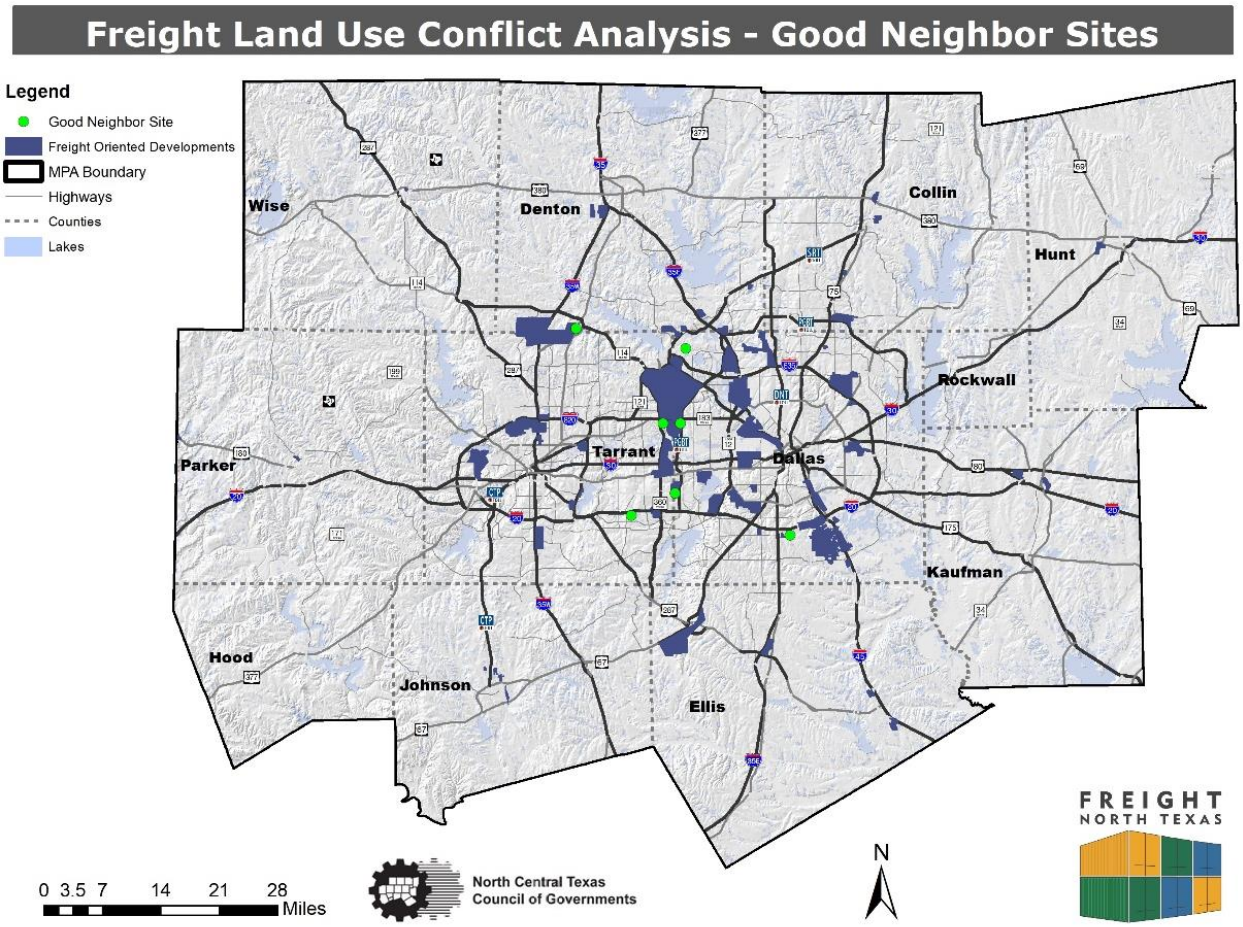
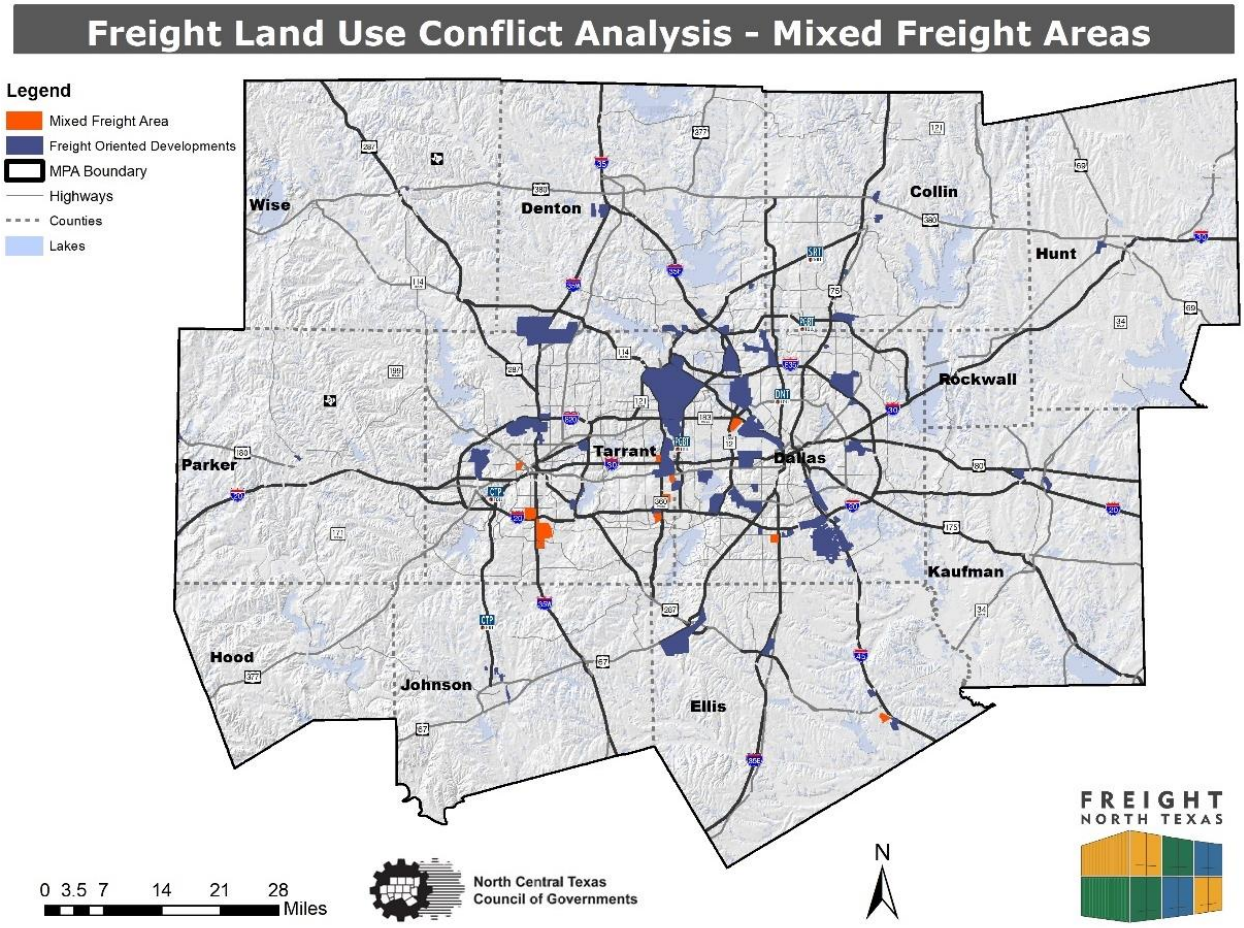


Figure 13: Mixed Freight Areas



3.3.3 Assessment Findings

The goal of the assessment was to identify the different conflicts and potential conflicts in the region. As stated earlier in this section, areas were identified using analysis from **Section 3.1** and **Section 3.2**, as well as site visits. Using the criteria earlier in this section, each of the identified sites was scored (full scoring is included in **Appendix A**). Scores were assigned to each of the criterion. For example, if a site met the criteria on adequate truck parking, the site received a higher score. **Figure 14** is an example of the scoring sheet. This shows how the scoring was applied. A higher score shows that steps are being taken to help with the potential negative impact a freight-focused site can have on the surrounding area. The end goal of the assessment was not to identify one site as better than the another, but to better identify trends and issues in the region. This would, in turn, help create a more effective policy toolkit and help guide cities as they deal with the different kinds of land use issues identified in this section.

Figure 14: Site Scoring Example

Freight Land Use Conflict Scoring Criteria			
Site:			
Site Type:	**Good Neighbor Site**		
	Score	**Not Applicable**	**Possible Points**
Good Neighbor Strategies			
Sidewalks and Bicycle and Pedestrian Paths			4
Raised Berms			2
Supplemental Vegetation			1
Sound Walls			1
High-Quality Fencing			1
Buffer Zones			4
Railroad Infrastructure			
Median Barriers		N/A	0
Quad Gates		N/A	0
Quiet Zone		N/A	0
Offset from Sensitive Land Use		N/A	0
Rail-Related Connectivity Issues		N/A	0
Buffers between Sensitive Land Use and Railroad		N/A	0
Site Design			
Loading Docks			2
Lighting			2
Vegetation and Fencing			2
Staging Areas			2
Roadway Infrastructure			
Loading and Unloading Zones			2
Truck-Related Roadway Damage			2
Access via Non-Residential Road			4
Adequate Truck Parking			2
Freight-Oriented Development			
Freight-Oriented Development Encroachment			2
Pipeline Setbacks		N/A	0
Environmental Justice Concerns			2
Subtotal	0		35
Score	0.00		

Trends and Common Qualities

The identification and scoring in this assessment showed some clear trends. Below is a summary of these trends:

- Land Use Conflicts are not determined by the age of the developments
- Good Neighbor Sites tend to be newer developments
- Areas of Concern tend to be older freight developments with new non-freight land uses being developed near them
- Mixed Freight Areas do not determine land use conflicts and were not scored
- Conflicts can be mitigated by Good Neighbor Strategies

Lessons learned as a result of this assessment were applied to the Policy Toolkit found in **Section 4.0**.

3.4 Environmental Justice and Freight Land Use

The purpose of this section is to examine the relationship between regional freight network infrastructure and populations under the protection of environmental justice laws and policies. Specifically, planning staff analyzed the potential for a disproportionate negative impact to occur as a result of freight land development near environmental justice communities.

Environmental justice (EJ) is defined by the Environmental Protection Agency as "The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."[15] More specifically, the Federal Highway Administration describes environmental justice in the

[15] https://www.epa.gov/environmentaljustice

context of freight and land use as "…the geographically equitable distribution of the benefits and burdens of government policies, programs, and investments, and to ensure the full and fair participation by all potentially affected communities in the transportation decision-making process."[16] Freight land uses in the North Central Texas region are frequently collocated with low-income and minority populations. Since freight facilities pose a risk of generating negative externalities for surrounding communities, it is important the topic of environmental justice is thoroughly examined for the purpose of mitigating an inequitable distribution of land use conflicts. As a result of this analysis, NCTCOG will pursue infrastructure and policy solutions to address disparities and land use conflicts identified in this report.

Analysis in this report relied on a combination of internal NCTCOG data, as well as the publicly available Environmental Justice Index (EJI), a product of the NCTCOG Environmental Justice Program. Geospatial data was combined, processed, and queried by planning staff using digital analysis tools, which yielded the graphics and tables in the sections that follow. More information on the methodology and assumptions used in this analysis can be found in the *Freight Land Use Compatibility and Environmental Justice* standalone report published by the NCTCOG Freight Planning Program.

The terms "EJ population" and "EJ communities" hereafter refer to areas that are identified by the EJI as above the regional percentage of population for low-income and ethnic minority households. The EJI identifies these districts based on the cumulative percentage of the regional population that falls into a given category of race and income and is not based on an average but rather a total count of individuals.

North Central Texas is home to a host of historic resources, as well as a diverse array of cultures and ethnicities to which attention must be paid in the land use planning process. It should be noted that a comprehensive environmental and ecological impact analysis of freight land use development is beyond the scope of this study and thus will not be addressed in detail. Rather, this section will outline the results of several areas of land use analysis as they pertain to freight network infrastructure and the location of minority and low-income communities. This report section analyzes the following:

- Prevalence of freight facilities in EJ areas
- Proximity of freight facilities to schools
- Presence of freight railroads in EJ areas
- Rail crossing grade separation efforts in EJ areas
- Spatial distribution of freight land use conflict sites in EJ areas
- Proximity of freight facilities to historical and cultural assets
- Proximity of freight facilities to sensitive ecological features

Freight Land Use and The Environment

The North Central Texas Metropolitan Planning Area is, as of the writing of this report, in a state of nonattainment for the Environmental Protection Agency's air quality standards. The majority of regional on-road mobile (vehicular) emissions are generated by medium- and heavy-duty vehicles. Because traffic attracted to FODs consists largely of these medium- and heavy-duty vehicle types, negative air quality effects are more likely in their immediate vicinity. Although freight businesses can mitigate this through the use of alternatively fueled and increasingly efficient freight vehicles, decreased air quality

[16] *Freight and Land Use Handbook*, Federal Highway Administration, 2012, pg. 1-4

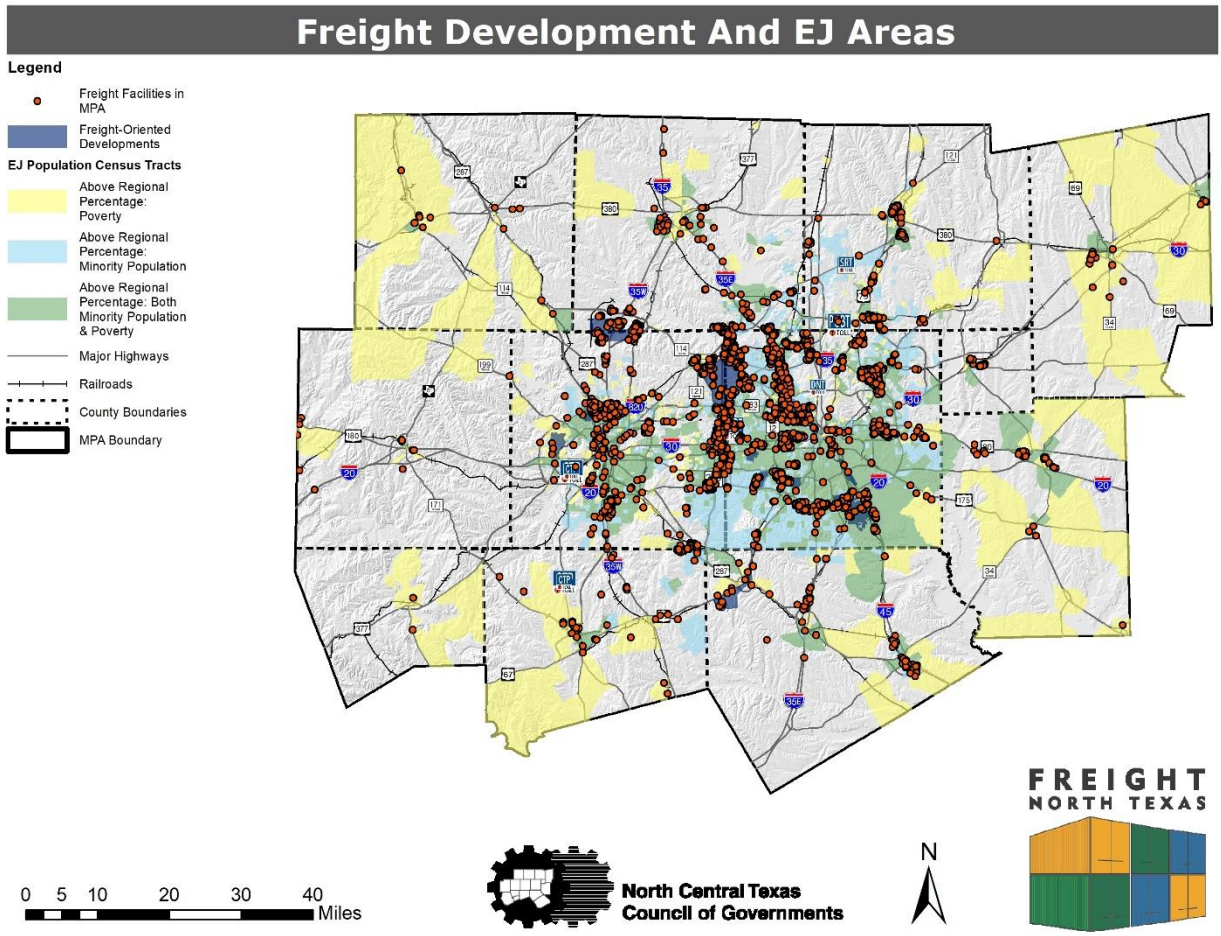
must be considered when examining freight facility proximity to EJ communities. This, combined with the economic need for goods movement infrastructure, generates a compelling incentive to ensure freight facilities are being designed, constructed, and operated in an environmentally responsible way.

In addition to air quality, there are many other factors that contribute to the impact freight land uses have on nearby ecologies:

- The need for diesel-powered heavy equipment causes higher than average nitrogen oxides and particulate matter emissions in the vicinity of the average freight facility.
- Freight sprawl can cause origin and destination points for trucks to be further apart, thus increasing vehicle miles of travel and emissions.
- The maintenance, fueling, and cleaning of heavy equipment can generate runoff that pollutes nearby surface water.
- New freight development can destroy valuable green space in the urban area.
- Freight facilities typically have many impermeable surfaces (parking lots, roads, yards, etc.), which inhibit the proper drainage of rainwater and can exacerbate flooding and soil erosion.
- Congestion resulting from a poorly planned FOD can increase delay, vehicle idling, and greenhouse gas emissions, correspondingly.
- The large-scale storage and use of petroleum products and industrial chemicals can present risks to the surrounding environment if leaks or spills occur.
- Freight facilities can generate large amounts of waste, which, if improperly handled, contribute to ground pollution.
- Older facilities tend to be less efficient in their use of electricity and fuels.

Additional impacts specific to various types of freight facilities exist as well (i.e., railroad infrastructure, manufacturing, warehousing/distribution etc.). Thus, involvement at the local level in planning for freight is essential in mitigating these environmental impacts, and ensuring that when they do occur, they provide equal benefits across all population groups and demographics. **Figure 15** compares freight developments within the region to EJ areas.

Figure 15: Freight Development and EJ Areas



Freight Land Use and Environmental Justice Communities

For the purpose of this report, "EJ population" and "EJ communities" refer to areas that are inhabited primarily by low-income and ethnic minority households in comparison to the overall regional percentage. The Federal Highway Administration notes the following with regard to freight land use:

"Externalities associated with the goods movement industry can negatively impact nearby residents. Increasing truck and train traffic can bring noise, increased air pollution, truck parking and safety concerns, and congestion impacts. Residents near ports, distribution centers, manufacturing facilities and other freight generating land uses can be impacted by light and noise pollution from 24-hour operations. Community impacts can overlap with social issues, including environmental justice (In 1994, Executive Order 12898 defined environmental justice (EJ) as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income.") and equity concerns because communities with large proportions of disadvantaged populations tend to suffer disproportionate negative environmental impacts."[17]

[17] https://ops.fhwa.dot.gov/publications/fhwahop12006/sec_3.htm

In accordance with EJ policy EJ3-001 and Freight Policy FP3-005 set forth in the NCTCOG Metropolitan Transportation Plan, Mobility 2045 Update, geospatial and demographic analysis was conducted to identify areas where EJ populations are at risk of being disproportionately affected by negative externalities resulting from FODs.

Environmental Justice Areas, Freight Facilities, and School Proximity

The location of freight facilities in EJ areas was studied for the purpose of determining prevalence and potential for impact on surrounding land uses. **Table 5** shows the freight facility locations and EJ areas in regard to the number of freight facilities and the Census tract demographic. Prevalence was measured by performing a crosstabulation between freight facility location data and EJ population data, which identified that a significant majority (73.10 percent) of freight facilities in the North Central Texas Metropolitan Planning Area were located in an EJ area of any type, while 48.24 percent were located within an area with both above regional average minority and low-income population. Potential for impact was measured by selecting a sample SLU type and calculating the distance between it and the nearest freight facility. The SLU type selected for this investigation was educational land use, including all primary, intermediate, secondary, and post-secondary school campuses within the region, to the exclusion of day-care and pre-kindergarten programs.

Table 5: Freight Facility Locations and Environmental Justice Areas

Census Tract Demographic	Number of Freight Facilities	Percent of Total
Above Regional Percentage Poverty	163	6.67%
Above Regional Percentage Minority Population	444	18.18%
Above Regional Percentage Poverty & Minority Population	1178	48.24%
Other	657	26.90%
Total	2442	100.00%

Proximity to educational facilities was analyzed for disparities between EJ areas and non-EJ areas in the region, given that the shorter the average distance between a freight facility and school, the more likely some level of impact or interaction is taking place. Schools in EJ areas were, on average, much closer to freight facilities than schools in non-EJ areas. This correlates with the finding that a large majority (1,785 out of 2,442, or 73 percent) of regional freight facilities are located within an EJ area of any type. Schools outside of EJ areas were, on average, more than twice the distance from the nearest freight facility when compared to those in EJ population centers. **Table 6** shows the school proximity to freight facilities data.

It should be noted that location selection criteria for schools and freight facilities overlap in some respects, including the need for access to major thoroughfares and relatively low cost of land. For schools, these roadway connections are an important part of servicing their educational district; even more so for larger secondary schools, since they are fewer in number than elementary schools and serve multiple neighborhoods rather than one. Likewise, freight businesses rely on expeditious access to highways and business centers to reduce operating cost by minimizing transit time. Affordable land prices allow school districts to conserve resources and logistics sector businesses to maximize return on investment.

Table 6: School Proximity to Freight Facilities

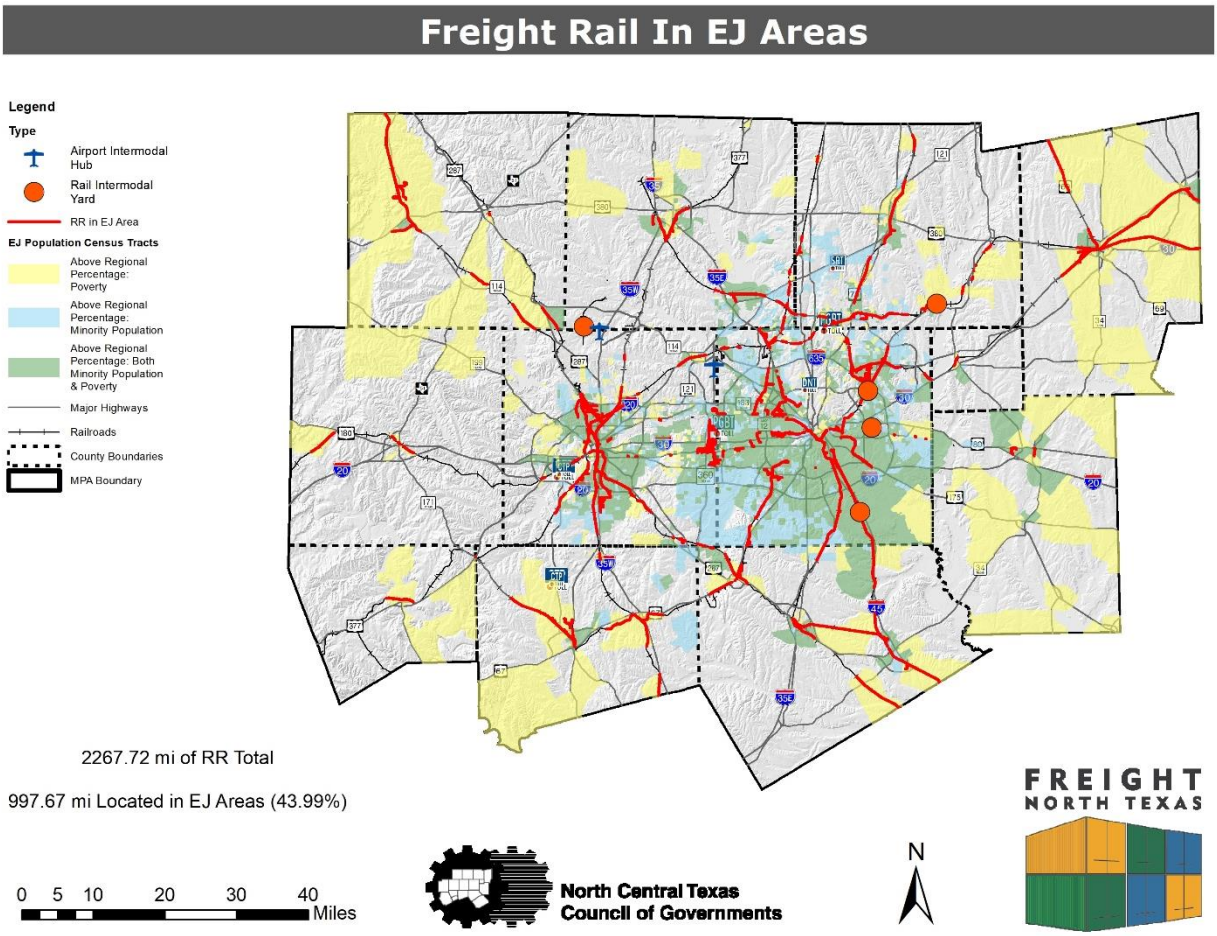
Location	Average Distance from Freight Facility	Number of Schools
All Schools in Metropolitan Planning Area	2.16 mi	2561
Schools in EJ Areas	1.38 mi	1354
Schools Outside EJ Areas	3.04 mi	1207

Cost minimization efforts on the part of industrial land developers may be a contributing factor to freight facility prevalence in EJ areas since land values in EJ areas tend to be lower than non-EJ areas. Alternatively, that freight land development occurs in these areas may have been the cause of lowered land value (and correspondingly, cost of living), attracting low-income earning residents due to reduced monthly housing costs. The manner in which a city zones industrial land is also a major factor in where freight facilities are located. NCTCOG proposes a more detailed analysis of construction dates, land values, and zoning policies be conducted as a follow-up to this report in order to more precisely identify underlying causes for this phenomenon.

Freight Rail and Environmental Justice Spatial Distribution

In similar fashion to the freight facility location analysis, freight railroads were analyzed for both prevalence and potential for impact. Prevalence was measured by calculating the number of rail miles that run through any type of EJ district, while potential for impact was measured again by proximity to schools. The analysis found that although the majority of the regional freight rail network lies outside of EJ areas, freight railroads are frequently collocated with EJ populations. **Figure 16** shows a map of freight rails that are in EJ areas within the region.

Figure 16: Freight Rail in EJ Areas



Out of a total of 2267.72 miles of freight railroad (excluding passenger rail) in the Metropolitan Planning Area, 997.67 miles of railroad run through areas with significant EJ populations, 43.99 percent of the total. Furthermore, out of the seven intermodal facilities located in the North Central Texas Metropolitan Planning Area, four are in an EJ area of any type. Educational facilities in EJ areas tended to have 41.26 percent less distance from freight rail lines than did those in non-EJ areas, which would not be expected considering that less than half of all regional rail miles are located within EJ areas. **Table 7** shows the location, average distance from freight railroads, and the number of schools within the region.

Table 7: School Proximity to Freight Railroads

Location	Average Distance from Freight Railroads	Number of Schools
All Schools in Metropolitan Planning Area	2.20 miles	2561
Schools in EJ Areas	1.77 miles	1354
Schools Outside EJ Areas	2.69 miles	1207

Out of 3,293 rail crossings (including public, private, at-grade, and grade separated), 1,689 of these are in an EJ area, slightly above half of the total (51.29 percent). Of crossings located in EJ areas, 26 percent

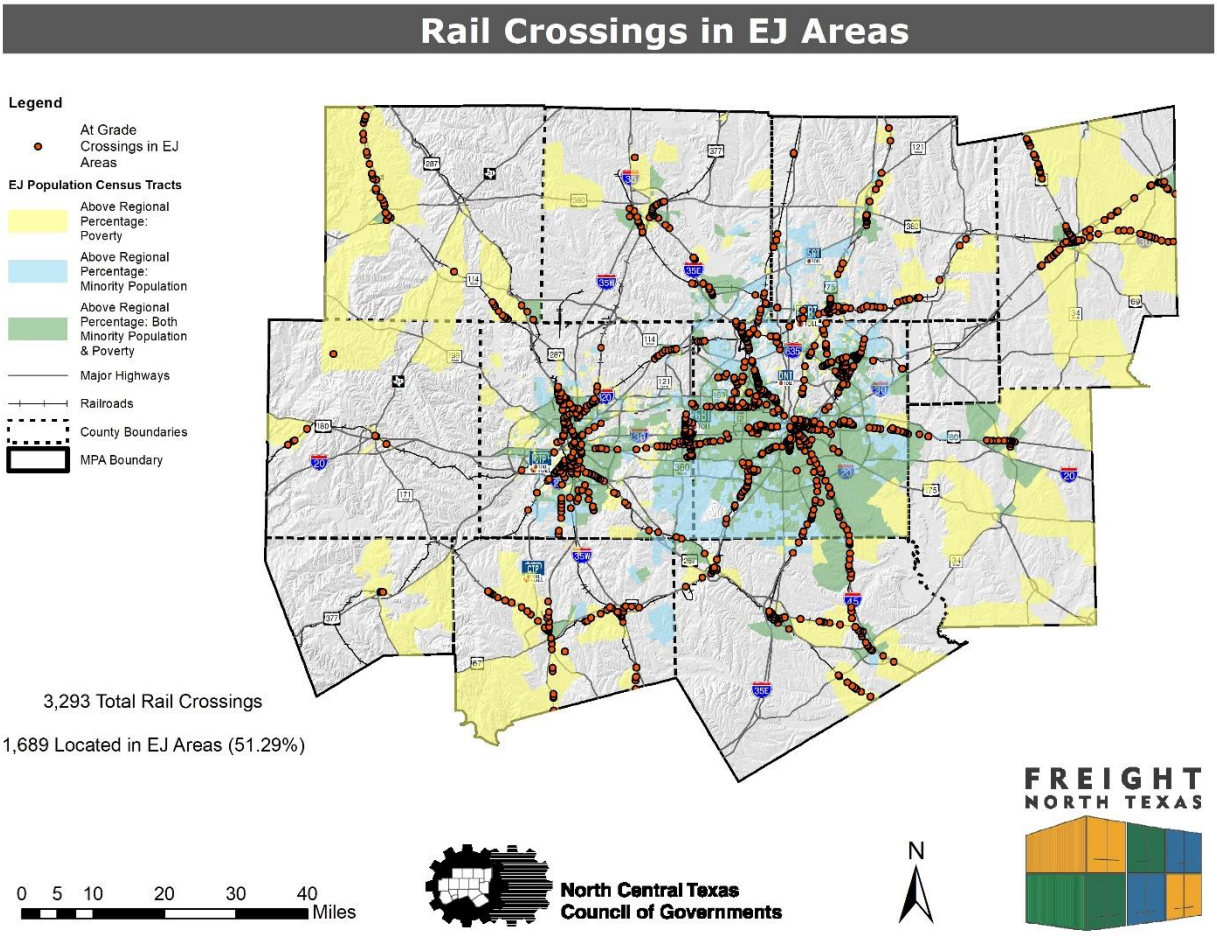
are grade separated, while 14 percent of crossings outside of EJ areas are grade separated. Although nearly half of all regional rail crossings are in an EJ area, crossings in these areas are more than twice as likely to be the target of a grade separation project when compared to those outside of EJ districts. **Table 8** gives an overview of the location of the rail crossings and if they are at-grade or grade separated.

Table 8: Rail Crossings in Environmental Justice Areas

Location	Grade Separated	At-Grade	Total
In EJ Area	434	1255	1689
Outside EJ Area	228	1376	1604
Total	662	2631	3293

Railroad grade separation projects are usually very expensive and represent a significant investment by railroad agencies, state transportation authorities, and local governments in safety and improvement of traffic flows (for both trains and road vehicles). The higher proportion of grade-separated crossings in EJ areas is not expected given that less than half of all regional rail miles are in EJ areas. This may be due to differences in annual average daily traffic. **Figure 17** gives a visual representation of the rail crossings that are in EJ areas within the region.

Figure 17: Rail Crossings in Environmental Justice Areas



Although rail crossings appear to be equitably distributed between EJ and non-EJ areas in terms of number and location, the proximity of schools in EJ areas to freight rail infrastructure – in addition to freight facilities – may indicate a disproportionate impact on EJ communities. NCTCOG proposes an analysis of annual average daily traffic and roadway properties in and out of EJ areas should be investigated in a follow-up study to this report, in addition to a more detailed analysis of freight rail assets and EJ communities at large.

Findings

Based on the preceding analysis, there are several key findings relevant for current and future freight infrastructure planning:

- 73 percent of regional distribution, manufacturing, and warehousing facilities are located in EJ areas.
- Freight facilities are, on average, 1.66 miles closer to schools in EJ areas compared to non-EJ areas.
- 43.99 percent of all regional freight rail miles run through EJ communities.
- Schools in EJ areas are 41.26 percent closer to freight rail lines than schools in non-EJ areas.
- Almost exactly half of regional rail crossings are located in EJ areas, and at-grade crossings in EJ areas are about twice as likely to be the target of a grade separation project.

- National Register Properties in EJ areas are – on average – closer to freight facilities than National Register Properties outside of EJ areas.
- There does not appear to be significant interaction between regional freight infrastructure and environmental resources, aside from the 77 freight facilities located within .25 miles of an impaired stream.

Given the findings of this analysis, NCTCOG recommends the following areas of emphasis when considering EJ populations in freight infrastructure plans:

- School proximity to freight facilities and railroad infrastructure
- Freight infrastructure proximity to historical, social, and cultural assets
- Proximity and interaction with nearby ecological features

Municipalities are encouraged to utilize the strategies outlined in **Section 4** of this study in order to mitigate negative externalities and ensure that vulnerable populations are not unduly affected by land use conflicts. The implementation of Good Neighbor Strategies also enables municipalities to leverage freight infrastructure development as an economic revitalization tool, especially as freight transportation infrastructure is an increasingly important aspect of the regional economy. As demands in shipping, fulfillment, distribution, and parcel delivery services continue to rise, NCTCOG seeks to ensure equitable distribution of the benefits and externalities associated with freight development across all demographics and income levels.

Many jobs in the freight transportation sector provide accessible opportunities for young populations and those who lack postsecondary education. The American Trucking Association reported that in the year 2018, there was a national driver shortage of roughly 60,800 truck driving jobs – an increase of 20 percent from the previous year; this large employment gap can be utilized as part of a larger strategy to increase access to employment opportunities in EJ areas. Similarly, warehousing labor demands have increased dramatically. Rapid growth of e-commerce created demand for 452,000 additional warehouse and distribution workers throughout the nation from 2018 to 2019. The COVID-19 pandemic expanded the use of delivery services for retail and grocery products and increased public familiarity with such platforms will likely result in more widespread adoption.

Investing in freight network upgrades has the potential to increase job growth in economically depressed parts of the region, as well as reduce the cost of goods and expand access to goods for low-income households. NCTCOG transportation plans and policies require that equitable transportation infrastructure investments are made in low-income and minority communities throughout the region. Likewise, member governments are encouraged to evaluate land use patterns in their jurisdiction to identify and mitigate issues resulting from freight land uses in EJ communities. Good Neighbor Strategies are equally important in EJ areas as they are in non-EJ areas, and freight facilities being constructed in EJ areas should follow modern design practices, as well as the Good Neighbor policies outlined in the final section of this study.

NCTCOG recommends that a follow-up study to this report section be conducted in order to analyze in greater detail the following:

- Freight facility construction dates, historical municipal land use policies, and land values
- Localized interaction and impacts on housing in EJ communities

- Freight infrastructure interaction with National Register Properties and other social/cultural/historical resources
- Freight railroad infrastructure interactions with educational facilities and EJ communities

In addition to follow-up studies, a critical aspect of response to EJ concerns is public involvement and engagement. As the effects of freight facilities on EJ communities is studied, NCTCOG and local government staff should arrange for public meetings and regularly communicate with residents and local officials regarding their experiences and concerns with freight facilities. Furthermore, public input should be sought from employees and business owners of freight businesses in EJ communities. These concerns should be documented and referred to local officials and planning staff to take action and form partnerships to identify where mitigation strategies are needed and capitalize on freight business investment and employment opportunities. In summation, significant disparities were noted in potential for interaction with freight land uses between EJ areas and non-EJ areas within the North Central Texas Metropolitan Planning Area; however, more granular analysis is required to ascertain the nature and magnitude of these impacts.

Analysis in this report section indicates that only a small portion of regional freight land use has the potential to negatively interact with surface environmental resources. Although National Register Properties in EJ districts were closer to freight land uses than their counterparts outside of such districts, the relatively high average distance may indicate that interaction between the two land uses is uncommon. Land Use Conflicts and Good Neighbor Sites identified earlier in this report appear to be proportionally distributed among EJ and non-EJ areas, while desirable railroad grade separations are more common in EJ areas despite fewer overall rail miles running through or near EJ communities. As freight land is developed and redeveloped in North Central Texas, city and county government agencies are encouraged to consider relevant impacts on minority and low-income communities, in addition to implementing Good Neighbor Strategies, land use conflict mitigation, and freight planning best practices with the aim of improving quality of life and economic prosperity for all residents of the region.

3.5 Freight Land Use Analysis Summary

The land use conflict analysis activities described in this report section identified the location of conflict sites throughout the region and presents a scoring methodology, analysis of conflict types, and a description of findings from the scoring process. Analysis of freight network features in EJ areas provided data and recommended actions to mitigate land use conflicts in EJ areas. The data and analysis in this section has identified locations throughout the North Central Texas region that require further attention from stakeholders and land use decision makers and provided an overview of freight facility conditions and regional freight land use patterns. The conflict sites and systemic patterns identified present opportunities for the implementation of the policies and strategies identified in the section that follows.

4.0 Key Findings and Recommendations

This section represents a synthesis of policy recommendations from technical literature and regional analysis in the preceding sections of this report. The Freight Land Use Policy Toolkit is an enumeration of Good Neighbor Strategies and other public and private sector solutions to the issues and challenges

pertaining to freight land use in the North Central Texas region and includes both proactive and reactive measures. NCTCOG advocates for the implementation of these policies where applicable and appropriate in support of Regional Freight System Plan and the Metropolitan Transportation Plan objectives.

4.1 Freight Land Use Planning Toolkit

Introduction and Purpose

Land use is directly related to the demand for freight, as the distribution of economic activities that both produce and consume freight is determined by land use policies and zoning. Freight land use policies are those that deal specifically with the regulation of land that facilitates the movement of goods, as well as their corresponding transportation infrastructure components (e.g., roadways, railroads, airport connections, pipelines, etc.). These policies are often embedded in the comprehensive plans of cities, regional mobility plans of MPOs, and state-level freight plans; however, they are not always expressed as separate policy objectives and, therefore, may not receive the necessary attention or priority to achieve implementation. For this reason, it is important to clarify and express freight land use policy objectives in the community's official documents.

The purpose of this section is to identify key policies for municipalities to consider when seeking to improve the quality of freight land uses within their jurisdiction. It is structured as a four-step process for local decision makers to use in evaluating their freight land use policy. **Figure 18** shows the four-step process. The first step involves developing a community vision for freight and industrial land use. This oftentimes can be adapted from previously developed economic development strategies and master plans and ensures that local officials understand not only the desires of their constituents, but also the needs of the industry they are seeking to develop.

Figure 18: 4-Step Freight Policy Process

The second step involves the geographic designation of freight districts or an otherwise comprehensive strategy of freight facility site selection. Although industrial land development is usually initiated and carried out by the private sector, cities and counties can shape the manner in which it occurs through proper land use controls, generally taking the form of zoning, and including more specific regulations on site design.

Step two also involves the evaluation of existing and planned transportation infrastructure as it pertains to goods movement. The availability of logical and interconnected truck routes, rail heads, and intermodal hubs greatly impacts site selection for freight facilities. Communities should seek to channel freight traffic in ways that avoid negative interactions with sensitive land uses while promoting the expeditious and safe conveyance of goods throughout their jurisdiction.

The third step involves the technical work of establishing site design regulations in accordance with the results of the previous two steps, along with input from industrial land developers, freight facility operators, and constituents.

In the fourth and final step, communities codify the desired ordinances, initiate needed planning programs, and execute relevant freight infrastructure development strategies. Subordinate to the final step, this section describes important considerations in ordinance development and freight project programming

After each step is outlined, a variety of relevant policies will be enumerated before the next step is presented.

Using this Toolkit

Although it is helpful for communities to begin the freight planning process at step one, in some communities, much work on economic and community development policies has already been done and, therefore, municipalities may wish to jump directly to steps two or three in order to avoid duplication of effort.

This policy guide is structured in a manner that allows it to be easily referenced on an as-needed basis, and not necessarily read through from beginning to end. Furthermore, the policies outlined in this section represent a distillation of technical planning tasks and programs into accessible, high-level tenants of each policy. When available, more detailed reference materials are provided for those who desire to learn more or become familiarized with nuances of the policy.

Although NCTCOG has compiled and commended these policies in general to member cities and counties, local conditions must be examined prior to policy implementation as economic, regulatory, or operational conditions may not lend themselves to policy success within a specific context. By way of example, *Policy 3-2: Establishing Curbside Loading Zones* provides a strategy of effectively utilizing curbside space to facilitate safe and efficient freight deliveries. However, this policy does not lend itself to more rural or exurban environments where lower population densities, roadway traffic, and commercial activity patterns generally do not produce a need for curbside freight deliveries.

To assist local governments in evaluating the suitability of these policies to local conditions, a rating description was developed that addresses the relative cost of implementation, amount of time required for implementation, and the level of impact policy implementation would have on freight network conditions. The policy rating descriptions are listed in **Table 9**. These descriptions are grouped into *Low, Medium,* and *High* for each category, and are listed in italicized text beneath the policy numerical designation and title in the section that follows.

Table 9: Policy Rating Descriptions

Cost		Time Required		Impact	
Low	Cost is nominal - requires only staff time and administrative costs.	Low	Policy can be enacted immediately and will require little time for public meetings or outside agency involvement. Less than 6 months.	Low	Policy has a relatively small direct impact on freight network conditions.

Cost		Time Required		Impact	
Medium	Policy will require one-time expenditures between $10,000 to $50,000 or will result in a moderate enduring financial obligation to the municipality.	Medium	Will require a minimum of 6 months to implement and may take as long as 4 years to complete or become effective.	Medium	Policy has the potential to moderately impact freight network conditions.
High	Policy will require one-time expenditures greater than $50,000 or significant recurring costs.	High	Policy is long term or continues indefinitely; a minimum of 4 years or longer will be required for implementation or project completion.	High	The highlighted policy or project is highly impactful on freight network conditions.

Note: All policy rating descriptions represent rough estimates on the basis of information available to NCTCOG staff at the time of publishing this report. NCTCOG makes no guarantees as to the actual cost, time requirements, or system impact that result from the implementation of these policies.

Create A Vision: Identifying Community Freight Development Goals

During this step, municipalities establish their overall strategy and approach to goods movement infrastructure. Many cities and counties have such policies expressed in their community master plan or comprehensive plan and should refer primarily to those when developing the foundation for municipal freight policies and programs. Other communities may find it necessary to conduct charrettes and other forms of community outreach to gauge the sentiment of the citizenry more precisely as it pertains to freight development.

Once community input has been gathered, planning staff should develop revisions and/or amendments to the comprehensive plan, as well as other documents or plans that codify city goals and objectives. Participation of local economic development agencies is important for these activities, as the needs and objectives of local businesses will also need to be assessed.

Some amount of educating the public on freight-related issues may be necessary to adequately implement the policies relevant to the community vision for goods movement. Involving local and regional freight business associations to help in determining answers to frequently asked questions about the freight industry is useful if outside expertise is needed.

Policy 1-1: Freight Inclusion in Community Outreach Programs

Cost: Low | Time Required: Low | Impact: Medium

Although community surveys are a common tool for measuring public interest, they rarely include questions about freight policies and infrastructure. Communities should engage with constituents concerning existing freight-related policies. Surveys should cite specific policy goals, then ask the resident whether they are in favor of, opposed to, or would like to provide a public comment on the policy in question. Once enough responses have been collected, cities can decide which policies need to be reconsidered or pursued more vigorously. Surveys can also be used as an outlet for any freight-related complaints and overall public awareness,

It is useful to include more general community economic goals such as what the resident sees as the most important local industry to be involved in and ask whether they have experienced negative interactions with freight facilities or commercial vehicles within the community. Cross referencing this outreach effort with local law enforcement data can be useful as well, since public complaints against noise, illegal truck parking, and idling are often geospatially catalogued. This information can help determine which freight facilities or districts need remediation.

Policy 1-2: Performing Local Economic Studies

Cost: Low | Time Required: Medium | Impact: Medium

In order to make more informed decisions regarding freight development strategy, municipalities should undertake key economic studies. Although Census-based economic data is universally available and has sub-city levels of granularity, it can become outdated rapidly, and may not answer specific economic questions. Conducting economic studies can be done through university partnerships, consultants, or local economic development agencies. There are two types of economic studies that are particularly useful for making freight development policy decisions at the local level. The first is an Economic Gap Analysis, and the second is an Economic Structure Analysis.

An Economic Gap Analysis is a tool that allows communities to gain insight on which products or services residents tend to purchase locally versus those that are purchased externally or imported. This type of analysis is an indicator of how well the local economy serves the needs and desires of residents and usually expresses what percentage of a given product or service is purchased locally.

An Economic Structure Analysis is a study that assesses the overall local economic structure, including the composition of employment by sector, wage levels, historic growth and decline, and a comparison of how the local economy compares to the regional economy. For freight planning purposes, the most important part of this study is the evaluation of industry concentrations and supply chain relationships.

It should be noted that trends in e-commerce utilization, as they pertain to the aforementioned economic studies, should be evaluated as well. Residents will often turn to online shopping services in order to acquire items they cannot find locally, or whose online counterpart is more competitively priced. It may also be the case that local businesses are participating significantly in e-commerce activities, exporting a significant proportion of their products to customers outside the locality. Since

e-commerce is a highly freight-dependent economic phenomenon, this information will provide a more comprehensive foundation upon which to base a freight development strategy.

Once the economic analysis is complete, local decision makers will be faced with deciding on a distinct freight development strategy, a few examples of which are summarized by the following statements:

1. Focus developing supply chain infrastructure around major local industries, capitalizing on local economic strengths.
2. Use freight development projects and programs to bolster the industries and markets that residents are unable to participate in locally, closing economic gaps.
3. Adopt a mix of fortifying goods movement infrastructure for primary local industries and expanding economic accessibility for residents.

Policy makers should also consider the various ancillary industries that provide services to local businesses, as they may be reliant upon or support trucking, railroading, air cargo, or pipelines.

Policy 1-3: Establishing or Participating in a Local Freight Industry Advisory Committee

Cost: Low | Time Required: Low-Medium | Impact: Medium

Although goods movement is largely a private sector operation, public policy decisions have a large impact on new freight facility location due to land use control resting with local cities; therefore, both policymakers and freight industry professionals have a vested interest in ensuring open lines of communication with each other. An effective and transparent venue for accomplishing this are local Freight Advisory Committees (FACs). FACs are standing committees that advise local policymakers on matters that affect freight network conditions and infrastructure, as well as discuss matters of regional or local significance. They are comprised of both public and private sector stakeholders in the local freight system and are convened on either a regular or ad-hoc basis. **Table 10** shows who should participate in FAC stakeholder meetings.

FACs are most commonly established at the regional level or above and are convened by MPOs. NCTCOG conducts Regional Freight Advisory Committee[18] meetings on a quarterly basis for the North Central Texas region, while the Texas Department of Transportation convenes the Texas Freight Advisory Committee.[19] Some municipalities that are home to large amounts of freight development may determine that it is necessary to establish a more localized FAC in order to meet specific policy objectives.

[18] https://www.nctcog.org/trans/about/committees/regional-freight-advisory-committee
[19] https://www.dot.state.tx.us/move-texas-freight/committees/freight/default.htm

Table 10: Recommended Freight Advisory Committee Stakeholder Participation

Public Sector	Private Sector
• City Council Members • Planning Department Director & Staff • Transportation Planning Staff (Local & MPO) • Planning & Zoning Commission Members • Economic Development Staff Representatives • DOT District Staff Representative	• Industrial Land Development Staff Representatives • Local Freight Operations Managers • Local Freight Business Owners & Executives • Directors of Business Development • Drivers & Freight Industry Employees

Matters that should be considered at FAC meetings are significant transportation projects and policies (e.g., truck routing ordinances), changes in industrial land use regulations, and master plan (comprehensive or transportation) development. FAC meetings are also opportunities for municipal and/or economic development staff to solicit industry feedback on programs and projects, as well as for outside agencies (state/national stakeholders, regional/local businesses) to present ideas for regional transportation system improvement. Industry feedback is especially important in Smart Growth communities as cities consider issues of urban and transportation design, road diets, and bicycle/pedestrian infrastructure. Such projects should be evaluated to ensure that access by freight shippers to their customers is not unduly impeded. Participation in some form of FAC is strongly recommended for municipalities and freight businesses.

Policy 1-4: Discouraging Incompatible Land Use Development

Cost: Low | Time Required: Low-Medium | Impact: High

Freight land use compatibility issues usually occur as a result of zoning and permitting authorities not fully considering community goals in practice relative to freight-oriented facilities. Other times, conflicts arise as land uses change over time or are rezoned without proper impact analysis. Ultimately, as land use controls in Texas are chiefly with the municipality, cities must ensure deliberate execution and enforcement of the planning and zoning policies outlined in the comprehensive plan.

Prior to rezoning parcels of land or granting construction permits, cities should evaluate whether the improvements are in line with previously established zoning guidelines, and whether the improvement makes sense for the location wherein it is to be implemented. By way of example, freight facilities may cause harmful effects to community health and safety when constructed near SLUs. SLUs are characterized by their susceptibility to negative externalities generated by freight land uses, including lighting, noise, vibration, odors, traffic conditions, accessibility restrictions, and safety risks. SLUs include, most frequently, low-density residential properties; however, mixed-use, light commercial, and some institutional properties can likewise be degraded in quality by close placement to freight facilities. Environmental justice communities and the land uses that support them should also be considered SLUs.

The Good Neighbor Strategies presented throughout this report[20] represent a body of creative and effective methodologies to help mitigate the negative freight land use externalities and promote the successful integration of freight infrastructure in communities, towns, and cities. These strategies seek

[20] See both *Site Selection & Transportation: Identifying Freight Districts and Assessing Freight Mobility* as well as *Site Design: Industrial Property Attributes* for an enumeration of specific GNSs.

to bolster economic performance and productivity while providing low-cost access to the global marketplace. NCTCOG strongly encourages municipalities to consider implementation of these strategies wherever freight land use exists. **However, the most effective land use conflict mitigation strategy is to prevent incompatible land uses from being developed in the first place.** Regardless of where a given city is in the freight planning process, discouraging incompatible development at every available opportunity is a vital component of optimizing and preserving freight infrastructure and ultimately leads to more livable and prosperous communities.

Policy 1-5: Performance Measurement and Monitoring

Local freight network performance measures are tied to specific outcomes and goals established by a governing body and are observed in order to ascertain whether or not those outcomes are being achieved. Additionally, performance measurement can serve as a tool for use in prioritizing the allocation of funding for maximum effectiveness and promoting transparency for constituents as to why certain projects are funded and why others are not. Establishing and monitoring performance measures for the freight network is essential to a data-driven approach to transportation system improvement.

At the regional and sub-regional levels of government, examples of freight network performance measures include:

- Truck Travel Time Reliability – This metric assesses how much extra time truckers and fleets must plan into their trips to arrive at their destination at the desired time due to variability in local highway network conditions.
- Freight Bottlenecks – This metric measures the amount of freight-related congestion on local streets, especially in districts with a high concentration of freight activity.
- At-Grade Railroad Crossing Conditions – This metric assesses the physical conditions, geometry, and presence of safety measures of at-grade rail crossings within the jurisdiction.
- Commercial Vehicle Related Crashes – This metric measures the frequency and locations of truck-related motor vehicle incidents within the jurisdiction.

Municipalities are encouraged to consider both these and other performance measures that assess the areas of greatest need and align most closely with the community goals outlined in the comprehensive plan or transportation plan adopted for the jurisdiction. Data collection and analysis activities in support of performance measure monitoring can help drive freight land use compatibility and preservation in three key ways:

1. By identifying local freight issues and directing funding to capital projects that address them
2. By promoting awareness of freight network issues and fostering partnerships with local businesses to deliver solutions
3. By tracking the effectiveness of previously employed strategies

Performance measures help to identify the most urgent needs in the local transportation network. Local governments can implement a wide range of solutions to address freight system performance in a manner that targets the performance measures they most want to prioritize. Municipalities are encouraged to leverage regional partnerships to maximize both performance measurement and project delivery.

Recommended Resource: The National Center for Fatality Review and Prevention Report 33: *Improving Freight System Performance in Metropolitan Areas: A Planning Guide (2015)*[21]

Policy 1-6: Freight Safety Public Awareness Program

The goal of this policy is to increase public visibility of freight safety concerns and influence the behavior of transportation system users to prevent freight vehicle related incidents. This can be accomplished by establishing a communication initiative that uses advertisement and messaging campaigns to raise awareness. Two key issues that should be considered as part of this campaign are:

- Driving habits – focusing on motorist actions that can contribute to commercial motor vehicle crashes such as following trucks too closely or not giving them enough room to stop or maneuver while driving
- Railroad Safety – highlighting safe practices to use when traversing an at-grade railroad crossing (for motorists, bicyclists, and pedestrians)

Municipalities and other districts may have their own challenges unique to that area; safety initiatives should focus on these as well and communicate what local governments are doing to improve safety as part of the campaign. Local governments should also avail themselves of regional, state, and national safety data resources that contain information on their jurisdiction and use them to tailor safety campaigns on the most relevant issues for them.

Site Selection and Transportation: Identifying Freight Districts and Assessing Freight Mobility

As the name implies, the Site Selection and Transportation phase has two distinct parts. In the first part, the geographic areas within a municipality wherein the community may wish to foster or dissuade industrial land development are decided. This frequently takes the form of business parks, master-planned industrial developments, and corporate campuses. In addition, they can include districts established by local governments wherein freight facilities are subject to additional leniency or severity under the city's zoning code such as planned manufacturing districts or planned industrial districts.

The second part of this phase is the consideration of transportation network strengths and weaknesses as they pertain to freight. Truck route ordinances, locomotive quiet zones, grade separation projects, airport access, intermodal hub connections, and highway infrastructure are all relevant examples of transportation system components to be examined. It is critical to investigate not only transportation assets within the municipal boundary, but also those that connect to the local system as part of a larger regional network.

The site selection and transportation evaluation processes involve the decision of where freight development should generally take place (or not take place), and ultimately seek to benefit the community and local businesses by preventing land use conflicts and developing infrastructure that best caters to the needs of surrounding properties.

Key Tasks:

- Designate planned industrial districts
- Establish communication with private industrial landowners and developers

[21] https://www.trb.org/Publications/Blurbs/172487.aspx

- Identify local transportation system shortfalls, bottlenecks, and externalities as they pertain to goods movement
- Review truck route ordinances, railroad connections, and multimodal freight hub access

Recommended Resource: The National Center for Fatality Review and Prevention Report 13: *Freight Facility Location Selection: A Guide for Public Officials (2001)*

Policy 2-1: Truck Routing Ordinance Establishment and Review

Cost: Low | Time Required: Low-Medium | Impact: High

The designation and maintenance of truck routes are critical for quality of life and efficient freight movement through local roadways. Although most cities in the North Central Texas region have truck routes designated by ordinance, they must be regularly reviewed and updated on the basis of changes in transportation network conditions, changes in land use, and regional freight network connectivity concerns.

The primary purpose of truck routing ordinances is to channelize commercial vehicle movements along routes that are most suitable for truck traffic, while also dissuading them from taking unsuitable routes as much as possible. By default, all state highways, US highways, and Interstate Highways are truck routes; for local and county roads, however, municipalities must regulate which roadways receive such a designation. The truck route selection criteria are outlined in **Table 11.**

Table 11: Truck Routing Designation Criteria

Physical Criteria	Connectivity Criteria
• Favorable intersection geometry • Sufficient bridge height • Absence of low-weight bridges • Overhead clearance • Road weight capacity limits • Minimal at-grade rail crossing interaction • Separation from bicycle/pedestrian infrastructure	• Commercial development/district access • FOD & industrial area access • Arterial or highway connections • Intermodal facility access • Truck parking facility access

The following paragraphs describe in greater detail these criteria:

Favorable Intersection Geometry. Trucks require a wider turning radius than traditional automobiles, and intersections along truck routes that require trucks to make sharp right turns will be damaged as a result of repeatedly being driven over by heavy tractors and trailers. The Texas Department of Transportation, the American Association of State Highway and Transportation Officials, and the National Association of City Transportation Officials have published intersection design and right turn radius recommendations for buses and trucks with various wheelbase lengths; NCTCOG recommends truck routes have at lease these minimum design standards to accommodate safe turning maneuvers by trucks at intersections. The types of trucks that frequent nearby establishments should also be noted. See *Policy 2-7: Roadway & Intersection Geometry Review* for more information.

Sufficient Bridge Height. Truck routes should not require trucks to pass under low-clearance bridges. Trucks may be required to transport irregularly shaped or tall objects, including various configurations of containers, at times. In order to accommodate this, bridge heights of 18.5 feet[22] or more along the entirety of the truck route are desirable; however, a minimum of 14 feet is generally necessary for standard truck trailers.

Absence of Low-Weight Bridges. Bridges with weight capacity restrictions under 80,000 pounds should be avoided when designated truck routes if at all possible; otherwise, truck route signage may direct commercial traffic to take an alternative route.

Overhead Clearance. As with bridge height, truck routes should not be designated along roadways with low-hanging utility lines, trees, streetlights, or building features that occupy overhead space. A vertical clearance of 18.5 feet should be provided based on bridge height standards advised by the Texas Department of Transportation for the Texas Freight Highway Network.

Road Weight Capacity Limits. Roadways selected for truck route designation should be of sufficient weight capacity to accommodate freight vehicles up to 80,000 pounds. Municipalities with certain heavy manufacturing activities may consider developing roadways capable of accommodating overweight vehicles (more than 80,000 pounds) on the basis of industry feedback.

Minimal At-Grade Rail Crossing Interaction. Although rail crossings are common in industrial areas with rail access, truck routes should avoid at-grade crossings to minimize freight delay due to blocked crossings. Additionally, humped crossings (rail crossings with sharp height increases) may not be navigable by some commercial vehicle trailers. See *Policy 2-3: At-Grade Rail Crossing Improvement Plan* for more information.

Separation From Bicycle/Pedestrian Infrastructure. Due to visibility, turn radius, and stopping distance concerns, trucks should not be routed through areas where there is a significant presence of bicycle/pedestrian pathways, sidewalks, trails, and bike lanes. Trucks can be routed on roads with such infrastructure so long as separation measures are emplaced (walls, rails, lane dividers, etc.).

Commercial Development/District Access. Truck routes should provide logical access to consumers of freight services, especially retail stores and restaurants. Dedicated commercial and mixed-use districts should be accessible either from the truck route directly, or via a short auxiliary route.

Freight-Oriented Development and Industrial Area Access. FODs are areas of heavy freight activity. These areas usually have warehousing or distribution facilities that bring in the freight movement. Industrial area access are streets that are adjacent to industrial and manufacturing developments. This allows for easier freight movement and access.

Arterial or Highway Connections. Arterial streets interconnect different highway connections. These connections increase freight mobility and movement.

[22] https://ftp.txdot.gov/pub/txdot/move-texas-freight/resources/executive-summary.pdf

Intermodal Facility Access. Intermodal facilities include different transportation areas like airports, rail terminals, truck terminals, bus terminals, and coast ports to pick up and drop off loads. These facilities alternate between different ways of distribution to move goods more efficiently.

Truck Parking Facility Access. Truck parking facilities are areas where trucks are allowed to park safely. These lots are designated for trucks only and allow for truckers to rest.

Policy 2-2: Address Local Truck Parking Availability

Cost: Medium-High | Time Required: Medium | Impact: Medium

Locating safe and convenient truck parking is a major challenge for many drivers, forcing them to sacrifice, on average, 56 minutes each day of what would otherwise be productive drive time.[23] This concern led the United States Congress to pass Jason's Law in late 2012, authorizing federal funds to be spent on truck parking facilities, and raising awareness of the severity of truck parking issues throughout the nation. Both NCTCOG[24] and the Texas Department of Transportation[25] have completed truck parking studies, mutually confirming that significant truck parking shortages exist in both the region and state.

Providing additional truck parking options has multiple benefits to the local freight system. As referenced above, safety is a top concern for most truck drivers; not only do they need places to park that have crime-deterring features, but the ability to find parking easily decreases parking illegally on the road shoulders and along highway ramps, along with reducing driver stress and distraction. Commercial vehicle operators are also subject to federally mandated hours-of-service limitations which force them to take breaks and limit the number of hours in which they may drive consecutively. When taking their mandatory breaks and ceasing to drive after their time limit has been reached, drivers must find a place to park, as electronic logging devices (which all commercial motor vehicles must legally have) count time spent trying to find parking against their overall limit. Truck parking availability also increases the efficiency and productivity of drivers, thereby benefitting the freight system overall.

Municipal staff and policy bodies should consider evaluating the availability of truck parking along major freight corridors and throughout their jurisdiction. In addition to the regional corridors identified in the NCTCOG Truck Parking Study, the evaluation should include:

- Areas with a high concentration of illegal truck parking
- Areas surrounding municipally designated truck routes and regional Critical Urban Freight Corridors
- Corridors within regionally identified FODs
- Areas with elevated rates of parked truck-related traffic accidents or delays

Once the overall local need for truck parking has been determined, cities should identify land that could be set aside or zoned specifically for truck parking facilities and engage with local/regional land developers to propose a truck parking facility be constructed. The most important amenities for truck drivers to have at a truck parking facility, as identified in the Texas Department of Transportation study, are safety features (such as lighting), food/dining, showers, and public bathrooms. Private trucks stops

[23] According to research by the American Transportation Research Institute (ATRI).
[24] https://resources.nctcog.org/trans/goods/freight/documents/TPSMasterDraftUpdated2018_FINAL.pdf
[25] https://ftp.txdot.gov/pub/txdot/move-texas-freight/studies/truck-parking/final-report.pdf

are much more likely to have these types of amenities than public safety rest areas; however, publicly owned safety rest areas can be designed to accommodate these features as well.

Additionally, cities should coordinate with MPO staff to identify funding opportunities and seek planning/project development assistance, as NCTCOG freight planning efforts include truck parking development and assessment.

Recommended Resource: NCTCOG *Truck Parking Study (2018)*[26]

Policy 2-3: At-Grade Rail Crossing Improvement Plan

Cost: High | Time Required: High | Impact: High

At-grade railroad crossings are significant components of the regional freight network. They are typically constructed when a corridor is anticipated to have low roadway or railroad traffic, when demanded due to rail/road alignment constraints, or when cost limitations prohibit the crossing from being grade separated. As traffic levels increase, at-grade crossings can generate costly delays for private and commercial motorists, especially when crossings are blocked by trains performing switching operations or crew changes. Additionally, at-grade crossings represent a safety hazard, as motorists can become stuck on the railroad tracks due to mechanical failure, or while trying to beat the train through the crossing. Furthermore, at-grade crossings represent a liability to railroad operators since safety equipment at crossings (flashing signals, gates, and sensors) occasionally fail, which poses a danger to both locomotives and roadway vehicles.

Grade separation of at-grade crossings should be performed whenever finances and logic permit. Although since a single grade separation can range in cost between $10 million and $40 million, municipalities and MPOs often seek alternative spot treatments to improve safety and traffic flow through crossings. **Table 12** outlines recommended strategies for at-grade crossing improvement:

Table 12: At-Grade Railroad Crossing Improvement Strategies

Solution	Estimated Cost	Impact
Traffic Signal Preemption	High	Improves safety through crossing signal integration with roadway traffic signals.
Four-Quadrant Crossing Gate Installation	High	Improves safety by omnidirectionally prohibiting motorist passage through a crossing while activated.
Median Barrier Installation	High	Improves safety and traffic flow by increasing visibility and channelizing automobile movement.
Flexible Delineator Post / Bollard Installation	Medium	Improves safety by adding an inexpensive barrier between lanes leading up to a crossing.
Close At-Grade Crossing	Medium	Improves safety and locomotive traffic flow by reducing opportunities for automobile/locomotive interaction.

[26] https://www.nctcog.org/getmedia/b5a888c4-1be5-426d-a193-b91e93bdb1b5/TPS-Master-Updated-2018_FINAL2_1.aspx

Solution	Estimated Cost	Impact
Blocked Crossing Warning & Detection System	Medium	Improves automobile traffic flow by warning motorists of a blocked crossing and suggesting detours.
Crossing Reconstruction	High	Improves safety and overall traffic flow by replacing damaged infrastructure and correcting geometry.
Roadway Rerouting/Realignment	Low-Medium	Improves safety and traffic flow at a potentially lower cost than grade separation.

It should be noted that the cost factors outlined above represent a combination of both rail agency and city costs. Although cities may pursue these treatments on crossings within their jurisdiction, rail agency ownership of the right-of-way will result in the need for coordination and planning. Rail agencies may decide not to construct these improvements if it interferes with their operations or if the cost of maintenance or liability is too high. The above strategies are described in greater detail below:

Traffic Signal Preemption. This type of improvement ties in railroad crossing safety equipment with nearby roadway traffic signals. Typically, once a train is detected, the system causes the traffic signals to halt automobile traffic from navigating the crossing for an amount of time prior to the train's arrival. This prevents motorists from attempting to beat the train across the crossing and allows additional time for automobiles to clear the track.

Four-Quadrant Crossing Gate Installation. Four-quadrant gates are a type of crossing gate that features two gates on either side of the crossing and functions to prohibit motorists from driving around single gate arms, as is common with standard two-arm gate systems.

Median Barrier Installation. Median barriers installed at grade crossings assist in keeping automobiles in their respective lanes, as well as provide additional separation between opposing directions of traffic as motorists approach a crossing. Median barriers can also influence automobiles to drive more slowly, similar to road diet strategies.

Flexible Delineator Post/Bollard Installation. These are typically brightly colored and reflective plastic or metal posts installed along the centerline striping of the roadway leading to the crossing deck-plate in either direction. These provide an additional visual cue to motorists and encourages slower speeds as they navigate the crossing.

Close At-Grade Crossing. The closure of an at-grade railroad crossing is warranted when concerns surrounding safety, accessibility, and locomotive traffic flow are raised, or if municipalities determine that roadway routing solutions are more appropriate than crossing modification solutions. Crossing closure is one of the least expensive solutions and can result in mutual benefits for cities and rail agencies.

Blocked Crossing Warning and Detection System. This improvement strategy leverages technology to communicate with motorists and advise them when an at-grade crossing is being blocked by a train. These systems utilize external sensors or tie into the crossing signal system to send alerts via smartphone navigation applications, DMS messaging signs, or on-board telematics systems to help

drivers take alternative routes, thereby improving the flow of traffic and reducing both private and commercial vehicle delay.

Image 3: Railroad Crossing with Supplemental Safety Measures

Source: NCTCOG

Crossing Reconstruction. Crossings with an obsolete design and geometric problems are the best candidates for reconstruction. A common warrant for crossing reconstruction is solving "humped" crossings or where the roadway grade increases sharply on either side of the tracks. These crossings can cause damage to vehicles with low ground clearance and can prevent long freight trailers from successfully navigating the crossing – instead becoming trapped on the tracks, risking collision with a locomotive. Other reasons for reconstruction include poor intersection angles, deckplate condition, and inhibited lines of sight for highway users.

It is important to remember that improving an at-grade crossing may not always be the best solution. For instance, roadway solutions to traffic flow and accessibility issues may be less expensive and more effective in the long term, especially when right-of-way procurement is required to implement desired modifications. Potential roadway solutions include new road construction, roadway realignment, and routing restrictions (e.g., truck routing). Proximity of the at-grade crossings to the nearest grade-separated crossing in a given corridor should be analyzed for alternative routing possibilities.

Cities are encouraged to develop a definite plan and strategy for at-grade crossing improvement that is nested in the transportation development priorities of local and regional transportation plans. Especially

with regard to at-grade crossing issues, community input and outreach is important. Likewise, communication with rail agencies is vital in addressing crossing concerns, since they have ownership of the rail infrastructure and determine the standards to which engineering, design, and construction must be completed. Municipalities should engage rail agencies early and often concerning plans for at-grade crossing improvement and be willing to consider alternative strategies that achieve community goals. Refer to the *Funding Strategies* section of this report for strategies to overcome financial constraints.

Policy 2-4: Locomotive Quiet Zone Designation

Cost: Medium | Time Required: Low-Medium | Impact: Low

"Quiet Zones," or No-Horn Restrictions, are geographic and/or temporal prohibitions on train horns. Trains are required by law to blow their horns when approaching at-grade crossings and highly populated areas for the purpose of alerting nearby pedestrians, cyclists, and motorists that a train is approaching and to stay clear of the tracks. Quiet zones may be used in order to reduce noise disturbances to residences and businesses in close proximity to an at-grade crossing.

Although local governments have the legal authority to enact quiet zones, they must coordinate with the rail agency that owns the track, as well as state transportation authorities who will make determinations about what supplemental safety measures are required to be installed at the crossing in order to facilitate the quiet zone. After any required supplemental safety measure installation is complete, the quiet zone can be enforced. Challenges to implementation include crossing geometry concerns, a history of frequent accidents, and inadequately installed safety systems. Rail agency collaboration is key – if the track owner has construction scheduled or maintenance concerns surrounding the crossing, the city may have to delay the implementation timeline or contribute financially to crossing remediation.

As city staff contemplate the creation of quiet zones, they should be sure to confirm that crossing inventory data maintained by the Federal Railroad Administration aligns with actual crossing conditions and, if possible, perform an internal assessment of traffic and safety conditions. The city must also determine what the boundaries of the quiet zone shall be, and whether or not it will be a *partial quiet zone*, wherein train horn restrictions are set in place only during certain hours of the day or night.

Quiet zones can reduce noise disturbances in communities located near at-grade crossings, which improves quality of life and land values, thereby lessening freight rail disbenefits. Cities seeking to implement quiet zones should initiate multilateral conversations early in the process and be prepared to provide information on traffic patterns and safety conditions to approving agencies, as well as maintain a flexible timeline for regulatory requirements.

Recommended Resource: ***Federal Railroad Administration Train Horn and Quiet Zone Fact Sheet***[27]

Policy 2-5: Commercial Vehicle Bans

Cost: Low | Time Required: Low | Impact: Medium

Commercial vehicle bans (or "truck bans") restrict the movement of trucks on selected thoroughfares, most commonly, residential streets. Many truck routing ordinances restrict the movement of trucks on routes other than designated truck routes except for the purpose of navigating to a delivery or pick up location that is not on a truck route. Commercial vehicle bans, however, restrict all truck traffic from traversing the designated streets, regardless of destination, and impose fines on violators. This strategy may require the passing of a separate truck ban ordinance, as well as the installation of signage. The enactment of such bans should be done on the basis of:

- Local traffic studies with an emphasis on commercial vehicles
- Community input and complaints
- Accessibility to businesses
- Proximity to truck routes
- Alternative routing considerations
- Feedback from local businesses (especially freight operators)

Commercial vehicle bans can also augment safety in areas with high volumes of pedestrian and cyclist traffic such as near schools, parks, and neighborhoods. Roadways not constructed to accommodate freight vehicles (either geometrically or because of pavement material) can sustain damage as a result of heavy trucks using them; truck bans should be considered for these roadways as well. Cities should be specific about what types of vehicles are included in the ban, and list height, weight, or cargo restrictions, as well as any intended exceptions to the policy (e.g., deliveries to schools).

Policy 2-6: Planned Industrial District Designation

Cost: Low-High | Time Required: Low-Medium | Impact: High

The deliberate designation of land for freight uses is one of the most vital aspects of a local freight planning program. Planned Industrial Districts (PIDs) are designated as part of the zoning code and include regulations on site design, transportation infrastructure design, and support services/utilities that cater to the needs of freight business operations and the local community. Examples of major regional PIDs include Alliance Texas in Fort Worth and the International Inland Port of Dallas. Site selection criteria for PIDs are as follows:

- Expeditious access to Interstate Highways or major State/US highways.
- Proximity and access to intermodal transfer hubs
- Low cost of land
- Proximity to major centers of commerce
- Proximity to manufacturing or natural resource harvesting operations

[27] https://railroads.dot.gov/sites/fra.dot.gov/files/2019-11/FRA%20Train%20Horn%20and%20Quiet%20Zone%20Fact%20Sheet.pdf

Although local business environment and available incentives are considered, these factors are not primarily how freight businesses select where to locate. "Freight facilities will only consider locations that fulfill the primary objective of moving goods in the most efficient manner from point of origin to destination. This trumps most other considerations."[28] As such, access to customers and transportation infrastructure that facilitates the timely movement of goods are essential in choosing where to locate a PID. Industry feedback and consulting with regional planning agencies are strongly encouraged during the site selection process.

Once a site has been selected, the city must determine what site design characteristics it wishes to stipulate, if any.[29] This determination should be based on community goals outlined in the municipal comprehensive plan, however site design regulations in PIDs may differ from those imposed on freight developments, which are bound by sensitive or otherwise non-freight land uses. Within PIDs, the potential for land use conflicts is mitigated by virtue of the collocation of like land uses; however, Good Neighbor Strategies should be implemented along PID boundaries. Site design regulations should not be overly restrictive within the PID so as to reduce cost of development and free up private developers to implement the most functional designs.

Transportation connections and accessibility for freight vehicles across modes must be designed and built into the PID early in the process. This includes intersection geometry, pavement/road construction, and railroad access. Other considerations may include alternative fuel infrastructure for corporate fleets such as liquified natural gas, compressed natural gas, hydrogen, and high-capacity electric charging stations. Pipeline or pipeline terminal access may be desired and should be investigated in consort with industry partners.

The *Freight Village* concept – as exemplified in the Alliance Texas development – should also be considered. "A freight village is a defined area, often master-planned, within which all activities relating to the transport, logistics, and distribution of goods are carried out by various operators. Freight villages are effectively clusters of freight and logistics facilities where any number of supply chain activities (such as consolidation, value-added activities, and transloading) occur within the boundaries of the district."[30] Freight villages also tend to feature logistics sector support services such as mechanics, truck parking, international trade services, and housing/lodging for employees in close proximity. The reduction of operating costs by consolidating a wide range of freight and logistics services into a single geographic location increases productivity and augments overall freight system efficiency. Reductions in vehicle miles traveled and emissions due to this consolidation may also contribute to air quality goals.

Policy 2-7: Roadway and Intersection Geometry Review

Cost: Medium | Time Required: Medium | Impact: High

Freight vehicles depend on reliable and functional road network connections in order to complete their daily shipping tasks. When roadways restrict commercial vehicle movement due to geometric or design issues, freight network performance is impaired and risks regarding safety, damage to equipment, and

[28] *National Center for Fatality Review and Prevention Report 13: Freight Facility Location Selection: A Guide for Public Officials,* pg. 29
[29] Public officials and staff are encouraged to refer to the following section of this chapter for site design policies.
[30] *FHWA Freight Land Use Handbook* (2012), pg. 3-16

damage to infrastructure increase. It is, therefore, important to ensure sound design principles that accommodate freight vehicles are included in major thoroughfares throughout the local transportation network, especially along designated truck routes.

In order to ensure the ability to accommodate freight vehicles, municipalities should conduct a review of roadways and intersections to identify designs or infrastructure that are unsuitable for freight vehicles. Examples of roadway designs that can cause issues for trucks include:

- "Jug-handle" ramps
- Tight right turns
- "Humped" at-grade railroad crossings (see *Policy 2-3: At-Grade Rail Crossing Improvement Plan)*
- Ramps or roadways that have steep changes in grade
- Low vertical clearance (low-height power lines, bridges, trees, etc.)
- Load-restricted roads and bridges
- Roundabouts that are small in size and/or lack an "apron" for large vehicles and trailers

Once problem areas have been identified, cities and counties should develop a program of projects to remediate them, establish a timeline, and identify relevant funding sources.[31]

Carrying out geometric roadway improvements has several benefits. Oftentimes heavy freight vehicles will damage roadway infrastructure by running over curbs where there is insufficient room to make turns with trailers, and by colliding with signage, bridges, and poles. Although these are caused by driver error in some situations, infrastructure conditions can also contribute to roadway damage when drivers are not made aware of the need to take an alternate route or if their destination can only be accessed by unsuitable routes. A related concern is safety, as traffic incidents can result from drivers trying to overcorrect during turns or due to collisions with the aforementioned infrastructural components. Designing intersections and thoroughfares with freight vehicles in mind results in improved infrastructure condition, reduced maintenance cost, and increased safety.

Land use context and function should be considered before determining to alter roadway geometry. Thoroughfares that feature large volumes of pedestrian and bicycle activity may not be good candidates for conversion into freight corridors, for example. Instead, municipalities are encouraged to consider alternative routing solutions and the designation of service roads that accommodate freight vehicles and loading/unloading activities.

All freight network infrastructure inherently operates as part of a regional, state, national, and international system, especially as increases in e-commerce drive further economic globalization. Because of this, once a system of projects has been identified, coordination with other local and regional transportation agencies is recommended in order to best prioritize projects and thereby optimize the flow of freight traffic in, though, and out of municipal boundaries.

[31] See *Policy Implementation: Enacting Ordinances and Executing Programs* for potential funding strategies.

Policy 2-8: Local Freight Land Use Conflict Evaluation

Cost: Low-Medium | Time Required: Medium | Impact: Medium

Land use conflicts between freight and sensitive land uses results in various negative externalities while making the task of freight land use preservation in the urban core more difficult. Compatibility amongst local land uses is an important component of quality of life and has wide-ranging impacts. Municipalities are encouraged to refer to the previous sections of this report for a more detailed enumeration of freight land use compatibility impacts. Although this report offers a wide-area assessment of freight land use compatibility in the North Central Texas region, cities may elect to conduct more localized investigations, especially those with higher concentrations of freight activity in their jurisdiction.

At the local level, the primary task in this evaluation is the identification of specific land use conflict sites throughout the jurisdiction or in certain sub-districts.

Types of land uses that should be examined for conflicts include:[32]

- Distribution centers
- Warehouses
- Rail yards
- Manufacturing and/or assembly plants
- Chemical processing facilities
- Pipeline terminals
- Airports
- Natural resource harvesting or processing sites

The following criteria can be used to identify conflict sites:

- Freight-related noise, light, and vibration pollution
- Freight facility juxtaposition with sensitive land uses (residential, institutional, mixed-use) that do not have Good Neighbor Strategies
- Community complaints (both private residents and local businesses)
- Illegal truck parking issues
- Truck routing issues
- Blocked at-grade railroad crossings

The above criteria represent some of the most common freight land use conflict issues; however, other adverse impacts that require more granular analysis to detect may be present. These might include environmental impacts (either ecological or environmental justice), traffic delay, roadway safety, bike/pedestrian safety, and reduced freight system performance. Communities may also take issue with the location and aesthetic of freight land uses – conversations amongst community stakeholders are recommended to arrive at a workable solution.

Land use conflict identification can be accomplished via several methods. Local geographic information system analysis can be conducted that identifies locations where industrial or freight land uses are in

[32] Additional examples and descriptions of freight facility types can be found in ***Section 2: Freight Land Use Typology***

close proximity to sensitive land use types such as residential and light commercial. Once these sites have been identified, they can be analyzed on a case-by-case basis to make determinations about whether or not a conflict is present. Alternatively, a manual, systematic review can be done of known industrial sites in the county or municipality. This method tends to suit smaller or less dense communities and yields a more refined initial list of sites. City staff are encouraged to include known problem areas and sources of community complaints in their site evaluations. NCTCOG welcomes requests for technical assistance in the land use conflict identification process.

Once local land use conflicts have been identified, cities should make plans to address them. Working with private freight businesses and developers, cities can redesign problem sites and/or emplace Good Neighbor Strategies.[33] Identifying and addressing freight land use conflicts directly supports the preservation of freight land uses in the North Central Texas region, especially in more dense urban districts.

Policy 2-9: Freight Land Use Preservation Plan

Cost: Low | Time Required: Medium | Impact: Medium

The preservation of freight land uses within the urban core is an essential component of NCTCOG's approach to regional freight planning. Maintaining distribution, warehousing, and manufacturing centers in close proximity to the commercial and residential land uses that consume freight services contributes to improved regional traffic conditions, improved air quality, and a more efficient freight network. This is accomplished by mitigating the effects of freight sprawl, preserving green fields for other uses, and redeveloping brownfields for more productive uses.

In order to facilitate this, cities may consider developing a Freight Land Use Preservation Plan. These plans identify key industrial and logistics assets within the jurisdiction and codify the city's commitment to maintain these land uses specifically for goods movement infrastructure. Additionally, these plans may set forth under what conditions the city will consider zoning alterations and outline the designation of Planned Industrial Districts.[34] Freight Land Use Preservation Plans should draw heavily from the community's comprehensive plan, seeking to support the economic and community development goals specified therein. They should also be subordinate to the local and regional freight plans, if already published. Cities are encouraged to coordinate with MPO staff where technical assistance is required in plan development.

Prior to developing the plan, planning staff should work with local economic development agencies or business associations to identify specific sites or facilities that are of high importance for the local and regional freight network and make deliberate efforts to retain or optimize their zoning designation. In practice, proposals by public and private entities to alter the zoning of industrial sites should be evaluated with a baseline commitment to maintaining logistics infrastructure, ensuring that freight land uses are converted only when absolutely necessary. As an alternative to converting freight land to other uses, cities should consider soliciting proposals for freight redevelopment in underperforming, vacant, or obsolete industrial properties. Local economic structure and gap studies are useful in identifying

[33] Refer to *Policy Implementation: Enacting Ordinances and Executing Programs* for potential funding strategies to use in mitigating land use conflicts.

[34] See *Policy 2-6: Planned Industrial District Designation* for more information.

highly productive freight facilities and logistics industry employers that can help inform land use preservation priorities.[35]

Policy 2-10: Brownfield Redevelopment

Cost: Medium-High | Time Required: Medium | Impact: Medium

According to the US Environmental Protection Agency, brownfields are defined as "a property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant."[36] Typically, the cost of environmental remediation required to develop these properties acts as a significant barrier to private investors, meaning that brownfield properties often remain undeveloped.

Municipalities should consider offering monetary or tax incentives to private developers willing to invest in the restoration and conversion of these properties; brownfields are often good candidates for logistics facility siting due to the low impact geological and ecological factors have on freight operations in comparison to other business types. Additionally, brownfield redevelopment may offer substantial benefits to the community, including increased employment, residential property values, and tax revenues. Superfund sites also represent opportunities for remediation and redevelopment into productive freight facilities, and there are eight such sites within the North Central Texas region.[37]

Public-private partnerships may be utilized to help cover cleanup costs and give the city additional stake in the development project if the community has specific goals relative to the site or district in which it is located. *Policy 4-1: EPA Brownfield Revitalization Program* identifies a potential source of federal funding for brownfield redevelopment projects.

Policy 2-11: Rail Infrastructure Evaluation

Cost: Low-Medium | Time Required: Low-Medium | Impact: Medium

Rail Infrastructure Evaluations are systemic examinations of all rail network components within the geographic area specified. The purpose of performing a rail system evaluation is to identify local issues and opportunities for rail system improvement, especially with respect to rail yards, intermodal facilities, and at-grade crossings. These evaluations should be done in close collaboration with transit agencies and freight rail operators that own track within municipal boundaries

If not already done, a comprehensive geographic information system database of local railroad assets should be acquired or compiled.[38] Abandoned rail lines or industrial spurs no longer in use should be noted as well, as they have potential uses for conversion to other land uses. Subsequently, municipal staff may begin analyzing the local rail network for land use conflicts (especially near rail yards and crossings) with residential and commercial properties. Rail yards should have robust buffers between

[35] See *Policy 1-2: Performing Local Economic Studies* for more information.
[36] https://www.epa.gov/brownfields/overview-epas-brownfields-program
[37] https://www.epa.gov/superfund
[38] The Federal Railroad Administration has county-level crossing and rail databases that are available for download from their website: https://railroads.dot.gov/maps-and-data/maps-geographic-information-system/maps-geographic-information-system.

them and nearby non-industrial land, and at-grade crossings should be analyzed for potential quiet zone designation.

Municipalities may also investigate level-of-demand for additional freight or passenger rail access within their jurisdiction by engaging with community stakeholders and local business. Meetings with rail agencies and MPO transportation representatives may also help to identify if any rail bottlenecks exist, and what regional plans are being pursued in order to remediate them. Cities should endeavor to be actively involved in project planning and coordinate other infrastructure improvements in tandem with rail network improvements as needed.

Policy 2-12: Off-Peak Delivery Programs

Cost: Low | Time Required: Low-Medium | Impact: Medium-High

Off-peak delivery programs (OPDPs) encourage trucking companies and businesses to conduct deliveries during times of day other than peak travel hours, typically between 6 AM to 9 AM and 4 PM to 7 PM. Such programs can take multiple forms and may target a specific geographic area (sub-municipal district or corridor) or a specific industry. Typically, these programs are enacted to reduce conflict between private passenger automobiles and freight transportation operations by conducting and receiving freight shipments outside of peak travel demand hours associated with daily commutes. Program objectives are to reduce the amount of idling and costly delay that freight vehicles encounter when traveling on congested freeways in urban areas.

OPDPs have the potential to bring about a variety of benefits:

- Decreased in-transit delay reduces cost of shipping services
- More consistent roadway conditions increase reliability of shipments
- Decreased idling time results in fewer emissions from freight vehicles
- More fuel-efficient trips result in cost savings to freight businesses
- Freight vehicles operating in off-peak hours are less likely to encounter pedestrians and bicyclists in dense urban areas, thereby increasing safety
- Segregation of commercial vehicle and private automobile traffic reduces severity of collisions, increasing safety

Enacting OPDPs requires participation from both freight businesses and local freight consumers. Freight consumers, specifically, must be willing to receive shipments during off-peak hours, and shippers performing the deliveries must be both willing and capable of adjusting to non-traditional delivery schedules. This level of coordination represents a sizable challenge for policy implementation.

Cities should identify which businesses are willing and able to participate in an OPDP via public outreach efforts (surveys, local business associations, interviews, etc.). Offering incentives to participate in the program may be an effective way to generate interest, in addition to public awareness presentations that demonstrate benefits and cost savings.

Policy 2-13: Cargo Vehicle Type Restrictions in Dense Urban Areas

Cost: Low | Time Required: Low | Impact: Medium

Goods movement in high-density environments represents geometric and safety challenges for many large freight vehicles. In such areas, restrictions on large freight vehicles (e.g., Class 8 tractor-trailer combinations) may be considered along certain thoroughfares, or in specific districts where automobile traffic and street/intersection geometry create unsafe or unsuitable conditions for those vehicles. Restrictions on vehicle fuel types may also be considered if municipalities are seeking to encourage the use of alternative fuel freight vehicles.

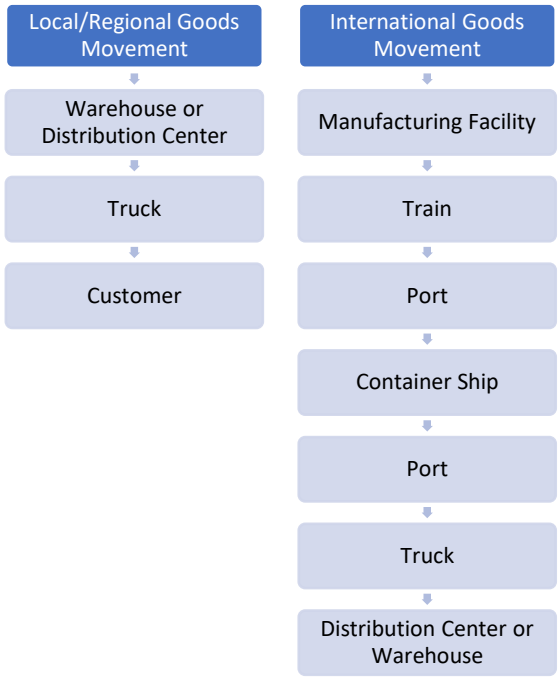
Enacting vehicle bans of this type usually require an ordinance to be enforced by local law enforcement agencies. At a minimum, signage must be installed to identify areas where the vehicle restrictions are in effect. When drafting the ordinance, exceptions to the policy should be identified such as emergency or service vehicles.

Policy 2-14: Encourage Intermodal Transfers

Cost: Low | Time Required: Low-Medium | Impact: High

Intermodal transfers occur when cargo is moved from one type of transportation platform to another along its journey to the destination or customer. Local or regional shipments are more likely to occur via a single mode, whereas transcontinental shipments are frequently transferred to different modes two or three times before they reach their final destination. **Figure 19** shows an example of intermodal transfers.

Figure 19: Intermodal Transfers



The mode by which cargo is conveyed is usually decided by factors such as required delivery timeframe, size and weight of the cargo, fragility, distance, overall cost, and accessibility. At the municipal level, a vital part of contributing to ease of intermodal transfer is facilitating expeditious first/last mile connections to intermodal hubs – or locations where cargo is moved between modes (e.g., airports and intermodal yards). For major freight-generating businesses or industrial operations, direct connections to rail or pipeline infrastructure is most efficient.

Trucking is the primary mode through which goods are shipped largely due to the level of access provided by the roadway network to both production and manufacturing sites, as well as to commercial businesses and other customers. However, freight and logistics sector businesses benefit from direct connections to airports and intermodal rail yards, as it provides options to shippers as to the mode by which their products are shipped. Whenever possible, cities should ensure good connections from freight-oriented developments to intermodal facilities, which can be accomplished through sound truck routing and roadway infrastructure improvements.

The Association of American Railroads notes that "US freight railroads, on average, move one ton of freight more than 470 miles per gallon of fuel,"[39] and is usually preferred for long-haul freight shipments. However, fuel efficiency in trucks has increased significantly over the past two decades, and some destinations do not have direct or nearby access to railheads. Other considerations include the need to take more vehicles off congested urban roadways, which is accomplished by increasing rail network connectivity and encouraging mode shift. Although normally a regional concern, cities can help bolster these efforts by encouraging rail access to industrial areas and promoting freight-oriented development in and around rail yards and intermodal facilities.

Although the North Central Texas region features a large and well-established rail network, there remain many large freight-generating businesses that do not have direct access to rail spurs. Industrial campuses and business parks should be analyzed for opportunities to add such capacity within the municipal jurisdiction. Cities should also gather feedback from local businesses to see which ones would most benefit from direct rail service. All feedback and potential sites should then be taken to industrial landowners, developers, and track-owning railroad operators in the corridors specified for feasibility analysis and industry feedback.

Policy 2-15: Utilize Freight Delivery Hubs

Cost: Low-Medium | Time Required: Low | Impact: Medium

Freight delivery hubs are facilities that allow consolidated delivery of parcels and freight for multiple customers to a single location. This strategy is especially effective in high-density urban areas where delivery directly to the customer is complicated by tight spaces and lack of access for freight vehicles.

Freight delivery hubs can be scaled to match the needs of businesses and customers. For example, "freight lockers" are temporary and secure storage areas for parcels located at a business or residential location; once delivered to the freight locker, the customer receives a notification and is sent a one-time access code that is entered at the locker, allowing them to retrieve their package.

[39] https://www.aar.org/wp-content/uploads/2020/06/AAR-Sustainability-Fact-Sheet.pdf

For businesses requiring larger deliveries, a freight hub may take the form of a small warehouse with easy access for trucks. Once the customer's delivery is made at the freight hub, a notification is sent to the customer, who can then dispatch a smaller vehicle (either cargo van or pickup truck) to the freight hub to retrieve the shipment. This enhances efficiency and performance for customers in dense urban areas where large freight vehicles cannot move or conduct deliveries as safely or quickly.

Policy 2-16: Freight Vehicle Emissions Reduction Program

Cost: Medium | Time Required: Medium | Impact: Low

The North Central Texas region (as of the writing of this report) is in a state of nonattainment for air quality standards set forth by the Environmental Protection Agency. Freight vehicles such as trucks, locomotives, and cargo aircraft contribute to overall greenhouse gas emissions. In pursuit of regional air quality goals, greenhouse gas, nitrogen oxides, and particulate matter emissions created by freight operations should be reduced by replacing outdated equipment, increasing operational efficiency, and improving infrastructure wherever possible. Municipalities can assist local businesses in reducing their air pollution emissions by establishing a program that promotes awareness and assists with implementation of emissions reduction strategies for freight operators.

A common method of reducing emissions is the replacement or repowering of freight fleet vehicles. A wide range of associated expenses are eligible to be funded by state and federal programs, including the repowering of fleet vehicles (conversion to alternative fuels) and replacement of older, less fuel-efficient vehicles with more fuel efficient conventionally fueled vehicles, as well as the purchase of new alternative fuel vehicles. Alternative fuels frequently considered for freight uses include battery electric (for local delivery vehicles or yard equipment), liquid natural gas, compressed natural gas, and hydrogen.

Another method of reducing emissions is by making operational modifications to shipping, manufacturing, and delivery processes. Examples of this include off-peak delivery programs,[40] freight delivery hubs,[41] truck routing reviews,[42] expanding mass transit access to industrial employment centers, and others. Municipal and regional coordination with freight businesses is necessary to implement operational modifications. Public sector entities must be willing to assist in providing the needed resources and coordinate such efforts across multiple private and public organizations to achieve implementation.

The use of local, state, and federal funding opportunities for freight vehicle emissions reductions strategies can help overcome fiduciary obstacles in the implementation of this policy.

[40] See *Policy 2-12: Off-Peak Delivery Programs*
[41] See *Policy 2-15: Utilize Freight Delivery Hubs*
[42] See *Policy 2-1: Truck Routing Ordinance Establishment & Review*

Policy 2-17: Promoting Freight Technology and Innovation Programs

Cost: Medium | Time Required: High| Impact: High

A recent wave of innovative technology applications in the freight transportation industry have resulted in the need for local governments to consider how to integrate these technologies into the existing transportation system, and how private sector users are applying them to business operations. Examples of these technologies include:

- Driverless and automated trucks
- Unmanned aerial systems and drones
- Automated freight delivery robots
- Automated freight shuttle systems

Many of these emerging technologies require high-quality roadway infrastructure to operate safely and effectively, and coordination with public sector law enforcement and transportation agencies is crucial as new transportation technologies are tested and deployed. Cities are encouraged to communicate with local freight businesses that are involved with freight technology developers and prioritize transportation system improvements where automated vehicles are being used or tested.

Furthermore, technologies that enhance the performance of existing infrastructure should be fostered (e.g., traffic signal optimization technologies, roadway sensor equipment upgrades, etc.). Cities may also pursue operational modifications to infrastructure within FODs in order to augment efficiency and safety such as programming signals along freight corridors to prioritize the flow of commercial vehicle traffic over that of private motorists.

Lastly, municipalities may also pursue investment in infrastructure for alternative fuel and automated vehicles such as automated vehicle truck ports, hydrogen fuel stations, and electric charging stations. Developing infrastructure for these technologies can foster investment by outside businesses and promote innovation, economic development, and freight transportation system efficiency.

Policy 2-18: Establish Truck Lane Restrictions

Cost: Low | Time Required: Low | Impact: Medium

Truck lane restrictions (TLRs) prohibit trucks from driving in specified lanes on freeways, usually the leftmost lane and occasionally the middle lane. The purpose is to separate private automobile traffic from commercial vehicle traffic, which has been shown to improve safety by reducing the severity and frequency of accidents involving commercial vehicles and improve the flow of traffic overall. [43] These restrictions are implemented jointly by local and state governments.

A highway corridor (or portion of a corridor) is recommended for TLRs if it meets the following criteria:

- Annual average daily truck traffic is higher than 4 percent
- At least 10 percent of truck traffic is using the lane for which a TLR is being contemplated
- Is absent of left exits

[43] According to research completed by the Texas Transportation Institute, https://static.tti.tamu.edu/tti.tamu.edu/documents/0-4761-S.pdf

- Has at least three travel lanes (excluding frontage roads)

Researchers recommend that TLRs be implemented in highway sections of not less than six continuous miles and should begin and end at roughly one mile beyond any entry or exit ramps to allow sufficient opportunity for motorists to move into the correct lane. Local governments should conduct a review of highway conditions and verify commercial vehicle activity data prior to implementing TLRs, and monitor their performance once emplaced. Overall, TLRs offer a relatively low-cost method to improve mobility and safety for highway users.

Image 4: Truck Lane Restrictions

Source: NCTCOG

Policy 2-19: Regulate Site Design and Industrial Property Attributes
Cost: Medium | Time Required: Medium | Impact: Medium

In the Site Design phase, communities contemplate the characteristics of specific sites, facilities, and plots of land, rather than focusing on broad geographical subdivisions of the city. The local government should regulate the design of freight facilities in accordance with the community's economic strategy and the vision identified in the community's master plan. Many of the Good Neighbor Strategies outlined in earlier sections of this report can be implemented during the site design phase such as mandating the emplacement of buffer zones and limiting access to freight facilities via primarily residential roadways. *Policy 3-3* of this toolkit outlines specific design requirements planning staff may consider implementing.

The community may also elect to stipulate more specific and quantitative regulations, such as floor-area ratio and building coverage percentage restrictions, depending on density goals and geospatial context. Many of the same types of regulations found in a form-based zoning code can be utilized, especially if the industrial district in question is historically or socially significant. Alternatively, if the site is located in an extant FOD, then site design requirements may be more lenient, since SLUs will not be nearby. Planners must be careful in crafting site design stipulations not to be overly restrictive, as certain design features may make developing an industrial facility too costly or impede business operations to an extent that private developers are unwilling or unable to accommodate. Open communication with both planning staff and policy bodies is crucial during this step, as site design stipulations may need to undergo multiple rounds of administrative review and alteration.

Key Tasks:

- Determine design aspects that need to be regulated (if any)
- Develop design standards
- Synchronize planning and land use permitting office disposition toward conditional use permit applications
- Solicit industrial developer feedback on proposed regulations

Recommended Resource: The National Cooperative Highway Research Program Research Report 844: *Guide for Integrating Goods and Services Movement by Commercial Vehicles in Smart Growth Environments (2017)*

Site Design

This section of the toolkit provides recommendations that pertain to the physical form of freight facilities, especially with regard to those identified in Land Use Type 1 (Warehousing and Distribution). It also covers policies that should be considered in the third step in planning for freight land uses, which is to determine what the community wishes to require of new and existing freight land uses regarding their physical form. These requirements will depend on the goals stated in the local comprehensive plan and transportation plan, and community and private sector feedback.

Multilateral partnerships and open communication with private sector partners should be employed in this step to identify barriers to implementation such as cost and structural feasibility. In areas where land use conflicts or areas of concern (see **Section 3.0** of this report), the policies outlined in this section of the toolkit can be utilized as treatments to mitigate or prevent conflicts. Properties within highly industrialized districts should be considered differently from other properties since the sensitivity of adjacent land uses is likely to be lower. Additionally, planners should pay attention to areas where land uses are transitioning or where they are likely to transition to other uses and ensure that Good Neighbor Strategies are implemented prior to new developments.

Policy 3-1: Utilize Off-Street Loading Facilities

Cost: Medium | Time Required: Low-Medium | Impact: Medium

Off-street loading facilities are stations or docks at a facility where freight vehicles can easily park and load or unload cargo, thereby eliminating the need for trucks to park on streets to make deliveries. This policy is applicable for commercial and industrial facilities in dense urban environments where loading docks and staging areas for commercial vehicles do not exist, and where freight deliveries must occur within streetside loading zones.

Streetside loading zones, especially during peak hours, can present safety risks to freight vehicle operators, take up valuable streetside parking space, and have the potential to impede the flow of both motor vehicle and pedestrian traffic. Furthermore, streetside loading zones require more time for unloading, and thus are less efficient for businesses. Cities with dense urbanized areas within their jurisdiction should consider the designation or construction of off-street loading facilities for new buildings and for those undergoing significant renovation. Off-street loading facilities can take the form of internal loading bays, loading zones within attached parking garages, designated alleyways, or other versatile spaces that can be reserved for freight activity during certain times of day. These offer several benefits:

- Increased safety for motorists and truck drivers
- More efficient deliveries
- Fewer blocked lanes in adjacent thoroughfares
- More efficient and safe routes for pedestrians and cyclists

Designating additional space for freight activity on the property may not always be possible due to building configuration or the price of land. In these scenarios, cities should designate curbside loading zones that safely accommodate freight vehicles and loading/unloading activities in dense urban environments.

Policy 3-2: Designate Curbside Loading Zones

Cost: Low | Time Required: Low | Impact: Low

Curbside Loading Zones are designated spaces along the road shoulder or street parking spaces where commercial vehicles are permitted to park and load or unload cargo (often for a specified amount of time). When the use of off-street loading facilities is not available, curbside loading zones should be designated, especially in dense urban areas. The municipality should work with local businesses to identify sites where curbside deliveries are required.

Oftentimes, shortages of on-street parking space cause freight drivers to park illegally. This makes it difficult for trucks to complete deliveries safely, quickly, and not impede the flow of traffic on high-volume urban roadways. In areas where parking and loading spaces are difficult for delivery vehicles to find and use, freight operators may have decreased on-time performance, while businesses suffer from increased shipping costs. Bicycle, pedestrian, and motor vehicle safety can likewise be adversely affected without space for commercial vehicles to conduct staging and loading along busy urban thoroughfares.

Policy 3-3: Establish Site Design Requirements (Good Neighbor Strategies)

Cost: Medium | Time Required: Medium | Impact: High

The cornerstone of freight land use compatibility is effective site design. This policy highlights multiple aspects of freight facility design that should be considered when developing or redeveloping freight land uses, addressing land use conflicts, or attempting to improve existing facilities.

- **Sound Wall Emplacements**

A sound wall is a barrier that reduces the level of noise adjacent land uses are exposed to. Sound walls are especially effective when combined with vegetation such as trees and shrubs and can be a valuable addition to a buffer zone or setback, depending on the severity of existing land use conflicts or the proximity of a freight facility to a sensitive land use. A sound wall is of good quality if it reduces measurable noise emissions a minimum of 5 decibels and is at least 6 feet high. A sound wall is often not needed if supplemental vegetation, high-quality fencing, or sufficient offsets are in place.

- **Earthen Berm Emplacements**

Earthen berms are mounds of earth, rock, gravel, sand, or similar material that is piled up around the periphery of a property as a barrier or as part of a buffer zone. In addition to impeding access to the property, they can help block unappealing sight lines and mitigate noise and light emissions. These can be required by zoning codes or mandated by agreements between local governments and freight businesses. Berms can be combined with supplemental vegetation or fencing to break up unappealing sight lines.

- **Staging Area Requirements**

Freight facilities should provide sufficient space for delivery vehicles to park while waiting for their opportunity to load or unload cargo. This prevents truck parking and safety issues while ensuring the flow of traffic on nearby streets is not impeded. Municipalities should communicate with freight businesses that lack sufficient staging areas regarding operational adjustments that can be made. This strategy may also be relevant for commercial facilities that frequently receive large freight deliveries.

- **Establish Sustainability Requirements**

Depending on community, local government, and private sector goals for sustainability, municipalities may consider encouraging or requiring freight businesses and developers to implement design features that reduce carbon emissions and preserve ecological assets. Examples of these include:

- Requiring the use of electrically powered material handling equipment
- Offering incentives for the installation of solar panels in parking areas or on the roofs of warehouses/distribution centers
- Systems that harvest and recycle rainwater within the facility
- Installing high-efficiency lighting and equipment throughout the facility
- Consider implementing Leader in Energy and Environmental Design standards and certification

Local governments should be mindful of the costs associated with sustainable technologies and work with private sector partners to incentivize their implementation using financial or regulatory tools. For

example, a city may offer to pay for a portion of new battery electric material handling exchange at a new warehouse or relax building height restrictions in exchange for the developer achieving at least an Energy and Environmental Design Bronze certification. Sustainability and environmentally sensitive sight design can support both public and private sector emissions reduction targets while enhancing the overall quality of the development.

- **Equipment and Container Storage Regulation**

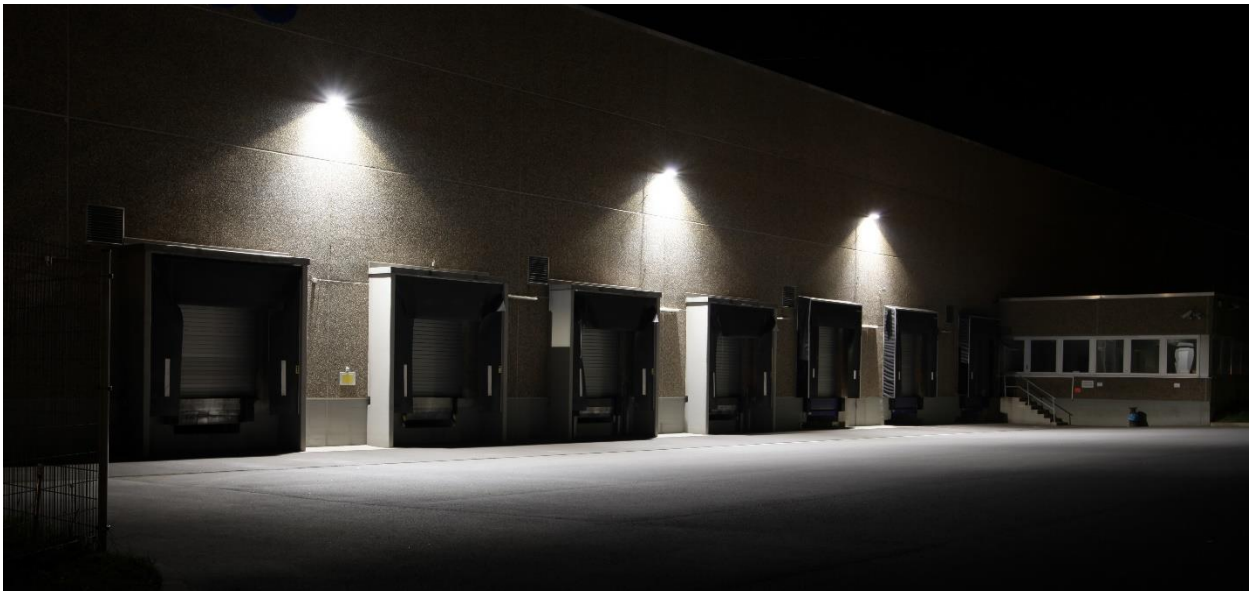
Municipalities are recommended to consider the implementation of requirements for the storage of equipment and materials (separate from staging area requirements mentioned earlier in this policy). Storing material handling exchange, shipping containers, palletized goods, and other items that are required for freight operations.

Furthermore, zoning ordinances can be used to establish minimum setback requirements for facilities near sensitive land uses. These mandate the emplacement of a minimum distance between nearby buildings. Although not always necessary in freight-intensive districts, minimum setbacks for new freight development should be considered for industrial properties located near commercial, residential, or institutional land uses. While buffer zones can easily be constructed as an improvement to an existing property, setbacks must be implemented before new freight facilities are developed.

- **Facility Exterior Lighting Requirements**

Municipalities should consider the implementation of design requirements for light fixtures that limit light pollution. These requirements should, at a minimum, ensure that light fixtures are directed downward (minimizing light pollution in the night sky) and away from nearby sensitive land uses, especially private residences. Depending on sustainability goals, it may also be desirable to require the use of high-efficiency bulbs to reduce energy consumption and environmental impact, and if interior lighting is included in the regulation, mandate the installation of motion sensors and other sustainability focused technologies.

Image 5: Downward-Oriented Warehouse Lighting Fixtures



Source: Getty Images

Policy Implementation: Enacting Ordinances and Executing Programs

This step is the culmination of the previous three steps and involves the codification of selected ordinances and zoning code emendations. Proposed ordinances should be considered by policy bodies (e.g. planning/zoning commission, city council, others as necessary) and officials should execute agreements and partnerships with freight operators in their jurisdiction.

Policy 4-1: US Environmental Protection Agency Brownfield Revitalization Program

Cost: Low | Time Required: Low-Medium | Impact: Medium

The Brownfield Revitalization Program is administered by the Environmental Protection Agency and offers grants and loans for site cleanup and environmental remediation, including assessment and job training activities. Since site cleanup cost is often a major barrier to private sector investment in these properties, municipalities should consider applying for funding through this program when planning brownfield redevelopment projects.

Key highlights:

- Grants for site cleanup may be applied for in amounts up to $500,000 for one or multiple brownfield sites
  - Applicants may only submit one Cleanup Grant proposal during each competition cycle
  - Requires a 20 percent local cost share (can be waived if the municipality has a population of less than 50,000)
- Brownfields Assessment Grant funds may be used for planning activities, cleanup plan development, and community involvement
  - Different grants and amounts for community-wide and site-specific assessments, as well as for Assessment Coalitions (see below table)
- Multipurpose Grants may provide up to $800,000 in funding for a range of cleanup and assessment activities in a target area
  - At the time of application, the applicant must own a site that meets the legal definition of a brownfield site within the target area wherein cleanup activities may be conducted
  - Requires a $40,000 cost share, which may be in the form of money, labor, material, or services, and must be for eligible and allowable costs

Municipalities interested in brownfield remediation activities other than assessment, cleanup, and redevelopment, may also consider applying for Environmental Workforce Development and Job Training Grants[44] and State and Tribal Response Program Grants.[45]

This toolkit provides a universal way to promote better land-use decisions across the region. There is no one-size-fits-all solution because every city is unique. However, it is important to use this toolkit as a guide to help promote sustainability and quality of life for communities in the region. Freight transportation is the community's link to the global economy and is, therefore, vitally important to preserve and use land in a sustainable way.

[44] https://www.epa.gov/brownfields/environmental-workforce-development-and-job-training-ewdjt-grants
[45] https://www.epa.gov/brownfields/state-and-tribal-response-program-grants

Brownfields Assessment Grant Types		
Grant Sub-Type	**Maximum Award**	**Remarks**
Community Wide Assessment Grant	$300,000	Used when a specific site is not identified and the applicant intends to spend grant funds on more than one site.
Site-Specific Assessment Grants	$200,000	Used when a specific site is identified and the money will be spent on this site only.
Assessment Coalition Grants	$600,000	Used when one lead agency manages the Environmental Protection Agency cooperative agreement for multiple other eligible entities, and assessment will be conducted in each coalition member's community.

Policy 4-2: Zoning Strategies

Cost: Low | Time Required: Medium | Impact: High

Zoning plays a critical role in freight land use preservation and is instrumental in the implementation of the Good Neighbor Strategies outlined elsewhere in this section. Statutorily designating freight land uses along key industrial corridors or activity centers helps prevent encroachment and can be a way for municipalities to foster freight land use development where it otherwise does not exist. Zoning is also a primary tool in brownfield redevelopment strategies, as well as other redevelopment activities of underperforming land uses. This policy enumerates a variety of zoning strategies and how they pertain to freight land use.

- **Conventional Zoning**

Conventional zoning techniques can be used to separate industrial land from other land use types by defining industrial and freight-related land use designations and implementing them into the zoning ordinance. The following should be considered when zoning for freight land:

- Freight districts should have sufficient access to truck routes, highways, railroads, airports, or intermodal facilities based on the type of facility being constructed.
- Transportation infrastructure should be constructed to accommodate the anticipated levels of truck traffic or other freight traffic that new development would generate (roadway geometry, overhead clearance, weight capacity, etc.).
- Municipalities may choose to adopt additional design requirements in addition to basic zoning specifications to ensure that freight facilities maintain the visual character of their surroundings.
- While large facilities with intensive freight activity may be located at a distance from sensitive land uses, smaller facilities may be preferable to designate in mixed-use areas.

Local planners should develop design guidelines and zoning requirements that balance the objectives outlined in the comprehensive plan and the needs of local businesses.

- **Form-Based Code**

Form-based code (FBC) is a common zoning strategy that focuses on the physical form of the built environment rather than the uses that comprise the structures. Many cities use FBC to maintain a

certain look and feel of a neighborhood, downtown district, or historical district. In new developments, it is used to create vibrant public spaces with a mix of uses, often mandating a similar design language to be used throughout.

Because the focus of FBC is on the quality of the public realm and not the uses of structures and land, certain types of freight land use development can be a valuable addition to a form-based zoning district. Most types of Land Use Type 1 (Warehousing and Distribution) and some types of Land Use Type 5 (Manufacturing and Processing) are especially eligible for inclusion in FBC districts, provided Good Neighbor Strategies are implemented and there is sufficient access to rail lines or highways.

There are multiple key areas of emphasis stakeholders should address when considering freight in an FBC environment:

- Medium- and heavy-duty trucks often have poor sightlines in the immediate vicinity of their vehicles. In the interest of safety, truck traffic should be routed away from areas with significant pedestrian or bicycling activity. The entryways and exits should be facing away from significant bike/pedestrian thoroughfares.
- Some types of freight facilities produce or process large amounts of chemicals or other hazardous materials. These facilities may not be optimal for inclusion in FBC districts. If included, care should be taken to minimize pollution and safety concerns.
- Planners and land use decision makers should work with freight land developers on the design of their facilities and develop standards for the accommodation of operational and functional features as necessary (lighting, loading bay placement, staging areas, etc.).

Readers are directed to **Sections 3.1** and **3.2** of this document for more information on the attributes and issues pertaining to unique types of freight facilities.

- **Performance Zoning**

Performance zoning, rather than based on the physical attributes or purpose of developments, focuses on the intensity of activity within a property and the effects they have on surrounding land uses. These regulations allow land use decision makers a large amount of flexibility in where industrial properties are located, as long as the impacts of the freight development on other properties is small. In order to be effective and feasible, municipalities desiring to implement performance zoning must:

- Identify clear and relevant performance metrics for land uses within the designated district
- Designate a method by which the performance of properties will be monitored and the regulatory mechanism by which it will be enforced

Performance zoning may be an effective tool, especially in high-demand areas of development near industrial sites. Local governments may implement performance standards that, while regulating certain design aspects, allow compatible development adjacent to industrial properties, as long as the external impacts of the industrial properties are kept within a certain threshold. Examples of metrics relevant for industrial properties include:

- Noise emissions from industrial activities during nighttime hours
- Intensity of light emissions during nighttime hours
- Truck-related traffic congestion on surrounding roadways

- Safety incidents involving trucks or freight equipment involving surrounding properties
- Ground, water, or air pollution measurements

It should be noted that feedback from residents and business owners, as well as site visits to affected areas, should always be considered when measuring impacts on other land uses.

Report Summary

This report included a literature review of technical documentation regarding freight land use planning, a summary of data collection activities, a typology of freight land uses in the North Central Texas region, analysis of collected data, a synthesis of literature review recommendations, and a policy toolkit for local governments to use in the freight land use planning process.

Compatibility concerns by land use type were considered and barriers to the preservation of freight land use were discussed. An analysis of regional freight facilities was conducted that assessed dispersion over time throughout the region, age, and type. An assessment of freight infrastructure impacts on populations protected by environmental justice laws and policies was presented, alongside an analysis of freight facility proximity to sensitive social and cultural resources.

The Freight Land Use Policy toolkit included in this report provides actionable strategies and polices that can be implemented or adopted by city and county governments (as well as special districts and transportation organizations) to prevent land use conflicts involving freight infrastructure and improve the overall performance of the regional freight network. A number of resources were provided to assist local planners in developing their own strategies and tailoring their approach to freight land uses in accordance with community objectives and goals.

The Freight Planning Program at the North Central Texas Council of Governments authored this report as a follow-up study identified in *Freight North Texas (2013)*. Its goal is to provide data and analysis of the condition of freight land uses in the North Central Texas region with the aim of equipping member governments to remediate and prevent freight land use conflicts within their jurisdictions. NCTCOG will, as a result of this report, continue to pursue freight transportation planning solutions in the interest of achieving the regional objectives outlined in Mobility 2045 and partner with member governments to deliver innovative solutions to improve quality of life in the North Central Texas region.

Appendix A: Land Use Conflict Analysis Scoring

This appendix contains additional information about the scoring of the different locations identified in the Land Use Conflict Analysis as outlined in **Section 3.3**. In this appendix, the scoring criteria is outlined with possible points and how those points are used. In addition, this appendix has the scoring sheet for each identified site. Finally, a summary of the sites and their scores are included.

Scoring Criteria

This is the scoring criteria used to evaluate freight-related land use conflicts in the North Central Texas region. This is a description of a scoring matrix with the weight assigned to each individual criterion, and an explanation of the rationale behind it. The table below shows the different criteria used in scoring the identified sites

Freight Land Use Conflict Scoring Criteria	
Good Neighbor Strategies	Railroad Infrastructure
Sidewalks & Bicycle/Pedestrian Paths	Median Barriers
Raised Berms	Quad Gates
Supplemental Vegetation	Quiet Zone
Sound Walls	Offset from Sensitive Land Use
High-Quality Fencing	Rail-Related Connectivity Issues
Buffer Zones	Buffers Between Sensitive Land Use & Railroads
Site Design	Roadway Infrastructure
Loading Docks	Loading & Unloading Zones
Lighting	Truck-Related Roadway Damage
Vegetation & Fencing	Access Via Non-Residential Road
Staging Areas	Adequate Truck Parking
Freight-Oriented Development	
FOD Encroachment	
Pipeline Setbacks	
Environmental Justice Concerns	

Good Neighbor Strategies

Sidewalks/Bike/Pedestrian Paths

This criterion evaluates the presence or absence of sidewalks, bicycle lanes, trails (either bicycle or pedestrian), and other active transportation infrastructure (micro-mobility access, “slow lanes,” etc.). Sidewalks are considered to be of good quality if they are able to accommodate both pedestrians and bicyclists and have a buffer between it and the road. Scores are as follows:

Sidewalk/Bike/Pedestrian Paths Scoring	
0	No sidewalks or active transportation infrastructure is present, and bike/ped conditions are unsafe.
1	No sidewalks are present; access via bicycle, walking, or active transportation is limited.
2	Sidewalks are present on at least one side of the street, but are not connected, or are in a state of disrepair; alternatively, sidewalks are not present, but a pedestrian or bicycle path exists.
3	Sidewalks are present on both sides of the street and provide access to bicyclists and pedestrians.
4	Sidewalks are present on both sides of the street, are of good quality, and in good condition.

Raised Berms

This criterion evaluates the presence or absence of raised earthen barriers between freight facilities and sensitive land uses. Berms are effective and of good quality if they act as barriers that block unappealing sightlines, light, and sound emissions. Scores are as follows:

Raised Berms Scoring	
0	No berms are present, and sensitive land uses are in close proximity.
1	Berms are not present, and sensitive land uses are at a distance; alternatively, berms are present but ineffective.
2	Berms are present and of good quality.

Supplemental Vegetation

This criterion evaluates the presence or absence of shrubs, trees, and other landscaping features. Supplemental vegetation is of good quality if it mitigates the emission of light and noise pollution while adding aesthetic value to the property and contributing to tree canopy cover. Scores are as follows:

Supplemental Vegetation Scoring	
0	No supplemental vegetation is present.
.5	Vegetation is present, but of poor quality.
1	Vegetation is present and of good quality.

Sound Walls

This criterion evaluates the presence or absence of sound-absorbing barriers, fences, or walls. A sound wall is of good quality if it reduces noise emissions a minimum of 5 decibels and is at least 6 feet high. A sound wall may not be needed if supplemental vegetation, high-quality fencing, or sufficient offsets are in place. Scores are as follows:

Sound Walls Scoring	
0	No sound walls present, and sensitive land uses are in close proximity .
.5	Sound walls are present, but of poor quality. Alternatively, sound walls are not present, but sensitive land uses are not in close proximity.
1	Sound walls are present.

High-Quality Fencing

This criterion evaluates the presence or absence of fencing along property lines. A fence is considered to be of good quality if it aids in blocking light and noise emissions, obscures unpleasant sightlines, and enhances safety by limiting access to the freight facility. Scores are as follows:

High-Quality Fencing	
0	No fencing is present.
.5	Fencing is present, but of poor quality, or fencing is not present and is unneeded.
1	Fencing is present and of high quality.

Buffer Zones

This criterion evaluates the presence or absence of buffer zones, or portions of terrain that spatially separate or insulate land uses via green space, forestation, landscaping, or changes in elevation. Buffer zones are of good quality if the sensitive land use is at least 200 feet away from the freight property line and includes landscaping features that reduce light and noise pollution (if measurable, reduces noise emissions by 9 or more decibels, and reduces light emissions by 50 percent or more). Scores are as follows:

Buffer Zones Scoring	
0	No buffer zone is present.
1	A small buffer zone of at least 25 feet is present, and has few, if any, landscaping features.
2	A moderate buffer zone of at least 100 feet is present and has some landscaping features or vegetation.
3	A moderate buffer zone of at least 150 feet is in place, which features trees and other vegetation, high quality fencing, and/or changes in elevation.
4	A large buffer zone of 200 feet or more is in place, and features trees and other vegetation, as well as changes in elevation or berms.

Railroad Infrastructure

Median Barriers

This criterion evaluates the presence or absence of median barriers on or around at-grade railroad crossings. Median barriers are of good quality if they clearly delineate lanes of traffic approaching an at-grade crossing and highlight the presence of a crossing (posts or barrier is in good physical condition and is painted or marked). Scores are as follows:

Median Barriers Scoring	
0	Intersection sees high volumes of traffic on either the rail line or highway, and no median barrier is present, or barrier is damaged or in poor condition.
1	Intersection sees moderate to low traffic on both rail line and highway, and no barrier is present.
2	Barrier is present and in good condition.

Quad Gates

This criterion evaluates the presence or absence of quad crossing gates (a four-gate system). These gate systems prevent motorists from driving around the gate arms while they are down and are effectively used in consort with other supplemental safety measures. Scores are as follows:

Quad Gate Scoring	
0	Intersection sees high volumes of traffic on either the rail line or highway or has a history of multiple incidents occurring at the crossing, and quad gates are absent.
1	Intersection sees moderate to low traffic on both rail line and highway or has few (if any) crossing incident history, and quad gates are not present.
2	Quad gates are present.

Quiet Zones

This criterion evaluates the presence or absence of a quiet zone. Quiet zones ban trains from blowing their whistles while in the zone; however, they require the emplacement of supplemental safety measures in order to ensure motorists are aware of approaching train traffic. Scores are as follows:

Quite Zone Scoring	
0	Crossing is in an active quiet zone with high numbers of crossing incidents occurring, and/or lacks supplemental safety measures. Alternatively, crossing is not a quiet zone but is nearby a sensitive land use.
1	Site is not in a quiet zone and there is no nearby sensitive land use.
2	Site is in a quiet zone, is nearby sensitive land use, and has supplemental safety measures installed.

Offset from Sensitive Land Use

This criterion evaluates whether or not the distance from the railroad (or rail infrastructure property) to the nearest sensitive land use is sufficient. A distance of 200 feet is generally considered adequate; however, based on site conditions, that distance may vary. Vibrations can be detected from some longer freight trains in excess of 250 feet from the track, while shorter and lighter passenger trains produce detectable vibrations out to a much shorter distance. This criterion does not consider the presence nor the features of buffers. Scores are as follows:

Offset from Sensitive Land Use	
0	The rail line is in an industrial area, and the distance to the sensitive land use is less than 200 feet.
1	Rail line is not in an industrial area, with an offset of less than 200 feet, or no sensitive land use is present.
2	There is an offset of 200 feet or more from the rail line to the sensitive land use.

Rail-Related Connectivity Issues

This criterion evaluates the presence or absence of connectivity, traffic flow, and accessibility issues on the roadway network caused by railroad infrastructure. These can take the form of reducing pedestrian or automotive access to nearby homes and businesses, rail-related delays in motor vehicle traffic, and blocked crossings resulting from crew changes or switching activities. High-quality rail infrastructure design blends well with other transportation modes in the area and does not restrict or inhibit pedestrians, cyclists, and motorists. Scores are as follows:

Rail-Related Connectivity Issues Scoring	
0	Severe connectivity issues are present across one or multiple modes.
1	Low to moderate connectivity impacts are present across multiple or a single mode.
2	Slight rail-related connectivity impacts, or rail infrastructure does not interact with other modes.
3	No connectivity impacts present.
4	Rail infrastructure is conducive to other transportation modes and is well integrated across all modes.

Buffers Between Sensitive Land Use and Railroads

This criterion evaluates the presence and quality of buffers between rail infrastructure and nearby sensitive land uses. Well-designed buffers utilize sound walls, vegetation, high-quality fencing, and changes in elevation to alleviate noise, light, and vibration pollution that may be emitted from railroads. Scores are as follows:

Buffers Between Sensitive Land Use and Railroads Scoring	
0	Site located in an industrial area, and no buffers exist between rail infrastructure and nearby sensitive land uses.
1	Non-industrial area with no or poor buffers near sensitive land uses.
2	Buffers are present but ineffective, or sensitive land uses are not in close proximity.
3	Buffers are present.
4	Buffers are both present and of good quality.

Site Design

Loading Docks

This criterion evaluates the orientation of loading docks, if present. Loading docks facing away from sensitive land uses is considered best practice, since they generate a large portion of freight facility noise and light. Outward-facing loading bays also disrupt what might otherwise be a visually appealing façade and lessen both privacy and security of the business operation. Scores are as follows:

Loading Docks Scoring	
0	Loading docks are facing outward towards any non-industrial property with no mitigation strategies in place.
1	Loading docks are facing outward, but are adequately mitigated by vegetation, fencing, or offsets/buffers.
2	Loading docks are facing away from non-industrial properties.

Lighting

This criterion evaluates the presence and quality of exterior lighting on freight facilities. Sites that score highly in this area feature floodlights and lighting fixtures that are oriented downward, away from nearby sensitive land uses, thereby reducing light pollution. Scores are as follows:

Lighting Scoring	
0	Lighting fixtures are oriented outward.
1	The facility has few or no visible exterior lighting features, or fixtures are facing outward but are mitigated by vegetation and fencing.
2	Exterior lighting is downward facing and mitigated by offsets and vegetation.

Vegetation and Fencing

This criterion evaluates the presence and use of vegetation and fencing on the freight property, as opposed to the Buffers Zones criterion in the Good Neighbor Strategies category which evaluates the interstitial space between freight and adjacent facilities. Examples of high quality vegetation include arrays of planters, trees, and shrubs that complement the façade of the building or serve to block sightlines to loading and staging areas. High quality fencing is defined here as the use of solid, opaque materials (wood, stucco, brick, etc.) and of sufficient height to insulate adjacent properties from light and sound emissions in non-industrial areas (typically around 8 feet high). The use of vegetation and fencing in a unified manner along property lines is also considered best practice when near sensitive land uses. Scores are as follows:

Vegetation and Fencing Scoring	
0	The site lacks vegetation and greenspace altogether, and fencing is of low quality.
1	Some greenspace is present, but no intentional landscaping, shrubs, or trees are present. Fencing is of average quality.
2	Greenspace, landscaping, and trees are present on the property in a deliberate manner. Fencing is of high quality.

Staging Areas

This criterion evaluates the presence, absence, and quality of staging areas for vehicles and equipment on the freight-oriented property. Staging areas are of good quality if they allow trucks, material handling equipment, and trailers to be staged on the property prior to and immediately after loading and unloading, preventing trucks the need to queue and park on nearby roadways, shoulders, or otherwise off the property. Scores are as follows:

Staging Areas Scoring	
0	The site lacks staging areas, and trucks are forced to park and queue outside of the freight property. Alternatively, trucks are forced to obstruct entrances or exits while loading/unloading.
1	The facility has some designated staging areas for trucks and equipment but is of small size or poor quality.
2	Large or otherwise high-quality staging areas are present.

Roadway Infrastructure

Loading and Unloading Zones

This criterion evaluates the presence of dedicated short-term parking for freight vehicles in high-density or highly trafficked areas. These may include parking for full-size tractor-trailer combinations or for smaller delivery vehicles (e.g., box trucks and vans) and must be available for use by commercial drivers conducting deliveries at the property in question. Loading zones are of good quality if they accommodate a variety of vehicle classes. Scores are as follows:

Loading and Unloading Zones Scoring	
0	No loading zones are present.
1	No loading zones are present, and the area is neither high-density nor highly trafficked. Alternatively, loading zones are present but of poor quality.
2	Loading zones are present and of good quality.

Truck-Related Roadway Damage

This criterion evaluates the presence and extent of physical damage caused to roadway and facility infrastructure because of geometry and design issues. This includes destruction or degradation of curbs, medians, and fencing, as well as potholes and pavement damage that typically result from heavy freight vehicle traffic. Scores are as follows:

Truck-Related Roadway Damage Scoring	
0	Severe truck-related roadway damage is present.
0.5	Slight truck-related roadway damage is present.
1	No truck-related roadway damage is present.

Access Via Non-Residential Road

This criterion evaluates whether the freight facility is accessible via non-residential roads. Well-designed entrances provide a direct route to freight facilities using roadway alignments or access ramps that eliminate the need for trucks to make use of neighborhood streets or connectors that are relied upon by private motorists for access to residential areas, schools, parks, and other sensitive land uses. Regulations and signage that route trucks away from residential roads are considered a best practice. Scores are as follows:

Access Via Non-Residential Road Scoring	
0	Facility may only be accessed via residential road, or sensitive land use is in an industrial area.
1	Facility may be accessed by a non-residential road, but residential road is still being used by freight vehicles.
2	Facility may be accessed by a non-residential road, and connecting residential roads are not utilized by freight vehicles.
3	Facility may only be accessed by non-residential road.
4	Facility may be accessed only by non-residential roads, and truck traffic is routed away from residential road.

Adequate Truck Parking

This criterion evaluates the presence and quality of truck parking at or near freight facilities. The designation of dedicated short-term or long-term truck parking areas on the freight property is a best practice, but truck parking areas outside of freight properties are also considered. Large amounts of illegal truck parking pose a safety threat and indicate the need for remediation. Scores are as follows:

Adequate Truck Parking Scoring	
0	No truck parking offered, or trucks are parking illegally.
1	Limited truck parking is offered, with no illegal truck parking.
2	An adequate amount of truck parking is available.

Freight-Oriented Development

Freight-Oriented Development Encroachment

This criterion evaluates the presence, absence, and severity of encroachment by other land uses into an established freight-oriented development. Sites will score poorly if significant encroachment by other land uses is taking place, especially by sensitive land uses. Scores are as follows:

Freight-Oriented Development Encroachment Scoring	
0	Severe encroachment is occurring, or the encroachment is by a sensitive land use.
1	Some encroachment is occurring, but it is not by a sensitive land use.
2	No freight-oriented development encroachment is occurring.

Pipeline Setbacks

This criterion evaluates the proximity of pipeline infrastructure to SLUs, as well as other safety and quality of life considerations. Sites will be evaluated based on their compliance (or lack thereof) with city ordinances on minimum pipeline setback distances, if enacted. Well-executed pipeline planning involves the establishment of a consultation zone or the emplacement of berms, walls, spill zones, or other additional safety features. Scores are as follows:

Pipeline Setbacks Scoring	
0	SLUs are in violation of city minimum setback ordinance.
1	SLUs are in compliance with setback ordinance (if any).
2	SLUs are an acceptable distance from pipeline infrastructure and feature additional protective measures.

Environmental Justice Concerns

This criterion evaluates the presence or absence of environmental justice issues at the site. Sites will score well if they equitably distribute any negative externalities and benefits amongst all classes of citizens and will score poorly in the opposite case. Scores are as follows:

Environmental Justice Concerns Scoring	
0	Freight facility externalities impact mostly or only environmental justice communities.
1	The freight facility has slight negative impacts to the surrounding community and/or environment.
2	No apparent unequitable or environmental impact.

Regional Conflict Assessment

Scoring the Sites

The sites were scored by each of the criteria that was qualifying at the site. This means if there was not Rail Infrastructure at the site, it was not scored for Rail Infrastructure. The score is based on how many points a site received out of the total possible points. It should be pointed out, as it says in the report, this is not to point out the good or bad of specific sites. It was to help identify trends and issues in the region. This would, in turn, help create a more effective policy toolkit.

Scoring Summary

The following table summarizes the scores for each type of site identified. Good Neighbor Sites have the highest average score out of the three scoring categories. This does not mean that there were not Areas of Concern or Land Use Conflicts that did not score well. In fact, Land Use Conflict sites that scored well can teach lessons. Understanding what helps them score well, despite appearing to be a conflict, can be applied to the policy toolkit.

Site Types Average Score	
Good Neighbor Sites	0.75
Areas of Concern	0.47
Land Use Conflicts	0.39

Freight Land Use Conflicts sites were identified based on lessons learned from the literature review and from observations made on site visits. Then, as discussed in **Sections 3.1** and **3.2**, the sites' scoring can be found in the table below:

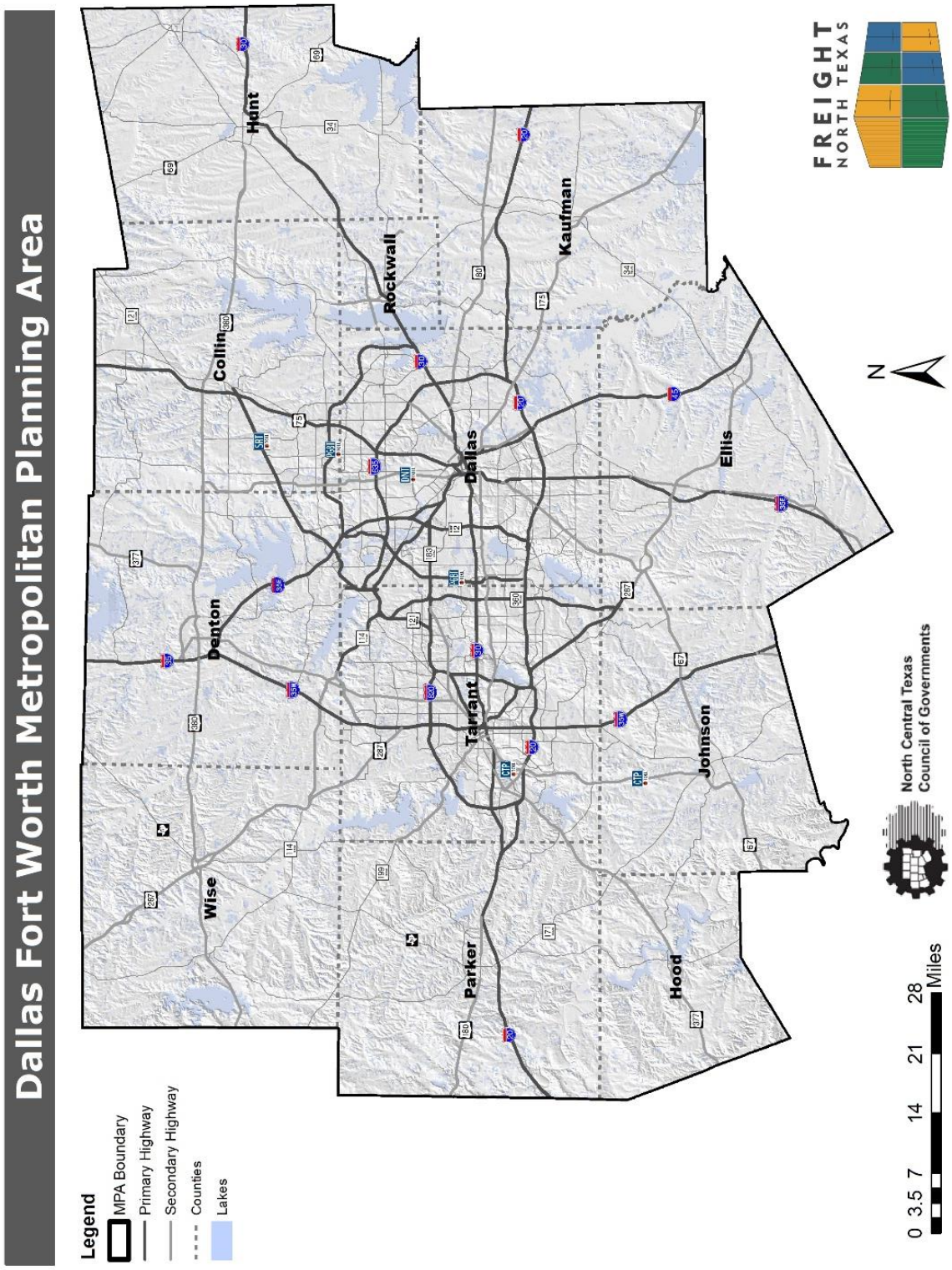
Identified Sites Scores			
Location	**City**	**Site Type**	**Score**
Conflans Road & SH 161	Irving	Good Neighbor Site	.54
Arkansas Lane & Typhoon Drive	Grand Prairie	Good Neighbor Site	.67
Cedardale Road & North Houston School Road	Lancaster	Good Neighbor Site	.91
West Bardin Road & Meadow Green Drive	Arlington	Good Neighbor Site	.81
South Coppell Road & Cooper Lane	Coppell	Good Neighbor Site	.81
Centerport (Sovereign Road & Centerport Drive)	Fort Worth	Good Neighbor Site	.74
Alliance District/Roanoke Town Center	Roanoke	Good Neighbor Site	.80
Shiloh Road	Garland	Land Use Conflict	.39
East Avenue K & 109th Street	Grand Prairie	Land Use Conflict	.46
Duncan Perry Road	Grand Prairie	Land Use Conflict	.41
Simonton Road & Dallas Parkway/Inwood Road	Farmers Branch	Land Use Conflict	.27
East Pioneer Drive & English Street	Irving	Land Use Conflict	.31
Heinz Way & Holland Street	Grand Prairie	Land Use Conflict	.12
Sherman Street & Trailerdell Street	Grand Prairie	Land Use Conflict	.18
Gerault Road & Old Gerault Road	Flower Mound	Land Use Conflict	.66
North Border Street & BNSF Cleburne Yard	Cleburne	Land Use Conflict	.21
Wintergreen Court & Gannon Lane	DeSoto	Land Use Conflict	.49
Miller Ferry Road & West Pleasant Run Road	Wilmer	Land Use Conflict	.58
Samuell Blvd. & Mesquite Business Center	Mesquite	Land Use Conflict	.57
Decatur Avenue & Norman Street	Fort Worth	Land Use Conflict	.46
Terminal Road & Zwolle Street	Fort Worth	Land Use Conflict	.35
January Lane & SH 161	Grand Prairie	Area of Concern	.77
Minters Chapel Road & East Dallas Road	Grapevine	Area of Concern	.63
SH 12 & Cuckner Baptist Chld Home Drive	Dallas	Area of Concern	.44
Empire Central Drive & Concord Avenue	Dallas	Area of Concern	.26
East Union Bower Road & River Hill Road	Irving	Area of Concern	.36
South Great SW Parkway & Osler Drive	Grand Prairie	Area of Concern	.46
Susan Drive & Pinewood Drive	Arlington	Area of Concern	.44
113th Street & UPRR (Great Southwest North Sub)	Grand Prairie	Area of Concern	.36
Fountain Parkway & Great Southwest Parkway	Grand Prairie	Area of Concern	.26
North Wilhite Street & Gray Place Road	Cleburne	Area of Concern	.36
Chattanooga Place & Mesa Circle	Dallas	Area of Concern	.54
Oak Grove Road & Enon Avenue	Fort Worth	Area of Concern	.64
NE Main Street & UPRR (Ennis Sub)	Ennis	Area of Concern	.53

Sample Scoring Sheet

Freight Land Use Conflict Scoring Criteria			
Site:			
Site Type:	**Good Neighbor Site**		
	Score	**Not Applicable**	**Possible Points**
Good Neighbor Strategies			
Sidewalks and Bicycle and Pedestrian Paths			4
Raised Berms			2
Supplemental Vegetation			1
Sound Walls			1
High-Quality Fencing			1
Buffer Zones			4
Railroad Infrastructure			
Median Barriers		N/A	0
Quad Gates		N/A	0
Quiet Zone		N/A	0
Offset from Sensitive Land Use		N/A	0
Rail-Related Connectivity Issues		N/A	0
Buffers between Sensitive Land Use and Railroad		N/A	0
Site Design			
Loading Docks			2
Lighting			2
Vegetation and Fencing			2
Staging Areas			2
Roadway Infrastructure			
Loading and Unloading Zones			2
Truck-Related Roadway Damage			2
Access via Non-Residential Road			4
Adequate Truck Parking			2
Freight-Oriented Development			
Freight-Oriented Development Encroachment			2
Pipeline Setbacks		N/A	0
Environmental Justice Concerns			2
Subtotal	0		35
Score	0.00		

Appendix B: Study Maps and Figures

Figure 1: Metropolitan Planning Area Boundary



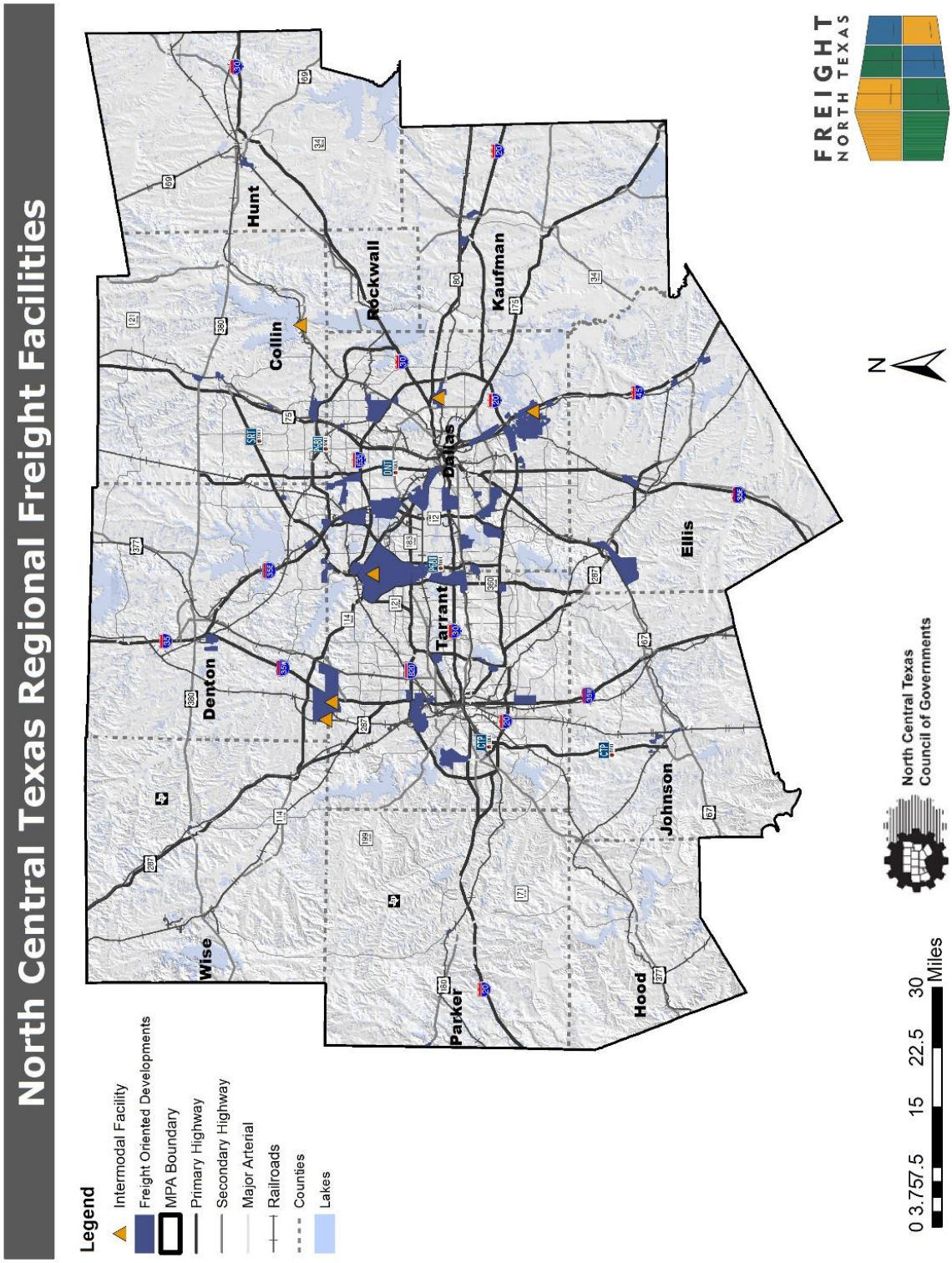


Figure 2: Regional Freight Facilities

Figure 3: Freight Facility Locations

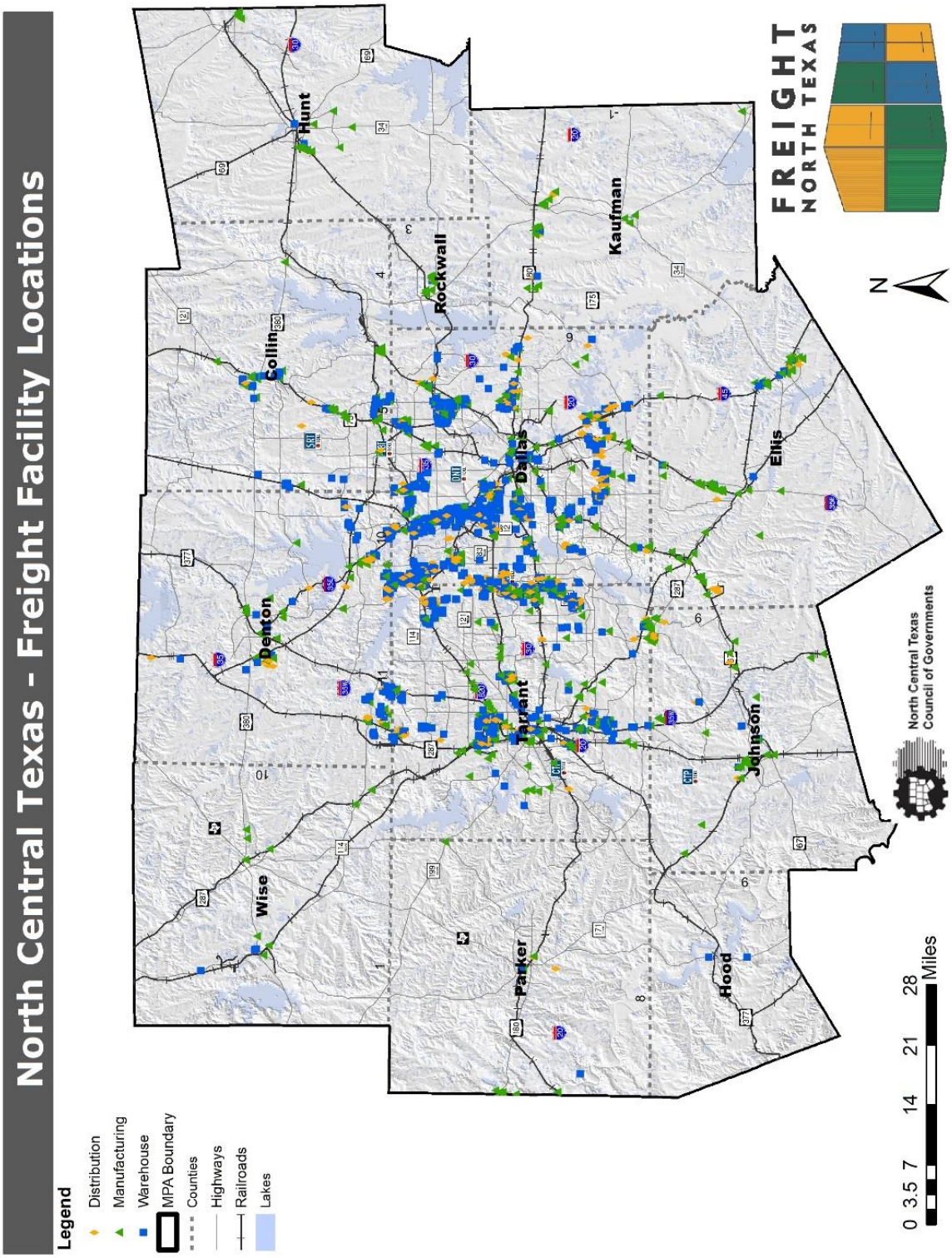


Figure 4: Freight Facility Age

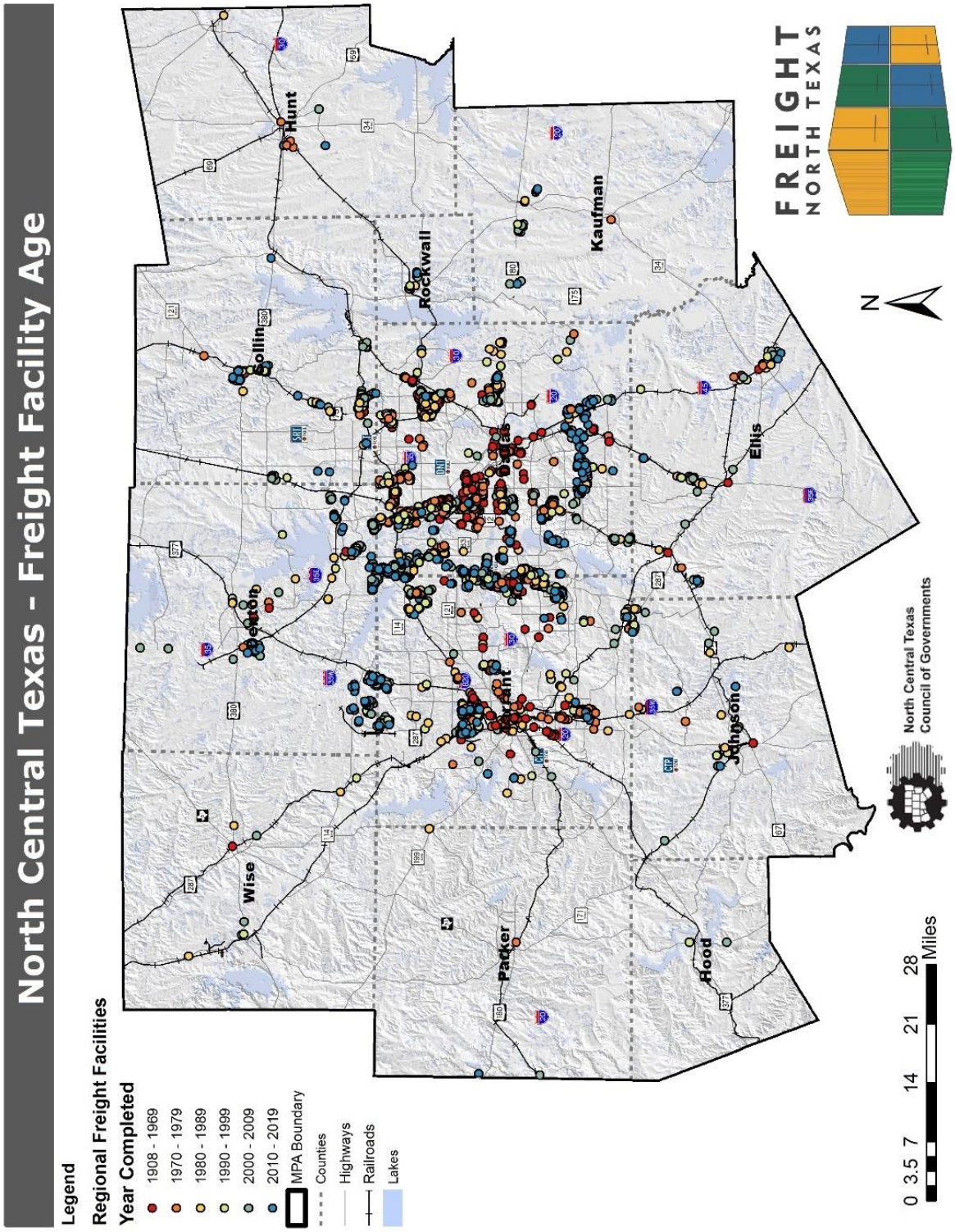


Figure 5: Year Constructed: North Central Texas

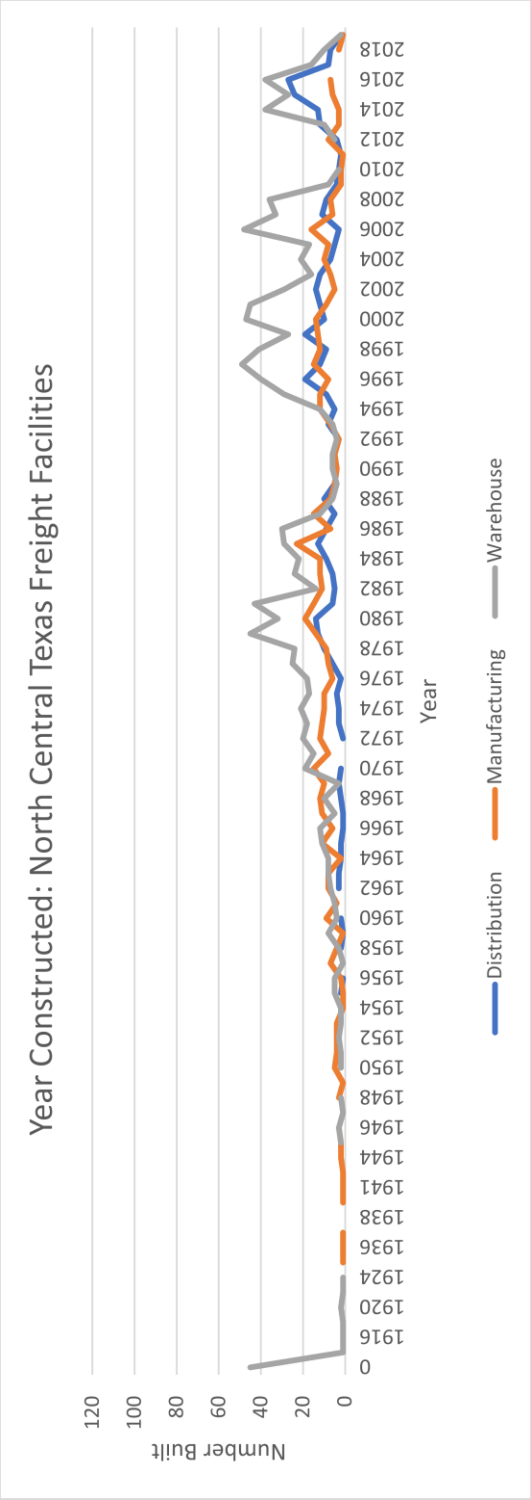


Figure 6: Average Distance of Freight Facilities to Urban Core Areas in Miles

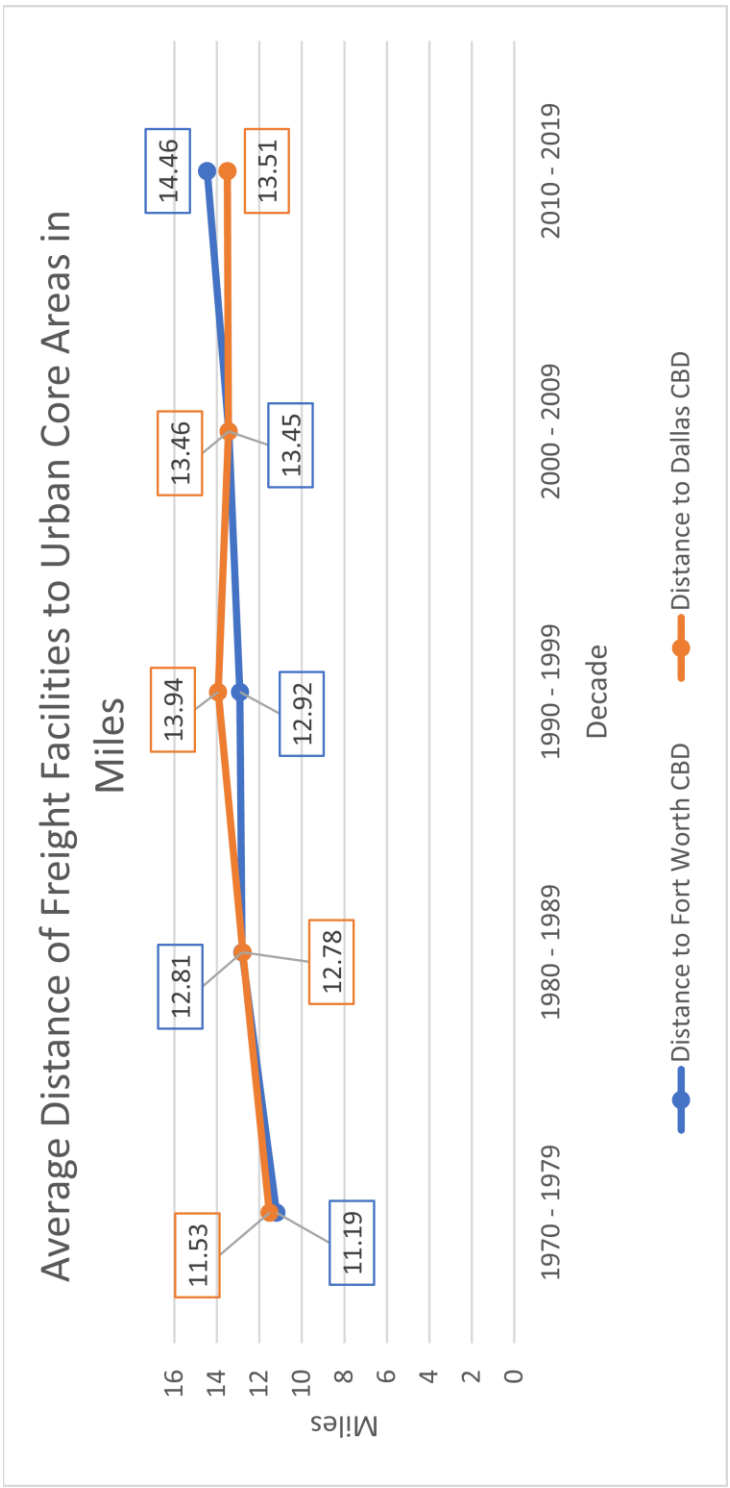


Figure 7: Average Freight Facility Square Feet Added Per Decade

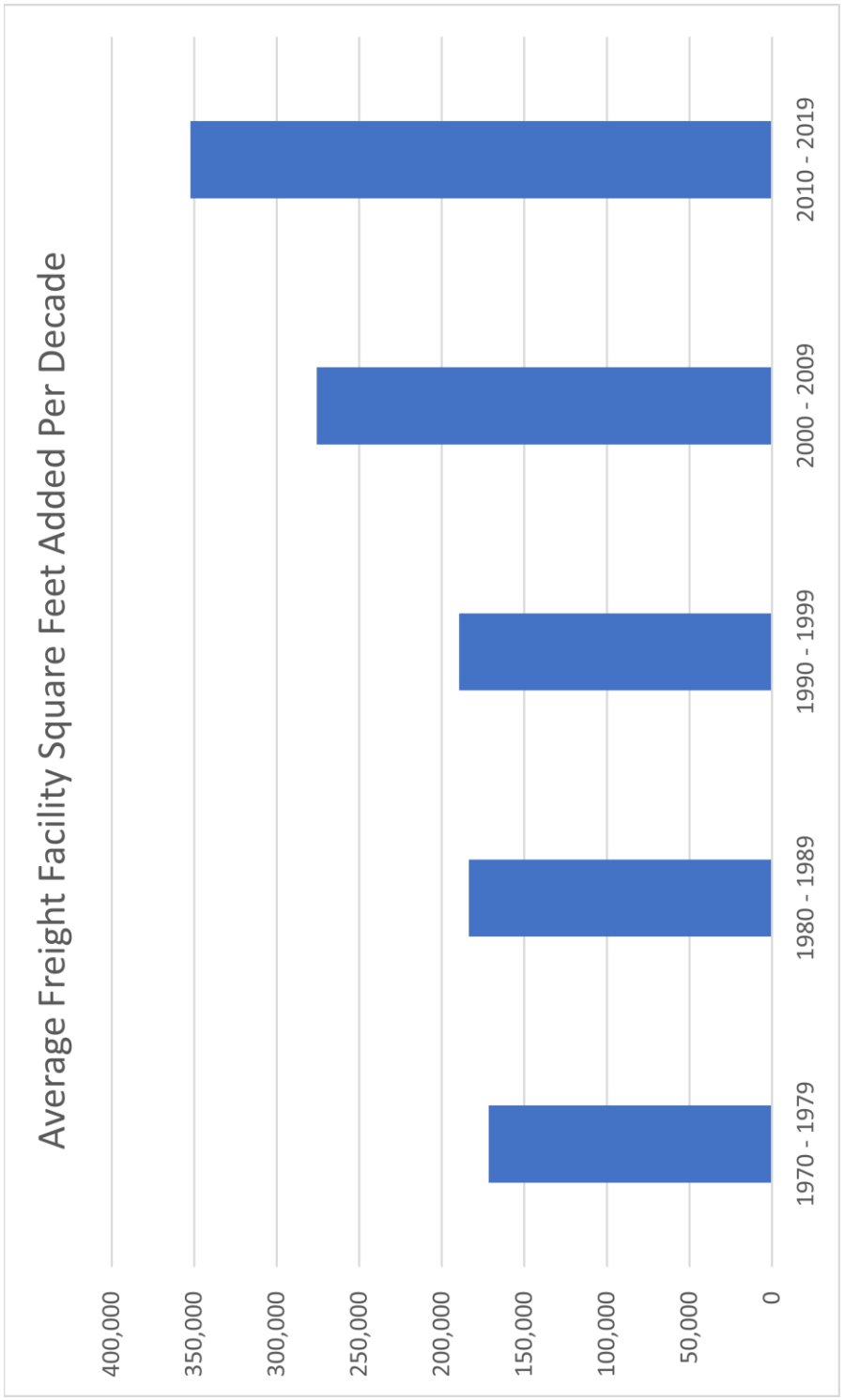
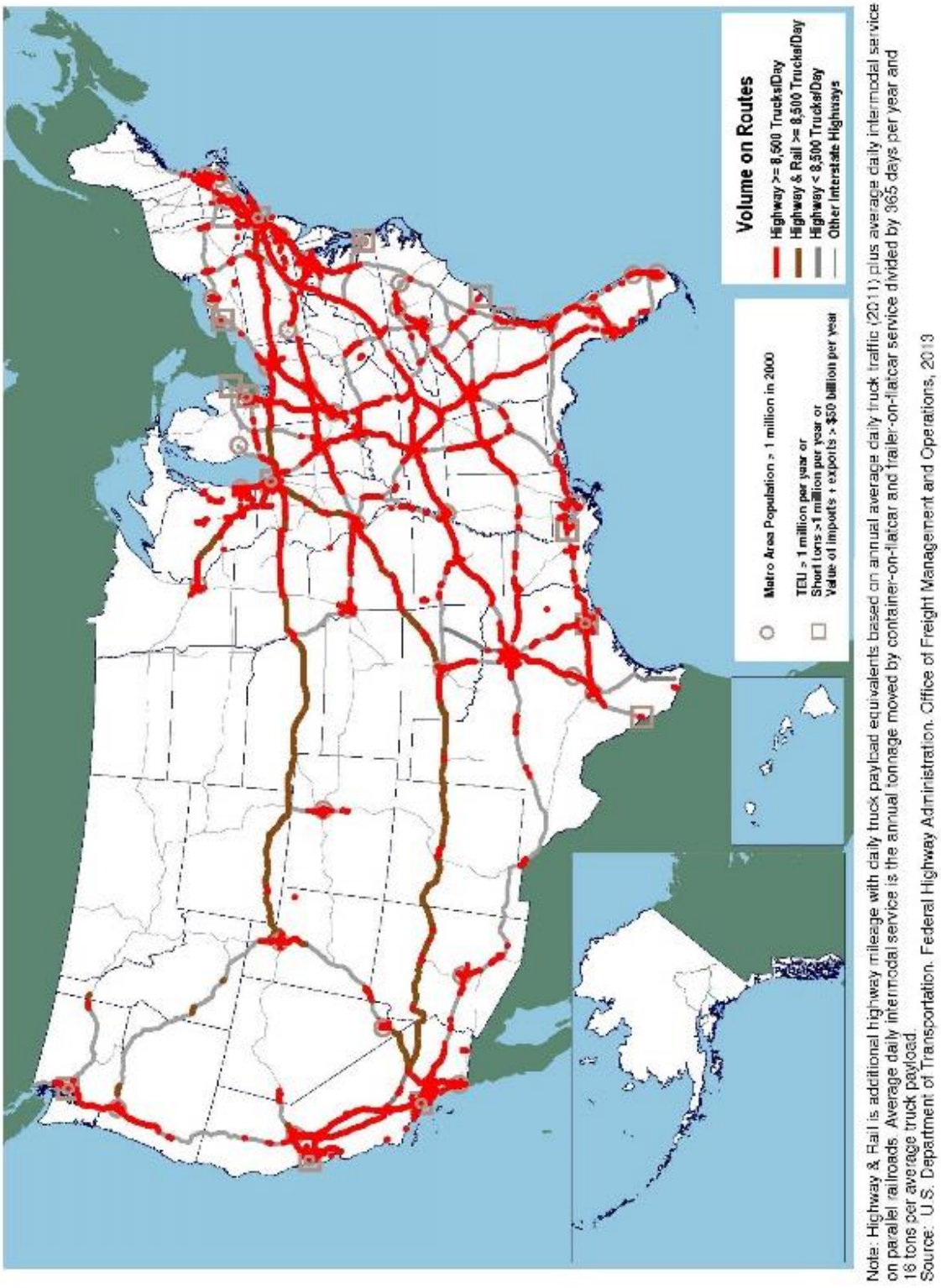


Figure 8: Major Freight Corridors



Note: Highway & Rail is additional highway mileage with daily truck payload equivalents based on annual average daily truck traffic (2011) plus average daily intermodal service on parallel railroads. Average daily intermodal service is the annual tonnage moved by container-on-flatcar and trailer-on-flatcar service divided by 365 days per year and 18 tons per average truck payload.
Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, 2013

Figure 9: Regional Assessment Overview

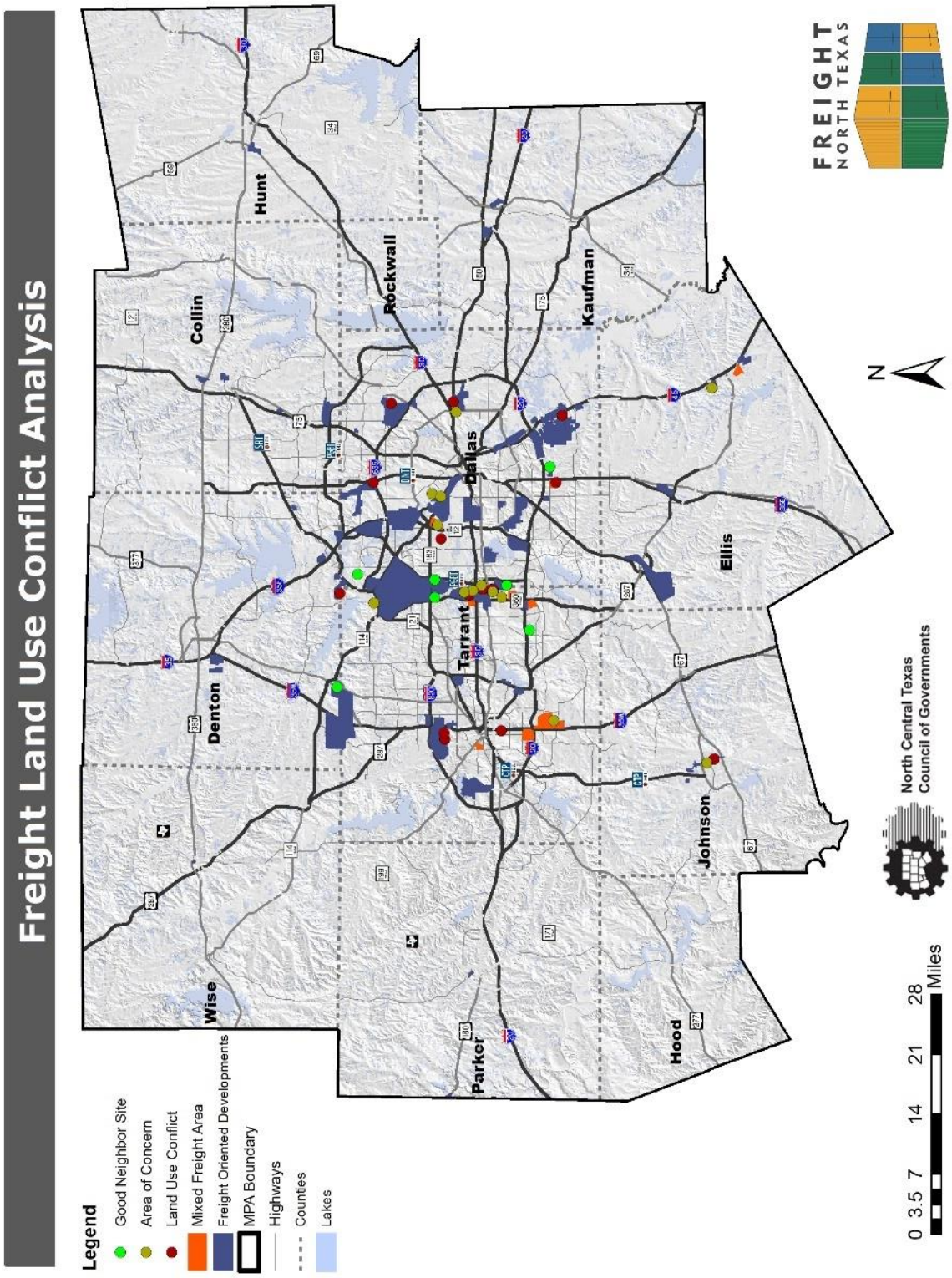
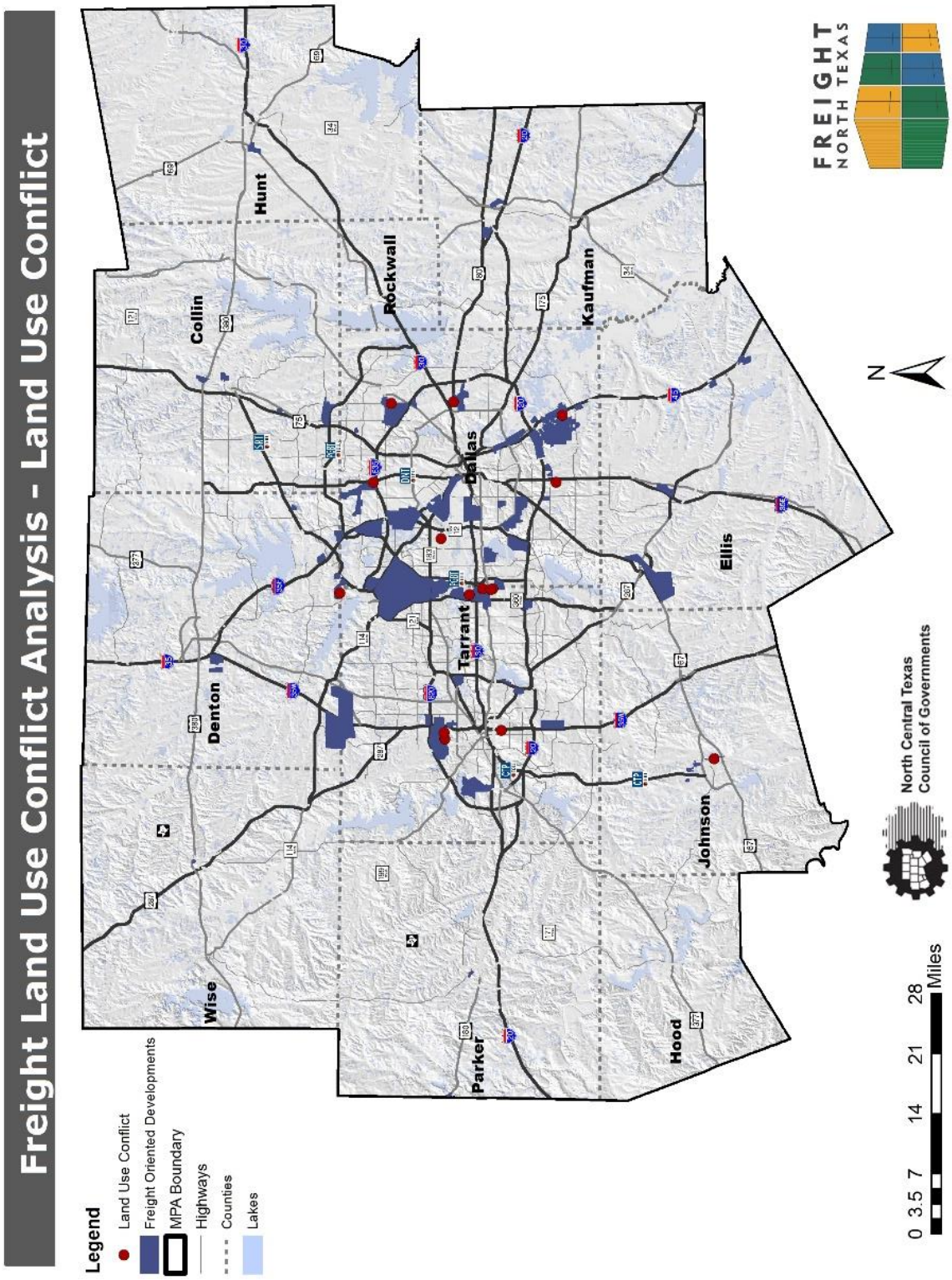


Figure 10: Freight Land Use Conflicts



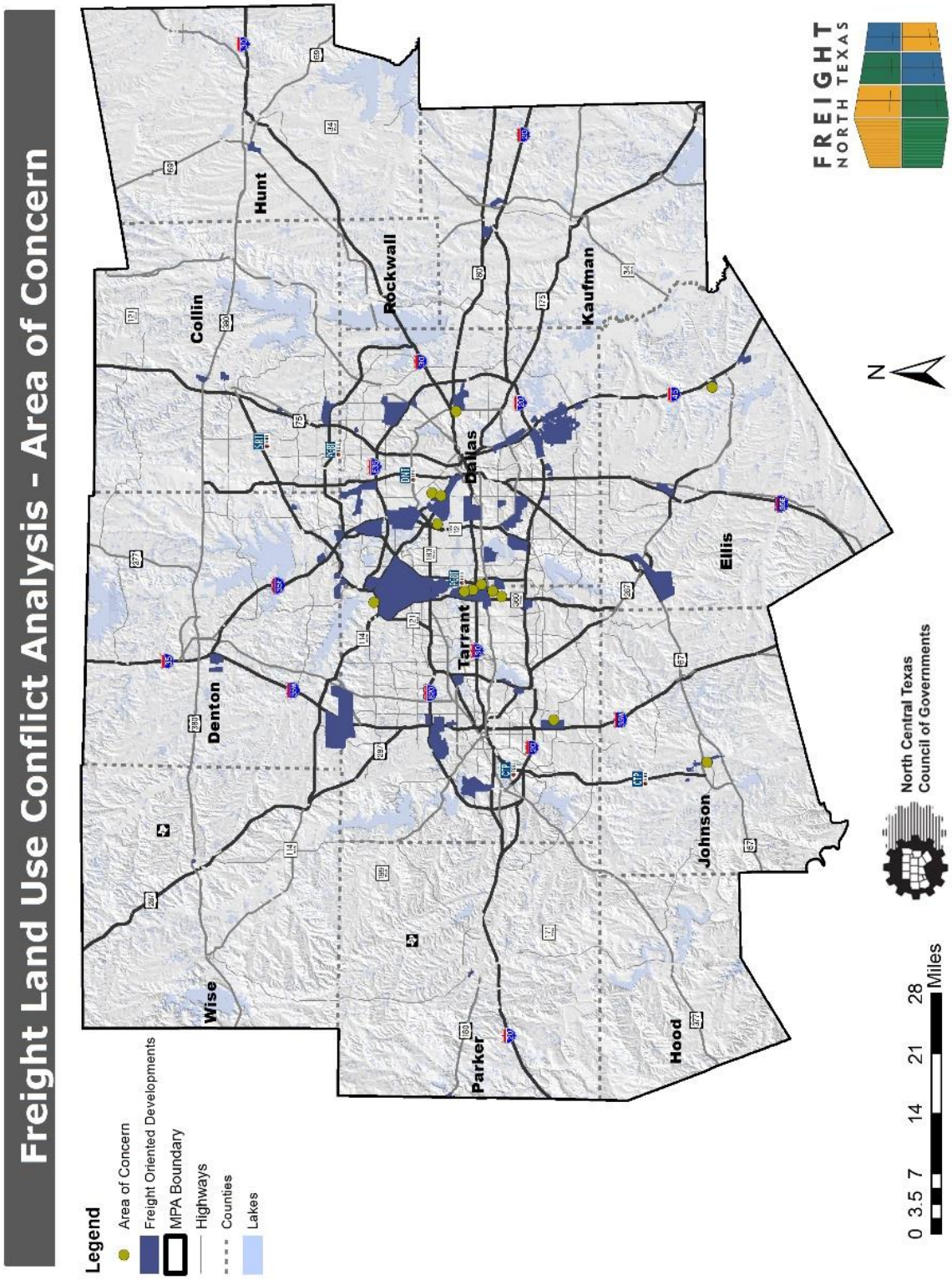
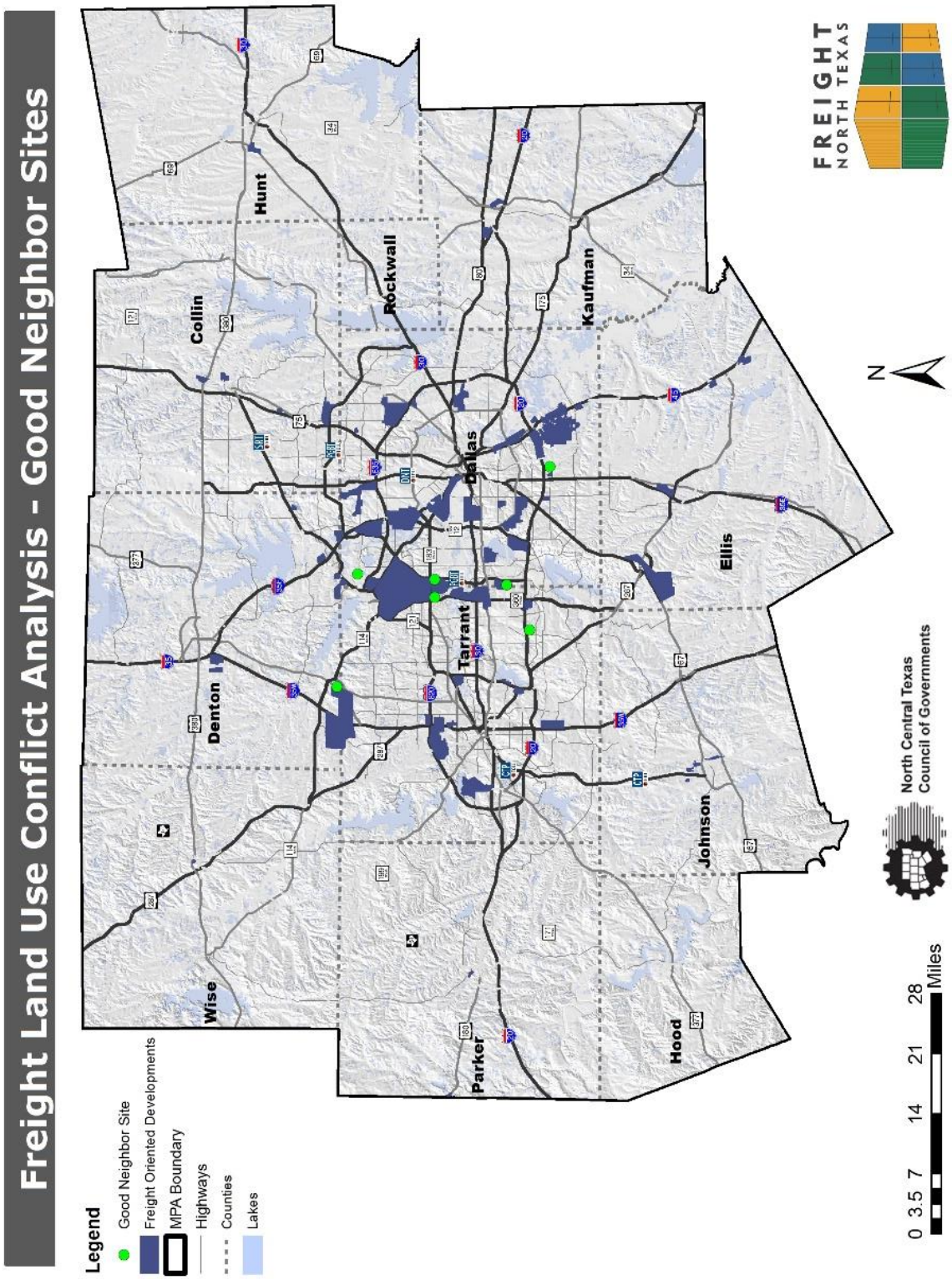


Figure 11: Areas of Concern

Figure 12: Good Neighbor Sites



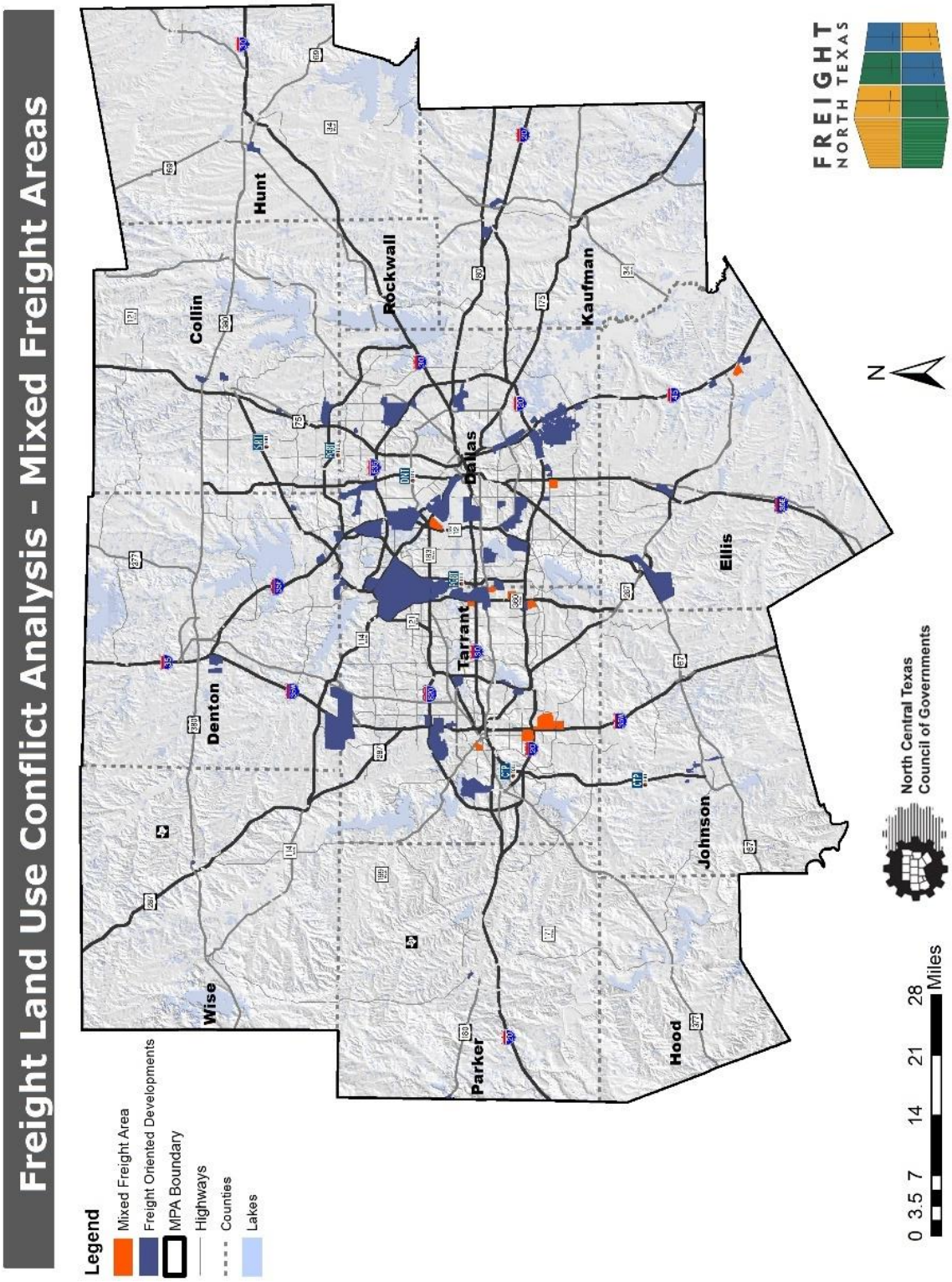


Figure 13: Mixed Freight Areas

Figure 14: Site Scoring Example

Freight Land Use Conflict Scoring Criteria			
Site:			
Site Type:	**Good Neighbor Site**		
	Score	**Not Applicable**	**Possible Points**
Good Neighbor Strategies			
Sidewalks and Bicycle and Pedestrian Paths			4
Raised Berms			2
Supplemental Vegetation			1
Sound Walls			1
High-Quality Fencing			1
Buffer Zones			4
Railroad Infrastructure			
Median Barriers		N/A	0
Quad Gates		N/A	0
Quiet Zone		N/A	0
Offset from Sensitive Land Use		N/A	0
Rail-Related Connectivity Issues		N/A	0
Buffers between Sensitive Land Use and Railroad		N/A	0
Site Design			
Loading Docks			2
Lighting			2
Vegetation and Fencing			2
Staging Areas			2
Roadway Infrastructure			
Loading and Unloading Zones			2
Truck-Related Roadway Damage			2
Access via Non-Residential Road			4
Adequate Truck Parking			2
Freight-Oriented Development			
Freight-Oriented Development Encroachment			2
Pipeline Setbacks		N/A	0
Environmental Justice Concerns			2
Subtotal	0		35
Score	0.00		

Figure 15: Freight Development and EJ Areas

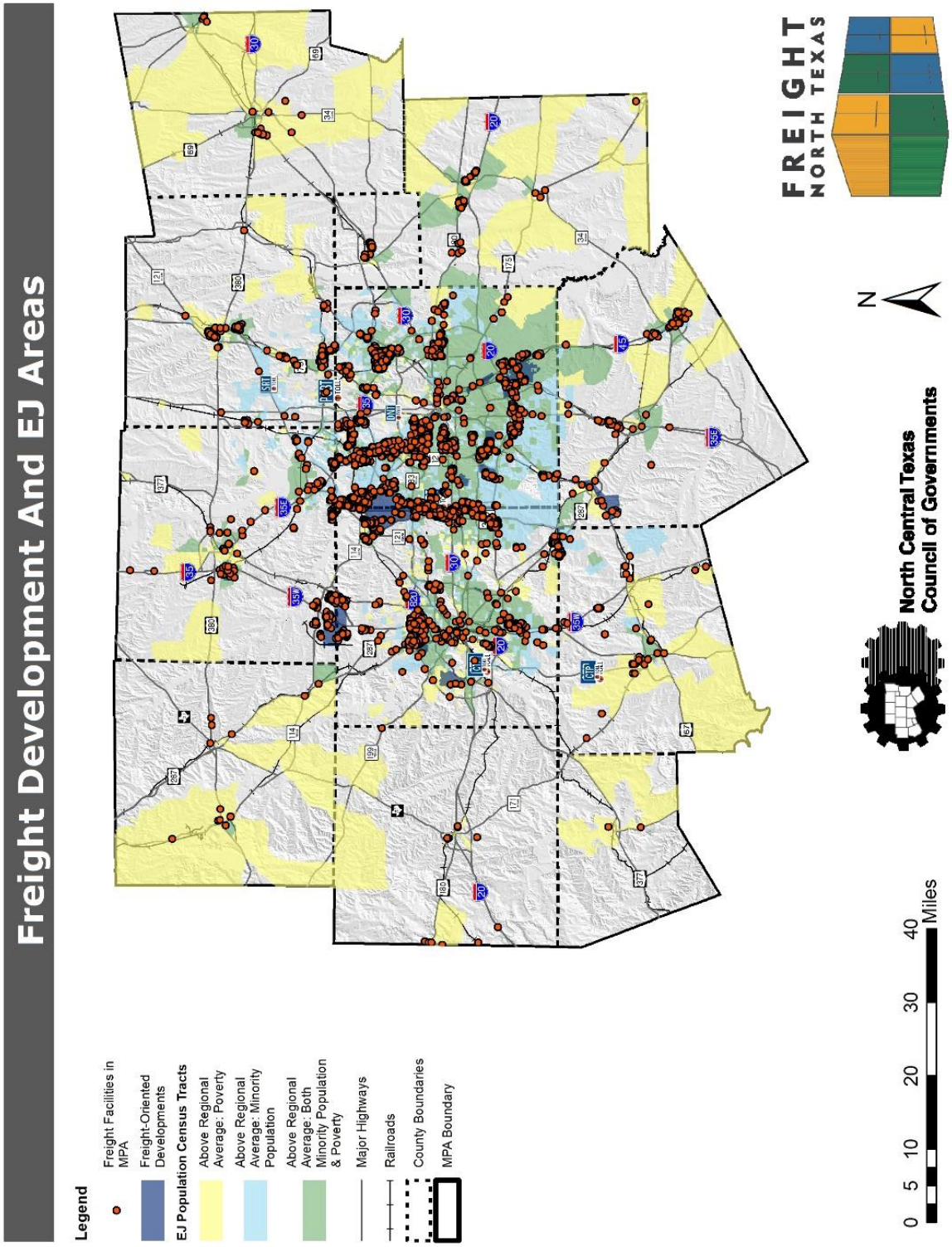


Figure 16: Freight Rail in EJ Areas

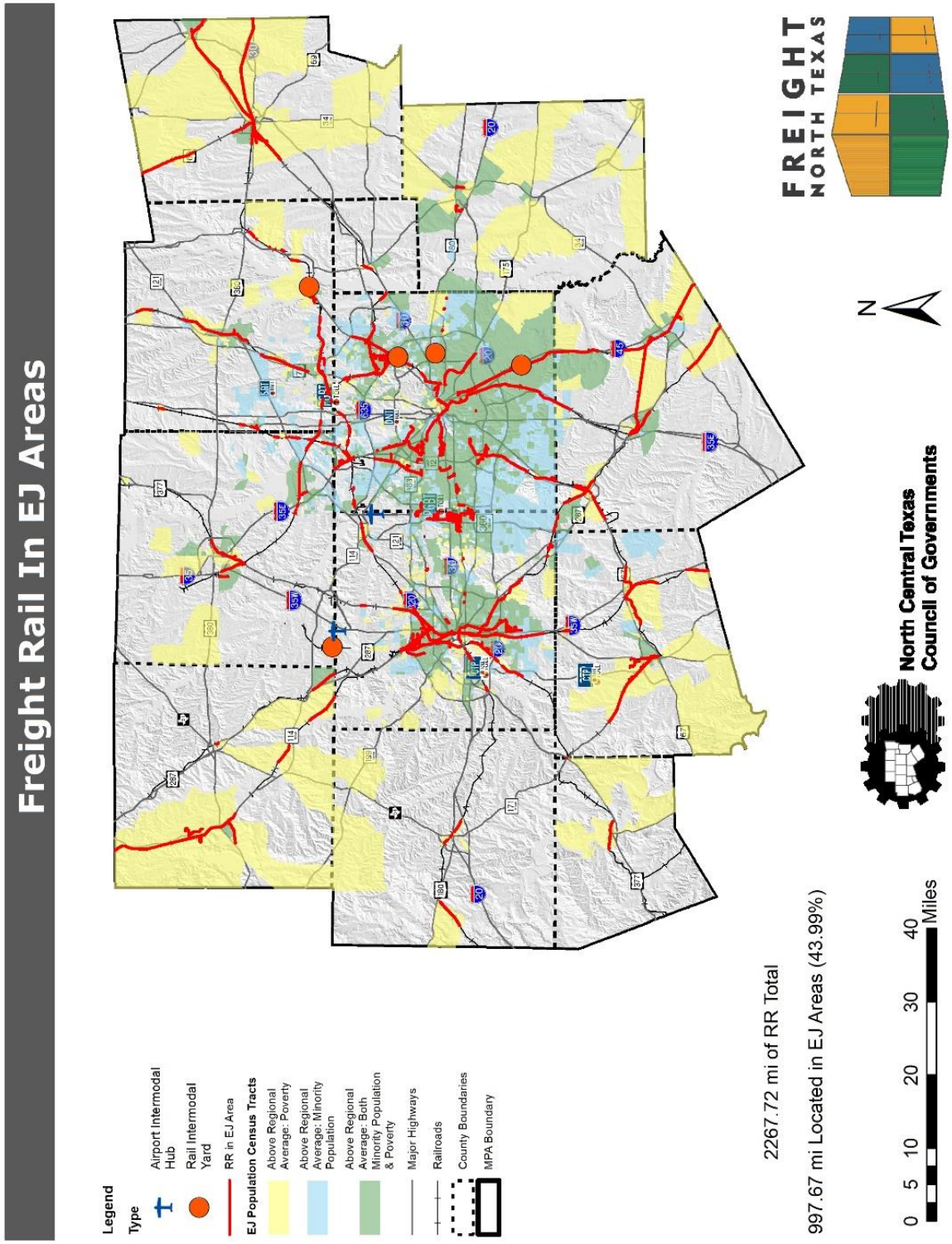


Figure 17: Rail Crossings in EJ Areas

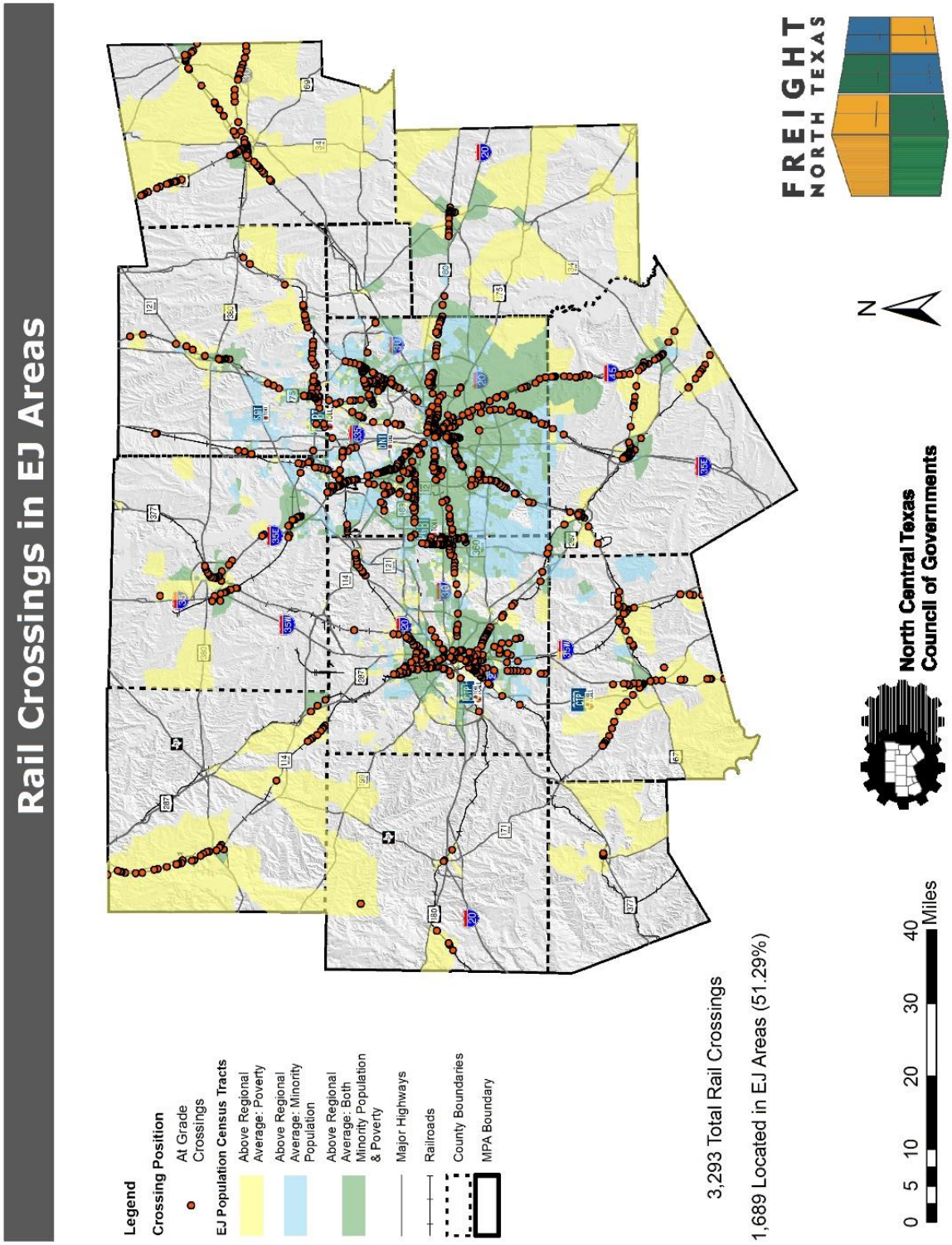


Figure 18: 4-Step Freight Policy Process

Figure 19: Intermodal Transfer