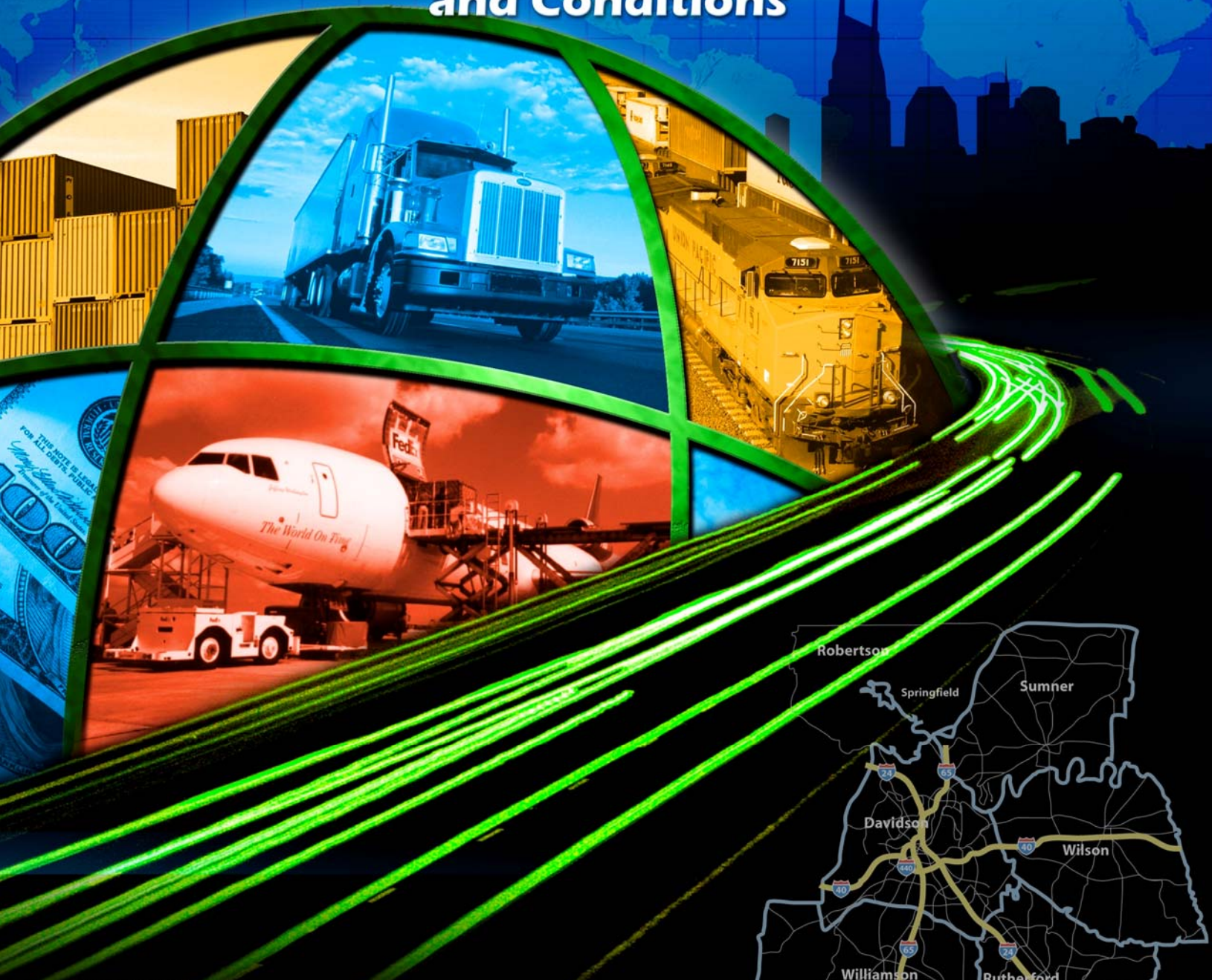
NASHVILLE REGIONAL FREIGHT & GOODS MOVEMENT STUDY

Technical Memo #3: Existing Trends and Conditions



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Submitted to: **Nashville Area Metropolitan Planning Organization**

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NASHVILLE AREA
Metropolitan Planning Organization

NASHVILLE REGIONAL FREIGHT & GOODS MOVEMENT STUDY

PHASE II

TECHNICAL MEMO #3: EXISTING TRENDS AND CONDITIONS

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Introduction

The Existing Trends and Conditions section of the Nashville Regional Freight and Goods Movement Study (Phase II) updates the findings and conclusions from the study's first phase and in some cases affirms the validity of that data. In Phase I, one of the primary study objectives was to establish the basis for subsequent freight planning efforts by developing a regional freight profile. This Existing Trends and Conditions report provides an update to the Phase I freight profile and offers additional data analysis for the movement of freight and the role it plays in the local economy. This report provides a base line from which future freight recommendations and policies can be developed.

TRANSPORTATION AND THE ECONOMY

Much has changed since the completion of Phase I of the Nashville Regional Freight and Goods Movement Study in December 2004. Most notably are changes to the national and regional economies. Facing rising unemployment, falling home values, and job loss, businesses and consumers are curtailing purchases and leading companies to slash production and jobs. The ongoing nationwide economic downturn and financial crisis that began in 2007 has impacted most all facets of life including the transportation sector, of which freight is an important part. The transportation sector is in itself a major component of the economy. The transportation sector moves goods and people, employs millions of workers, generates revenue, and consumes materials and services produced by other sectors of the economy.

The benefits of freight transportation to the economy are enormous. Freight transportation increases the value of goods by moving them to locations where they are worth more and encourages competition and production by extending the spatial boundaries of commodity and labor markets. Freight transportation also stimulates demand for goods and services and employs millions of people. Freight transportation infrastructure is a significant component of our nation's wealth and productive capacity. For this reason the American Recovery and Reinvestment Act of 2009 was executed by the federal government to help stimulate the economy in part by investing in transportation infrastructure. These funds have been responsible for the implementation of numerous transportation projects throughout the country and the Nashville region.

A specific example of the economy's impact on the Nashville region's freight transportation was the shut down of production at the General Motors assembly plant in Spring Hill, Tennessee. This has resulted in thousands of job losses, fewer shipments of goods via truck and rail, and has implications for the future analysis of how the plant actually impacted freight movement throughout the region.

While still suffering high unemployment rates and other consequences resulting from the economic situation in 2010, the Nashville region continues to rely on commercial transportation and the ability of goods and services to be transported in a time-definite manner. Reliable, predictable travel times are especially important in an economy where

many goods are expensive and are needed in tightly scheduled manufacturing and distribution systems. Late arrivals can have significant economic costs for factories waiting for parts to assemble and for carriers who are missing guaranteed delivery times. These issues are possibly more sensitive now than ever.

Freight is big business. It is a necessity, not a luxury. When transportation system performance decreases, freight-related businesses and their customers are affected in two ways. First, freight assets become less productive. Second, more freight transportation must be consumed to meet the needs of a thriving and expanding economy. Thus, when freight transportation under-performs, the economy pays the price – a cost that may be too high in the current economic climate. And, while a well functioning commercial transport system is largely responsible for the modern quality-of-life attributes that consumers' value; for most consumers commercial transport is an invisible process manifested only by big, intimidating trucks and loud, cumbersome trains that threaten their own timely commute. In the current business environment cost effective, time sensitive transportation services are increasingly a strategy for competitive advantage in manufacturing and service based industries.

ORGANIZATION OF THIS REPORT

This report is organized into the following sections:

Previous Studies and Their Impact on the Nashville Region

The first stage of data collection involved the review of existing literature, plans, reports, and studies that have implications for the Nashville region with regard to freight and goods movement. A summary of these studies and their impacts and suggestions for the Nashville region are provided in this section.

Freight in the Nashville Region

Current Transearch freight flow data acquired by the Tennessee Department of Transportation (TDOT) for use by the various Tennessee Metropolitan Planning Organizations was used to generate maps and tables for the Nashville region that include county level and zip code level commodity and unit flows for the year 2007. Existing freight flow data for 2007 illustrate the current condition of the Nashville region freight transport system and provide insight into areas of potential improvement. This information combined with the local stakeholder interviews paints a picture of the current situation in the Nashville area freight market and helps assess trends that can be used in subsequent portions of this study to identify needs and help prepare the MPO region for future growth.

In addition, truck related freight flows are assessed by utilizing the freight model specifically developed for this study. The truck flows and maps produced by the model are based on a combination of Transearch data and observed truck classification count data from TDOT.

Field Observations

Field observations included updated traffic count information at key intersections and facilities providing an actual, on the ground picture of the current congestion and traffic situation at key freight intensive intersections. This information is summarized and a map of these locations is provided in this section.

Stakeholder Interviews

The consulting team conducted field interviews and observations that included 19 personal interviews with stakeholders representing a cross-section of the regional economy. Issues facing drivers, distribution companies, and other local freight recipients and distributors revealed key freight routes, areas of congestion, and issues and opportunities needing to be addressed to improve freight transport in the Nashville region.

A thorough review and analysis of each of these components provides an overview of existing conditions within the Nashville Area MPO region that could potentially impact the transport of goods and services now and in the future. Existing studies, freight flows, the condition of key freight corridors, access to freight facilities, and on-ground conditions have all been evaluated to assess opportunities for improvement to the transportation system for the regional freight industry. A thorough inventory of the current freight transportation network provides a base line from which future improvements can be recommended by highlighting areas in need of improvement, deficient traffic conditions, or other inadequacies.

Previous Studies and their Impact on the Nashville Region

This portion of the data collection process involved collecting existing information from public sector studies and reports. The consultant team reviewed the following list of existing literature and studies which affect the study area:

- Nashville Area MPO 2030 LRTP
- Nashville Area MPO Freight Study Phase 1
- TDOT Long Range Transportation Plan (LRTP)
- Tennessee Rail System Plan
- Tennessee State Airport System Plan
- Latin America Trade and Transportation Study (LATTS)
- I-40/I-81 Corridor Study
- Norfolk Southern Crescent Corridor

State DOT plans (such as the I-40/81 study and LRTP), freight corridor studies, MPO freight plans and studies, and freight related projects are summarized below. Once reviewed, each plan, report, and/or study was analyzed for its relevance to existing conditions and planning activities in the Nashville region. Recent developments in the freight industry outside of the Nashville region (e.g., the Crescent Corridor initiative) were also considered.

NASHVILLE AREA MPO 2030 LRTP

The MPO's current regional transportation plan, adopted in October 2005, provides a vision for transportation through the year 2030. As adopted, the program provided nearly $3.5 billion worth of projects for the greater Nashville region. Regional goals include:

<u>Goal 1: Link Land Use & Transportation</u>
Encourage local governments to develop land use policies and plans that enhance the quality of life and that recognize the relationship between land use and the transportation system of the transportation system.

<u>Goal 2: Regional Mobility through a Multi-modal System</u>
Achieve enhanced mobility by providing an intermodal and multimodal transportation system that supports safe, efficient and convenient travel options for the movement of people and goods.

<u>Goal 3: Reduce Congestion</u>
Address traffic congestion through strategies that seek first to reduce vehicle-trip demand and second, to increase the operating capacity of the existing and planned transportation system.

<u>Goal 4: Relationship between Transportation, Air Quality & Energy Conservation</u>

Maintain and improve the quality of the natural environment through the implementation of transportation policies and programs that reduce vehicle emissions and energy demand.

Goal 5: Manage Financial Resources Efficiently
The regional transportation plan and the implementation of the Transportation Improvement Program (TIP) must be based on an effective evaluation and screening process that considers cost (capital, operating and maintenance) constraints in selecting the highest priority short and long-range improvements and programs.

The primary purpose of the Long Range Transportation Plan (LRTP) is to provide a vision for satisfying the existing and anticipated demands on the transportation system serving the five-county Nashville metropolitan area. The five counties include Davidson, Rutherford, Sumner, Wilson, and Williamson. The MPO region also includes the cities of Springfield in Robertson County and Spring Hill in Maury County. Prepared by the Nashville Area Metropolitan Planning Organization (MPO), the LRTP covers a 25-year planning horizon – through the year 2030 – in which a balanced, multimodal, and sustainable transportation system is sought.

As an instrument used to distribute federal monies, the document begins by looking at federal planning legislation and the role and responsibilities of the MPO. Next, it assesses *Where We Are* by looking at historical population and employment, land use, and existing transportation infrastructure. In order to determine *Where We Are Going*, the LRTP uses population and employment projections developed from their Travel Demand Model to establish a congestion management system and mobility options while considering air quality and the fiscal outlook of the area. The *Where We Want To Be* section provides regional goals as well as bicycle and pedestrian goals, objectives, and vision. Finally, *How We Get There* outlines a performance based assessment with environmentally sound and fiscally constrained transportation recommendations.

The document also provides an in depth appendix with information on the public participation process, a complete list of the 2030 Long Range Transportation Plan projects, Title VI assessment, regional destinations, existing plus committed projects, projects needed to implement the regional bicycle and pedestrian network, illustrative list of potential stand alone bicycle projects, detailed revenue projections, population and employment by Traffic Analysis Zone, and the LRTP adjustment process map. All of this information is supplemented with a variety of maps and illustrations to help readers visualize the concepts and recommendations presented.

Implications for the Nashville Region

Given the Nashville area's rapid and consistent growth in both population and employment, the LRTP is a necessary tool for addressing transportation needs. The plan provides a balanced, financially feasible set of transportation improvements that will facilitate the movement of people and goods by all modes of transportation within the Nashville metropolitan area. These proposed improvements are intended to help alleviate

traffic congestion, provide more transportation choices, improve transportation system operations, and meet the region's air quality goals through the future 25-year planning period.

The Nashville Area MPO 2030 LRTP has major implications for the Nashville region since it determines, through the prioritization process, which transportation projects will receive federal funds that make up a large portion of transportation funding sources. Important road widenings along Interstates, including I-65 and I-40, local arterials such as State Route 109, and intersection improvements like the one recommended at McEwen and I-65 are just some examples of projects listed in the LRTP.

NASHVILLE AREA MPO FREIGHT STUDY PHASE I

In 2003, the Nashville Area Metropolitan Planning Organization (MPO) published results from Phase I of the Regional Freight and Goods Movement Study. That report served to highlight the role that the freight industry plays in the success of the local economy and to illustrate the movement of freight in, around, and through the Nashville region. A principal goal of the study was to institutionalize freight needs into the overall MPO planning process, by modifying existing planning tools and priorities. In order to meet this goal, the study was designed to achieve the following objectives:

- Establish the basis for subsequent freight planning efforts by assembling a regional Freight Advisory Committee and developing a regional freight profile.
- Produce freight related strategies, policies and projects specific to the Nashville Area that can be implemented within the MPO planning process in the near term.

A common starting point for freight planning is to understand predominant freight patterns in the study region. Coupled with efforts toward engaging the private sector in public transportation planning efforts, the Freight Advisory Committee has continued to provide input throughout subsequent phases of the Freight and Goods Movement Study. Besides establishing the Freight Advisory Committee, Phase 1 also described the process, findings, and implications from research and field observations that focused on depicting logistic needs of major employers in the region. It described the relationship between freight, land use, and air quality.

Once regional freight needs were identified through the system monitoring process, it was necessary to specify projects to address them. Using feedback from regional freight stakeholders to identify freight related strategies, policies and projects specific to the Nashville Area. Six freight oriented projects and improvements that were of immediate concern were also selected by the advisory committee: Beechcroft Road (SR 2247) at the CSX Crossing, 8th Avenue Railroad Bridge, Elliston Place, Lebanon and Watertown Exit 239, New Shackle Island Road at Gallatin Rd (US Hwy 31), and Old Hickory Blvd at Firestone Parkway.

Regional planning agencies, such as the Nashville Area MPO have historically focused planning on passenger/commuter transportation needs. The increasing need for freight

transportation places an emphasis on understanding private industry behavior and needs as well. This study is intended to set the foundation and provide direction for future freight related planning and investment efforts. Finally, based on field work and research, this study summarized the issues relevant to the Nashville Area, and presents policies and strategies as opportunities for meeting freight transportation needs in the planning process.

Implications for the Nashville Region

The evolving business environment and associated impacts on transportation networks has significant implications for regional and local economic development. Robust growth in Nashville's economy and population over the past several decades is now putting pressure on the Region's transportation system, resulting in unwanted externalities and unforeseen consequences; traffic congestion is growing, air quality is declining and industrial land use patterns are shifting away from the center of the city. Nashville's strategic location within North America brings a set of challenges in dealing with the various aspects of traffic, particularly highway congestion and air quality, as the city's major freight sources originate outside of the area.

A common starting point for freight planning is to understand predominant freight patterns in the study region. The Modal Profile in Phase 1 provides a profile of Nashville's freight infrastructure by mode and offers insight into opportunities and challenges for freight transport in the region. For instance, the large amount of through truck freight implies the need for coordination with surrounding municipalities and other MPOs regarding congestion and air quality. This study provides important knowledge regarding regional freight planning issues and supplies policies on how to address these issues and plan for the future of freight transport in the region through land use planning, regional zoning, focusing on key truck corridors, and coordination among private and public industry and organizations.

TDOT LONG RANGE TRANSPORTATION PLAN

The Tennessee Department of Transportation (TDOT) Long-Range Transportation Plan (LRTP) is a multimodal plan for the state of Tennessee that provides a basis for making informed transportation decisions for all modes of transportation including rail, aviation, public transportation, bicycles and pedestrians, ports and waterways, highways, and bridges in Tennessee. The LRTP was completed in 2005 and identifies Tennessee's transportation system needs for the movement of both people and goods for the next 25 years. The plan aims to create a process to evaluate, prioritize and deliver transportation projects in a financially responsible manner, cultivate an understanding of the state's role in transportation, and involve all interested parties in decisions made about transportation.

The Long-Range Transportation Plan consists of the following three components:

- 25-Year Vision, which describes what type of transportation system the state will have in the future and provides policy direction for investments and operating decisions;
- 10-Year Strategic Investments Plan, which identifies the programs that should be accelerated to achieve the plan's vision;
- 3-Year Project Evaluation System, which guides the selection of the 3-year Program of Projects, giving state and local leaders a broader view of projects under development.

The LRTP process began by identifying the challenges and opportunities for transportation across the state presented in the *Challenges and Opportunities* report. This report defines the baseline conditions of Tennessee's transportation system and assesses the many uses and demands placed on the system. The report also examines how these demands influence travel, transportation, and development patterns in Tennessee, and it identifies trends and issues that must be considered as part of the planning process. Next, the transportation goals and objectives were decided for Tennessee's multimodal transportation system. These address the basic necessities of moving a growing, diverse, and dynamic population; supporting the State's economy; improving safety; building communities; and environmental stewardship. Once the goals and objectives were established, each was matched with the needs and plans for all modes of transportation which resulted in a more detailed description of the potential projects for meeting the state's goals. This *Modal Needs* report examines each component of the state's transportation network to identify the long-term needs of the transportation modes to 2030. The report highlights the purposes of transportation system performance measures and identifies key measures to be used to periodically evaluate the state's performance in implementing its modal programs and specific transportation projects.

The projects identified through the modal needs study are measured against a set of criteria to determine the value and effectiveness of each project. This allows all Tennesseans to see how projects will perform, how they relate to an overall statewide multimodal system and how they will impact the citizens of Tennessee. The costs involved in transportation improvements were assessed and a plan for financing improvements was also developed.

Implications for the Nashville Region

TDOT will utilize the LRTP to guide future investment decisions and prioritize projects, including those in the Nashville region. The LRTP provides valuable baseline data and future forecasts of expected transport of passengers and freight and its impacts on local infrastructure. Each component of the overall document offers trends and implications for each transportation sector (air, rail, water, bicycle and pedestrian, etc.) by reviewing existing plans and policies in major areas of the state, including the Nashville region, that can be used for future freight planning.

The LRTP can be used to determine where future growth is expected and gaps in each service area. For example, according to the plan's *Challenges and Opportunities* section, a preliminary assessment of the transportation system reveals that for current traffic conditions, capacity is reasonably sufficient in most intercity travel corridors; however, within the metropolitan areas and several corridors extending from the metropolitan areas, congestion is a growing concern. Urban areas have fewer highway lane miles than rural areas, but accommodate more vehicle travel than do rural areas, with more than 36 billion Vehicle Miles Traveled (VMT). Increased travel in new suburban areas has also resulted in traffic congestion in the larger metropolitan locations. Because much of Tennessee's recent growth has occurred in suburban areas, commuting patterns are not only suburb-to-city, but also are increasingly suburb-to-suburb and city-to-suburb, thus creating new demands on the state's transportation system.

Rail system trends and implications revealed that in 1998, 80 million tons of freight valued at $33 billion was moved by rail. In addition, freight moved by rail is expected to increase to 137 million tons by 2020. While shipment of freight over rail is a viable and growing alternative to shipment by truck, the projected growth in rail traffic raises the possibility of increased rail/vehicle conflicts, traffic delays, and noise impacts. While increased use of freight rail could decrease demands on Tennessee highways, it could also require increased public investment in rail-related infrastructure to add sufficient capacity. Intermodal connectors and access may also require additional investment.

Evaluation of existing infrastructure, demographic trends, environmental implications, and existing plans and policies result in recommend projects based on this existing data to supplement where existing plans are lacking. For instance, in addition to improving key highways, TDOT will invest up to $170 million in program to enhance the speed and safety of freight transport. One way they will accomplish this is to upgrade Tennessee's shortline railroads to the new, heavier 286k-pound standard, which is the current loading capacity favored by the Class 1 railroads and many major shippers. If unable to meet this standard, shortline railroads and the shippers they serve would remain in an unfavorable competitive position. This program will provide 85 percent matching funds, to maintain the state's ability to ship goods to and from many industries that provide a vital employment base in rural areas. Besides providing useful data that can be used to help plan for future freight improvements in the Nashville region, the TDOT LRTP looks at how local efforts can come together to function at a statewide level.

TENNESSEE RAIL SYSTEM PLAN

The Tennessee Department of Transportation (TDOT) developed a comprehensive rail plan to provide policy, procedural, and system management guidance defining a new role for the department in rail system projects. Although, this plan was completed in early 2003, it is the most current data available. The purpose of the plan is to identify the most promising corridors for establishing new inter-city passenger rail service in Tennessee. Using various criteria to select the most promising corridors, the four most promising corridors for development of intercity passenger rail are:

- Memphis-Nashville
- Louisville-Nashville-Chattanooga
- Chattanooga-Knoxville-Bristol
- Nashville-Knoxville-Bristol

The development of a Rail System Plan by TDOT reflects a need to better understand the current role of railroads in Tennessee and perhaps most importantly, understand the potential role that railroads can play in the future of passenger and freight transportation currently transported on the interstate highway system. The development of the Rail System Plan involved work by the TDOT Public Transit, Rail and Waterways Division, public involvement, and analytic and engineering support.

The Rail System Plan provides an overview of the Tennessee rail network and identifies the important role that both the Class 1 and the short line railroads play in the state. Forecasts of future rail freight traffic on Tennessee railroads show that traffic on the railroads is expected to increase 50 percent by the year 2020 from 2002 levels. This means that there will be more, faster, and longer freight trains in the future. It is apparent that the efficient movement of rail freight traffic will continue to be essential to the economy of Tennessee.

The rail planning process also focused on the fact that there is no direct all-Tennessee east-west rail link in the state. From the options available, two corridors that would reestablish an all-Tennessee direct east-west rail link were examined extensively to assess the role those corridors might play in meeting the objectives of passenger and freight transportation. These are referred to as the Basic Freight Rail Connection and the Planning Horizon Scenario.

According to the Rail System Plan, the State of Tennessee should plan to take the actions necessary to accommodate the projected growth in rail traffic. This includes maintaining and improving shortline rail infrastructure, adding additional intermodal rail facilities, and increasing rail service and safety levels should. The Planning Horizon Scenario for a multi-state east west rail connection demonstrates a need to coordinate with neighboring states to develop the action plans necessary to accommodate the expected growth in all freight traffic and to explore options to divert freight traffic from the congested highway systems to rail.

Implications for the Nashville Region

Findings from the Rail System Plan indicate a significant growth in rail traffic by 2010 as a result of constraints on building new highway capacity. The basic forecast suggests that by 2020 rail traffic will be 50 percent higher than the levels currently being experienced in the year 2002. Much of this increase will occur by the year 2010. This may well be the minimum level of growth expected on the rail system because the underlying forecasting methodology is predicated on an unconstrained transportation infrastructure. For this

reason, it is believed that more truck freight will shift to the railroads. However, limited access to the railroads, caused by inadequate intermodal facilities and congestion within existing rail yards may hamper this diversion from truck to rail. This has implications for the Nashville region as it is centered in the state and will be impacted by such growth and plans to improve rail facilities.

Rail traffic growth suggests a continuing need for the Nashville region to take the appropriate action required to sustain its rail infrastructure. This means ensuring adequate access to the railroads along with other rail infrastructure improvements, policies, or regulatory interventions that would enhance rail operations. Specific to the Nashville region, such enhancement efforts would consist of urban rail congestion relief efforts that include a Nashville Rail Bypass. Intermodal facilities identified in the Rail System Plan as strategic railroad infrastructure investment opportunities in the Nashville region incorporate a Nashville Competitive Access Intermodal Facility. Finally, a Nashville to Memphis rail passenger service would also impact the region by providing a potential alternative mode of transportation and relieving highway congestion.

TENNESSEE STATE AIRPORT SYSTEM PLAN

The purpose of the Statewide Airport System Plan (System Plan) is to provide a framework for the orderly, ongoing, and timely development of a system of airports that is adequate to meet the current and future aviation needs of the state. The document was completed in 2001 with the TDOT Long Range Transportation Plan Aviation System Plan component serving as an update in 2004. The update considers the State's six commercial service airports and 14 regional airports.

Immediately after the September 11, 2001 terrorist attacks, aviation activity throughout the nation declined dramatically, and the airports in Tennessee were no exception. Thus, all forecasts performed prior to the events of September 11, 2001 were reviewed for all segments of aviation, including passenger, cargo, and general aviation traffic. The updated airport system forecasts for the six commercial and 14 regional airports in Tennessee were prepared to include based aircraft, passenger enplanements, cargo tonnage, and aircraft operations for 2010, 2015, and 2030.

The 2001 system plan established goals and objectives for all 83 system airports, which were grouped into three classifications: Commercial Service (six airports), Regional (14 airports), and Community (63 airports). In addition, the relationship between airports and economic development was established. Next, activity forecasts were prepared for each airport and general facility needs were identified. The priority ranking system used to determine funding priorities was also revised and updated. Environmental factors were also considered. Finally, a set of projects (including their cost and timing) was prepared as input to the Aeronautics Commission CIP.

The tasks completed for the update included an inventory of facilities, aviation industry review, review and update of previous system plan forecasts, and development plans for each of the 20 airports included in this study.

Visits were made to each airport to take inventory of each facility and familiarize the team with existing and proposed future facilities and to explain the update process to local airport staff. An aviation industry review provided significant national, regional, and local aviation-related events occurring since the completion of the previous plan were covered such as the September 11, 2001 terrorist attacks as well as technological advances.

The State has a well-balanced aviation system comprising six commercial airports (to accommodate passenger and cargo airline activity), 14 regional airports (designed to meet the needs of higher performance general aviation aircraft—typically jets), community business airports (designed to meet the business aviation needs of communities), and community service airports (designed to meet the general aviation needs of communities). Although detailed facility requirements were not developed for the update, the data gathered for this study suggests the State Aviation System will be able to meet future aviation demand (i.e., passenger enplanements, cargo, and aircraft operations) provided the existing infrastructure is preserved and maintained and the development projects identified by airport sponsors are implemented in a timely fashion.

Implications for the Nashville Region

The Nashville International Airport is one of the two largest airports in the state with Memphis International serving as the other largest carrier. Located in the District's transportation hub and major urban center, Nashville is also at the convergence of three interstates (I-40, I-65, I-24) that provide connectivity throughout the region. However, an over-dependence on highway transportation leads to traffic congestion and lost time, which will, in turn, negatively impact economic growth. This combination of factors has driven efforts to promote intermodal transportation development that incorporates aviation.

Specific intermodal recommendations for the middle Tennessee area are shown in the table below. The table is a snapshot from the plan's Intermodal chapter. It provides a summary of the Middle Tennessee airports with key elements for intermodal opportunity. Airports noted under the Expansion column have existing efforts planned, under the Opportunity column could provide community/economic development opportunities through coordinating transportation facilities located in and around the airport, and airports listed under Development have strong population growth and should have planning undertaken to provide for greater transportation opportunities. The plan also recommends that the Department of Transportation establishes a policy to include state system airport locations as a part of planning for roadway projects in the state. A second recommended policy would be to establish an ongoing program for improving both the efficiency and aesthetics of roadway connections for the planned network of regional airport facilities.

Airport	Expansion	Opportunity	Development
Nashville International Airport (BNA)	X	X	
John C. Tune Airport (JWN)	X	X	
Cornelia Fort Airpark (M88)		X	
Smyrna Airport (MQY)	X		X
Outlaw Field (CKV)		X	X
Springfield-Robertson County Airport (M91)			X
Portland Municipal Airport (1M5)		X	X
Sumner County Regional Airport (M33)		X	X
Lebanon Municipal Airport (M54)		X	X
Murfreesboro Municipal Airport (MBT)		X	X
Dickson Municipal Airport (M02)			X
Ellington Airport (LUG)			X
Upper Cumberland Regional Airport (SRB)			X
Crossville Municipal Airport (CSV)			X
Tullahoma Regional/William Northern Field (THA)		X	
Winchester Municipal Airport (BGF)		X	

Source: HNTB Analysis

This plan summarizes recent trends in the aviation industry, while also outlining unique challenges and capital improvements for both Nashville International and other area airports, such as John C. Tune. Proposed improvements, like runway extensions and parking expansions, will help support efforts toward intermodal transportation in the Nashville area by developing these facilities in important areas where growth is forecasted to occur, such as the case in the Nashville Region. Offering a wide variety of transportation options will help reduce traffic on congested highways and promote a balanced approach to transportation that will provide greater mobility and reduce the high costs of continuous roadway improvements.

LATIN AMERICA TRADE AND TRANPORTATION STUDY (LATTS)

The Southeastern Transportation Alliance was formed in 1996 for purposes of undertaking the Latin American Trade and Transportation Study (LATTS). Members of the Alliance include Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, Missouri, North and South Carolina, Oklahoma, Puerto Rico, Tennessee, Texas, Virginia, and West Virginia, and the FHWA.

LATTS began on August 1, 1997 with the purpose of identifying trade opportunities with Latin America, evaluating infrastructure investments needed to support growth in international trade, and developing strategies to guide infrastructure investments. The premise of the study was the recognition that Latin America is poised for growth and that the recent boom in exports is a sign of things to come. Trade liberalization, which includes lowering and eliminating tariffs, combined with economic restructuring and privatization in Latin America presents huge trade potential. Following the completion of

LATTS (Phase I) in March 2001, the Study was taken to the next level under the name of LATTS II.

The study's principal goals are:

1) To strengthen the transportation planning process, especially the intrastate component;
2) To enhance the analytical basis for use in developing statewide transportation policy, planning and programming, including the integration of analytical and data systems especially those that encompass more than one mode of transportation;
3) To monitor and document the implementation of the recommendations contained in the LATTS I report;
4) To facilitate additional implementation of the recommendations contained in the LATTS I report; and,
5) To develop appropriate, fact based, and credible communication formats and procedures for informing the elected and appointed officials in both the private and public sector as well as the general public of the benefits, costs, opportunities and problems associated with the implementation or nonimplementation of various transportation related investment recommendations.

This study examined international trade opportunities on a state-by-state, country trading partner basis. It included the development of a commodity flow database (commodities, origin/destination, mode of transportation), forecasts, and assessments of 15 states' waterports, air cargo, rail and trucking system capabilities, systems, and needs. The study emphasized international trade, and the opportunities for states to help their economies by improving their international trade knowledge and capabilities. The study also included best practices in marine freight movement for the 33-deep water ports in the LATTS Strategic Ports network and assisted the jurisdictions in the region with their port-related planning efforts.

Implications for the Nashville Region

While LATTS is a multi-national study that involved 15 states (including Tennessee) and Puerto Rico, there are lessons to be learned for the Nashville Region. The overall goal is to help the Southeastern Transportation Alliance states develop their competitive advantages to maximize production and wealth at home while, at the same time, broadening their global market opportunities. Study findings regarding Tennessee's portion of the LATTS Strategic Transportation System were also included.

Although the main focus of LATTS was on the Alliance Region as a whole, some of the analyses were structured so that the transportation elements associated with individual states and commonwealths could be separately reported. In Tennessee, certain facilities identified for inclusion in the LATTS Strategic Transportation System are as follows:

- International Port of Memphis
- Two airports, viz:
    - Memphis International
    - Nashville International
- 1,391 miles of railroads
- 1,269 miles of mainline highways

The LATTS Strategic Transportation System comprises the main transportation facilities in the Alliance Region which are important in accommodating trade with Latin America. In some cases, it also includes facilities which may not be of great significance to trade with Latin America, but which nevertheless are important to the economic well being of the state or commonwealth. The system consists of all four modes typically used for freight transportation.

I-40/I-81 CORRIDOR STUDY

TDOT's Long Range Transportation Plan's 10-Year Strategic Investment Plan component established three interrelated core investment initiatives: Congestion Relief, Transportation Choices, and Key Corridors. The Interstate 40/Interstate 81 (I-40/I-81) Corridor from Bristol to Memphis was identified through this effort as a strategic statewide corridor. The purpose of the I-40/I-81 Corridor Feasibility Study, completed in April 2008, was to develop a more detailed understanding of the deficiencies of the corridor and to develop corridor level multi-modal solutions to address these deficiencies. The study considers improvements to the I-40/I-81 corridor, looks at parallel arterials to I-40/I-81 that could be used for local travel, examines rail lines that could be candidates for freight diversion from the interstate, and also considers major inter-modal hubs located along the corridor.

The study produced a prioritized list of multi-modal projects that can be considered by TDOT for the Department's transportation improvement program. Identified multi-modal solutions will address capacity, operations and maintenance, safety, freight movement, inter-modal connections, and economic access issues along the study corridor.

The study area for the I-40/I-81 corridor extends about 550 miles from Memphis to Bristol, and traverses 27 of the 95 counties within Tennessee. The study area falls within nine of the twelve Rural Planning Organization (RPO) boundaries and eight of the eleven Metropolitan Planning Organization (MPO) and Transportation Planning Organization (TPO) areas. Numerous cities including Nashville, Memphis, Jackson, Lebanon, Cookeville, Crossville, Knoxville, Sevierville, Jefferson City, Morristown, Ridgeway, Kingsport, Johnson City and Bristol are dependent upon this corridor for commerce, tourism, and daily access. The study area also includes parallel Class I railroads, including their junctions with short-line railroads.

The report describes the results of a screening analysis conducted on possible multi-modal solutions for the I-40/I-81 corridor. The analysis was performed on four

"packages" of initial solutions that exhibited strong potential for addressing corridor deficiencies:

- Roadway Capacity – providing additional capacity to I-40/I-81 by widening the existing interstate
- Corridor Capacity – providing additional capacity to parallel highway routes (by-passes or widening parallel arterials) as well as implementing high capacity transit projects in Memphis and Nashville
- Rail-Focused Improvements – diverting freight from trucks traveling along I-40 to rail lines
- Intelligent Transportation System (ITS)/Operational Solutions – providing variable message signs, traveler information, weather management systems, interchange improvements, truck climbing lanes, etc. This package also includes improvements to existing high occupancy vehicle (HOV) lanes along I-40 in Memphis and Nashville.

Implications for the Nashville Region

The I-40/I-81 corridor travels east/west through the state of Tennessee and provides direct access to and from the Nashville region. The heavily traveled corridor carries a large amount of freight and deals with a variety of capacity and volume issues. This study looked at the corridor's deficiencies to develop corridor level multi-modal solutions that will improve freight and commuter transport throughout Nashville and surrounding regions. Existing data and forecasts of auto and truck delays from the study indicate the need for capacity improvements as well as ITS and other solutions to divert traffic from the facility.

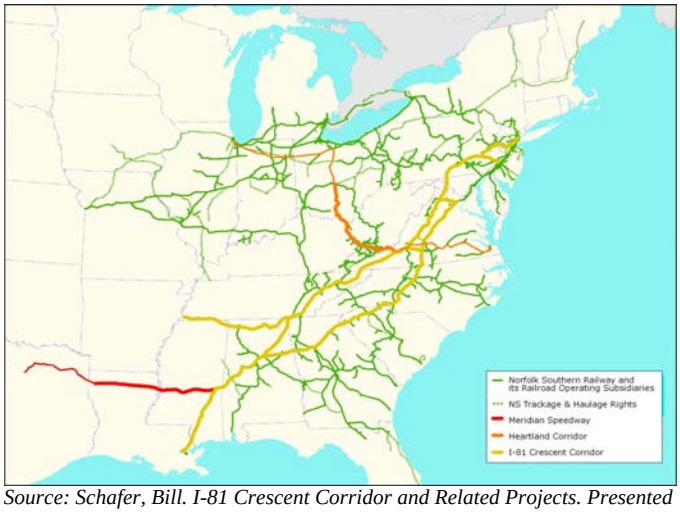
Specifically the greater Nashville area faces many challenges in developing lane solutions along the corridor. Physical attributes of I-40 in the Nashville area reflect deficient interchange spacing, substandard acceleration, deceleration and weave areas, frequently spaced major interchanges, and limited right-of-way. An example of a short-term recommendation is to modify the current HOV lanes on I-40 east to HOT lanes, allowing use by single-occupant vehicles willing to pay a toll through the use of electronic transponders. In the longer term, two parallel managed lane strategies should be considered and studied further. Solutions such as these, along with new interchanges or interchange improvements identified to increase access to areas along the study corridor are recommended in the region.

NORFOLK SOUTHERN CRESCENT CORRIDOR

In the past several years, the rail industry has embarked on a number of "public-private partnerships" designed to secure public funding for capital investments that increase rail capacity in designated high volume freight corridors such as The Heartland Corridor by Norfolk Southern and the National Gateway project by CSX Corporation. One of these initiatives, the $2 billion Crescent Corridor, has been developed by Norfolk Southern

Railroad (NS) in conjunction with federal, state and local governments. The proposed route runs in a crescent shape along the railroad's southeast rail line paralleling Interstate 81 (I-81), a key congested highway route connecting markets in the Northeast, Mid-Atlantic, and Southeast United States (see Image).

Norfolk Southern Crescent Corridor



Source: Schafer, Bill. I-81 Crescent Corridor and Related Projects. Presented at the I-81 Corridor Conference, Carlisle, PA, September 11, 2007.

The goal of the Crescent Corridor is to divert motor carrier traffic from I-81 by adding intermodal capacity, upgrading track infrastructure, and building intermodal terminals. The project is slated to be completed in 2013[1] and will terminate in Memphis. One of the key track improvement areas will be between Memphis and Roanoke[2] and NS is actively looking for site locations to construct a new intermodal terminal to support the project.

The corridor is 1,400 miles long and 28 new trains daily would be expected to go into service along with improvements to rail yards along the corridor. Construction on the first phase began in 2008. The Crescent Corridor's public benefits include improved roadway safety and air quality, stemming from the projected reduction of trucks on highways.

Implications for the Nashville Region

The Crescent Corridor would expand the entire NS network from the Northeast to the Southeast with implications for the Nashville Region's traffic congestion, air quality, and access to the Memphis freight network. The Corridor has the potential to significantly improve rail access between Memphis, Knoxville, and major northeast metropolitan areas

[1] Remarks by Henry C. Wolf. Merrill Lynch Global Transportation Conference, New York, NY, June 14, 2007. http://www.nscorp.com/nscportal/nscorp/Investors/Executive%20Speeches/2007/hcw061407.html. Logistics Management. *Norfolk Southern Unveils Plans for $2 Billion Rail Corridor from New Orleans to New Jersey.*

[2] Schafer, Bill. I-81Crescent Corridor and Related Projects. Presented at the I-81 Corridor Conference, Carlisle, PA, September 11, 2007.

served by NS, including Washington, D.C., Philadelphia, and New York. A Memphis regional terminal will be an anchor for the Crescent Corridor, and the new facility will help make possible truck-competitive freight transportation between the Nashville Region and major Northeast markets. The Crescent Corridor and the Memphis intermodal terminal will expand the role of freight rail in the Nashville Region with recently approved TIGER funds.

The Crescent Corridor is anticipated to absorb more than one million truckloads of freight from the highways to the rails annually, saving the U.S. more than 170 million gallons of fuel per year. This will not only relieve traffic congestion throughout the region but also help the environment by removing trucks from long-haul transport. While focusing primarily on domestic traffic, the Corridor will also improve transit time to the Port of Norfolk as well.

Freight in the Nashville Region

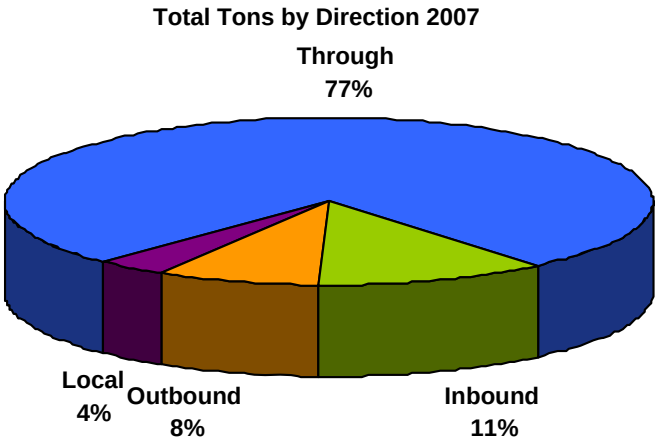
The Nashville region is serviced by all modes of goods movement including highway, rail, air, and barge facilities and is situated at the convergence of three major U.S. interstate highways: I-40, I-65, and I-24. The area is served by numerous freight carriers with terminal locations throughout the metropolitan region. The Cumberland River provides river barge access to the Gulf of Mexico, and CSX Transportation serves Nashville with class I rail access via Radnor Yard, an intermodal switching yard in south Nashville. The Nashville International Airport is the source of most inbound and outbound air freight. A map of the regional transportation network can be seen in **Exhibit 2.**

Using the Transearch data set from IHS Global Insight, a 7 county overview of the 2007 top commodities shipped to, from, and through the region by tons and by mode and a review of producers and attractors of freight by zip code revealed that Nashville's freight infrastructure carried a significant volume of freight traffic in 2007 with approximately 298 million tons. While all four modes of transport – truck, rail, water, and air – are represented, trucking signifies the majority of freight volumes carried in the region. Of the total tonnage moving in the Nashville region, 82 percent is moving by truck which makes it the primary form of goods movement, while the air mode provides the smallest volume of goods movement with less than 1 percent of the total tons. The other modes, water and rail, play a key role in the region and carry 3 percent and 15 percent of the regions freight respectively. **Exhibit 1** shows the total tons by direction and mode.

EXHIBIT 1 – TOTAL TONS BY DIRECTION AND MODE

2007	Truck	Rail	Air	Water	Total
Inbound	22,986,773	**2,596,042**	23,910	7,157,439	32,764,164
Outbound	20,827,788	1,501,328	45,589	318,307	22,693,012
Local	13,765,307	42,990	0	322	13,808,619
Through	187,809,349	41,096,250	0	0	228,905,599
Total	**245,389,217**	**45,236,610**	**69,499**	**7,476,068**	**298,171,394**

Source: Transearch Data



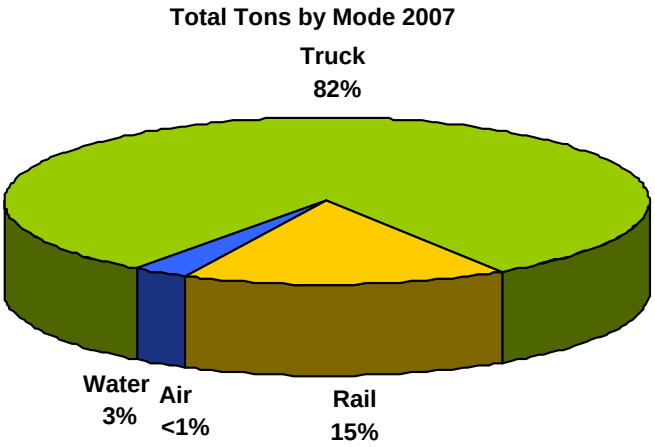
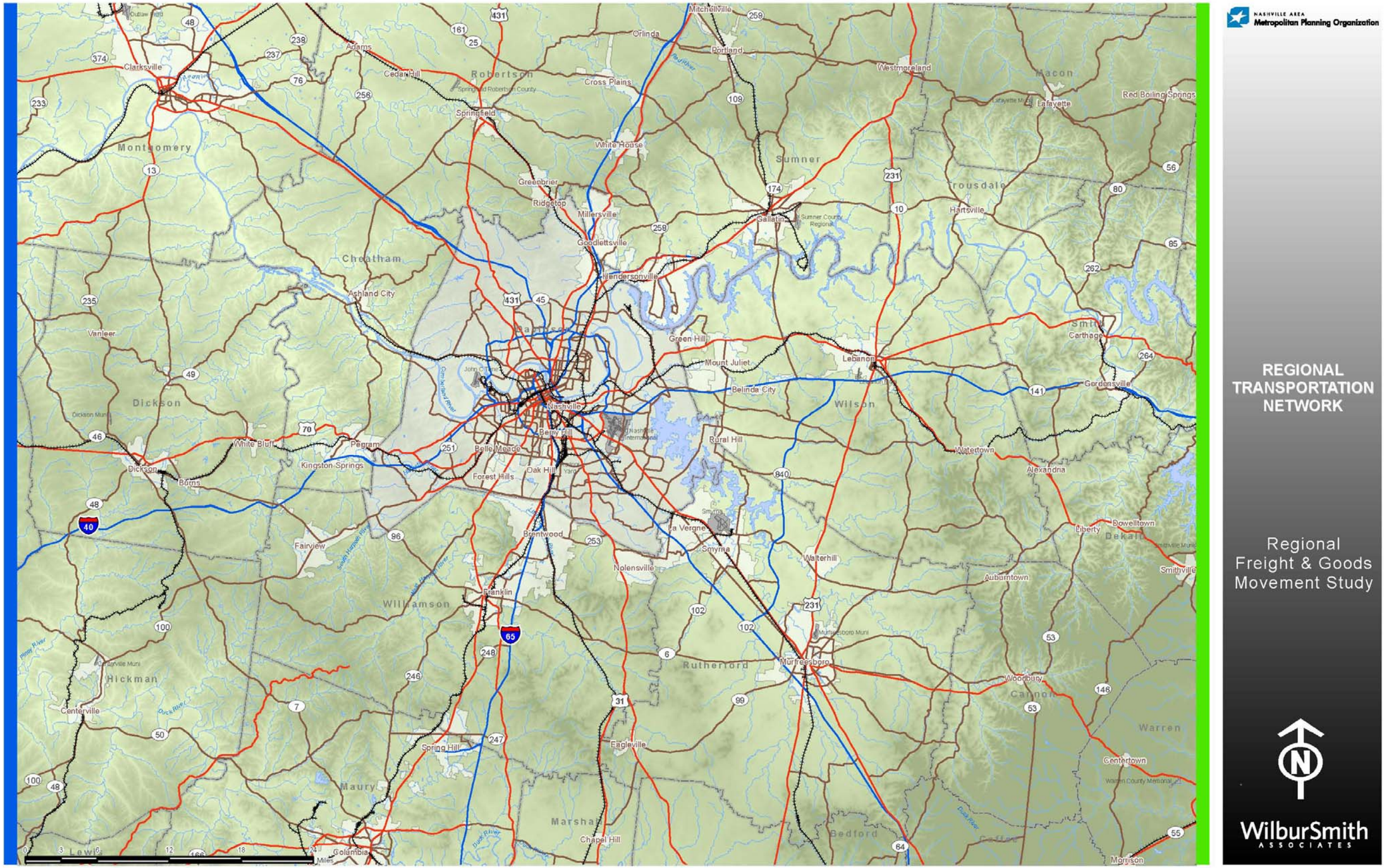


EXHIBIT 2 – REGIONAL TRANSPORTATION NETWORK



Inbound and outbound logistics are a vital part of the supply chain process. Once goods are produced, they must be shipped to their final destination. "Inbound" freight is freight that is entering the region and "outbound" freight is freight that is exiting the region from a supplier or manufacturer. These terms represent key commodities originating (outbound) and terminating (inbound) in the Nashville region. "Local" freight represents freight that is traveling within the region – it originates and terminates in the area. "Through" freight enters and exits the region, with no origin or destination in the area.

As shown in **Exhibit 1**, a substantial portion of the total freight traffic traversing the Nashville region is through traffic, with no origin or destination in the area. Looking just at tonnage based in the area (excluding through traffic), Nashville is a medium sized freight market with a typically heavy reliance on the truck mode: 82 percent of area-based tonnage moves by truck, which is slightly above the 79% national average. The rail share of this volume is half the U.S. average, but that is common in markets where the water mode is also active. The smaller inbound and outbound volumes are fairly well matched - in the neighborhood of 18 percent.

In comparison to Knoxville and Memphis 2007 Transearch data for truck, air, and water moving inbound, outbound, and locally, Memphis experiences more freight tons than Nashville and Knoxville in most of the comparable categories (**Exhibits 3 and 4**). Memphis sees the most inbound and outbound truck tons as well as the most air and water freight tons moving inbound and outbound. The large amount of freight that Memphis sees can be attributed to its location along the Mississippi River, near Memphis International Airport (the busiest airport in the state in terms of freight), and at the convergence of major north/south and east/west interstate routes.

In comparison to Knoxville, Nashville sees more inbound water freight while Knoxville experiences more outbound and local water freight movement. Memphis also has more air and water freight than Nashville and Knoxville except for local water freight where Knoxville sees more tons than both Nashville and Knoxville. Even though Memphis sees much more inbound and outbound truck freight than the other two comparison cities, Nashville sees more local truck traffic than both Knoxville and Memphis.

EXHIBIT 3 – TOTAL TONS BY DIRECTION AND MODE, KNOXVILLE

2007	Truck	Air	Water
Inbound	12,193,823	17,478	1,879,300
Outbound	9,112,786	18,958	912,998
Local	2,509,810	0	4,096

EXHIBIT 4 – TOTAL TONS BY DIRECTION AND MODE, MEMPHIS

2007	Truck	Air	Water
Inbound	44,840,963	1,067,725	14,553,607
Outbound	30,540,299	847,226	3,957,439
Local	45,389	0	0

While the majority of total freight in the Nashville region is through traffic, the 7 county overview of 2007 top commodities shipped to, from, and through the region and an analysis of producers and attractors of freight by zip code revealed important information about the top producers and receivers in the area as well as the amount of inbound and outbound freight by mode. **Exhibit 5** shows the top zip code producers for all modes.

EXHIBIT 5 – TOP ZIP CODE PRODUCERS (ALL MODES), 2007

Area Name	Total Outbound Tons 2007
Nashville	8,187,536
Murfreesboro	1,767,362
Lebanon	1,458,614
Smyrna	1,391,849
Gallatin	1,290,276
Spring Hill/Maury	946,343
Portland	658,521
La Vergne	638,139
GoodlettsvilleSumner	454,170
All Other	*2,987,792*
Total Outbound	**22,693,012**

Source: Transearch Data

Exhibit 6 shows the top zip code receivers for all modes in 2007. Compared to **Exhibit 5**, it is evident that Nashville is a stronger receiver than producer.

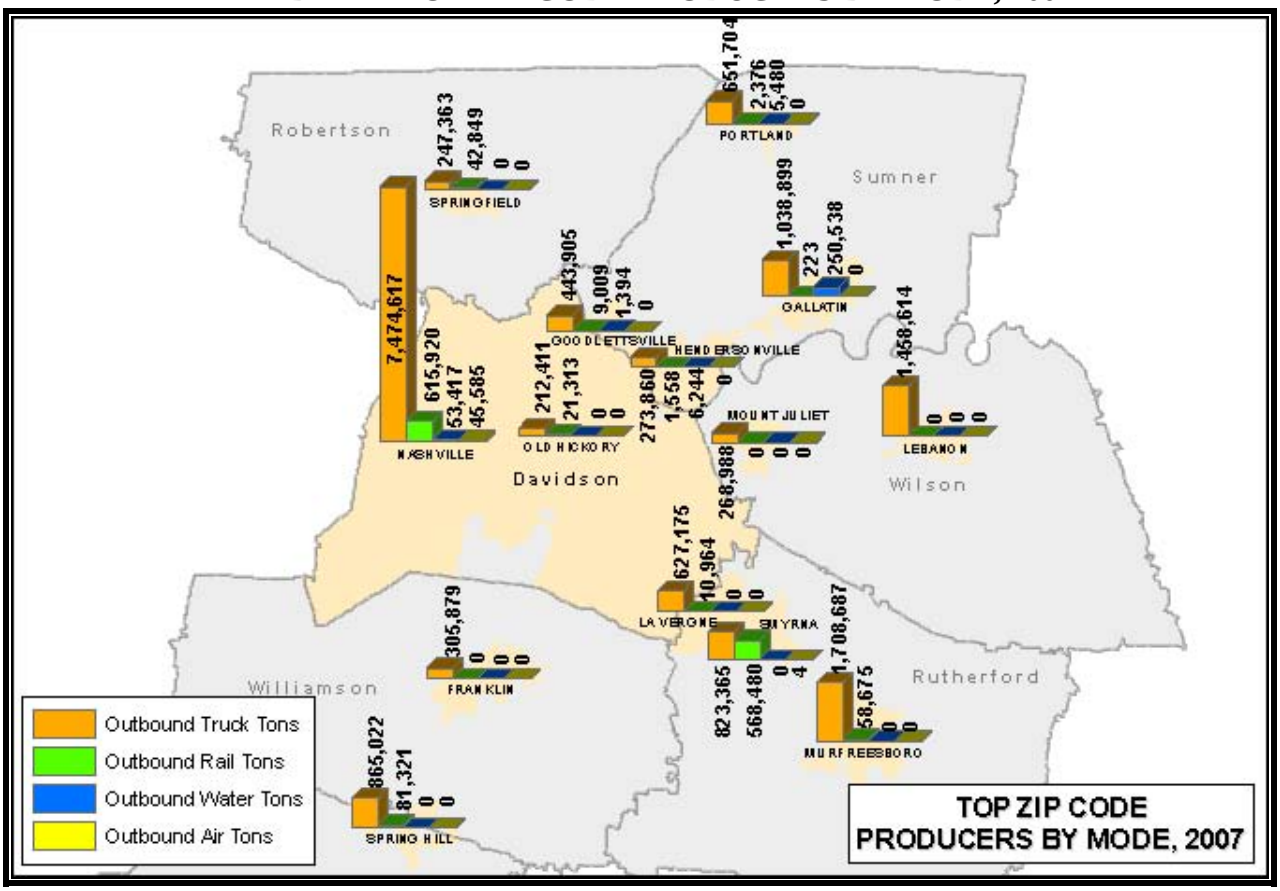
EXHIBIT 6 – TOP ZIP CODE RECEIVERS (ALL MODES), 2007

Area Name	Total Inbound Tons 2007
Nashville	12,837,602
Lebanon	4,069,664
Gallatin	3,949,295
Murfreesboro	2,727,949
Mount Juliet	1,266,302
Brentwood	737,238
Franklin	678,099
Hendersonville	616,482
Springfield	583,946
All Other	*3,750,492*
Total Inbound	**31,217,069**

Source: Transearch Data

Exhibit 7 shows the amount of outbound freight by mode with trucks representing a large majority of the total outbound tons. This table shows that Nashville is the largest area for outbound air, which consists of mostly miscellaneous mixed shipments. The miscellaneous mixed shipments category is a catch all category that is made up of less than truckload, general commodity type movements.

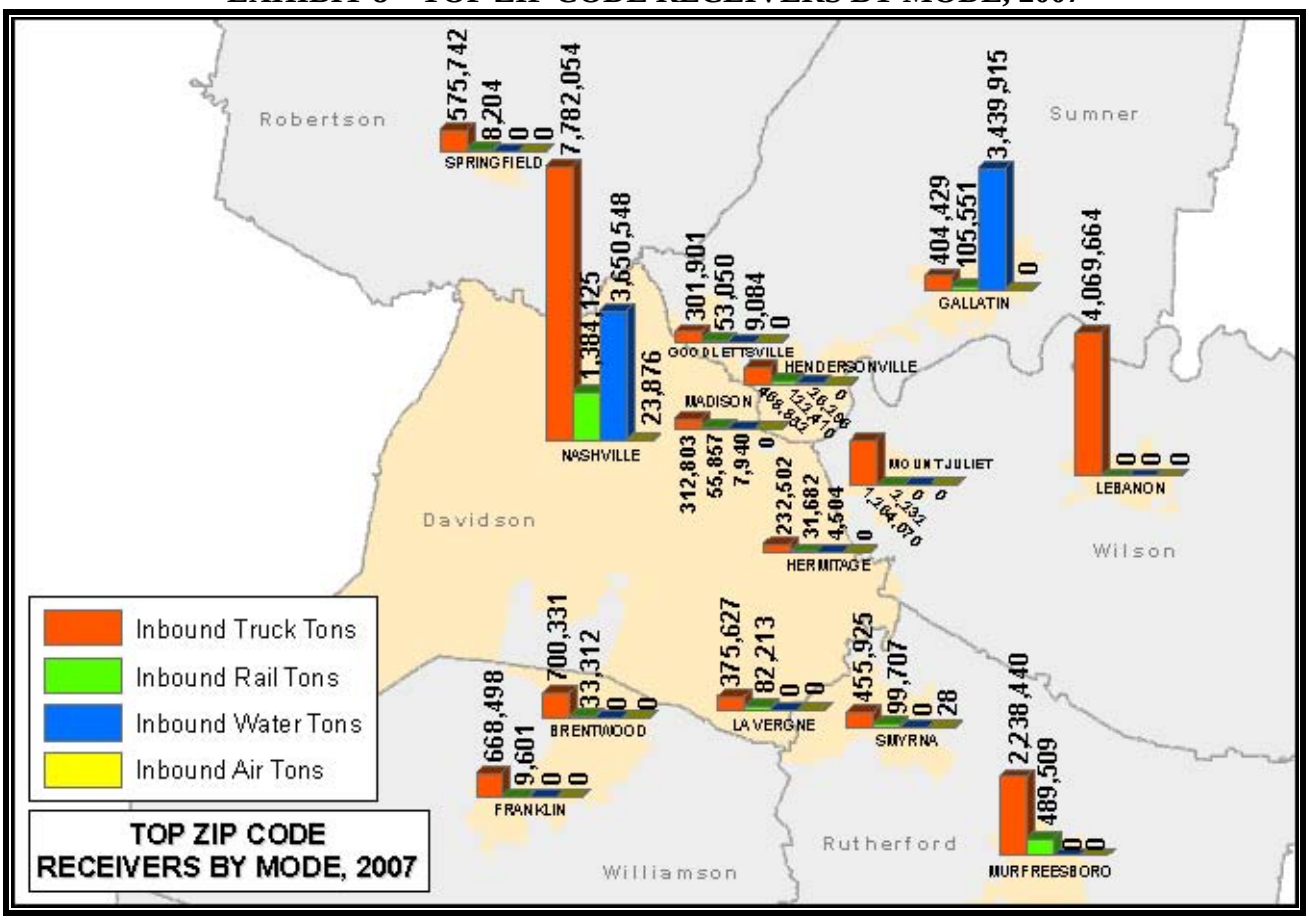
EXHIBIT 7 – TOP ZIP CODE PRODUCERS BY MODE, 2007



Source: Transearch Data

Exhibit 8 shows the amount of inbound freight by mode with trucks still representing a large majority of the total tons. Compared to **Exhibit 7**, almost all modes increase the total amounts of freight since the Nashville region receives more freight inbound than it ships outbound, however, the amount of freight shipped inbound by air decreases from the amount shipped outbound. Some modes increase substantially with the amount of water tons increasing over 2000 percent. Rail tons increase 42 percent from the amount of outbound compared with the amount of inbound.

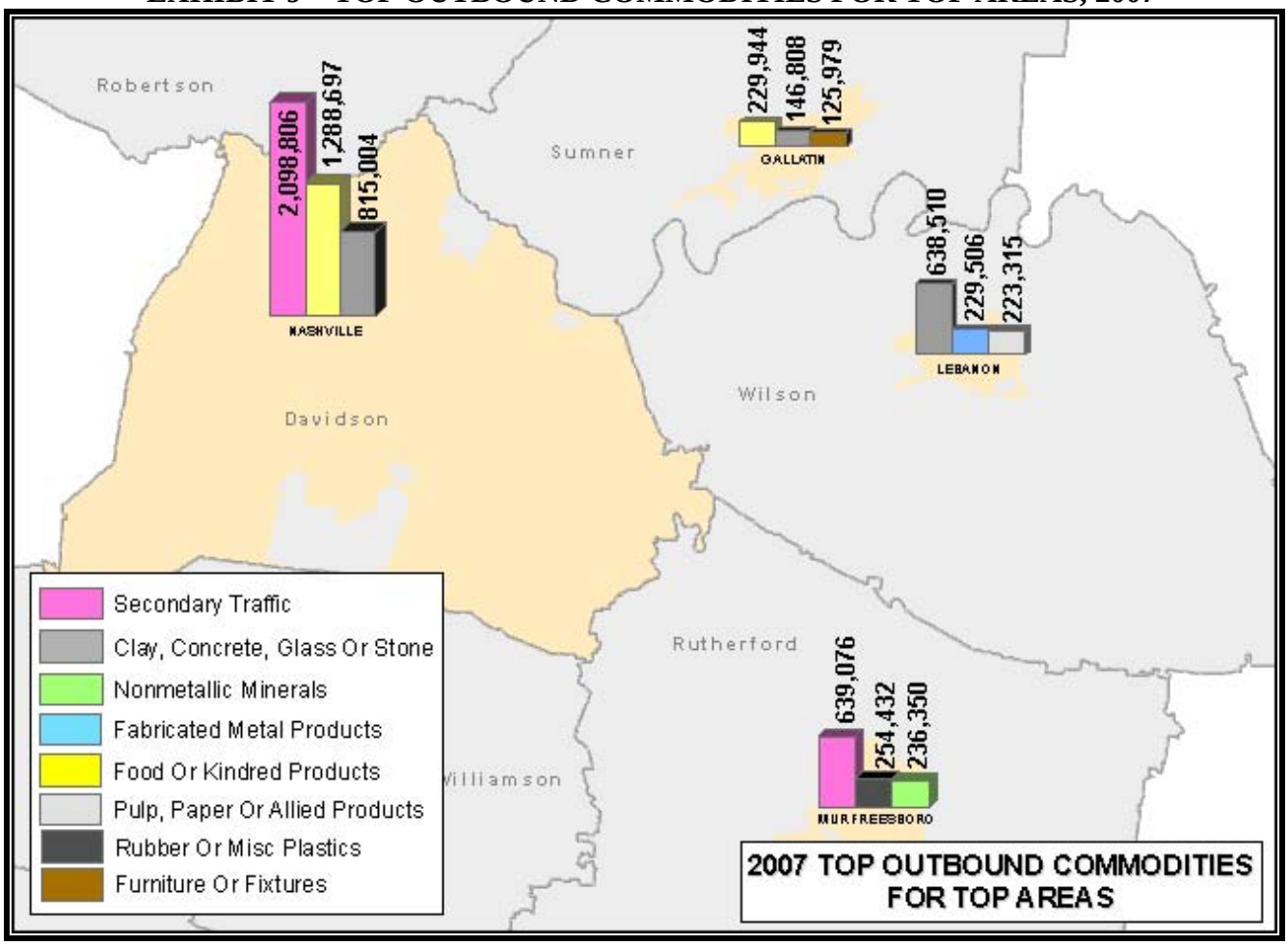
EXHIBIT 8 – TOP ZIP CODE RECEIVERS BY MODE, 2007



Source: Transearch Data

Exhibit 9 shows the top outbound commodities for top areas in 2007.

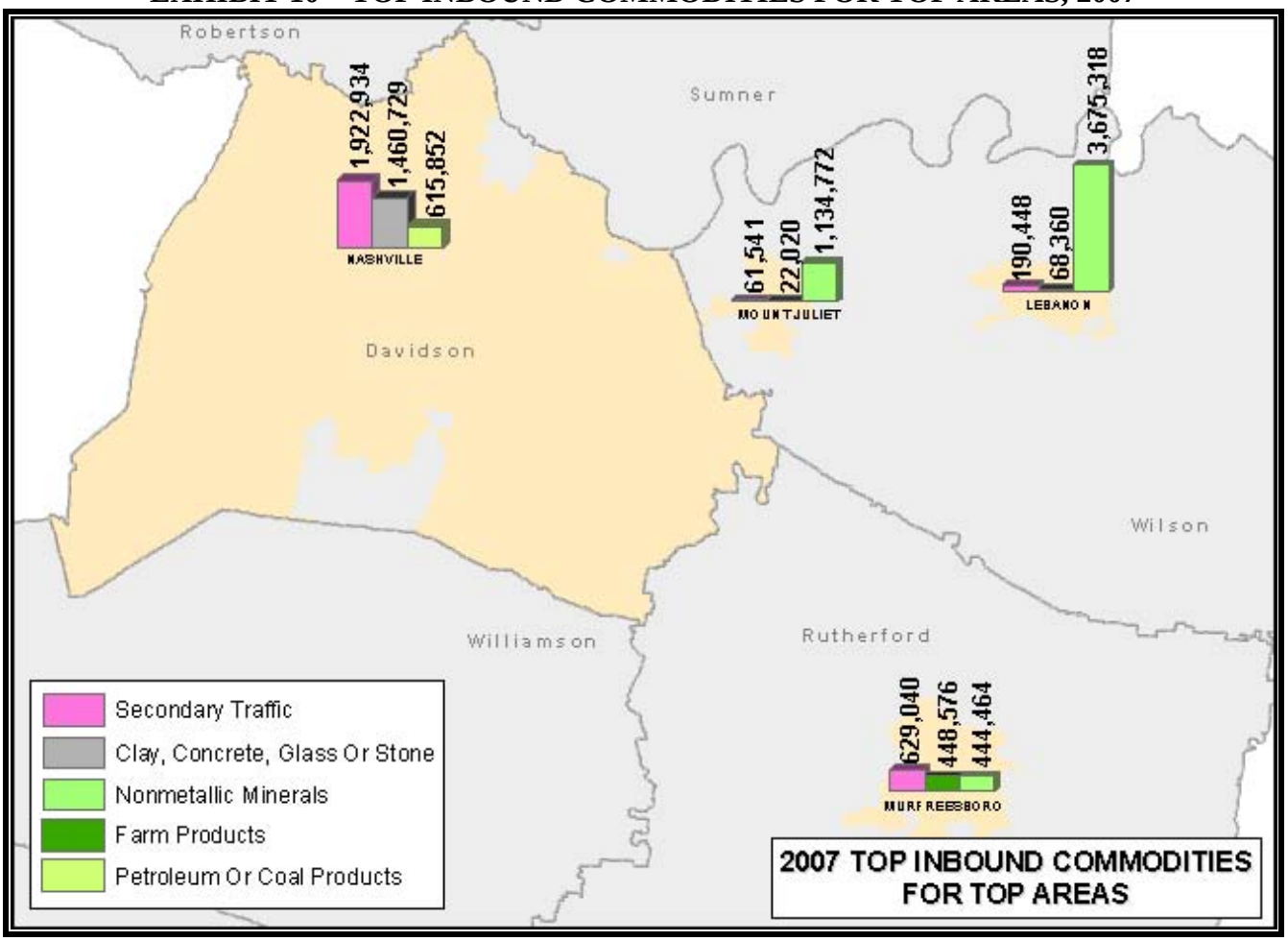
EXHIBIT 9 – TOP OUTBOUND COMMODITIES FOR TOP AREAS, 2007



Source: Transearch Data

Exhibit 10 shows the inbound commodities for top areas in 2007.

EXHIBIT 10 – TOP INBOUND COMMODITIES FOR TOP AREAS, 2007



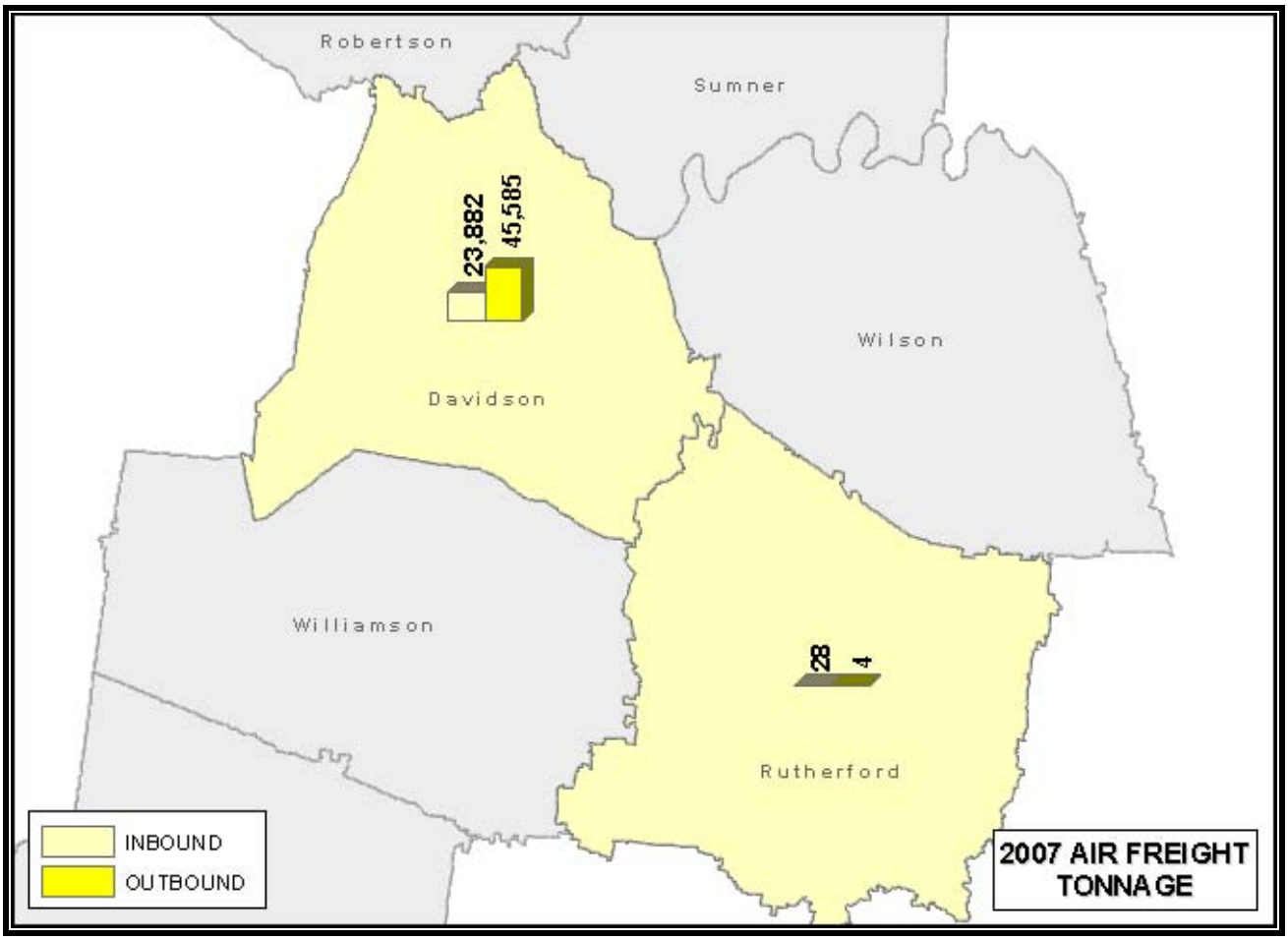
Source: Transearch Data

The Nashville region has a substantial amount of goods movement utilizing key local arteries. However commodities are the key to any successful economy, so their presence is required. Below is a summary of freight movement by mode.

AIR

Within the 5-county region of the Nashville Area MPO area there are three airports that have facilities capable of shipping and receiving goods by air. The largest and most active airport is the Nashville International Airport (BNA), with almost 70 thousand tons of freight annually in 2007. According to Airports Council International, BNA ranked 61 in total air cargo tonnage handled in North America in 2008. This far outranks the two other airports in the region, Smyrna/Rutherford County Airport and John C. Tune Airport (JWN). JWN is located on the west side of Nashville off Briley Parkway, and is owned and managed by the Metropolitan Nashville Airport Authority. It serves an important niche in Nashville's metropolitan economy by catering to corporate and personal aircraft users, but it does not offer scheduled air cargo services.

EXHIBIT 11 – AIR FREIGHT TONNAGE IN THE NASHVILLE REGION



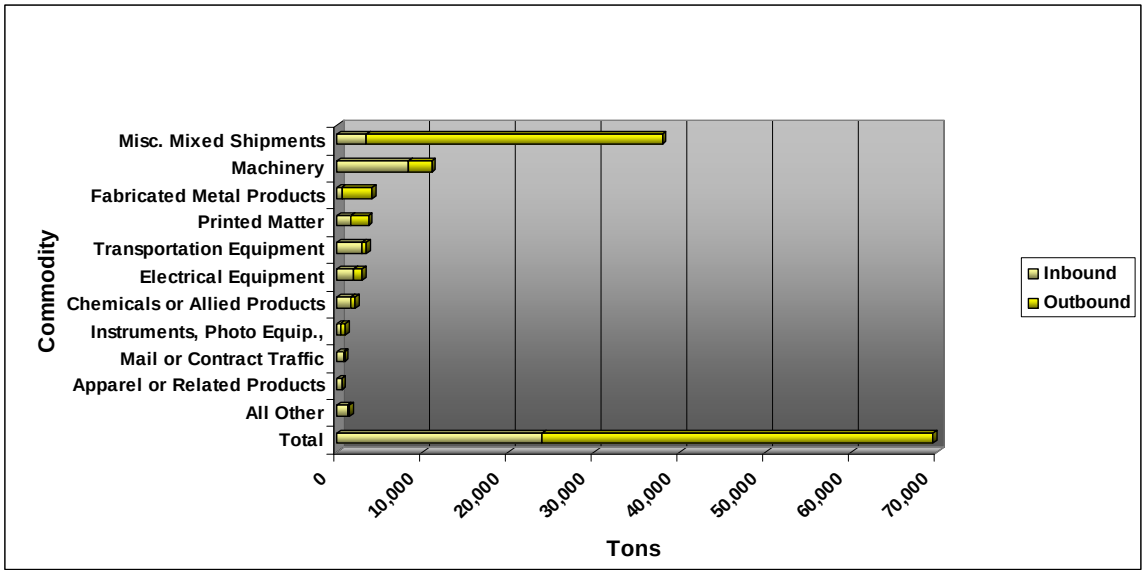
Source: Transearch Data

Nashville International Airport

The Nashville International Airport is second busiest passenger airport in the state following Memphis International. The Nashville Airport covers more than 4,460 acres and is served by 16 scheduled air carriers. The Nashville Air Cargo Link all-cargo complex is located across the airfield from the passenger facility. Several passenger carriers and FedEx Express utilize this facility. FedEx operates a regional sort center at the airport. UPS used to operate aircraft at this facility but, within the last two years, switched to trucking air cargo to their global hub at Louisville Sanford International Airport (SDF). Until 2009 the airport received freighter flights on China Airlines 747 aircraft six days per week. This China Airlines flight supported Dell Computer's nearby assembly and distribution facility. This flight now arrives in Birmingham and Dell products are trucked to their Nashville facility. The US Postal Service maintains an air transfer station at the airport to expedite the shipment of mail via belly cargo on passenger airlines. Additionally, there is an array of transfer agents, freight forwarders, ground trucking companies, and contracted cargo carriers that rely on the airport to conduct business.

The Air Cargo Link complex helps meet the high speed goods movement needs of area industries. Automotive manufacturers and health care facilities in particular rely on air cargo to keep their assembly lines moving and health care facilities supplied. The major commodities transported by carriers at the airport are comprised mostly of small mixed shipments. Other key commodities originating (outbound) and terminating (inbound) are machinery, fabricated metal parts, printed material, and transportation equipment specifically motor vehicle parts and accessories. Almost half of the freight moving outbound from the region is characterized as "miscellaneous mixed shipments" which is indicative of integrated express carrier traffic such as FedEx Express. **Exhibit 12** shows the top 10 air commodities.

EXHIBIT 12 – TOP 10 AIR COMMODITIES

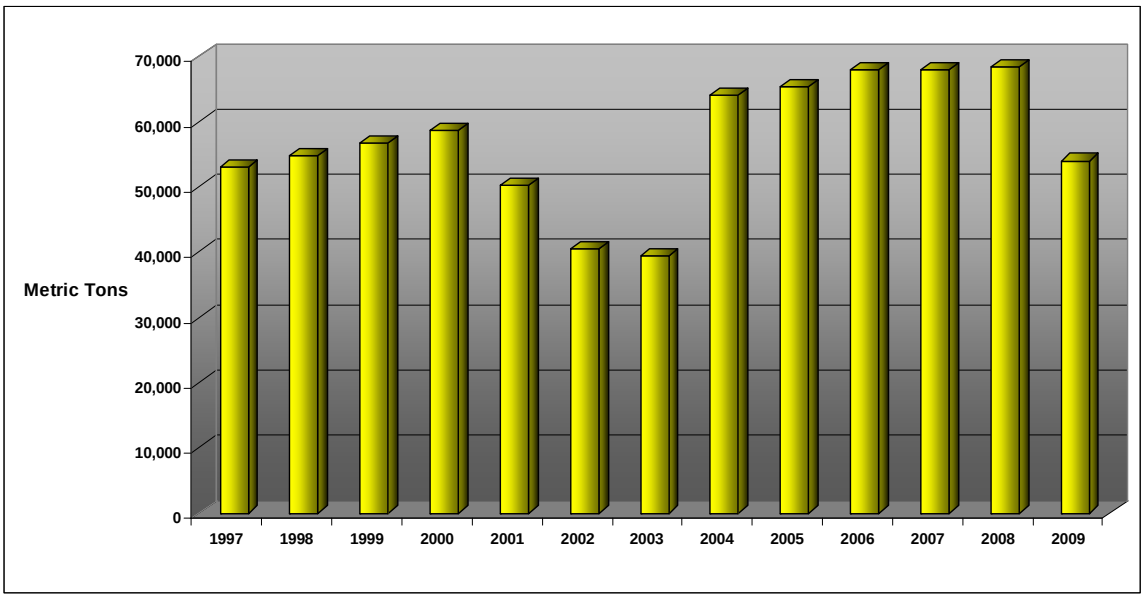


Source: Transearch Data

Increasing fuel and security costs have driven overall operating costs up substantially for the air industry. However, domestic cargo competition for goods that might be moved by air has grown due to carrier consolidation and trucking market-share gains. E-commerce, globalization, and increased competition are driving demand for just-in-time shipments, along with new technological advances and increased efficiencies.[3] Air cargo tonnage at the airport has increased steadily since 1997 after experiencing a dip in activity in the years following 9/11. Total air cargo tonnage equaled 69,499 tons in 2007 with the majority of air freight moving outbound (66 percent). Overall, the airport has experienced a .14 percent average annual growth rate in the last 12 years (see **Exhibit 13**). In 2007, approximately 55% of the cargo tonnage at the Airport was domestic air freight and about 45% was international air cargo. Air cargo dropped considerably in 2009 as a result of the China Airlines flight relocating to Atlanta or Birmingham.

[3] "Long Term Strategic Business Plan", Metropolitan Nashville Airport Authority, June, 2006.

EXHIBIT 13 – NASHVILLE INTERNATIONAL AIRPORT AIR CARGO TONNAGE 1997 – 2008 IN METRIC TONS



Source: Airports Council International

Air cargo traffic fell precipitously in the United States in 2008 and 2009 as a result of the global recession, a decline that was nearly twice as much as that experienced in 2001 from the 9/11 attacks. The severity of the air freight slump is partially driven by manufacturers seeking to correct large inventory "overhangs" that emerged in late 2008. The lingering decline in air freight is also the result of international shippers switching to maritime containerized shipping. While this mode is a much slower transport alternative, the cost savings are considerable. More importantly, it is unclear if this shift to container shipping will reverse as the economy rebounds.[4]

For the past decade, rising fuel costs and more cost conscious shippers have created a shift in focus from overnight express to time-definite service. Coupled with financial and cost-saving measures, air cargo shippers are increasing the use of trucks on longer routes that were traditionally served by aircraft. This modal shift is particularly pronounced within the integrated express carrier community. In addition, less-than-truckload (LTL) companies have become major competitors to air freight. These trucking companies enjoy a significant cost advantage over air cargo carriers because of lower capital costs for equipment and lower wage scales. These trends do impact interstate highways such as I-40 as integrated express companies rely more on trucking to airports from distant markets. Integrated express truck operations face the same traffic congestion issues other trucking firms face. Most congestion issues for integrated express carriers occur in metropolitan areas, near major bridges and, to a degree, in the vicinity of airports. This is critical since integrated express companies' measure on-time performance in one-minute increments as opposed to 15- or even 60-minute increments utilized by some trucking companies.

[4] "Memphis Freight Infrastructure Plan", IHS Global Insight, October, 2009.

Air transport can impact the local highway network when dealing with delivery of those goods between the airports and their origin or destination within the region. However, in comparison to the freight truck flows on the roadways, air freight contributes very little congestion to the region. However, an over-dependence on highway transportation leads to traffic congestion and lost time, which will, in turn, negatively impact economic growth. This combination of factors has driven efforts to promote intermodal transportation development that incorporates aviation.

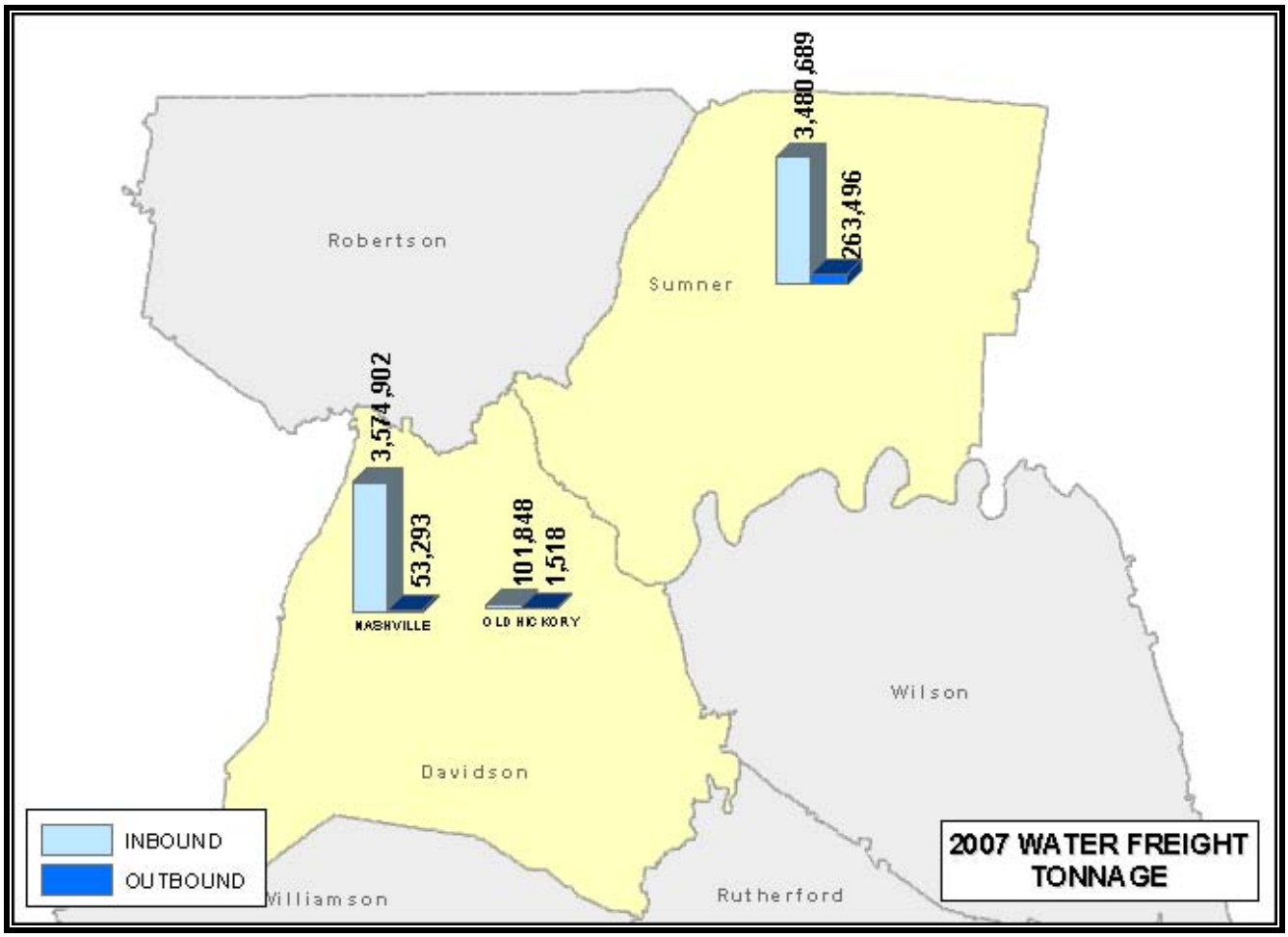
WATER

Nashville lies on the banks of the Cumberland River, an important waterway in the Southeastern United States that provides full river barge access to the Gulf of Mexico via the Ohio River (**Exhibit 16**). The waterway flows through southern Kentucky, looping through northern Tennessee before returning north to join the Ohio River after a course of 687 miles. Most of the river below Lake Cumberland's Wolf Creek Dam is navigable because of several locks and dams. Dams at various locations of the Cumberland River have created large reservoirs for recreation such as: Lake Barkley in western Kentucky and Lake Cumberland (the deepest lake in the Tennessee and Cumberland river valleys) in southern Kentucky; Cordell Hull and Old Hickory Lake to the east of Nashville; and Cheatham Lake to the west. Laurel Lake, on the Laurel River in southern Kentucky, the Dale Hollow Reservoir on the Obey River in northeast Middle Tennessee, and Percy Priest Lake on the Stones River in Nashville are each created by dams located just upstream from their respective confluences with the Cumberland River.

There has been minimal change since the Phase I study as far as the waterway freight system is concerned. While tonnage may vary slightly, many of the commodities remain the same and the majority of water transport is still mostly inbound. Most of the freight is delivered by truck to nearby locations – usually terminating within twenty to thirty miles of the riverside. Aggregates like sand and gravel are the chief form of outbound traffic, and primarily originate at locations adjacent to the riverbank.

As shown in **Exhibit 1**, water carries approximately 3 percent of the total tons of freight in the Nashville region. 96 percent of the total tons of water freight are inbound to Nashville and Gallatin (see **Exhibit 8)**. Water freight transport is very limited by the available docking and inland waterways available for cargo shipments. There are three main zip code areas within the study region that receive and ship water freight from Nashville, Old Hickory, and Gallatin. Gallatin and Nashville are almost equal in total water freight (**Exhibit 14**).

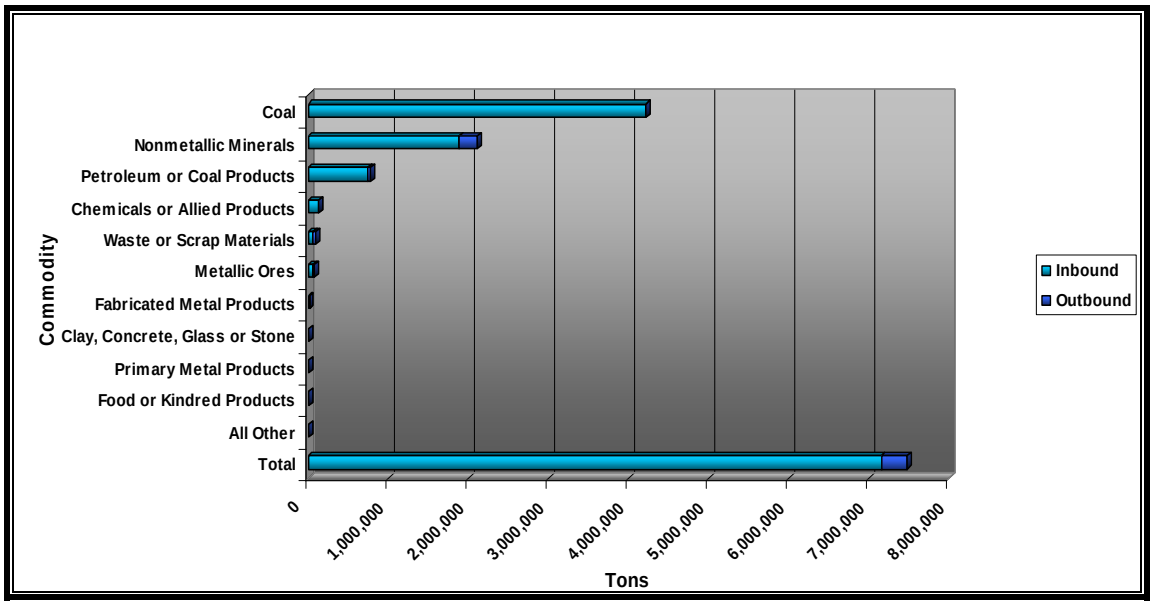
EXHIBIT 14 – WATER FREIGHT TONNAGE IN THE NASHVILLE REGION



Source:Transearch Data

For water freight, the two largest commodities are coal and nonmetallic minerals, accounting for 85 percent of the total water freight in the Nashville region. It is very common for these two commodities (coal and nonmetallic minerals) to be the largest commodities carried by barge due to the fact that heavy, non-perishable goods are most compatible with water movement. Most of the coal is delivered to the Gallatin power plant with 2.9 million tons annually followed by Nashville which receives 1.3 million tons of coal. Almost all the nonmetallic minerals (typically gravel and sand) traveling by water are going to Nashville. **Exhibit 15** shows the top 10 commodities transported by water.

EXHIBIT 15 – TOP 10 COMMODITIES FOR WATER

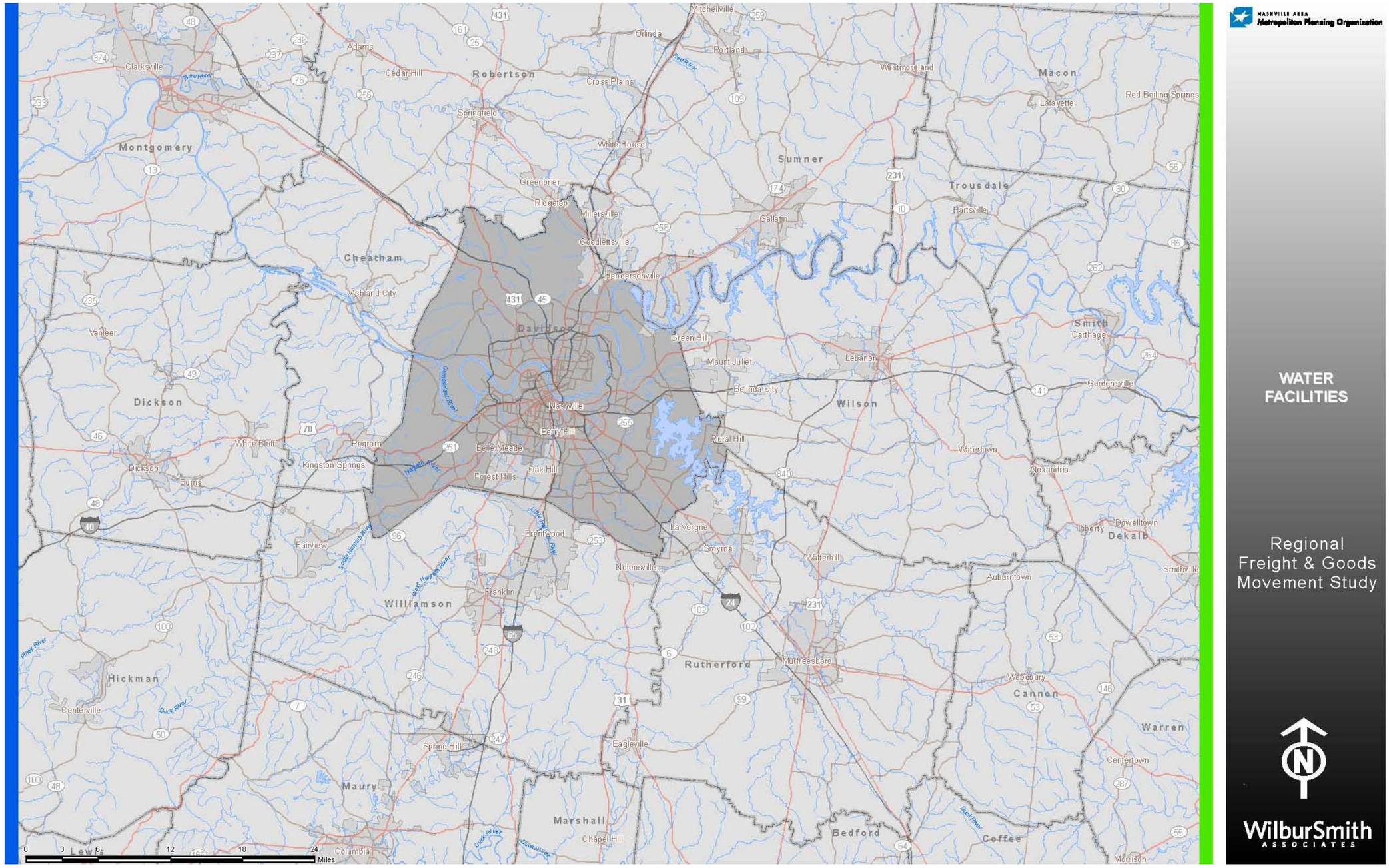


*Nonmetallic minerals are mostly gravel and sand.
*Petroleum or coal products are mainly petroleum refining products.
*Chemicals are mostly fertilizers and cyclic intermediates or dies.
*Metallic ores are mostly iron and bauxite or other alum ores.
*Fabricated metal products here represent mostly fabricated plate products, Fab metal NEC, and fabricated structural metal products.

Ingram Barge Company is the primary provider of water related goods movement. Access to and from the water is still considered adequate with sufficient roadway access and multiple interstate highways paralleling, crossing, and radiating from the Cumberland River. Steel for automotive plants, for example, is supplied in part by water and trucked south from Nashville. Substantial changes in traffic volumes are not anticipated, so current capabilities should remain sufficient. The inland waterway system is maintained by the U.S. Army Corps of Engineers, including its lock and dam structures at Hickory Lock and Dam upstream between Nashville and Gallatin and Cheatham Lock and Dam located downstream. For further discussion on the inland waterway system, please see the Phase I Freight and Goods Movement Study.

Waterway freight system conditions in short still remain adequate, and allow the river to continue as a low-cost method of supplying basic and heavy bulk goods to the Nashville Area community and industry. Should the waterway become victim to neglect, the primary goods it supplies to the Nashville Area must continue to move. If they cannot go to the at-capacity rail network, they will add many slow and heavy trucks to the road system, affecting congestion, air quality, and highway maintenance budgets. In the view of one of the stakeholder's interviewed, there should be a maritime presence on decision making boards and commission in the Nashville region and Nashville in general should work to be "more river friendly" by providing better river and rail access. Potential for increasing steel, outbound agricultural products, salt, and inbound fertilizers was also discussed (see **Appendix A**).

EXHIBIT 16 – WATER FACILITIES IN THE NASHVILLE REGION



RAIL

Nashville is a crossroads for rail as it is for the highway, carrying approximately 15 percent of the total freight tonnage for the Nashville region with 60 percent of this freight moving inbound. Nashville is served by a single Class I railroad: CSX Transportation, and its related intermodal unit, Radnor Yard. Nashville also has two short line railways, the Nashville & Eastern, extending from Nashville eastward toward Monterey, and the Nashville & Western, running a briefer distance west to Ashland City. Class I railroads are the primary freight haulers for most of the country. There are seven of them in the U.S. and Canada, and most are privately owned and operated. For this reason, improvements in capacity are generally part of a rail carrier's capital program with little input from the public sector.

CSX Transportation (CSXT) operates 22,000 route miles in 22 eastern and Midwest states, the District of Columbia, and two Canadian provinces. Its network stretches from Chicago, East St. Louis, Memphis, and New Orleans to the eastern Great Lakes to Boston, New York, Philadelphia, and Baltimore on the east and down the Atlantic coast to Tampa and Miami (see **Exhibit 17**). Besides a major rail yard and Intermodal terminal, CSX facilities in the Nashville region include TRANSFLO terminal services in Nashville and TDSI automotive distribution centers in Smyrna, Nashville, and Spring Hill.

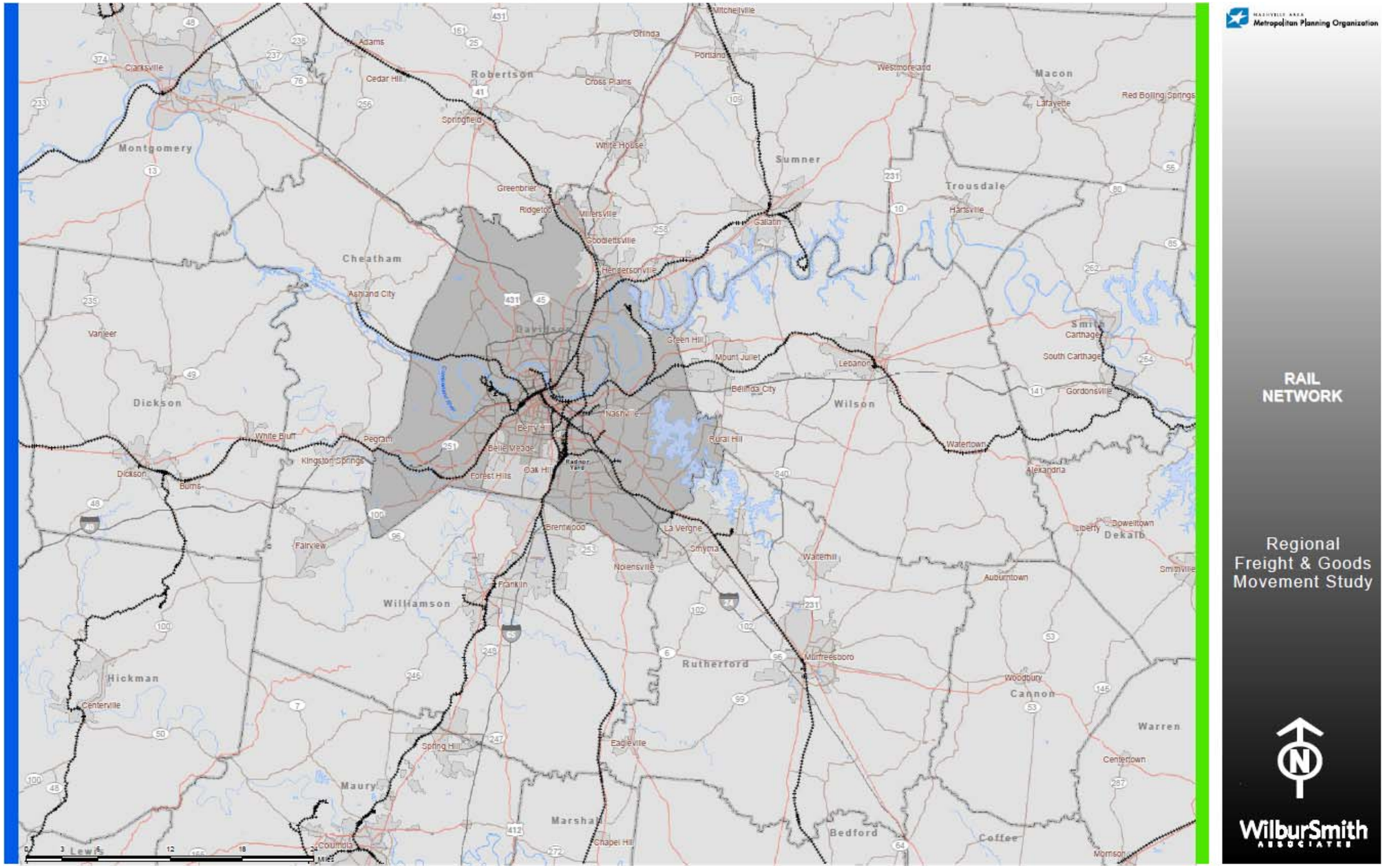
The orientation of CSX lines in Tennessee is chiefly north-south, with a spur west from Nashville to Memphis, but none eastward. A second Class I railroad, the Norfolk Southern (NS), has a network orientation running northeast-southwest. The NS has a curving east-west line between Memphis and Knoxville via Huntsville, Alabama and Chattanooga, skirting Nashville and lying over 100 miles to the south.

Nashville is a key hub in the CSX system, routing sixty trains per day through the Nashville Area toward five key cities: Atlanta, Birmingham, Chicago, Louisville, and Memphis (see Nashville region rail network in **Exhibit 18**). Forty of these trains simply pass through; the rest are “hubbed” in a classification yard, with the majority of railcars sent out again on a different train set – much like airline passengers change planes in an air hub.

EXHIBIT 17 – CSX SYSTEM MAP

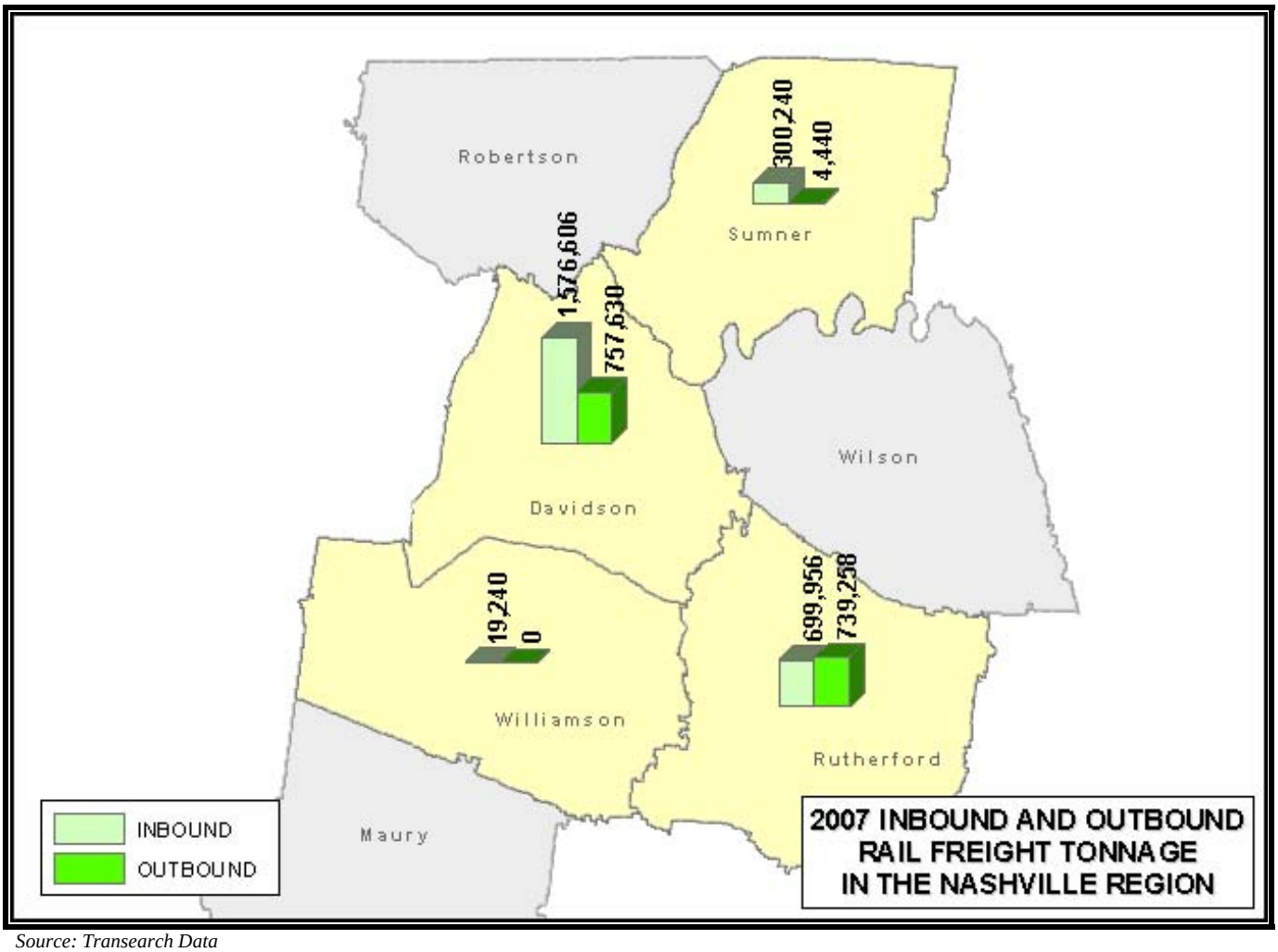
Source: https://www.csx.com

EXHIBIT 18 – NASHVILLE REGION RAIL NETWORK



Rail movements of freight are limited to the current rail infrastructure in place, but there are many more destinations within the region than with water or air modes of freight transport. At a county level, Davidson and Rutherford are the major producers and consumers of rail freight. When it comes to local rail transfers, there are only a few between Davidson County and Sumner County as well as between Rutherford and Sumner Counties. Nashville and Gallatin are key receivers of local traffic, and Murfreesboro and Nashville are key local producers.

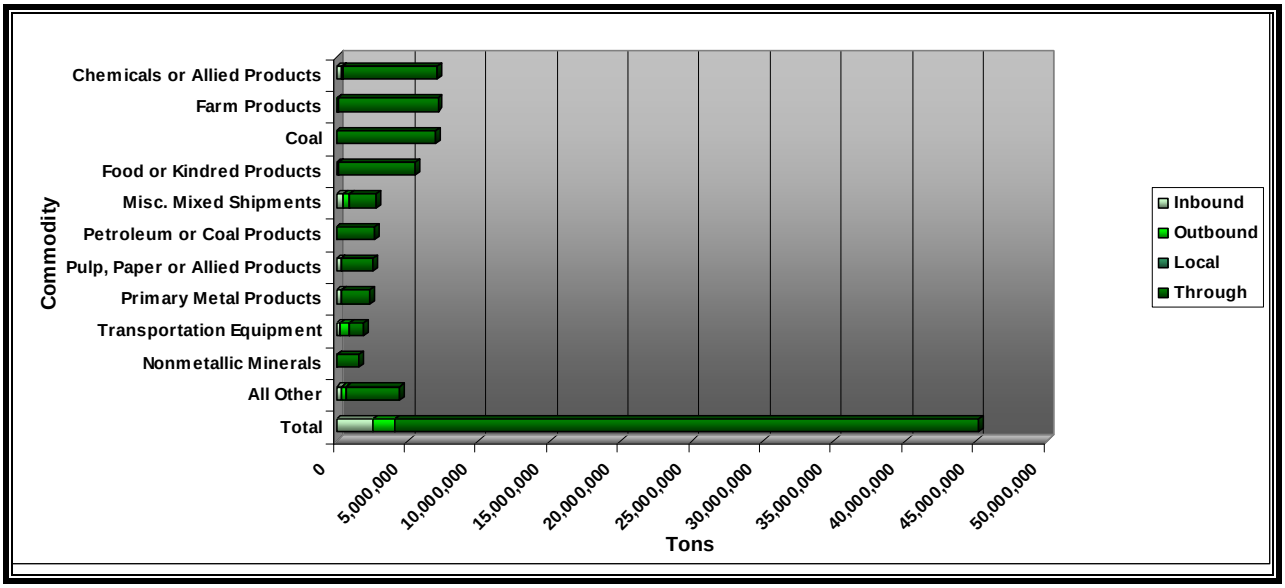
EXHIBIT 19 – INBOUND AND OUTBOUND RAIL FREIGHT TONNAGE IN THE NASHVILLE REGION



Source: Transearch Data

The commodities being traded locally are chemicals or allied products and waste or scrap materials. The top inbound commodity to the region is characterized as "miscellaneous mixed shipments" which suggests intermodal movement of many different commodities to make up a container. Also inbound are chemicals, paper, and metal products. The top outbound commodity is transportation equipment as completed motor vehicles. Through rail freight accounts for the majority of freight along the regions rail lines. If through freight were removed from the total rail freight calculation for the Nashville region, approximately 4.2 million tons of rail freight remain.

EXHIBIT 20 – TOP 10 COMMODITIES FOR RAIL



Source: Transearch Data

Since a lot of the rail freight going through the region consists of the same commodities that are moving locally, it suggests that there is potential for further expansion. Value-added production could increase in the region easily since the infrastructure and market already exists with reasonable transportation.

Two primary facilities are used in Nashville. The major CSX terminal and classification operation is Radnor Yard, located south of town on I-65 by route 255. Three rail-truck transfer facilities are part of the terminal, handling intermodal containers, new automobiles produced outside of the Nashville Area, and bulk commodities. Daily service is provided to the auto plants in the area for Nissan in Smyrna, and formerly for General Motors in Spring Hill. Currently the GM plant in Spring Hill is on stand-by status and is therefore not currently operating at full capacity. Kayne Yard is downtown alongside I-40, in the gulch; it is a smaller facility serving industrial customers, and performing truck trans-loading for bulk goods.

Both yards are convenient to interstate highways and there are no access restrictions at either one, according to railroad and motor carrier personnel, although trains using Radnor will sometimes block the entrance to the intermodal facility, creating self-imposed delays and congestion. This was commented on in the stakeholder interviews, however, utilization of Radnor yard is at approximately 98% of capacity and the facility is landlocked, leaving no room for expansion to accommodate growth. The existing CSX rail lines are also near capacity, meaning they can accept little incremental traffic before triggering the major fixed expense of new train starts, and it is likely that some of the rail lines touching Nashville are approaching capacity limits as well. The consequence is that opportunities for train traffic growth – even normal growth in current rail volume, and apart from any traffic that now moves by highway – are materially restricted, and would require both substantial financial investments and new land solutions.

Basic Freight Rail Connector

The Tennessee Department of Transportation (TDOT) developed a comprehensive rail plan in 2003 to provide policy, procedural, and system management guidance defining a new role for the department in rail system projects. The rail planning process focused on the fact that there is no direct all-Tennessee east-west rail link in the state. From the options available, two corridors that would reestablish an all-Tennessee direct east-west rail link were examined extensively to assess the role those corridors might play in meeting the objectives of passenger and freight transportation, one of which is the Basic Freight Rail Connection. (See the *Literature Review* section for further discussion of the plan).

The Basic Freight Rail Connector proposed in the Tennessee Rail System Plan, proposes using a combination of abandoned, non-operating, operating, and newly constructed track, to bridge the gap from Algood on the Nashville & Eastern rail line to Class I lines at Oliver Springs in east Tennessee, and thereby complete a through route between Nashville and Knoxville. This route does not establish a complete equivalent to the I-40 corridor, though it is a step in that direction. A critical freight function of I-40 is its feed into I-81, a key truck route to large consumer markets of the northeast. While CSX with the connector could operate from Memphis to Knoxville on a path parallel to I-40, its lines from Knoxville turn due north, and away from I-81. Norfolk Southern conversely can parallel I-81 and presumably would reach back from Knoxville to Nashville on the Connector, but would need track rights on rival CSX facilities to extend from Nashville to Memphis. In other words, neither Class I railroad would have a through route combination like I-40 and I-81, and in addition, both systems terminate at the Mississippi River in Memphis.

The Tennessee Rail System Plan does not claim that trucks traversing Tennessee on I-40 will divert due to the Connector, but does suggest a modest number of trucks running between Nashville and Knoxville may divert. The plan points to the NS Memphis route via Alabama as already capable of attracting I-40 through freight. There is validity to this concept, but a rather complex set of considerations boils down to a single key point: network ownership and structure are basic barriers to railroad capability of providing alternatives to highway freight transportation at Nashville.

Findings from the Rail System Plan indicate a significant growth in rail traffic and suggest a continuing need for the Nashville region to take the appropriate action required to sustain its rail infrastructure. This means ensuring adequate access to the railroads along with other rail infrastructure improvements, policies, or regulatory interventions that would enhance rail operations. Specific to the Nashville region, such enhancement efforts would consist of urban rail congestion relief efforts that include the Freight Rail Connector. Intermodal facilities identified in the Rail System Plan as strategic railroad infrastructure investment opportunities in the Nashville region incorporate a Nashville Competitive Access Intermodal Facility. Finally, a Nashville to Memphis rail passenger service would also impact the region by providing a potential alternative mode of transportation and relieving highway congestion which would benefit truck travel along the corridor in terms of travel times and decreased operations costs.

High Speed Passenger Rail

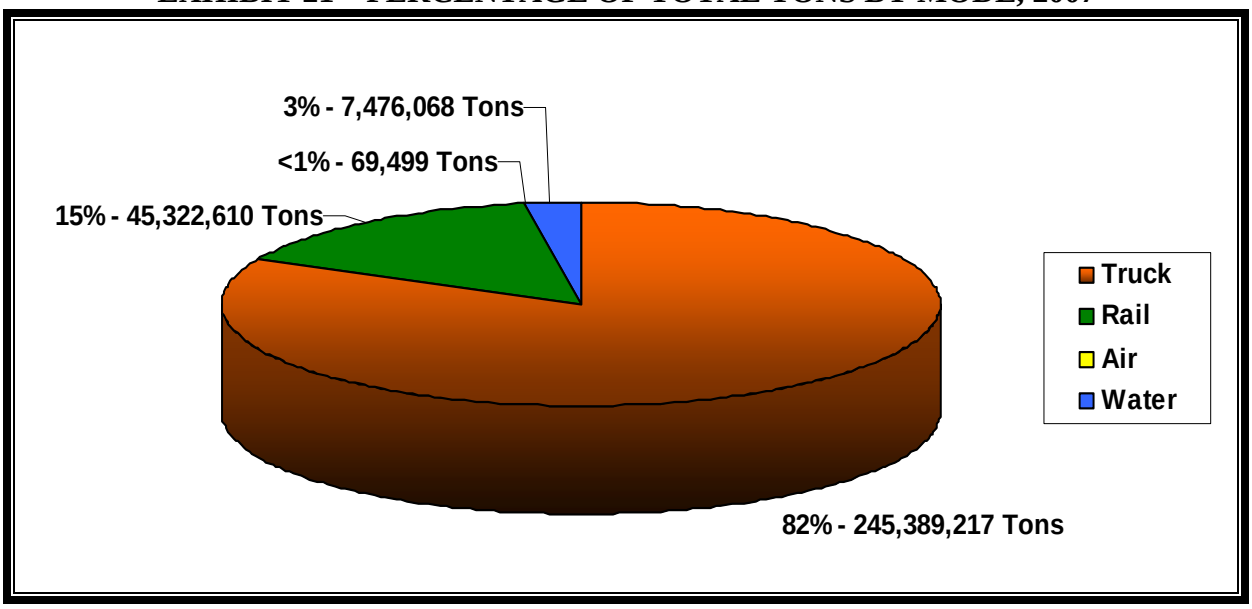
While this Plan focuses on freight infrastructure, the growing importance of high-speed passenger rail that links major urban areas such as Memphis, and its development in conjunction with freight infrastructure, cannot be ignored. Consideration of highspeed rail raises the larger issue of sharing future infrastructure development between passenger and freight. Shared facilities provide significant economies of scale, and the opportunity to leverages scarce funding for maximum benefit. Future transportation infrastructure improvements in the region need to be evaluated with this shared use in mind. One example of this has occurred in the Nashville region with the Music City Star commuter rail line to Lebanon.

Similar to places like Memphis, Chicago has intermodal service by numerous Class I railroads with significant volumes of intermodal freight. Experience in Chicago demonstrates that coordination among rail carriers to ensure rail operations achieve maximum public benefits and minimum disruption is difficult. To guide and coordinate rail infrastructure within Chicago, the Chicago Transportation Coordination Office (CTCO) was created to coordinate each carrier's capital planning process. As rail intermodal activity grows in the region, Nashville needs a similar coordinating office in the development of its rail infrastructure.

TRUCK

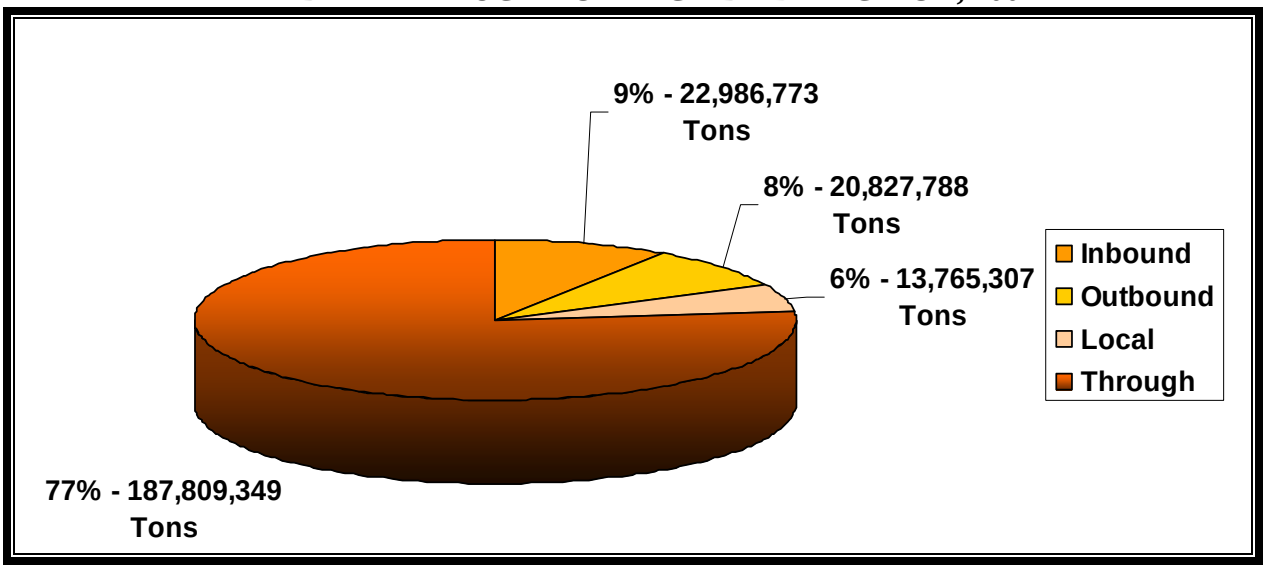
Truck movement is an integral segment of any freight transportation system as highly evidenced in the Nashville region. While all four modes of transport – truck, rail, water, and air – are represented, trucking accounts for the majority of freight volumes carried inbound, outbound, locally, and through the area. Of the 298,171,394 tons of freight handled in 2007, 82 percent was transported by truck (**Exhibit 21**).

EXHIBIT 21 – PERCENTAGE OF TOTAL TONS BY MODE, 2007



Over 76 percent of the total tons carried by trucks are through freight (**Exhibit 22**). This represents a significant portion of truck traffic that uses the region's roadways without any freight originating in or coming to the Nashville region.

EXHIBIT 22 – TRUCK TONNAGE BY DIRECTION, 2007



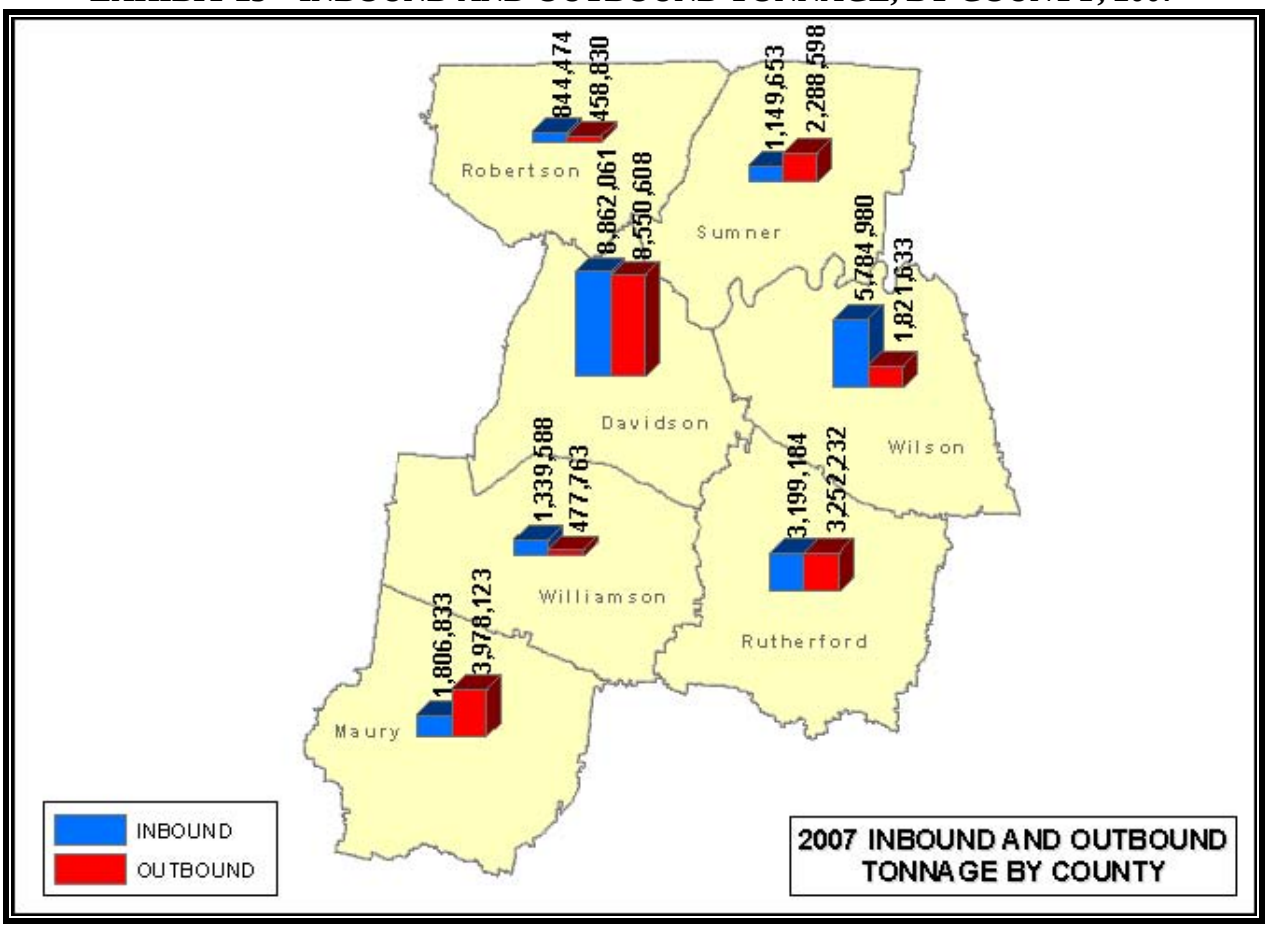
The large percentage of through truck traffic, traffic that does not originate or have a destination within the region, places significant wear and tear on the region's roadways, and creates the need for through traffic management and cooperation with other cities within Tennessee and with neighboring states, in the formation and implementation of highway development plans. States surrounding Tennessee have the ability, through their individual policy decisions, to influence the volume of traffic in the Nashville area. It is therefore incumbent on area planners to be

involved and attentive to the projects in surrounding regions. In fact, the interests of other MPO groups are directly in line with those of the Nashville area, as through traffic is an issue across the state. These common interests suggest the need for organizations to ally, in seeking comprehensive solutions to transportation and air quality challenges in Tennessee.

Even though the majority of through freight utilizes the interstate and freeway routes where the MPO has limited funding responsibilities, the arterial, collector and even local supporting roadways associated with corridor transportation support services still generate maintenance needs. These support services include truck stops, rest areas, freight terminals, hospitality sites, and other points where the truck may stop without involving the handling of cargo.

Through truck traffic is a significant portion of the overall truck volumes, but does not overshadow the need to understand and plan for regional traffic solutions and its influence on the area economy. The inbound and outbound tonnage, 18 percent or 43,814,560 tons, moves to/from local businesses within and outside the region. Inbound and outbound movements are still mostly associated with interstate transit but are more localized than the through movements. The need to access and exit from a local freight generator places increased usage on non-interstate roadways. The remaining Local tonnage, 5.6 percent or 13,765,307 tons, access a greater number of local points as both origins and destinations (**Exhibit 23**).

EXHIBIT 23 – INBOUND AND OUTBOUND TONNAGE, BY COUNTY, 2007



With the expectation that through movements will be most closely assigned to interstate travel, the MPO's understanding of the impact of non-through movements is important to the planning process. A clear understanding of these movements will provide insight into future improvements and policies to enhance not only the freight transportation system but the economic development of the region.

Davidson County accounts for the majority of inbound and outbound traffic in the Nashville region (Exhibit X above). This is to be expected given the fact that Davidson County is the "hub" of the region in terms of population, employment, and the cross-roads point of the Interstate system. Like the remaining counties within the region, Davidson County exhibits a near balance of inbound and outbound truck movements. This does not necessarily translate to greater efficiency of trips because the variety of commodities, in conjunction with the diverse type and number of motor carriers in the region, generates empty trips by trucks.

The top three inbound commodity types for the region are non-metallic minerals (8.3 million tons), wholesale trade (durable goods) at 4.5 million tons), and stone, clay, and glass products at 2.5 million tons. These constitute 66.5 percent of total inbound freight. Outbound commodities are slightly more diverse in comparison to inbound commodities. The top five outbound commodities constitute 62.9 percent of the total commodities. These are wholesale goods (durable goods) at 3.7 million tons, stone, clay, and glass products at 2.6 million tons, non-metallic minerals at 2.4 million tons, food and kindred products at 2.4 million tons, and transportation equipment at 2.0 million tons.

Like inbound and outbound freight, local movements, where trips originate and terminate within the region, mostly occur within Davidson County (**Exhibit 24**). The top commodity for the region, non-metallic minerals except fuels, comprises 76.3 percent of the total tonnage handled within the local movements. Wilson and Williamson Counties are decidedly the greater consumers of local transportation needs. This can be attributed to the acceptance of high volumes of non-metallic minerals – 88.4 and 89.9 percent of the total inbound, respectively. Maury County, having the greatest ratio of outbound to inbound, includes a significant percentage of ready mix concrete, 33.8 percent of the total outbound.

Local movements mostly occur on collector and local roads and typically employ a greater number of drivers with knowledge of area roadways. Travel along local and collector roadways may be an attempt to reduce mileage or travel time between stops, increase productivity, or result as an alternative to a delay occurring on the arterial or interstate systems.

EXHIBIT 24 – LOCAL TONNAGE, BY COUNTY, 2007

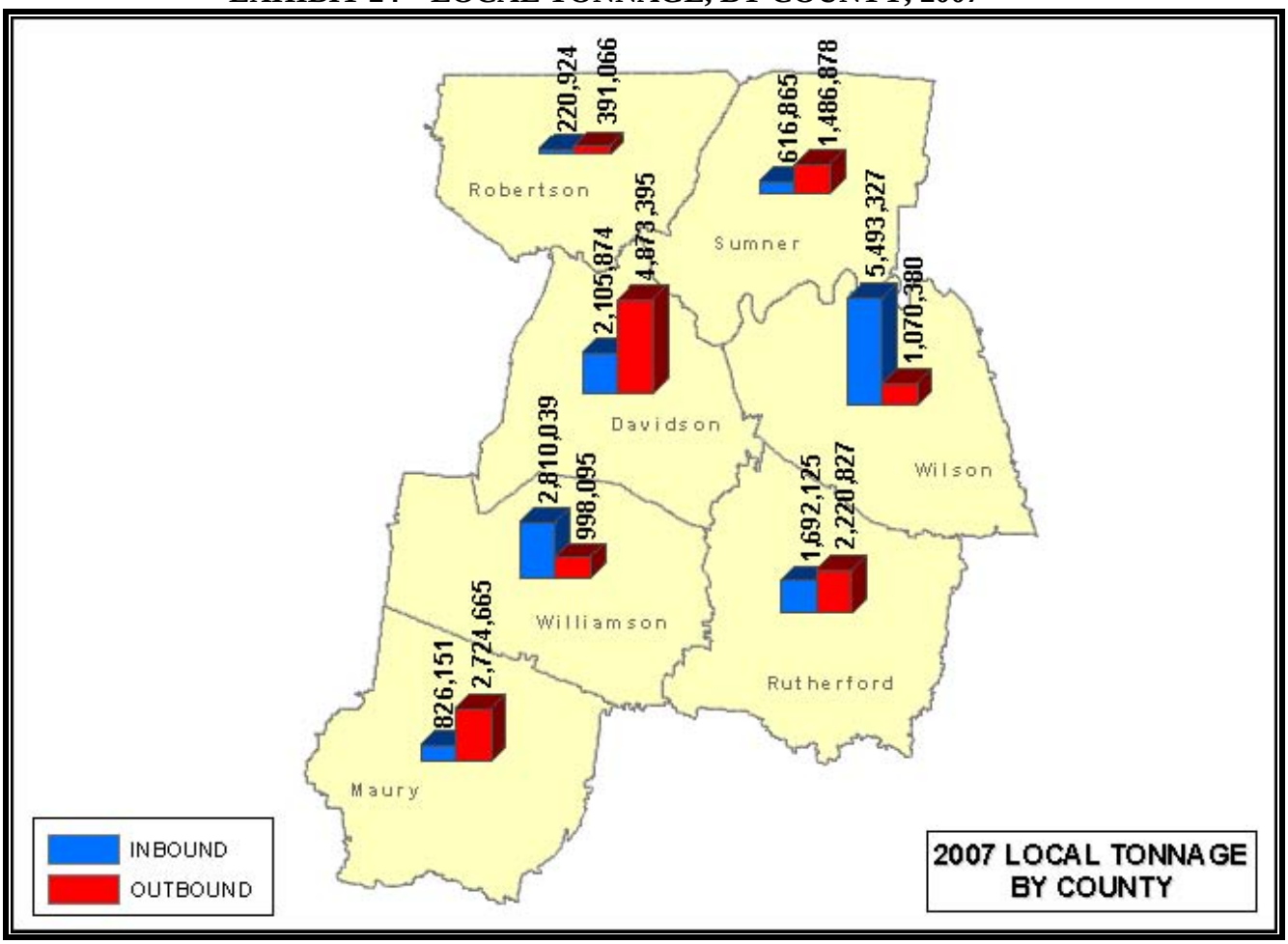


Exhibit 25 illustrates inbound movement and highlights several significant trends:

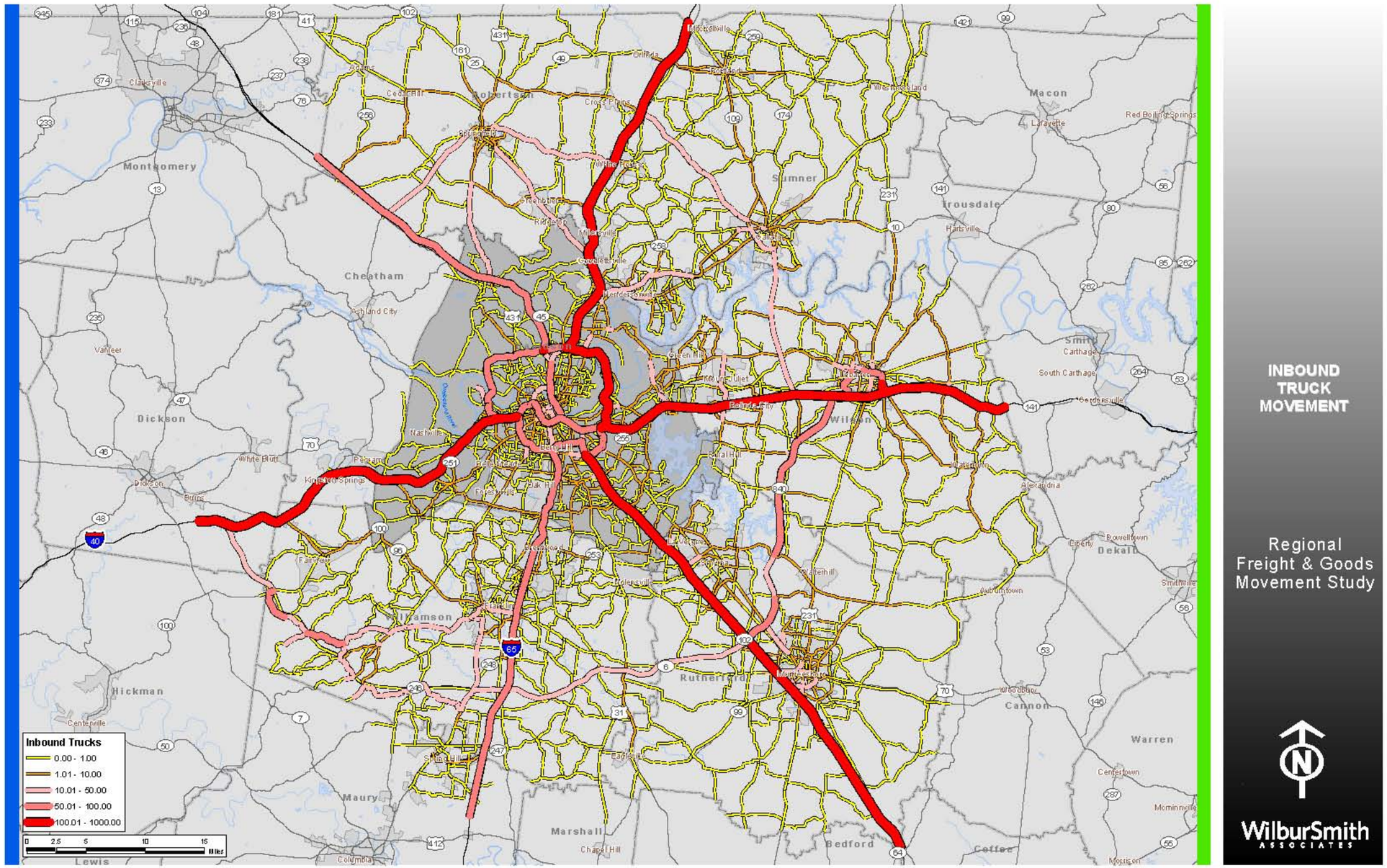
Traffic may not select the most direct route from the interstate system. Truck traffic continues to select roadways which provide more direct access to pick-up locations and where access includes non-interstate routes. The presence of freight intensive activity is not necessarily an indicator of the need for truck routes.

Freight movement occurs at a multi-jurisdictional level. What is inbound and outbound for a given area results in "through" moves for other areas of the same region to gain access to the interstate or freeway system. The traffic levels in the "through" areas may prove to be higher than routes associated with the actual freight generator. This "through" movement may result in contradictory policies; one county identifies a roadway as a local truck route, while the other prohibits the same truck movement.

Traffic is disseminated over many roadways, with specific freight facilities typically spread across a greater number of locations. Beyond the traditional warehouse and plants associated

with goods movement, freight delivery supports other industries including hospitality, healthcare, education, and offices.

EXHIBIT 25 – INBOUND TRUCK MOVEMENT

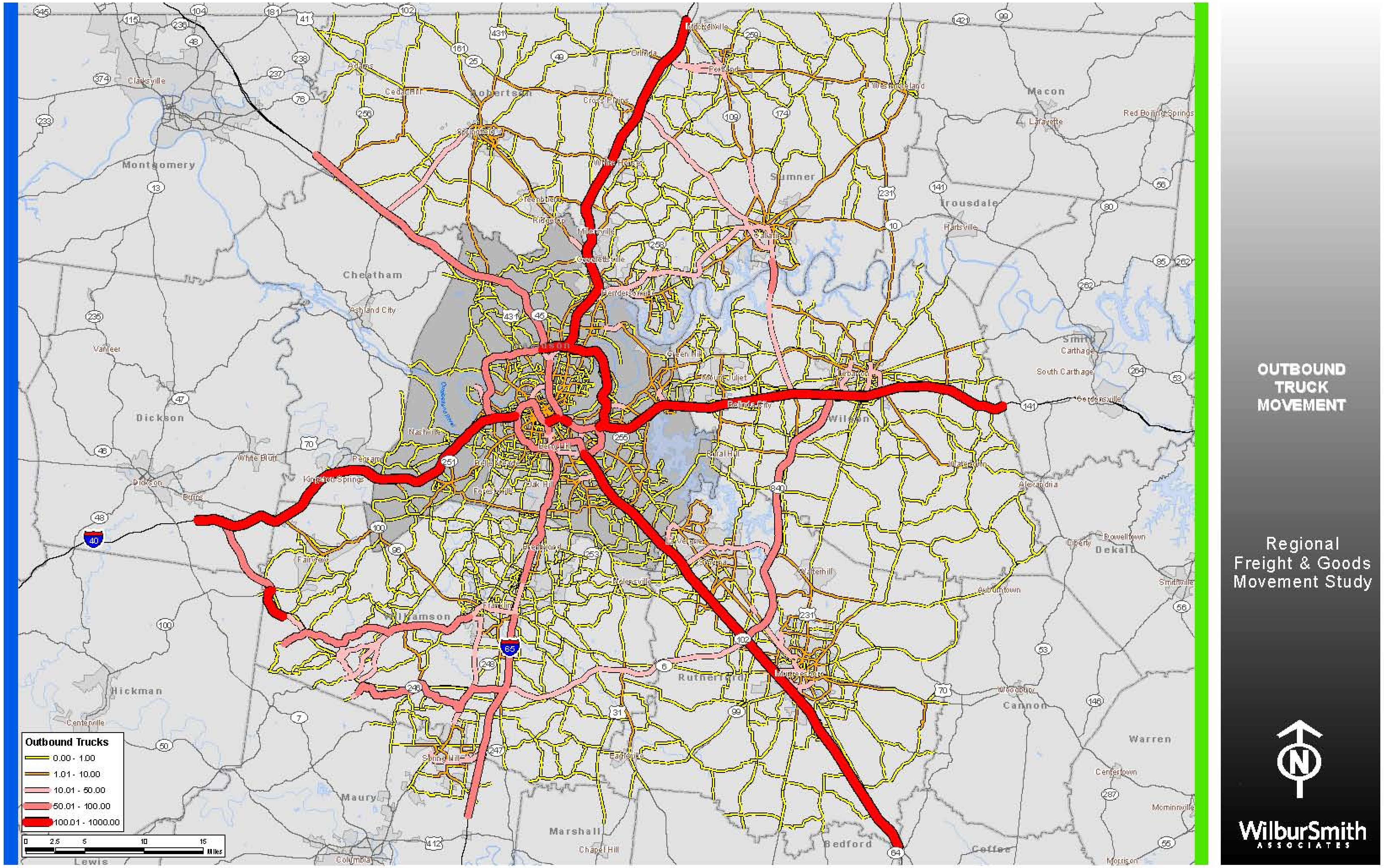


Outbound movements are extremely similar to inbound patterns (**Exhibit 26**) though network utilization does present several key differences:

In contrast to inbound, facilities generating outbound freight are less associated with non-traditional freight generators. This creates nodes of freight generators consisting of one or more shippers in a more concentrated area. Resulting from this trend, fewer roadways are selected to carry more truck volume to the interstate system.

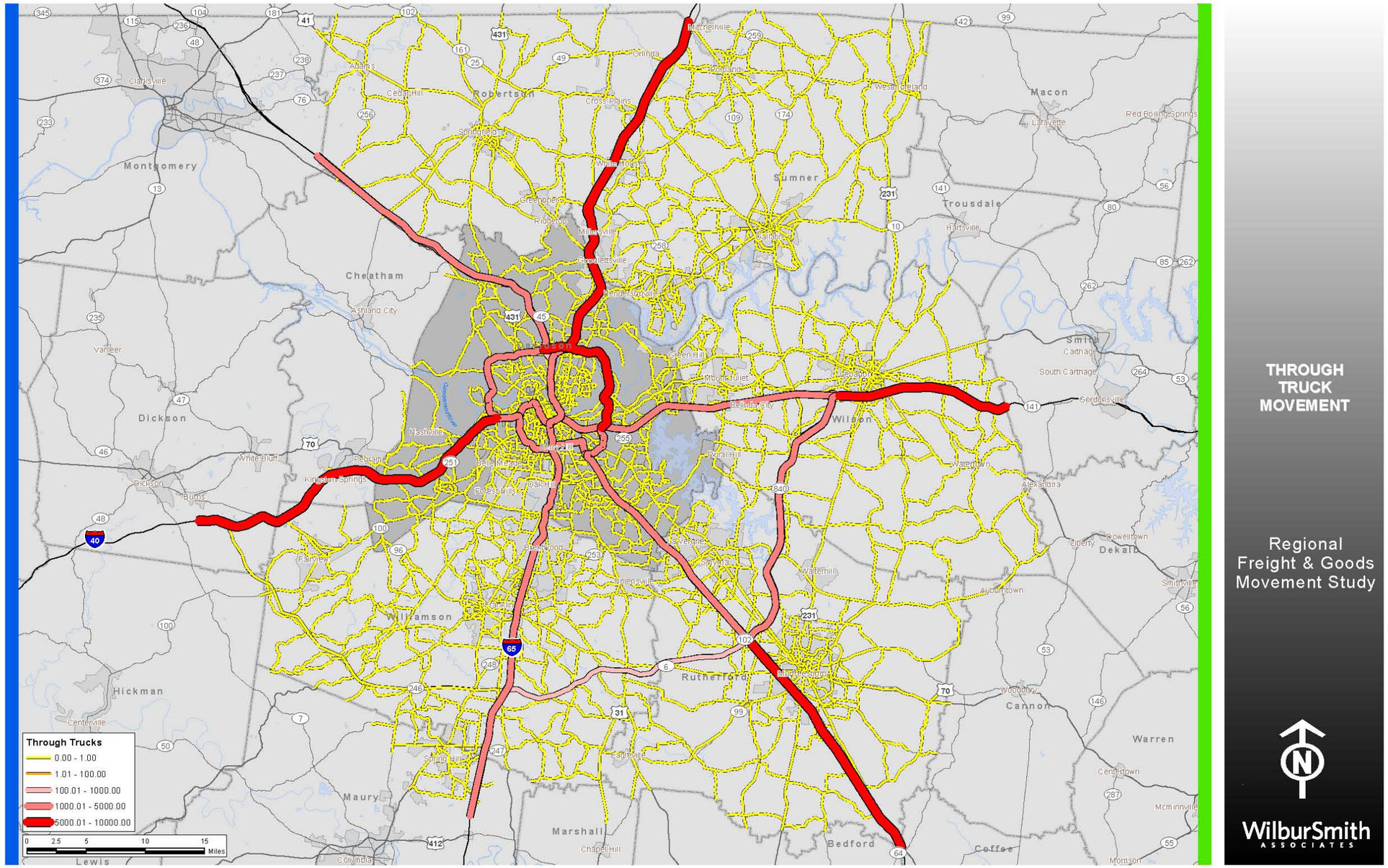
When gaining access to the interstate network, route selection continues to be widespread.

EXHIBIT 26 – OUTBOUND TRUCK MOVEMENT



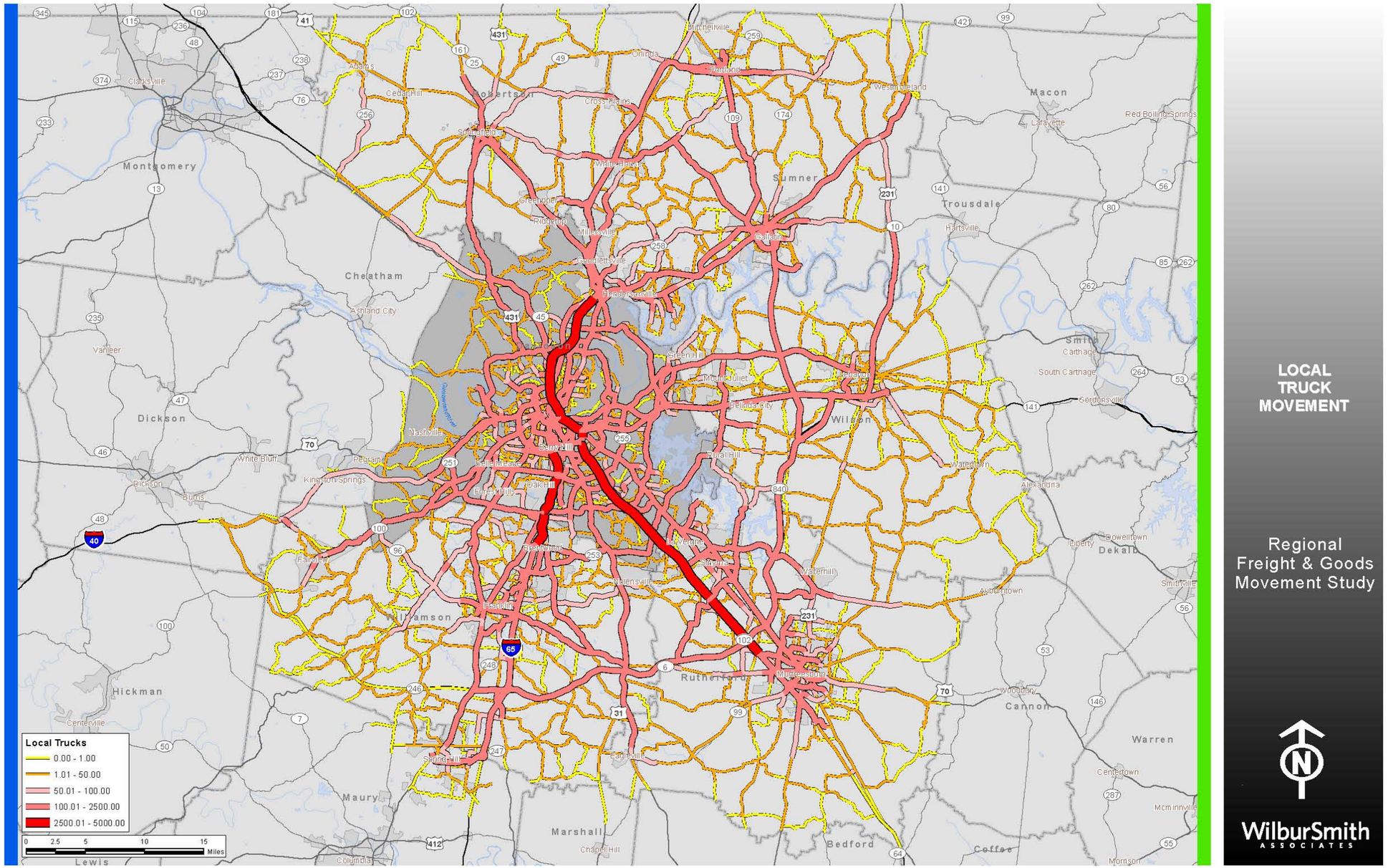
As predicted, "Through" movement is almost singularly aligned with the interstate and freeway system (**Exhibit 27**). One route, US-31E appears to carry through traffic for the region, connecting freight generators to the north and east of the region to the interstate system.

EXHIBIT 27 – THROUGH TRUCK MOVEMENT



Local traffic contributes to truck volumes along arterial and collectors parallel to the interstate system (**Exhibit 28**). The pattern of selection that incorporates the interstate system suggests the need for a truck route designated network of arterial and collectors to assist in congestion mitigation. Through and inbound-outbound traffic will require capacity on the interstate system. With a defined structure of roadways to facilitate local movements, capacity gain can be achieved while directing funding more precisely to benefit truck movement.

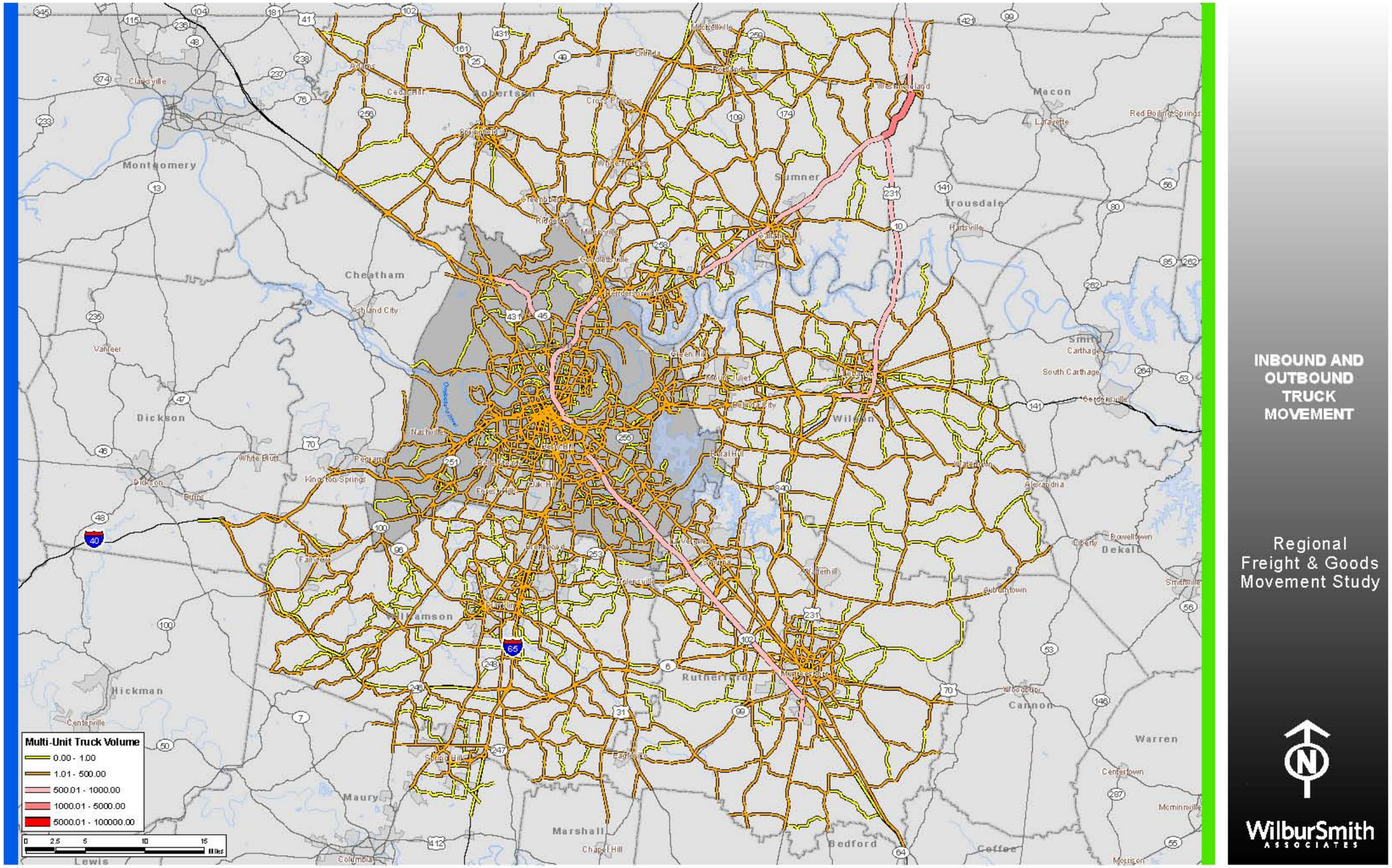
EXHIBIT 28 – LOCAL TRUCK MOVEMENT



Though each direction of travel is presented independently, all four constitute an overlapping network of preferred routes currently utilized to fulfill the needs of freight generators. This system of preferred routes is categorized based on the intended use or functional classification of the roadways in conjunction with the volume of truck traffic. The Primary Freight Highway System (PFHS) consists of interstates and US highways that are observed with an aggregated volume illustration compiled from all four directions. The PFHS may include arterials that exhibit truck volumes consistent with interstate and US highways. The Secondary Freight Highway System (SFHS) consists of arterials and collectors where larger truck volumes are present, as in the Primary System. This system should further reflect roadways that contribute to the overall mobility of the two systems. A third category, Connector Freight Highway System (CFHS), are those roadways similar to the Secondary Freight Highway System, but appear to supply access to a specific geographical area and thus do not contribute to overall mobility of the region's freight transportation system.

This three part system does not, however, represent a guide for the future designation of a Regional Truck Route System. A truck route designated network requires data analysis consistent with evaluation of road design and construction, environmental justice, land use access, and performance factors. Cooperation among key players in the public sector, private sector, and communities of the region is important to this process to objectively identify future routes to support freight needs and economic development while mitigating negative impacts on the region's residents. **Exhibit 29** combines the truck volumes identified in all four directions.

EXHIBIT 29 – COMBINED TRUCK MOVEMENTS



Following the construction criteria noted above, the Nashville MPO region has a clearly defined system (**Exhibit 30**).

The Primary Freight Highway System consists of:

INTERSTATES	US HIGHWAYS / ARTERIALS
I-24	US-31E (north from TN-155)
I-40	TN-155 (I-40, western region, to I-24, southeastern region)
I-65	TN-840 (I-65, east to I-40)
I-440	

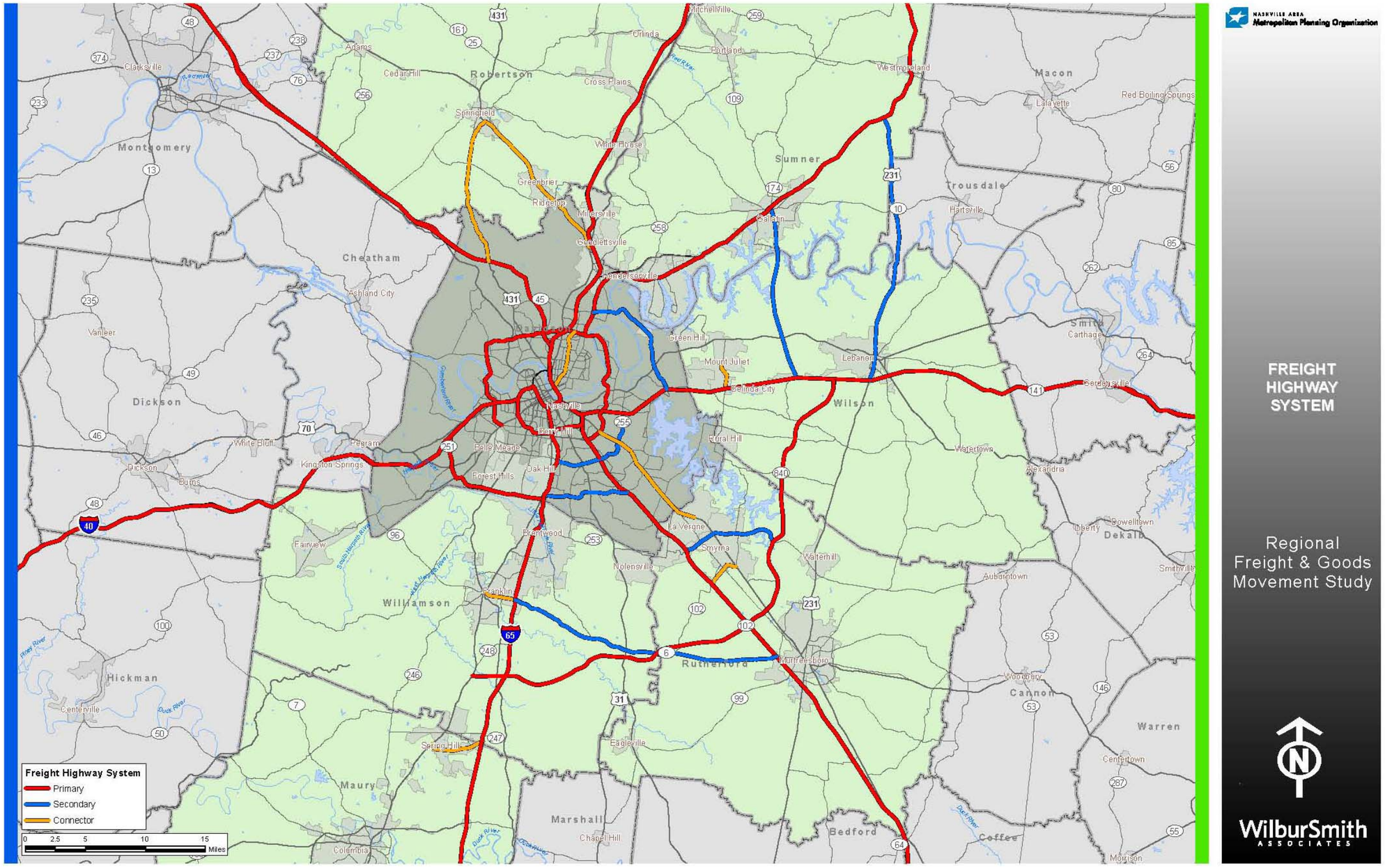
The Secondary Freight Highway System consists of:

US HIGHWAYS	ARTERIALS
US-231 (I-40 north to US-31E)	TN-45 (I-40 north to US-31E)
	TN-96 (I-65 east to TN-840)
	TN-109 (I-40 north to US-31E)
	TN-254 (I-65 east to I-24
	TN-255 (I-65 east to I-40)
	TN-266 (I-24 east to TN-840)

The Connector Freight Highway System consists of:

US HIGHWAYS / ARTERIALS
TN-102 (I-24 east to US-41)
TN-396 (I-65 west to Spring Hill TN)
TN-65 (I-24 north to Springfield TN)
TN-96 (I-65 west to Franklin)
US-41 (at TN-41 north to Springfield TN)
US-41 (TN-155 south to LaVergne TN)

EXHIBIT 30 – NASHVILLE REGIONAL FREIGHT HIGHWAY SYSTEM



Stakeholder Interviews & Observations

This section provides a summary of stakeholder interviews and findings to reveal a personal perspective on issues and opportunities facing the Nashville region's freight transportation system. As part of this process, 18 stakeholders representing a cross-section of the regional economy and goods movement industry including the health care, publishing, electronics, rail, automotive, and distribution industries offered valuable information and insight into the Nashville freight transportation system such as:

- Type of freight mode used
- Inbound/outbound freight destinations
- Types of freight transported
- Key freight corridors and local routes
- Operation and maintenance issues with these routes
- Access issues
- Areas of congestion; and
- Issues and opportunities for new routes and improvements

This information will prove invaluable in further developing the freight transportation system in the Nashville region since these stakeholders can offer insight into situations and issues that may not be revealed by freight flow data alone. Highway, rail, water, air carriers, and logistics firms were all represented to offer a full range of issues from a variety of perspectives. Some of the stakeholders interviewed include representatives of FedEx, Ingram Barge Company, Lifeway, Vanderbilt Medical Center, local municipalities and developers, logistics and trucking companies like M&W and Old Dominion, Smyrna and Nashville airports, and CSX Transportation. Interviews also included a portion of those involved in the Phase I study. A complete list of the stakeholders that participated in the interviews can be found in **Appendix A**.

FREIGHT MODE

The majority of stakeholders interviewed depend on the region's highway system to transport and receive freight via truck (refer to **Exhibit 30**). Other modes of freight, such as air, water, and rail transport, also rely on the highway system to deliver freight to/from its final destination in the form of drayage. Highway issues from the perspective of truck drivers, businesses' access to goods and services, and those responsible for the delivery and receipt of important freight were all considered.

Ingram Barge Company represents the only water transport which moves freight along the river that then gets transported to trucks to be dispersed to locations throughout Nashville.

Two airports, the Nashville Airport Authority and the Smyrna/Rutherford County Airport, were interviewed to present issues and concerns regarding freight transported by air. These commodities are also shifted to trucks to be dispersed to/from the airport so these issues centered on access to and from these facilities.

CSX Transportation and Nashville & Eastern Railroad are the two modes of rail transport represented in the interviews that highlighted issues facing the transport of goods via rail within the study area. Nashville serves as a major hub for CSX Transportation, the largest railroad east of the Mississippi. Its service supports the operations of Nashville-area companies such as Visteon Industries, Ford, GM, Nissan, Phillips Metal Services, and many others. Nashville is also the headquarters of CSXT's Nashville Operating Division, which encompasses 1,377 track miles and has an annual operating budget in excess of $81 million. Freight to and from major U.S. cities, including Chicago, Louisville, Evansville, Birmingham, Chattanooga and Memphis, converges at CSXT's Radnor Yard in Nashville.

Nashville & Eastern Railroad is a shortline railroad that does not offer intermodal services and are somewhat limited in their abilities to expand, however they carry important goods from Nashville to east Tennessee and west of Nashville, approximately 18 miles.

KEY FREIGHT CORRIDORS

Since the majority of stakeholders depend on the region's highway system to transport freight, those heavily traveled interstate, arterial, and local routes specifically mentioned by those that were interviewed are listed in **Exhibit 31**.

EXHIBIT 31 – KEY FREIGHT CORRIDORS

Key Freight Corridors
Interstates
I-40 (East to I-81; Memphis to Nashville)
I-65 North (to Chicago)
I-65 South
I-24 (from Smyrna to KY)
Arterials
Hobson Pike (from Mt. Juliet to I-40; as an alternate to I-24)
Murfreesboro Road
Briley Parkway
SR 840
Old Hickory Boulevard
Ellington Parkway
I-440

While other roadways may also be used to transport freight, the routes listed above were specifically mentioned during the interview process.

CONGESTION

Specific areas of congestion along area corridors and local routes are listed in **Exhibit 32**. Some denoted specific areas or certain directions of interstates and roadways and particular intersections that experience congestion, bottle necks, and generally cause slow downs while other stakeholders simply named roads they commonly travel that experience areas of overcrowding and traffic jams. **Exhibit 32** lists the name of the road that experiences some form of congestion, the intersection, direction, or precise location of the problem area if named, the time of day when such traffic is experienced if applicable, and additional comments regarding the congestion if mentioned.

EXHIBIT 32 – CONGESTION

Congestion			
Road Name	**Intersection/Location**	**Time**	**Comment**
Old Hickory Boulevard/Hobson Pike			
I-65	North	3 to 6 PM	Gridlock
	North side		Congestion at the I-24 merge and at the river crossing
	Nashville to Spring Hill		A mess
	South, exit 65		Bottlenecks
	Off I-65 onto I-440		Lots of crossing traffic, bottleneck, need flyover
	West side		Good unless wreck at Rosa Parks
	Exit 74, Old Hickory to I-24		Bottlenecks and Access Issues; quickest from Brentwood to LaVergne/Smyrna/Murfreesboro
I-24	(In General)	AM	Bad in the AM
	Nashville to LaVergne		Has a lot of Industrial traffic
	West on I-40 onto I-65		Lots of crossing traffic
	West, exit 56	Rush Hour	Bottlenecks during rush hour also to I-65 South; turn right to I-40, turn left to I-65; connects to I-40 to avoid downtown past exit 56

	West, exit 54 (Briley Pkwy)		Bottlenecks and Access Issues; Can use to go to I-65 North of town or all the way to 40 West to Memphis
I-40	West		No congestion until the Bellevue exit
	East from Memphis to I-440		Bottlenecks and Access Issues; I-440 circles south of the city to I-65, I-24 and I-40
Murfreesboro Road			
Fesslers Lane	Where highways merge		"pinch points"
	Where traffic funnels into the bridge system		
I-440	East and West	AM/PM	I-440W bad in AM, I-440E bad in PM
Lebanon Road	To Briley Parkway		Bottlenecks and Access Issues from downtown to get north

TYPE OF FREIGHT TRANSPORTED

A substantial amount of goods are transported along key freight corridors through the region, some of which is time sensitive. Stakeholders identified a variety of materials transported via highway, rail, water, and air and, in some instances, quantities and the destination of the inbound and outbound freight. **Exhibit 33** lists the location of the facility, type of freight transported, the quantity, and destination (whether inbound or outbound), as available.

EXHIBIT 33 – TYPE, AMOUNT, AND LOCATION OF FREIGHT TRANSPORT

Location	Type of Freight Transported	Quantity	Destination	
			Inbound	Outbound
FedEx				
Nashville Facility	Retail, some manufacturing, DVD distribution	150-200 cargo schedules daily plus local pickup	- I-40 East - I-65 South - I-24 (some)	Volume Ratio is 2:1 in favor of outbound

		and delivery		
Ingram Barge Company				
Harding Road Nashville, Tennessee	**Coal**, Sand, Gravel, Asphalt, Raw materials into Dupont, Automotive Steel, Heavy Equipment, Scrap metal	Coal: 4 to 5 million tons (primary commodity); Sand & Gravel: 1 million tons; Total of 6 million tons annually	Coal: to Gallatin power plant; Raw Materials: to Dupont	Scrap Metal (about 200k tons) from scrap facility near Titans stadium

Lifeway				
Lebanon, Tennessee (Distribution Center)	Monthly magazines, Sunday school literature, hymnals, books, furniture	- 70-80% of volume lies between VA, KY, MO, OK, TX, and Gulf. - TX biggest market, - 10% of market in CA, NE some - - International is 5% of market	- Quebecor World (Clarksville) is biggest supplier; - Korea, China via Memphis; - Kansas City; - NY (Yorkville), - MI - IL - Rose Printing in Clarksville - FL	- Less-Than-Truckload (LTL) and small package: Saia, Wilson AB, Milan; - About 45% of outbound goes to stores
M & W Logistics Group				
Visco Drive Nashville, Tennessee	Food grade products; Girl Scout cookies, US Smokeless tobacco (largest customer)	- 30 to 40 loads per day; - Average length of haul is 400 miles	Mothers Cookies in KY	- Nashville to Chicago; - Memphis; - Indianapolis
Metro Nashville Airport Authority				
Nashville, Tennessee	Dell products, US Postal Service products, airplane wings and tail sections	- 6 to 7 747s per week serving Dell; - FedEx operates 1 narrow body and 2 wide body air crafts	to Dell from China	- Some outbound traffic; - Vought Aircraft Industries (in Nashville) to Dallas Fort Worth International Airport

Nashville & Eastern Railroad				
Knoxville Avenue Lebanon, Tennessee	Rail goods (that then ship out by truck)	- 110 miles from Nashville east to Monterey, TN and west about 18 miles to Ashland City, TN; - 500,000 freight tons; - 140,000 passengers	70% (deliveries)	30% (originations)
Old Dominion Freight Line, Inc.				
Bridgestone Parkway LaVergne, Tennessee	Retail delivery, pick up from local manufacturers, automotive steel, Dell products (primary carrier)	Memphis and Morristown, Tennessee and Columbus, Ohio are big connecting hubs where cargo is exchanged across modes of transport	- Operates north to Bowling Green, south to Lewisburg and Atlanta; - Receives ocean containers from Charleston, Savannah, & Jacksonville	
Smyrna/Rutherford County Airport Authority				
Smyrna, Tennessee	Wiring, radio harnesses, bumpers, some passengers (for Nissan); UPS small packages	-	Cargo radius is 75 miles	

Tennessee Express/TCW (Tennessee Commercial Warehouse)			
Nashville, Tennessee	Mostly cigarettes (KY-TN-AL-AR-MS-LA-MO)	- 75 drivers in Nashville; - The Nashville lane (200 miles around) is 30 to 40 loads daily both ways. This is equivalent to 60 loads or 30 trips	- Average LOH 170 to 180 miles; - Export and Import to ports; - Relays via Atlanta for port traffic; - Large service region includes: LA-MS-AR-MO; some: KY-TN-AL-GA-SC-NC, FL & VA; - Crossdocks (unloading materials from an incoming semi-trailer truck or rail car and loading these materials directly into outbound trucks, trailers, or rail cars, with little or no storage in between) at Memphis, Jackson, Birmingham, Columbia, South Carolina, Charleston, & Charlotte; - Receive consolidated freight from Memphis, Birmingham, & Kenner, LA. - Heavy lane between Memphis & Nashville and ports of Charleston and Savannah. - Run dedicated lanes for Nissan; - International (port) trucking, rail intermodal drayage from Memphis are large portion of business (drayage makes up 70 to 75%); - At CSX Radnor Yard in Nashville 20 times/day; - Memphis is main rail head, uses BNSF and UP with terminal at Homewood

Aldi Foods				
Aldi Boulevard Mt. Juliet, Tennessee (food distribution)	Private label food (90% of products)	-	45 to 50 trucks per day	- 30 trucks/day; - Serve stores in: TN, south KY, Birmingham, MS (south of Memphis), northwest GA
Vanderbilt Medical Center				
Nashville, Tennessee	Medical/Surgery (Med/Surge); Medical Pharmaceutical (MedPharm); laboratory supplies; office supplies; Miscellaneous: linens, Sysco food service, Coca-Cola, FedEx & UPS, oxygen cylinders, Red Cross delivery of blood, waste hauling	- MedPharm: daily service, 3 deliveries to clinics, VUH, VCH; - Med/Surge: 7 days/week from 1AM to 5AM; - Office Supplies: all day long; - Lab supplies: 5 days, AM delivery	- Distribution center off Briley Pkwy does 80% of volume to Vandy; - DC in Atlanta also; - Med/Surge: deliver to West End and off-site clinics	
Dollar General				
Nashville, Tennessee	Variety of goods catering to lower income and budget conscious shoppers; preponderance of heavy merchandise such as laundry products	- Trips start in the early morning and in general there are 2.5 deliveries on a truck. - Each delivery takes approximately 4 hours and the drivers are working at deliveries 5-6	Dollar General has a distribution center in Scottsville, KY which caters to the stores in Nashville and surrounding areas. There are 21 stores in the Nashville area. The store deliveries are contracted to Werner and U.S. Express as dedicated fleets. Deliveries occur throughout the business day. Some night delivery is possible but not as much as is desirable.	

		hours per day.		
Celestica				
7950 East Gate Blvd, Lebanon, TN	Distribution Center (DC) for consumer electronics (computer printers) for Lexmark	The DC itself is 400,000 SF and is full. There are about 50 dock doors, but it functions as a storage point and not just a cross-dock.	Inbound: 20-30 trucks per week. Essentially all of it is imports from two sources: a) Asian production brought in by ship through Long Beach CA, shipped in full containers by intermodal rail to Memphis, then drayed by truck to their facility; b) Mexican production brought to Lebanon in full truckloads.	Outbound: 15-25 trucks per week, representing a mixture of full truckload, LTL, and parcel shipments. Goods move in nationwide and international distribution – this is not strictly a domestic DC for imported goods.
CSX Transportation				
Nashville, TN	- The important Nashville local business is autos and intermodal; the rest is one-to-two carloads traffic. - Its service supports the operations of Nashville-area	At Radnor Yard, employees classify approximately 3,000 railcars of freight carried by close to 80 CSXT trains	- CSXT Nashville Division has 1,292 route miles, and 1,377 miles of track. - It handles daily: 8 intermodal, 7 auto, 14 coal, and 100 merchandise (carload) trains.	

	companies such as Visteon Industries, Ford, GM, Nissan, Phillips Metal Services, and many others.	moving in and out of the city.	

ISSUES AND OBSERVATIONS

Besides congestion, several other issues, observations, and concerns for regional freight transport were discussed by the stakeholders. Many of the issues/observations dealt with surrounding development, location, time sensitive deliveries, and the economy. Below is a summary of issues mentioned by the stakeholders.

Congestion and traffic delays affect the delivery of time sensitive goods, especially medical supplies and perishable goods like food. Short notice for delivery times and limited storage space is a concern. The location of delivery destinations and truck terminals near school zones and heavy residential areas can also cause traffic delays for trucks. Specifically, Murfreesboro was named as being harder to navigate due to the growing number of both people and schools. It was noted that the current highway network is insufficient to handle growth to the east of Nashville. Stakeholders also mentioned a long commute from east and southeast of Nashville.

The location of stores and delivery destination also impacts the routes that drivers must take. Drivers can use the main thoroughfares to move around the outside of the city; however, when stores are not necessarily located in the primary shopping areas, the trucks must use smaller streets for the actual delivery. In most cases, the drivers set the schedule and routing and make decisions about congestion avoidance. Other location and surrounding development concerns include issues with encroaching retail development, which increases traffic and interactions between trucks and other vehicles. Rutherford and Sumner Counties are growing which means more freight into and out of these communities.

Other local issues facing CSX Transportation include incompatible land uses being built near CSX facilities. Namely, condos have been built on top of the CSX Kane Avenue yard, and developers seem to have had trouble selling them as residents complain about the train noise, and proximity to the yard itself is a drawback. Other condos have gone up by Centennial Park, also near rail lines. This points to the need for planning support to maintain the local rail option and promote private investment. Other stakeholders commented that they did not feel that planning for freight in the region was being addressed regionally, in terms of development patterns, and stated that instead there was competition in the area for development.

The economic climate is discussed by stakeholders as causing reduced work and downsized industry. In particular, the loss of the UPS air hub from Smyrna and Dell computers moving to Mexico has had an impact on area freight. Budget restraints, rising fuel prices leading to increased operation costs, and the concern that funding for infrastructure is continually decreasing are all economic factors mentioned by stakeholders that affect the freight industry. As a result of the economic decline, Tennessee Express/TCW mentioned that they had been experiencing a 15 percent growth for international drayage operations until the current economic down turn. As far as deliveries to the Nashville economy, according to one stakeholder, when the UP Class I rail provider moved their terminal across the Mississippi River to Arkansas, it exposed them to more congestion on bridges in Memphis which slows truck delivery times coming to the Nashville region.

Other comments, issues, and observations included some suggestions from stakeholders. It was suggested that Nashville could be more "river friendly." One stakeholder asked why trucks must use the right lane since it is the exit lane, adding that there have been side swipe issues. There were also comments concerning rubber necking from police car lights.

ACCESS ISSUES

In addition to the issues listed above, access issues were another topic addressed by stakeholders. Areas of concern regarding access to and from various delivery locales are summarized here. Specifically, not enough dock space at printing houses was mentioned along with specific areas where access is an issues due to encroachment from surrounding development. For instance, Hendersonville and Goodlettsville are hard to access due to residential encroachment to commercial parks. Stakeholders commented that access in Lebanon is much better than in downtown Nashville, yet downtown Nashville was named as having narrow corridors, being congested, and having lots of cross traffic. In particular, stakeholders named the Vanderbilt and West End areas as being difficult to access. For the Vanderbilt area, it was mentioned that all Vanderbilt docks are extremely busy, and there are security issues with using off peak hours as an alternative.

Dollar General's future facilities development plan includes a list of criteria for developers that include being located along retail corridor with good traffic with full ingress and egress that can accommodate accessible truck deliveries with a 53 foot trailer. The primary concerns for servicing the stores are highway access, connectivity, and congestion. The location reality is that there are existing stores in urban areas, sometimes in strip centers, where there is inadequate capability to deliver from a 53 foot trailer.

In general, stakeholders stated that business conditions are "awful" in regards to access. Several of those interviewed stated that it is difficult to access the CSX Radnor Yard stating that it is often blocked with trains, and it is dangerous when trucks are parked on Sidco Drive. They suggested improving river and rail access.

CSXT commented that Radnor yard will still be at capacity when traffic volumes return (as it was several years ago). CSX efforts to alleviate this to some degree in fact were stymied by the fact that Radnor is effectively landlocked. CSX efforts to free up space at Radnor by moving the TDSI (Total Distribution Services, Inc.) automobile handling area to a new facility in Smyrna failed so the project has now been taken off the list for the CSX capital committee.

OPERATIONS AND MAINTENANCE ISSUES

Specific operations and maintenance issues on area freight corridors were also mentioned. A list of specific issues along roads and bridges that cause problems for regional freight transport include issues like a big bump where Hobson Pike meets Priest Bridge (due to an expansion joint) and bridge weight restrictions mentioned by stakeholders. Dollar General Corporation stated that there were no large complaints about Nashville relative to other cities, but they did cite the age of the infrastructure as a general concern along with turning radius. For their general operations the primary concerns are weight limits and trailer length restrictions.

Along with operation and maintenance issues, stakeholders also listed things they felt would improve these issues. For instance, stakeholders suggested bigger line haul lanes along I-40 to I-81, I-24 south to Atlanta, I-65, and to Memphis. Old Dominion truck lines suggested a place in the middle of the road to stop for truck use with a hand cart, like UPS. Stakeholders also want wider alleys. Specifically, the signal to the entrance of Old Hickory Boulevard by the TA truck stop was mentioned as having operation and maintenance issues. Stakeholders stated two left turn lanes are needed here. Drivers suggested email alerts for traffic and pothole crews. TCS stated that they can’t run a chassis except at Kingsport where they have triaxle for heavy loads.

The above comments and requests were also accompanied by suggestions for new routes including suggestions to complete the eastern bypass, a new east/west (I-40) rail corridor, and requests for completion of the State Route 840 loop. A suggestion for the commuter rail that once existed to the north and west was also discussed. Stakeholders requested a good alternative to I-24, especially to Kentucky, an alternative to I-40 from Knoxville to Memphis, and a way to go through Nashville besides I-440 and Briley Parkway, which are “not great.”

POSITIVE ISSUES AND OPPORTUNITIES

Conversations did not center solely on the negative aspects or problem areas for freight transportation and distribution in the Nashville region. Stakeholders offered praise and named specific opportunities they felt would be beneficial to the Nashville freight industry. A summary of positive comments and potential opportunities mentioned during the interviews are discussed here.

In regards to freight industry, the potential for an increase in steel, outbound agricultural products, inbound fertilizer and salt, and developing container traffic was suggested. In

fact, it was stated that there is ample river front acreage for barge development. Also mentioned was a major prospect with Rogers, who owns a zinc mine in Gordonsville, Tennessee. The mine itself has had ups and downs but accounts for a large quantity of stone, which Rogers is trying to sell to the Nashville market and have a new facility for it at Vine Hill, off Visco Drive (visible from I-40). A possible commodity at the facility would be rock, sand, or both with hopes for 250,000 tons per year that would be local to their line. If successful, the venture probably equates to truck diversion, since it replaces rock most likely trucked in from elsewhere.

Other industry prospects mentioned include a resurgence in the publishing industry in spite of increased fuel costs. Also as a result of the poor economy, business is returning from off shore as costs decrease. Stakeholders suggested continuing the development of industry and distribution on the east side of Nashville (near Cracker Barrel in Lebanon). Also pertinent to the east side of town, Lifeway stated that Lebanon was a great location for several reasons including access to carriers and the interstates. Other areas of opportunity near Lebanon include plenty of undeveloped land along the rail line east of Lebanon. However, this would create infrastructure needs including roads, water, sewers, etc. It was stated that there are better opportunities around the Cookeville area. Also in regards to Wilson County, Aldi commented that they were attracted to Wilson County because of the tax benefits offered and the proximity to SR 840, I-24, and I-40 that provide access to both Nashville and Memphis.

SR 840 is seen as a major development opportunity because it will have better traffic (meaning less congestion) and will keep through traffic out of downtown. Stakeholders even suggested toll roads be built to help offset financial limitations. They did not feel there would ever be a SR 840 going north. A few stakeholders mentioned the potential for development and jobs and to add freight to the region in south central Tennessee, near Alabama, where Tennessee would compete with Huntsville and its initiatives for an inland port that is air centric. Other areas of potential interest to the freight industry mentioned by stakeholders include the Chattanooga Volkswagen plant and the Clarksville megasite that could potentially impact Nashville traffic. The auto maker plants, such as VW and 5 others in the region, will have a long term impact on the region's freight transport according to the views of stakeholders.

Besides opportunities near Alabama, the auto maker plants, and the Clarksville megasite, it was mentioned that the Smyrna airport has the ability to expand and do more cargo. Stakeholders stated that Tennessee is seen as a through corridor with the combination of I-81 and I-40 going northeast, especially with the NAFTA corridor and intermodal traffic in Memphis. While this has potentially resulted in a large percentage of through traffic for Nashville, I-69 through Memphis has the potential to divert traffic.

As for compliments and/or opportunities pertaining to operation and maintenance issues, stakeholders mentioned that the widening of Charlotte Avenue has helped traffic congestion. Stakeholders suggested two dedicated truck lanes. In regard to rail, grade crossing problems have been mitigated by the commuter rail. The NERR rail line could possibly provide some highway relief with the most development opportunities existing

to the north and east of Nashville. A missing link is an east/west rail. Some stakeholders feel that CSX deemphasized the Radnor Yard when there was still was a market for it. CSX commented that the company has been seeing sequential volume growth (month-to-month) and security analysts predict more. The important Nashville local business is autos and intermodal; the rest is one-to-two carloads traffic. This and other investments in the Nashville rail infrastructure makes Nashville an important place on the network from a global perspective. Even though it continues to function principally as a through terminal; CSX expects the company to be open to this changing to some degree if there were a major business opportunity.

Other positive comments from stakeholders included the observation that the east/west routes are good, widening of I-40 at Fesslers Lane was good, White Bridge Road is a good exit off I-40, Old Hickory Boulevard and downtown are both better due to improved signals, Briley Parkway improvements are good (wish more drivers used it), and the Nashville airport is easy to get in and out of. Celestica stated that there are no service performance issues and things work pretty smoothly. Specifically, there are no chronic service problems on the inbound side either by rail or truck. This facility has been operating four years, and their customer seems happy with it and with the Nashville location for their distribution.

Areas of opportunity stakeholders felt would benefit the Nashville area freight community included the need for a statewide plan that would account for the needs of the individual areas while also addressing mobility throughout the state and regionally. Stakeholders felt this should be a coordinated effort cooperating within the state and with adjacent states as well. Rural areas of the state have strong economic needs as well. One stakeholder, familiar with the previous study, suggested direct efforts to long term strategic initiatives instead of the quick start projects listed in Phase I.

Field Observations

Local data collection efforts were focused on specific intersection locations identified by MPO staff and the Freight Advisory Committee that were thought to have a high volume of truck turning movements. These efforts involved field observations and truck counts at key intersections to provide an actual, on the ground picture of the issues that truck drivers may have to deal with on a regular basis that can lead to unnecessary delays in deliveries and potential goods damage due to load shifts. **Exhibit 34** provides a list of the field survey locations, which are illustrated in **Exhibit 35**, Truck Count Locations. Specific field observation information is listed in **Appendix B** with accompanying diagrams of the intersections. Observers noted the intersection configuration and whether they could adequately accommodate truck movements, the adequacy of lane widths, scuffing and tracing on curb radii, signage, speed limits, and turning volumes

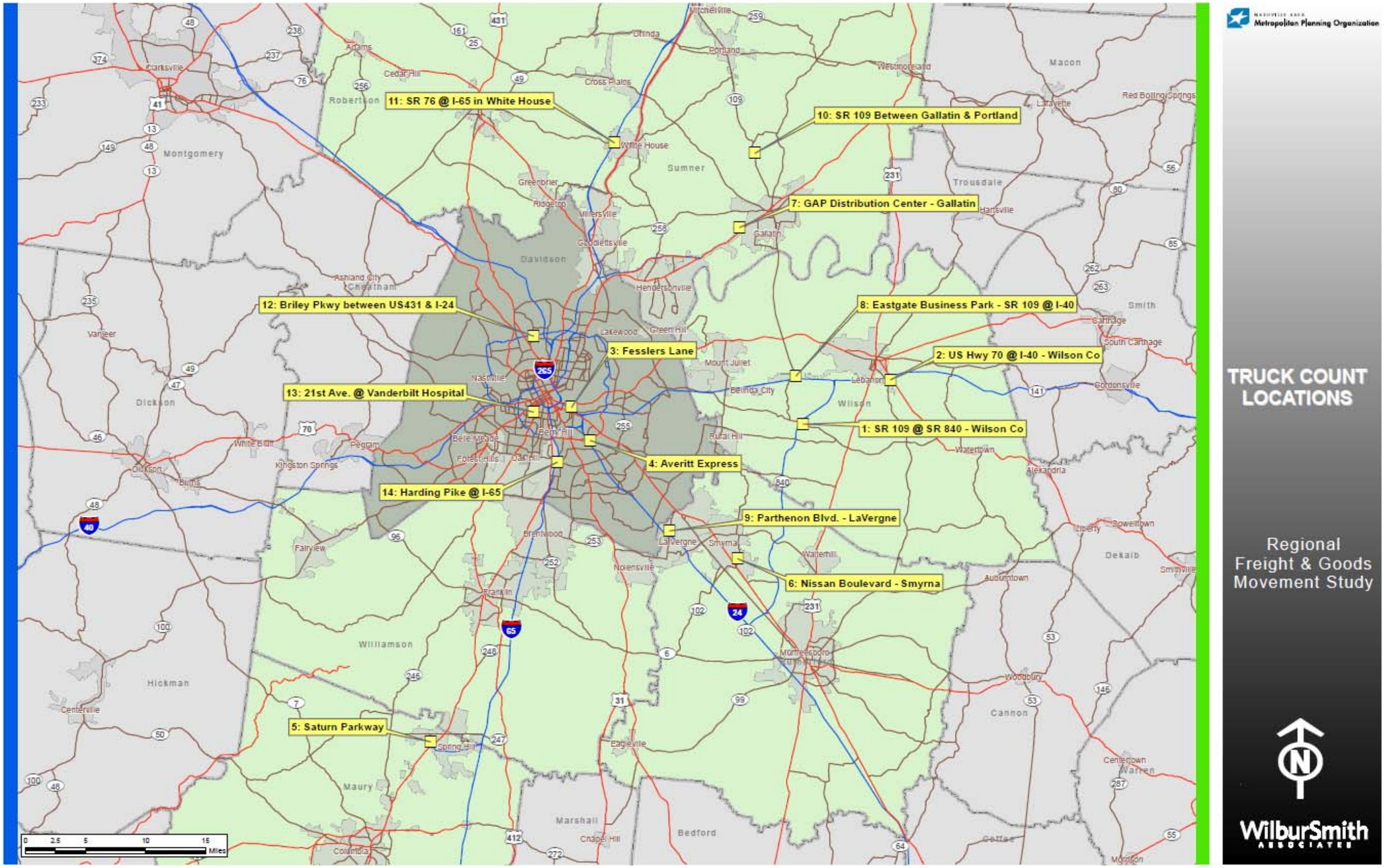
EXHIBIT 34– FIELD SURVEY LOCATIONS

ROAD NAME / CITY	LOCATION
Fesslers Lane, Nashville	Intersection at I-40 west entrance ramp
Centennial Boulevard, Nashville	West of interchange at Briley Parkway
Nissan Drive, Smyrna	Intersection at Enon Springs Road
Saturn Parkway, Spring Hill	West of interchange at U.S. 31
Airways Boulevard, Nashville	East of interchange at Briley Parkway
Providence Place, Mt. Juliet	Belinda Parkway at Delivery Entrance
CSX Intermodal/Radnor Yard, Nashville	Intersection at Sidco Dr. and Powell Ave.
Firestone Parkway, LaVergne	Intersection at Old Hickory Boulevard
Firestone Parkway, LaVergne	Intersection at Parthenon Boulevard
U.S. 231, Murfreesboro	Intersection at Butler Drive
Maddox Simpson Parkway, Lebanon	Intersection at U.S. 70/Sparta Pike
U.S. 31W, Portland	Intersection at U.S. 31W and SR 109
SR 109. Portland	Intersection at SR 109 and SR 52
U.S. 31, Gallatin	Intersection at Gap Boulevard

The field data collection observations reveal a number of issues surrounding truck goods movement at the various intersections. Types of issues observed range from needed pavement markings to a lack of adequate turning radii for trucks to safely maneuver the intersection. These types of issues lead to decreased travel times which and delayed deliveries resulting in higher costs of trucking operations. Further, issues such as short turning radii lead to damaged loads and goods costing more money in an economy where these types of costs must be minimized.

While these are only the observations for each of the intersections, further detail will be provided in the recommendations and projects technical memorandum regarding potential fixes for these observed issues.

EXHIBIT 35 – TRUCK COUNT LOCATIONS



Conclusion

A thorough review and analysis of the above components provided an overview of existing conditions within the Nashville Area MPO region and offers insight into freight facilities and modes that may be in need of improvements that could be addressed in subsequent technical memorandums. Existing studies, freight flows, the identification of key freight corridors, access to freight facilities, and on-ground conditions were evaluated to assess opportunities for improvement to the transportation system for the regional freight industry.

The Nashville region has a unique position as a transportation crossroads. A thorough inventory of the current freight transportation network provides a base line from which freight flows can be projected into the future. These projected freight flows (i.e. future conditions of the freight network) will reveal information about the routing of freight and its impact to area roadways and how best to address deficiencies of key freight corridors. These results will be presented in Technical Memo #3 – Evaluation of Capacity / Regional Needs Assessment and Technical Memo #4 – Policy and Project Recommendations. These documents will provide the results of analyses conducted to evaluate the region's ability to meet future freight demand including a detailed assessment of key issues, economic importance, and freight infrastructure operational needs.

Finally, once the future analysis is completed a list of recommendations will be developed that are intended to address the future demands and facilitate a process to screen a broad range of projects, programs, and strategies to accommodate goods movement expansion.

APPENDIX A

Stakeholder Interview Summaries

Nashville Freight Field Interviews
Halcrow Summaries

FedEx Freight
Keith Lenfant, Service Center Manager
2/3/09

(This is LTL division of FedEx). This location 3rd to 4th largest hub in FedEx Freight system, due gateways. 150-200 linehaul schedules daily during week, plus local P&D.

Linehaul is static: runs on set schedule whether full or not. Outbound departs 7 PM to 9 or 10 PM, inbound arrivals run 11 PM to 2 AM, then another group 4-7 AM. Terminal crossdocks 3.5 million pounds between 6 PM and 5 AM. Use no rail. (Corporation has some on the international side, but none in freight division. Usually it's overseas where use vessels in lieu of planes.) Dominant linehaul lanes are I-40 East to I-81, and I-65 North. Inbound is I-40 East. 65 South and 24 probably weakest. Volume ratio is 2:1 in favor of outbound here.

P&D: ran 65-70 drivers (daily) before economy sank, now 35-40. Each does combination city (driving) and dock work. Goal is 6 PM for receipts of cit pickups at terminal. Other carriers have later cutoffs, but they run less aggressive linehaul schedules. P&D starts out the gate from 8:30 to 10:30 AM. Year ago was 7 AM, now later due depressed business levels. Average 13-1 stops per driver in good times. Majority is done with 45' trailers, but use 28' pups in city, and pups can allow drops in outlying areas (e.g. in with one, out with two). No 53' trailers in NSV; using 45' because volumes are down and limited number of vans. Local work includes distribution: customer brings them truckload, which they break down.

70% deliveries done before noon. Try to avoid appointments: this is down from past. For true city delivery, probably 25% appointments. If add consolidation e.g. as they do for Borders Books, it's 50%. They squeeze between 8:30 AM (the P&D departure) and noon. "Customers want their freight earlier, and want shipment times later"

FedEx has many time-definite services: 8 AM, 10:30 AM, and this worked into (all) schedules. If late, it's free, so they don't miss. Believes are 98-99% on time [expect this is overall, and ~100% for time definite]. If are delayed, response is a) call everyone else on cycle to rearrange, with pickup customers called first [because not on delivery guarantee]; b) add resources [drivers, trucks]. If inbound linehaul is late, try to turn (deliveries) into a couple of milk runs [i.e. peripatetic multi-stop] and try to break even. Service commitment overrides cost of this.

Don't handle much automotive; have more retail than manufacturing, although it's more equally balanced in today's conditions. Retail customers becoming more demanding on service requirements, putting pressure on their vendors. Handle a lot of DVD distribution

from here: for Ingram and others. A huge market, where delivery must be there on the day and not after.

Local routes:

- Best route to I-40 from here is Old Hickory/Hobson Pike (changes names as it goes).
- Major routes other than interstates: Murfreesboro Rd, Briley Pwy, 840 in south.
- Main thoroughfare for them is Hobson Pike/Mt. Julep. Put in a lot of windshield time, but has a lot of congestion.

Conditions:

- New Antioch high school is on Old Hickory/Hobson Pike, and are schools within half mile of terminal in each direction. A lot of kids traffic during morning schedules, and is dangerous; less an issue in afternoon. [This time of day effect: schools start during AM linehaul arrivals and departures for city delivery, but schools let our before the afternoon pickup crush.] Also 500 unit housing/condos scheduled here, plus 2,000 houses in the woods, all on narrow roads. These create daily problems.
- [Consultant's observation of Hobson Pike: pretty good 2-lane blacktop. Huge retail development as reach I-40: Providence Marketplace, plus surrounding hotels, and office park due to come]
- Difficult areas apart from town: Murfreesboro's become screwed up last couple years: population explosion, school system.
- Drivers complain about Franklin and Brentwood, but this is because residential area
- Nashville itself has gotten better, especially west Nashville due widening of Charlotte Ave.
- Eugenia area (across from CSX, Citgo) is difficult: designed for residences but has smaller businesses now, hard to get in and out, and hilly
- Basic congestion due to 24 and 65

Access:

- Chronic difficulty with printing houses, who get so much truckload business, and they can't cycle it through [is implying no dock space because slots tied up with TL trailers in extended process of unloading]
- Hendersonville and Billetsville both have places where residential encroachment around a pre-existing commercial park is restricting access and slowing service

Specific Condition Issues:

- Big bump where Hobson Pike meets Priest Bridge: expansion joint?
- I-24 EB off exit 62 (Old Hickory): 2 lanes left, 1 merge right, 2 lanes of traffic, difficult for inexperienced drivers with e.g. pups
- Bell Road exit; 2 lanes can turn left, far left lane cannot, so need to be in right hand; signs would help. Issues like these last two cause traffic to back up when truck can't make the turn.

Use prescribed routes. In city (P&D), it's the stop sequence. Daily monitoring of actual vs. expected miles, and compare goals for miles and stops vs. actual. Going to Vorad satellite system: GPS, logging, safety, routing.

Congestion monitoring: local drivers are reporting via own equipment and pump info into internal systems. So, are tracking in-house, and don't see much value to them from public feed.

Ingram Barge Company
Craig Philip, President
11/20/08

Ingram is moving approximately six million tons of cargo annually in the Nashville area. The primary commodity for Ingram Barge is coal to serve the Gallatin Power plant. Coal accounts for four to five M tons moving about 10 river miles. The coal comes from the Powder River basin and transfers at multiple points between St. Louis and Paducah KY. Ingram hauls another one M tons of sand and gravel and they operate the primary sand and gravel depot. They have a subsidiary which mines sand and gravel from the bottom of the Ohio River.

Products moving by river also include some asphalt, raw materials into Dupont, and some automotive steel. This is not all handled by Ingram.. There is occasionally movement of heavy equipment but it is more episodic in nature. The majority of the outbound barge product is scrap metal, around 200 K tons, largely moving on the coal barges The primary scrap facility is immediately above downtown Nashville near the Titans stadium.

Ingram has some interest in a partnership that does a ship to barge container transfer from New Orleans to Memphis which takes 7 days, 3 days on the return. There is a limit to the number of TEUs that can be loaded into a hopper barge, approximately 30-40.

Mr. Philips commented that in his opinion the 840 bypass on the south side of Nashville had fostered sprawl to the detriment of the city.

Ingram also owns Ingram Publishing which is the largest distributor of books in the world. They wholesale books to retail establishments and also do "on demand" printing. The majority of the book shipping is small lots handled by UPS and FedEx.

Mr. Philips commented that there was no maritime presence on the board. He felt that the city could be "more river friendly". He felt that there were places where the river and rail access could be made better.

In terms of opportunities, we discussed the potential of increasing steel, outbound agricultural products, and inbound fertilizers. Salt is another possible prospect.

Developing containerized traffic is not out of the questions but the fuel/carbon shift has to be greater before that will be feasible.

There is no lack of riverfront acreage available for barge development.

City of Lakewood
Bobby Franklin
11/19/08

Mr. Franklin participated in the original study and has attended several of the meetings and presentations related to both Phase I and II. During the first research effort he held a different position, not in the City of Lakewood. Mr. Franklin has a long history of planning and management work in the greater Nashville area and is well versed in the history of many projects and issues.

The City of Lakewood grew as industries, particularly automotive, came to the Nashville area. The city has been affected by the downturn in the economic climate. Mr. Franklin commented that many industries were downsizing but that some, like the publishing industry had seen resurgence due to the previously escalating price of fuel. Business which had been moved off shore was returning due to changing costs in the supply chain..

During the interview Mr. Franklin discussed the need for the completion of the eastern by pass. His primary reason for this belief is the continued development of industry and distribution on the east side of the city out toward the area where Dell and Cracker Barrel distribution is located. He did not feel that the current highway network was sufficient to handle the anticipated growth to the east and that this was something that should be addressed in the plan. Old Hickory Blvd is one of the eastern routes and it is a primary route through Lakewood. He discussed the political nature of the by pass routing and land acquisition issues related to the reluctance or “non-cooperation” status of certain agencies.

We discussed the bottle necks created by the bridges and the need for additional river crossing points to allow the traffic to spread over more points. In addition to the bridge situation he mentioned the congestion on 65 and 24 on the north sides of the river.

Mr. Franklin is a private pilot and suggests that aerial views are invaluable in getting an accurate picture of particular traffic bottlenecks and flow issues.

He discussed the loss of the UPS air hub from Smyrna to Louisville KY.

There was some discussion as to the value of the "quick start" projects in the last study compared to efforts be directed to more long term strategic initiatives.

One key point that Mr. Franklin raised is that the blue collar workforce in Nashville is largely rural and has a strong desire to maintain a country or suburban lifestyle. The commuting distance for many workers is quite long and is concentrated in areas to the East and Southeast of the city.

Lifeway
1st of 2: Don Potts, Transportation Specialist
2/3/09

Product: outsource almost all printing. Produce bibles (Southern Baptist Convention has own version now), monthly magazines, Sunday school literature, hymnals, books, plus furniture. DC in Lebanon, serving 150 stores. Used to have separate locations for dated and undated literature, but now all at Lebanon. Leb is central DC for about everything they ship, to stores and to churches.

He pays invoices and arranges Truckload (carriers and brokers) inbound to Lebanon DC. Large shipments from printers go direct into Leb. Doing mainly spot quotes, changed from set carrier: fuel and truck availability matter to the price. Outbound is LTL and small package: Saia, Wilson AB, Milan. TL use CH Robinson (broker), Schneider & brokerage, M&W, Deacon, Christiansen.

Vendors: NY (Yorkville), MI, IL. Mostly in North, some in Kansas City. Also lots from Quebecor World, 1 in Clarksville. And Rose Printing in FL, and another in Quincy [IL?] Majority come thru Lebanon, are a few vendor directs. Most product is ready to ship today or tomorrow; has longer leads on furniture. Are some IB and OB international containers, but he does not handle.

IB TL can be nothing for a week, then other times 10-12 a week. Based on production runs and seasonality. Easter, Christmas, and (EBS? VBS?) are rush. Christmas runs Oct & Nov into DC; 20 a day is the extreme. Summer slower but have camps all over, some as far as CA.

Service expectations: buyers take care that ready date is related to need by date. For transport, he requires pickup right away, no longer than 12 hours. If failed pickup or delivery, makes changes. If 3 failures in 6 months, cut off carrier for a while. Do have hot loads, but handle same process. Early deliveries not a problem.

Carriers used to complain about access to Lifeway downtown location (where used to handle dated product), and access better at Leb. Hasn't heard of congestion or other problems. Only trouble is driver appearing without delivery appointment, which they require (and carrier makes), and without one driver will sit and wait. Occasionally can't

get a truck for a lane, mostly in west. Have some local (TN) carriers who always want to get home to Leb.

2nd of 2: Diane Trescott, Manager, Transportation Logistics Dept.
2/5/09

Diane is on Exec Committee of NASSTRAC [what follows is the supply chain perspective]

Compact distribution territory. 70-80% of volume lies in circle: VA-KY-MO-OK-TX-Gulf. TX biggest market. 10% CA. Rest elsewhere, e.g. New England. Inbound is in East; Quebecor is biggest supplier.

Two best options for siting central DC were 1) Atlanta and 2) Nashville, where already had operations. Hence stayed, and have expanded Lebanon once so far. Specific site in Leb selected for a) travel time for employees; b) land price; c) incentives; d) access to carriers and interstates. A primary (LTL) carrier is Wilson, whose terminal is down the street. Once we moved out of Nashville (downtown), it helped tremendously. Now have enough doors – with doors split inbound and outbound - room for drop trailers, and better access.

Keep 2 warehouses [sections?] at Lebanon:

- Dated, for Sunday Schools: quarterly/monthly/daily. 127 sku's
- Undated, consisting of anything used in group (like cookbooks). 35,000 sku's

Dated stock 100% cleared each quarter. Undated has more typical replenishment characteristics.

Partnership with firm in LaVergne to combine shipments, but partner keeps that stock and is invisible to user. Have a van that runs between Lifeway and partner.

Five business units:

- Church resources: dated, plus some vacation school
- Retail: 150 stores, plus web
- B&H Publishers: bibles and trade books
- International: floats between, B&H plus other
- Direct Sales: building of churches, fixtures. They don't stock this material, but arrange transport, from suppliers mainly in their Circle e.g. Staples, vendors

Lebanon DC serves 4 business units [presumably Direct Sales is the one they don't]. OB is 21% LTL, 78% small package, 1% TL. #1 destination TX. Service is mainly standard ground; able to use same for dated as well as undated. Keep metric of on-time vs. carrier's standard: most are 97% + on time. Track Lifeway retail stores monthly because fixed commitment to them: your shipments will appear on Day X in window between

10AM and 1PM. Do pickups as late as 5:30/6:00 PM; DC closes at 4 but are drop trailers. Is some customer-routed freight.

International: 5% of volume, mainly inbound: bibles from Korea, trinkets from China. Much is purchased domestically but produced overseas. Mainly is containers railed to Memphis and trucked to Lebanon DC. Memphis gets congested – at rail ramps, and generally – but not in today's economy. Have a few OB international small package shipments from Lebanon, plus a few customers who may consolidate TL on own account – and Lifeway consolidates for a big customer about once a year.

Importance of service: they monitor, and change carriers who fail. Not high precision, but has to work. Consistency is thing needed, especially for Lifeway stores, who are on fixed delivery of x times per week. Other retailers served based on orders.

Conditions:

- Is new access road at Leb ("Martha something"), so interstate access better. Immediate access to DC remains clear.
- Is mall at 238 with smaller retail. No effect on access yet, but should watch.
- Most of their traffic is going away from NSV (congestion), so interstate (local) conditions not a problem
- Use Lifeway truck to do NSV deliveries. He goes against traffic in his route plan daily.

Growth: dated product is flat. Undated growing 3-5% a year, though fluctuates. [about 45% of outbound goes to stores, so that ought to affect the growth rates]

M&W Logistics Group
Wayne Dorris (no title, experienced management level)
2/4/09

Regional truckload carrier, mainly in TN and north. Drop yards in Memphis & Indianapolis. 50 road drivers, plus 30 regionals doing out and back and 20 city pickup and delivery (yard drivers). All company drivers. 100 power units, down from 130, all 53' dry vans. Are on Quallcomm (satellite). Probably do 30-40 loads per day total. About 400 miles average length of haul. Main lane is NSV-Chicago. Lots of food grade product, largest customer is US Smokeless Tobacco. Do some warehousing at this (Nashville) facility (only), ~100,000 SF.

Is lifelong NSV resident, but feels hasn't seen much change in conditions. Cut out many rail spurs, roads have been widened. Generally feels improvements have kept up with growth, not much [net] change on conditions

Hot spots:
- I-65 N, between 3 & 6 PM is just gridlocked

- 24 toward LaVergne is same
- 40 is *not* that way: east is good, west too except as get to end of town, around 200 mile mark at Bellevue
- Don't dare go to LaVergne in afternoon, try to do it in morning. Between their location in NSV and LaVergne is a lot of industrial traffic [believe he means much business to serve]
- Murfreesboro Road is a main thoroughfare with congestion.
- And here at Fesslers Lane, which they need to cross frequently to access their shop

Arteries they use that are not interstates:
- Briley Pwy to get out of town
- 41 north of town
- Murfreesboro Rd to go toward Murfreesboro
- Not Ellington [we asked because of another respondent]: doesn't take you anywhere, just back to 2-lane stuff. Nice road, has no access to town, but connection to Briley new

Access issues:
- US Smokeless is in an old location, yet they put 10-20 trucks into it daily with no problem. (But their average tenure for all drivers is 20 years, so they have much experience.)
- Lots of customers have moved out to LaVergne, and that's pretty good

Driver asked today: "why are trucks kept to right lane, when that's the exit lane?" Should question the way we've always done it. [They're not the only truck line to wonder this, here or around the country]. In past, had many sideswipe issues. Mostly from right side, indicating from traffic merging in, so it's an entrance problem more than an exit. Dedicated truck lanes would be beneficial – maybe as simple as like HOV, but do need two lanes (middle? left?). They set their trucks at 68 mph max, recently cut to 65, drivers can't go any faster, so no one can pass.

Driver training: all must have 2 years experience. Orient new drivers, plus 20 mile road test. Safety meetings every 3 weeks for small groups.

Growth they see: Rutherford and Sumner counties, not really in Davis

Toshiba TV plant in Lebanon was big customer who shut down last year; DC may still be functioning. Akzel Noble uses M&W warehouse as DC, M&W shuttles between there and the plant: 3-4 turns daily. Innophos uses another part of warehouse, same kind of shuttle to plants; drivers turn 5-6 times a day.

M&W handles Girl Scout cookies for middle TN, has been for 28 years, is done once a year, and happens this weekend: 25 truckloads disperse to church, elementary school, convenience store parking lots all over on single Saturday morning – Tullahoma probably furthest away. M&W brings product down from Mothers Cookies in KY starting in

December, warehouses, then releases all at once. Each delivery truck normally makes 3 drops, has driver plus helper, and carefully account for every individual box.

Metro. Nashville Airport Authority
Bruce Gelband, Manager of Planning
11/20/08

Mr. Gelband was a participant in the previous study and has continued involvement with the process. The airport is expecting traffic to double in the future although the economic climate will have a slowing affect.

China Airlines was landing 6 or 7 747s per week at the time of the interview, primarily serving Dell with inbound product. They had some outbound traffic but not nearly balanced in volume with the inbound.

FedEx was operating one narrow body and two wide bodies nightly, going to three wide bodies in the future. These flights operate between Nashville and Memphis and Indianapolis, primarily for the US Postal Service.

Vought Aircraft Industries, a manufacturer of airplane wings and tail sections, operates in the area. They have been primarily shipping their products to DFW. The facility had a down turn and nearly closed but is now in resurgence.

The airport currently operates four runways. One has 10,200 feet of pavement. One of the four will be expanded to 11,500.

Passenger airlines are not carrying any mail. There is no UPS facility at the airport.

The east side of the airport accommodates the freight services of the airlines – belly freight. The west side is the cargo center where Dell has two facilities. Trucks on the west side use Briley Parkway for access. On the east side they come off I40.

The Tennessee Air Guard operates eleven C130s from the airport and it also serves as a refueling stop for fighter jets, F16 and F18 etc.

The airport has land available for freight expansion. There are no new plans for the private side. Passenger traffic is down nationwide and regional jets are falling into disfavor because they are expensive to operate and uncomfortable for the passenger. This may cause some new rationalization in airline networks, accompanying the changes due to fuel concerns.

Huntsville Alabama is marketing an inland port project that includes the use of their air facilities for a developing cargo break bulk facility. They are doing marketing in the Nashville area in competition with the airport.

Metro. Government of Nashville and Davidson County
Dept. of Public Works
Bob Weithofer, Engineer
11/20/08

Mr. Weithofer has worked in the traffic engineering area in the city for some time and has experience in other metropolitan areas as well, including California. He has knowledge of the previous study.

This discussion focused on traffic bottlenecks and areas of congestion, specifically the north-south interstate corridors. The primary areas of concern are the pinch points where highways merge together and the funneling of traffic to the bridge system through Nashville. The opening of the bridge near the Titans stadium has diverted some local traffic and in fact created a "park and walk" capability that eliminates vehicles crossings altogether in some instances where the proximity and weather are conducive.

Bypass routing was discussed with the issues of land acquisition in some neighborhoods or areas where opposition to the highways was strong.

The department has had budgetary restraints which have affected their ability to keep abreast of developing issues and needed solutions. Mr. Weithofer offered access to the automated traffic equipment and study capabilities which was forwarded to the project management team.

Nashville & Eastern Railroad
Anthony (Tony) Linn, Chief of Marketing
6/29/09

NERR runs 110 miles from Nashville east to Monterey TN. Also own NWR, running west ~18 miles to Ashland City. The two are discontinuous, linked over CSX track (and don't have any meaningful connecting traffic). NERR started 1986, NWR 2000, web site claims 500,000 freight tons plus 140,000 passengers in recent commuter service. Discussion focused o NERR, where most of the traffic is.

All carload business in less than unit train quantities. No intermodal. Former unit train for Rogers Group went away when business moved to different location; do expect unit train coming up (more below). Business essentially all with CSX, 70% inbound (deliveries), 30% outbound (originations): most customers are receiving rail goods, then shipping out by truck. Business local to their lines is small, though hope to grow. Believe is a future for Class I carload business except for the one and two car lots; most of their traffic moves in bigger blocks most of the way.

Major prospect with Rogers, who own a zinc mine on Gordonsville. Mine itself has had ups and downs, but accounts for large quantity of stone, which Rogers trying to sell into

Nashville market, and have a new facility for it at Vine Hill, off Visco Drive (visible from I-40). [Unclear from comments if commodity would be rock, sand, or both.] Hope this could be 250,000 tons/year, and would be local to their line. If successful, probably equates to truck diversion, since replaces rock most likely trucked in from elsewhere.

Up until recession, freight growth positive, both new customers and growth from existing (enough to offset traffic losses, which were not due NERR service failures, in any case). Customers happy with service; make sure train and rehab crews know who pays the bills. For building business, in constant contact with a) economic development agencies and chambers; b) CSX, so they know their properties. NERR does not have real estate; it's existing property along line owned by others – and this is limited. Plenty of undeveloped land along line east of Lebanon, but needs roads, water, sewers, etc. Better around Cookeville.

Track weight up to 263,000 lbs, reach 286 in places; issue is bridge weight, not track per se. Mainly ok to Lebanon, falls off after that, but not much of a business constraint: customers who need 286 have it.

Most grade crossing problems were mitigated by introduction of commuter rail over the 30 miles from Nashville. Also don't run trains of such size as to really keep people waiting – so no big grade crossing issues.

Regarding TDOT plan for east-west (I-40) rail corridor, which would use NERR line: hopes it's in limbo (vs. dead; thinks isn't really alive). NS probably favors their e/w route to the south instead. Feels is a good vision, but a lot of hard work to achieve.

Passenger operation is via a subsidiary; is an accommodation to the MPO and RTA. An "experiment" at the moment, 2 in/2 out each AM/PM rush hour, making 6-8 stops. Continues to grow in the nearly 2 years of service, but less than people would like. No freight capacity constraint from this service for now, none really in prospect, and did create first class welded rail to Lebanon. Currently looking (along with mayors of Nashville & Cookeville) at resurrection of commuter rail that once existed on N&W.

General situation: plenty of ability to accept growth from current customers. Limited properties to develop new, although much undeveloped land to east. Won't be a major source of highway relief, but could supply some.

Old Dominion Truck Lines
Ron Baucom, Service Center Manager
2/3/09

OD is a leading, multi-regional LTL carrier. Baucom lives in Tullahoma, commutes up daily, here 18 months.

Terminal is mini-hub and major relay terminal due [crossroads] location, plus city P&D. Memphis and Morristown TN (N of Knoxville) are the big connecting hubs, plus Columbus and a few others. Domicile 60 road drivers, 40 city. City operates N to Bowling Green, S to Lewisburg. Operate 6 AM to 9PM for metro region (say 5:30 for Bowling Green). Hub works 2:30 PM to 4:00 AM. Use ~48 dock workers, not drivers. Linehaul arrives all day long, but 2 AM-9AM heaviest. Outbound linehaul starts 8 PM, then 30 minute intervals.

Monday heaviest deliveries (due weekend). Pickup slow Monday, then builds through week and Friday heaviest. Delivery stable rest of week, dips on Wednesday. Are month and quarter end surges, especially when quarter ends on Friday. Activity is light for 36 hours ending Sunday around 3 PM. Breakbulk works all weekend.

Trailers mostly 48', some 40', and some 53's for swaps. Pups used strictly in linehaul, because 28' not big enough for city, where using 48' and 40' [this seems affected by fuel prices]

Little rail – half dozen (lanes) or so – but company as a whole does a lot. These are ocean containers feeding imports into OD (distribution) system, from Charleston, Savannah, Jacksonville, etc. This moves rail, but also are owner/operators moving full containers direct to customers – brokerage operation for customers who don't use a lot of it (international)

Handle lots of retail deliveries, pick up all local manufacturers, much automotive, and are Dell's primary carrier. Lebanon Dell is moving to Mexico. All jobs are leaving – are desktop models. Laptops are at airport plant, and remaining.

Bigger (linehaul) lanes are, in order, I-40 to I-81, 24 S to Atlanta, I-65, and Memphis. Handle relays from all over; do a Memphis-Morristown meet.

Monday AM deliveries start [departures] at 6:30, but if not out by 7:15, may as well wait until 8:30 due traffic. Vast majority of city needs to be back by 6:30 (customers nearby can be later, or shipments on 2-day lane with Morristown break). City deliveries are mix of appointment and regular stop. If run late, response depends: some customers work with you; for others, you wait or go to back of line. Others like Sams Clubs make you come back (and they have a 15 minute window). If come back, goods come off the truck back at terminal, and more times you handle, the greater risk of damage. Have ~ 2 a day where shipment comes back. Thinks congestion affects 20%.

In general, are dealing with congestion: sometimes late, but mostly plan for it. Better to be early and wait. [which means use more assets and make fewer stops]

Road conditions:

- Conditions very bad on 24 in AM – and 24 was widened and is better than 2 years ago. Are no good alternatives to 24: if going to KY, that's the way. Can use Hobson Pike, but is 2 lane.

- On I-40 from Knoxville to Memphis are no good alternatives to going thru NSV. Can use 440 part of way, but … And Briley is out of the way.

Main roads not interstates:

- Murfreesboro Rd, Hobson Pike, 840. Drivers avoid interstates when can.
- Use Ellington and 440 once in a while (pedal runs) and 440 for linehaul.
- Use Briley a lot, depending on time of day.

Difficult areas: downtown conditions: atrocious, as everybody knows - narrow, congested, not conductive to tractor-trailers, and lots of crossing traffic. But you know downtown is bad, like all downtowns.

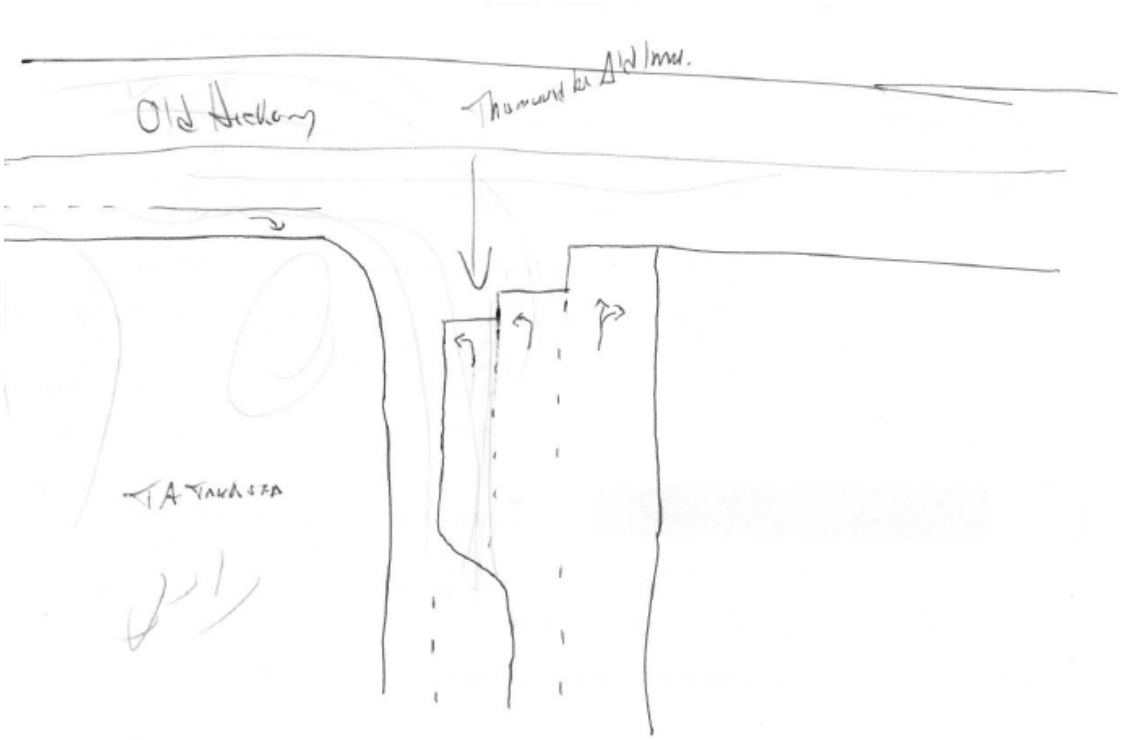
- Vanderbilt (west end). Roads 3.5 feet wide and cars parked both sides. Bad loading docks. OD uses dedicated straight truck for it.
- Everywhere else is reasonable. Hears no complaints from drivers about access issues in other industrial parks or retail pockets
- Dispatcher gave example of signal at entrance to Old Hickory, by TA Truck Stop (near terminal). Hand drawn map (below) suggests two left turn lanes, with stop lines each set progressively further back.
- ➡ Need a place in middle of road to stop truck and use hand cart, like UPS gets away with. Wider alleys would be nice, but alleys are hard to get in and out of.

Likes idea of email alert about traffic backups (and pothole crews). "Tremendous help", and if got all local LTLs in it, that in itself would diminish problems by moving off that segment of trucks.

Expects to be on GPS this year: it's mapping technology that has made the difference (where all the businesses really are all there). "Every mile I run costs money" and thinks can use lower paid people and make better decisions with technology.

"Everything boils down to miles: linehaul, and city". And not interested in any (terminal) property in the wrong place, at any price.

"If drivers complain about one thing, it's people on cell phones: a) OD forbids own drivers this, and will lose job if caught twice; b) drivers can see down into cars (so know it's happening)



Prime Properties, Inc.
Howard Sanders, VP Planning and Development
11/21/08

[Company is local property developer. Conversation supplies historical perspective on development and their view of future.]

Nashville located within long days' drive of 70% US population (he says), so is hub. Davidson County (in center): affluent to south, residential and high end office. West: becomes rural until Memphis; Jackson is halfway. North: generally hospitable terrain for development except Portland & Clarksville; former is limestone, latter home of 101st Airborne at Ft Campbell. East is direction of development: Wilson County, where larger projects have been. Southeast is Rutherford County, aggressive for expansion but mainly residential around Middle TN University. Original loop was 265, then choked with development. Next 440 exploded south side of NSV; extended west, but less value due river obstacle.

Company got ahead of development to east: 700 acres at I-40 & 109 "Eastgate". Started slowly, then faster which confirmed their view of direction. Next: SR840 – the 3rd loop – where have 500 acres for distribution and light manufacturing. Are at Exit 67, anchor tenant was Aldi, a German grocery chain expanding in US, 500,000 SF. Also Wilson Sporting Goods, etc. Has built out in 4 years, which is fast. Nashville Super Speedway

really broke it open: brought in sewers, and they jumped on it. Flat area south of I-40 is "the Glade" (seems to think good property).

Expects continuation of 109 north to 65, linking from 840. If do this, accomplishes what is needed for hub. Avoided calling SR840 I-840 to retain state control; 840 has 30 years before built out. [Suspect he means the 4-year build out was his property, and the 30 year is 840 generally.] Doesn't see northern 840 ever built, believes replaced by 109, which believes will be last connection. Missing link east/west is rail to do same as interstates.

NSV is "little Atlanta"; as Atlanta becomes more congested and sprawling, you move north and do it again. This is 50-60 year horizon. Compared to Memphis, NSV is better crossroads, and Memphis has the river in the way. NSV has wide range of everything; climate, culture.

Great believer in toll roads: build for people willing to pay for it and accelerate their productivity. Thinks NSV has been short sighted: 840 could have gone in years earlier as /if tolled. Clients tell of trucks stopped in peak traffic. His solution is come out on 840 to get out of it, have your own exit, light traffic all day long. It's dollars and cents, plus flexibility.

Smyrna/Rutherford County Airport Authority
John Black, Exec. Director
11/21/08

8,000 foot runway, can handle up to 747's. Handle corporate aviation, cargo, aviation maintenance. Cargo is limited, but is use they contemplate. Thinks cargo radius is 75 miles.

On outer loop of 840 and new 24. Have ability to expand. 1700 acres in total, with 500 to be developed: 400 west side, 100 east. Are a landlord airport: provided a land use map, of which they own all, so want to develop it and lease it out. And are an airport authority, meaning government entity, guaranteed by county and town of Smyrna, but still stand-alone.

As an outlying airport, are unique in size, so if wish to run cargo, it's good. Plus have 3 interstates and are close to NSV. Only airport with tower and instrument landing system outside of NSV.

Estes (large LTL truck line) is across street (mainly coincidentally), CSX is half mile away but have spur. Had Saturn parts when up and running. Nissan is 2 miles away (has rail spur with huge rail yard, and do exports). Nissan has passenger hangar here. They do fly in emergency parts: wiring, radio harnesses, bumpers. It's infrequent, more in winter, mostly light jet but up to 747. Still, Nissan says wouldn't be here without airport. UPS doing some night time small package with medium prop plane.

Have seen themselves as being in a triangle surrounded by Memphis, Louisville, Atlanta (all big air cargo hubs) so difficult for air. Are in between general aviation and commercial airport, so must be *non-scheduled* commercial. Sees it changing, probably over 5-10 years, with more point-to-point service for Smyrna-like airports outside major cities.

Middle TN Development: Chattanooga just landed VW plant last summer. Clarksville to north is talking some major development (Clarksville mega Site, 600 acres). So vibrant corridor in middle of state. All this is relevant to NSV traffic. And in between, what are the big tracts of land? Theirs is one.

Development surrounding: the Sam Riddley Road retail is all new within 6-8 years. In last year when slowing down everywhere else, was still going here. Murfreesboro has done excellent job of attracting retail. Mentions FedEx Freight has a new facility in Murfreesboro, maybe a regional sort. Several warehouses a long way down 24. Nweest exit on 24 Joe B. Jackson Parkway, just opened last year, lots of infrastructure ready there. Generally, is much infrastructure ready for growth. A lot of big box went in last 6-12 months along 840 not all full. (Looking at NSV area as a clockface) this really means 3 o'clock to 6 o'clock is where development is or will be. 6 to 9 quadrant is residential.

Concerns: Funding, because when company comes, may need infrastructure grant. Other concern is competition for development: people not thinking regionally.

Tennessee Express/TCW
Dave Manning, President
2/3/09

Dave is head/chair of the Intermodal conference at American Trucking Association

Have ~100,000 SF warehouse space thru 2 facilities. 2/3 of space goes to cigarettes, which are how company started. *Large* service region: LA-MS-AR-MO (bits)-KY-TN-AL-GA-SC-NC-bits of FL & VA. 10 terminals. Crossdocks at Memphis, Jackson, Birmingham, Columbia SC, Charleston, Charlotte. Only warehouse is Nashville. Receive consolidated freight [assume from others] from Memphis, Birmingham, Kenner LA. Cigarette hauling is KY-TN-AL-AR-MS-LA-bits of MO

TN Express operation: 225 power units across network, 50 in NSV. Non-sleeper cabs. Run 320 drivers, with 75 in NSV (with maybe 1/3 strictly local, and rest with loads starting in NSV). Avg LOH 170-180 miles. Heavy lane between Memphis & Nashville, also from ports of Charleston and Savannah.

Mix of regular route TL and LTL (latter is really partial load/multi-stop TL). Run dedicated lanes for Nissan, mainly from west coast. International (port) trucking, and rail

intermodal drayage from Memphis are big part of their business. Drayage makes up 70-75%.

Schedules run 24/7, were 70% slip seated until recently. Love to run at night because businesses not open [meaning less congestion]. Prefer that linehaul driver do delivery, but if can't get into customer [due time of day or appointment] will drop load at terminal. Probably do 60-70% of P&D during daytime; this is driven by customer. Two driving factors are customer time specifications and (whether customer is) running two shifts. Customers on international side are less anxious about receipt times "they've waited a long time already", and the international goods then become the ones the customer plays with [means irregular schedule causes customer to treat use of the goods as more fungible] They leave routing to driver, but may (now) do more through dispatch

They are at CSX Radnor Yard in Nashville 20 times a day. CSX has deemphasized Radnor through the years, substituting truck from Memphis and ports. CSX drove this change – not the market; railroad was capacity constrained and drove off the business. Everyone used to have a hub there, but not now.

Radnor is hard to get into, and dangerous when trucks parked on Citgo. CSX bloacks access (with trains) for hours a day. Even when not blocked, it's difficult access – althougn have not had accidents. Used to be Tn Ex. Would charge extra for Radnor service due to all this, but not today [economy, presumably]

Memphis is their main rail head, handling mainly international boxes off west coast, and some domestic. Good mix of BNSF and UP; they have a terminal at Homewood a few miles from BNSF; when UP moved their yard across river to AR, it became further away [for their service] and (exposed you to) congestion on the bridges. From Memphis, run 2 heavy lanes: a) Nashville and 200 miles around (but not past ~Knoxville); b) Canton/Jackson MS (affected by Nissan). The Nashville lane is 30-40 loads daily *both* ways: 60 loads, 30 trips – at least up until 6 months ago.

They specialize in balanced loads "1-way trucking", export and import, to ports. Difficult to do; charge more per mile each way, but less in total. Has a lot to do with terminal network: they run many relays, especially via Atlanta, for the port traffic. They do get breaks on container free time form ship lines, and have real or virtual container yeards to stop the (demurrage) clock. Serve a lot of shiplines, who can't work out this kind of operation for themselves. And, they do find domestic loads for the balance sometimes. Growth target for years had been 15% for international and drayage – but not now (economic conditions). Do not run own chassis (exception at Kingsport TN where have triaxle for heavy loads). Would supply own chassis if system allowed it: e.g. can't get the box live-lifted (off the chassis), and railroad wants the box dropped while mounted.

Service requirements vary by customer, but are tight. Mainly appointments; not many give you 10 hour drop & hook windows. DC people are worse than manufacturers, due to their (inferior) dock door management. Even when coming from Japan, delivery

managed very closely. If plan for 21 days, it's not 24 days, and is no place for (off-schedule) cargo to be stored. Appointments also vary, but typically +/- 30 minutes. (TN Ex tries to arrange them with flexibility, because their operation ties loads together sequentially). If driver late, usually they wait. (If customer is late, are limits on equipment free time). On-time performance is 98-99%. For local service, they figure 30-40 mph; for Memphis runs, 50 mph

Conditions:

- Road conditions pretty good for congestion. Seeing more rollover accidents on I-40 between Memphis and Nashville.
- But in last 5 years, overall conditions worse: volume increased, capacity not. NSV has done better than other cities, and NSV (usually) has other ways to get around (alternative routes)
- Problem with I-24 east of NSV ("don't pretend to know why, just see result"). From 3 or 4 PM, can't run there – and is heavy lane for them, due Nissan. Backs up to Nashville: it's much worse than anything else and more than I-65 North of town (whose problems he thinks are due to the hill). Knows are widening/widened, but didn't go far enough.
- I-24 has gotten a lot worse. Not a day goes by without gridlock, and there is not a real good alternative. I-65 is a bit better.
- The problem of land use disconnected from transport planning is very much alive in Nashville [this is response to question], thinks this is why 24 has gotten so bad
- Interior roads getting around 65/440 are tough, with lane mismatches and crossing traffic
- Ellington Parkway is a problem: great direct access to 65 at north, but south end by Spring St has no connection. "For a long time, Ellington was the best kept secret, but has more on it now" "used to use Ellington all the time (for commuting), now use Briley, and it's better"
- [Consultant observation of Ellington: nice road, light volume and just 1 truck at 11:30 AM. Problem at south end apparently due 2 housing projects.]
- Any time a road drops lanes, must be a bottleneck, or where volume is growing

Policy options:

- Dedicated truck lanes ok so long as work out ingress and egress – can't have traffic crossing each other - plus must be 2 lanes
- Tolls on new capacity are ok by them; tolls on old capacity are ok if they have a choice (as with managed lanes).
- Trucking [this is his ATA hat] favors fuel tax increase over tolls, because there is an existing way to pass this on to customers

➡ TN Express subsequently sent us a list of 5 bottlenecks and access issues, with accompanying map, prepared by one of their drivers. List follows.

Nashville Regional Bottlenecks and Access Issues
Explanation of Markups on Map **From: TCW/TN Express**

Number	Location	Explanation of Issue
①	24 west Exit 56 Turn Right to to I-40 Turn Left to I 65	Connects to I-40 to Avoid Downtown Past Exit 56 Bottlenecks during rushhour also to I 65 South
②	24 west Exit 54	exit 54 is Briley Pkwy can use to go to I 65 North of town or all the way to 40 west to Memp
③	Lebanon Rd to Briley Pkwy	From down town to get North
④	I 65 Exit 74 Old Hickory to I-24	Quickest from Brentwood to Lavergne / Smyrna / Murfreesboro
⑤	I 40 East from Memphis to I 440	I 440 circles south of the city to 65, 24, and 40.
⑥		

Tennessee Trucking Association
Dave Huneryager, President
11/21/08

On road conditions: "Twenty hours a day we don't have a congestion issue". I-65 from NSV to Spring Hill is a mess. East and West routes are pretty good. Bottlenecks:

- Exit 65 on 65S goes from 4 to 2 lanes. Have 4.5 miles of 2 lanes, then up to 4 at 840 – same kind of problem that was solved at Murfreesboro
- Off 65 onto 440 is crossing traffic, probably needs a flyover. It's west 440 in AM, east in PM
- 65 on west side is good except when an accident at Rosa Parks
- Widening of 40 at Fesslers Lane was good
- I-24 the west on 40 onto 65: just lots of crossing traffic
- 440 into ___ [couldn't hear] above Briley: just rush hour bottlenecks, unless an accident
- Nice job done with crossing at White Bridge Road – good exit
- Old Hickory Blvd is better, so is downtown at Broadway (seems due to signals)

Wish troopers would turn off flashers when pull over – causes rubbernecking on other side.

No airport issues: "easy to get in and out of there"

Briley improvements helpful. If were a way to get people to use it more … (but has lots of passenger traffic)

Business conditions awful. Long term depends on autos. Looking ahead to new VW plant in Chattanooga, will make 5 plants in region (including GM)

Regarding 840: legislature set up Transportation Funding Committee, Dave is on it. 2 sections, 12 miles: 65 to 40W (south of Franklin to Dickson). They'll keep all the through traffic out of downtown. "All trucks on W40 at peak must use southern route" and vice versa at opposite peak. Don't think will ever be a northern 840: lots of water obstacles, etc.

University of Tennessee Center for Transportation Research
David Clarke, Mark Burton
11/21/08

This interview was conducted in Knoxville at the Center for Transportation Research with Dr. Clarke. The Center has moved away a bit from issues of freight operations more toward research in technical areas like intelligent transportation systems and modeling and also into the marketing and economic development needs of the state.

We discussed a current project where they have involvement to draw development and jobs to the areas of south central Tennessee on the border with Alabama where a lack of employment is a serious problem. This is an area south of Nashville that could add freight to the region but is also close to Huntsville where there are initiatives toward an inland port that is air centric. The rural areas of the state have strong economic needs.

There was discussion of the nature of Tennessee as a "through" corridor with the combination of I40 and I81 going to the Northeast particularly with NAFTA traffic short stopping rail intermodal at Memphis then moving via truck. Their opinion was that this was not really prevalent.

The heavily traveled North-South corridors of I75, I65, and I24 were mentioned as areas of congestion. The new corridor extending I69 from Michigan through Texas will pass through or near Memphis and has the potential to divert some traffic.

One primary focus was the need for a statewide plan that would account for the needs of the individual areas but would also address the mobility throughout the state and also regionally in a coordinated effort cooperating within the state and with adjacent states as well. The example of the Tri-Cities area in cooperation with Bristol Virginia was noted.

Aldi Foods
2080 Aldi Blvd, Mt. Juliet, TN 37122
Brent Franke, Distribution Manager
8/12/09

Company is a German grocery store chain expanding in the US. Stores are a sort of small scale, private label warehouse – sized like a small supermarket or big convenience store, with no-frills presentation but a complete line of goods, almost all of it private label and economy priced. [These are interviewer characterizations after visiting a store, in preparation for the interview}.

Company is fairly new to middle TN. Located in Wilson County because County offered tax benefits, also 840/40/24 are close, so made sense logistically. Central TN helps them cover both Memphis and Nashville, and is a great crossroads.

Improvements they would like to see:

- Complete 840 to 40W
- Widen Aldi Blvd (their street): Aldi was first on it and wasn't bad because a lot of space was empty; now busier and a wider street would be safer

This is a food DC; company has 19 in US, mainly eastern. This location serves TN, S. KY, Birmingham, one store in MS south of Memphis and one in NW GA. Serving 44 stores now; DC's geography shouldn't change, but number of stress should. Expect to about double the number of stores – they are still getting known.

Outbound is hauled by a contractor, who might get backhaul. Outbound: ~30 trucks/day, all full truckload, ideally one stop per truck, sometimes two. Inbound: guess 45-50 trucks per day, probably 50/50 commercial truckload and private fleets, includes reefers. 90% of products are private label. Not sure how much they import, but a lot comes from name brand (US) suppliers; for example, their chicken comes from a big US company, and is domestic.

Service: delivering to time windows at their stores: 12-7 PM, and 9PM-6AM; carrier picks which. Also some ASAP loads for goods selling well; then go to earlier delivery.

Try to stay away from traffic – and won't unload in AM anyway. Typically do overnight. Driver does his own loading and unloading; stores typically have one dock door.

Regional conditions are good. Compared to where he worked in St. Louis, it's better: he'd rate St. Louis a 3 and Nashville about an 8, but then he doesn't drive the truck (so doesn't know intimately), and they do a lot at night (when conditions clearer). The choice of night operation is purposeful and in Aldi's control. The big thing for him is widening Aldi Blvd (and 840 affects them, but not greatly). If they had that, they would be good for growth.

Vanderbilt Medical Center
Teresa Dail, Supply Chain Manager
8/17/09

VMC is a major teaching and diverse care hospital, attached to the University in the west end of Nashville. They operate 4 separate supply chains:

- Medical/Surgery (Med/Surge). Floated an RFP in 2007 to 4 3PLs, awarded to Owens & Minor (O&M) Medsearch Distribution (this is the operation that Cardinal Health Care was running for them in 2004).
- Medical Pharmaceutical (MedPharm), operated for the by McKesson, who has large DCs
- Laboratory Supplies, just re-awarded to Labsco
- Office Supplies, which is a shared contract with the University (Guy Brown)

There also is some daytime activity [sounds like miscellaneous things that happen outside the formal chain]. Had reorganization; previously materials management team had no

clinical enterprise responsibility, nor coordination with University. But only actual change in last few years is with Med/Surge.

MedPharm:

- Pharms have big regulatory requirements: FDA as well as others. You don't mix product for this reason, even if vendor can manage it (hence is a separate chain)
- Daily service, 3 deliveries: to clinics, VUH and VCH. 27' truck Monday-Friday, 6:30 AM arrival to dock to TVC to main pharmacy who receives inside, then Children's (so going to off-site and to central pharmacy)

Med/Surge

- Generic type of supplies for patients, not drugs
- Have local DC off Briley Pwy that does 80% of volume to Vandy. Most is manufacturer direct, but O&M has a hub DC in Atlanta as well. If product is "inter-branch", comes from yet another DC, not from manufacturer
- 7 days a week service, trucks arrive 1 AM to 5 AM. Semi's, loaded based on urgency of use, so surgical supplies are first off. All product is put away by 6 AM; orders are placed once daily, by 4 PM.
- Deliver to on-site (here in west end) and off-site clinics. Also some on-campus, which O&M takes direct to site. Plus clinics outside the county; they may deliver or use FedEx.. Deliveries are 2 on children's side, 2-3 adult; more if a clinic order, consolidate those weekly
- Also have a Hot Sheet [urgent goods]: if this is because Vandy forgets to order, couriers will handle at no cost up to a point. If O&M screws up, no cost. Service available 24/7. If product not in stock, will overnight however necessary.

Office Supplies:

- Desktop delivery. Electronic ordering for everyone in clinical enterprise, people buy from a catalogue off prearranged list. Normally a dept. secretary does this (so department orders consolidated) and manager must approve, then order goes out, delivery next day.
- Delivery by little van-type truck (like UPS step van) with a rolling cart. Show up all day long; is a university-wide service, so many reasons to come

Lab Supplies:

- 5 days, AM delivery, if rush will return in afternoon
- Direct from manufacturer to DC in Nashville itself
- 24' box truck, one a day, delivering to central lab
- Pallets arrive before 11 AM, smaller goods arrive before 2 PM (so 2 arrivals)

Miscellaneous:

- Linen trucks arrive at off-hours, early AM at one facility, after 6 PM at another. Use semi's, do a cart exchange on the floor [clean for soiled], truck thus full both ways. Multiple trucks arrive at each facility. Is a shared service, handling multiple clients [assume means e.g. dorms]
- Sysco (food service) delivers once or twice a week, about 8 AM

- Coca Cola arrives at 7 AM [seemed to be daily]
- FedEx & UPS: bring some manufacturer directs for patient-specific needs, which isn't via DC
- Respiratory therapy: oxygen cylinders delivered daily: full in, empties out
- Red Cross deliveries of blood
- Waste hauling

Access: all docks extremely busy. Have 2 people working; even the Coke driver has a set appointment. Must get the big trucks in and out before the smaller stuff that can be at off hours. Are 3 docks. Main has 8 bays, but some are stationary (like for waste) and some biohazardous.
Access issue are mainly due to Vandy itself – its growth and construction. But are a number of routes to get in. They make sure carriers have alternative routes as part of disaster planning e.g. ice storm. Carriers submit these plans to Vandy. ➡ Do not wish to reveal routes for security reasons (e.g. tales of people assaulting medical supply trucks after hurricanes), but are interested in what MPO plans.

Local logistics: Vandy <u>changed</u> ordering patterns <u>to use off-peak</u> hours, both for logistics reasons [congestion] and for staging supplies into the wards: it was a dual reason. But are many traditional Monday-Friday daytime deliveries [the miscellaneous listed above], which cannot be extended into daytime. Is a security aspect to this: if at night, access must be limited to control which doors are open, etc.

Service Sensitivity: outside office supplies, hospital runs just in time, being able to react when medically critical
- Many things are patient specific
- Order every day for what med will use next day: thus makes sense for financial management to carry no inventory [means uncertain what is needed until shortly before], and makes sense for patient to procure latest technology and materials
- Plus have limited space, both at docks and internally to buildings. Must have central receiving for financial and other reasons, so this is built-in part of control that must be managed – (central receiving acts as) a gate
- Even linens are time critical: must be clean, but little space and volume can change dramatically, with big spikes in usage. Can't store it, and are big quality issues.

Dollar General
Lee Bandlow, Vice President Transportation
November, 2009

Dollar General is a retail chain with approximately 8,700 stores in 35 states. There are 767 stores in Kentucky and Tennessee with 21 in the Nashville area. The company has stores in operation across the United States catering to lower income and budget conscious shoppers with a median income less than $75,000. Dollar General has a distribution center in Scottsville, KY which caters to the stores in Nashville and

surrounding areas. The store deliveries are contracted to Werner and U.S. Express as dedicated fleets.

Dollar General has a future facilities development plan that includes the following criteria for developers:

- Located along retail corridor with good traffic
- High visibility
- Full ingress and egress
- Shopping center and freestanding opportunities considered
- 9,014 sf building
- Customer friendly parking (minimum 30)
- Building and pylon signage
- Accessible truck delivery (53' trailer)

The primary concerns for servicing the stores are highway access, connectivity, and congestion.

The location reality is that there are existing stores in urban areas, sometimes in strip centers, where there is inadequate capability to deliver from a 53 foot trailer.

Drivers arrange their own transit routing and delivery schedules. The delivery times are made with the store. The drivers will "peddle" the stores if the volume is such to fit that model. Otherwise they are delivering full truckloads. The service is completely driver unload. The trips start in the early morning and in general there are 2.5 deliveries on a truck. In strip mall locations the driver must coordinate the delivery with the mall manager as well as the DG store. Each delivery takes approximately 4 hours and the drivers are working at deliveries 5-6 hours per day.

They operate the fleet with a new version of the Manugistics software and use satellite systems from Qualcomm for tracking and driver communication.

Deliveries occur throughout the business day. Some night delivery is possible but not as much as is desirable.

Local routes and Access: The primary route to the city is south on I65 and they are subject to the congestion on the north side of the city at the I24 merge and also the river crossing area. The drivers can use the main thoroughfares to move around the outside of the city. Given their demographic the stores are not necessarily located in the primary shopping areas and the trucks must use smaller streets for the actual delivery. As noted, the drivers set the schedule and routing and make decisions about congestion avoidance. Qualcomm satellite service is their standard communication means.

Conditions: There were no large complaints about Nashville relative to other cities. They did cite the age of the infrastructure as a general concern along with turning radius.

For their general operations the primary concerns are weight limits and trailer length restrictions. A DG load will weigh out before it cubes out. This is due to a preponderance of heavy merchandise such as laundry products. In northern New Jersey they have to transload freight to a box truck in order to meet weight restrictions. They estimate that a restriction of this type costs $4,000 per year per store. With 8000 stores that becomes a very large cost concern.

Mr. Bandlow also expressed his belief that the rail infrastructure, not just in Nashville, but through the country is "woefully inadequate".

Celestica
7950 East Gate Blvd, Lebanon, TN
Sergio Ruiz, General Manager
3/5/10

Company is a diverse operator in supply chain functions, in some cases performing manufacturing and in some contract logistics.

The operation at Lebanon is a contact Distribution Center for a single major manufacturer, handling consumer electronics (computer printers) for Lexmark. Celestica receives inbound goods, stores them, and stages outbound shipments. There is no processing of the goods, and Celestica is not directly engaged in transportation functions in either direction, which are controlled by their customer. Thus their view of those issues is limited.

The DC itself is 400,000 SF and is full. There are about 50 dock doors, but it functions as a storage point and not just a cross-dock.

Inbound: 20-30 trucks per week. Essentially all of it is imports from two sources: a) Asian production brought in by ship through Long Beach CA, shipped in full containers by intermodal rail to Memphis, then drayed by truck to their facility; b) Mexican production brought to Lebanon in full truckloads.
Outbound: 15-25 trucks per week, representing a mixture of full truckload, LTL, and parcel shipments. Goods move in nationwide and international distribution – this is not strictly a domestic DC for imported goods.

Operations: inbound shipments are all by appointment, but there is a 1-2 day window. Outbound works the same way, but the window is 24 hours. All shipping/receiving is live load/unload: there are no drop trailers. The facility has ample room and suffers no access issues or limitations. Volumes were growing prior to the recession; they fell since and have not been climbing lately.

There are no service performance issues, things work pretty smoothly. Specifically, there are no chronic service problems on the inbound side either by rail or truck. This facility

has been operating four years; their customer seems happy with it and with the Nashville location for their distribution.

CSX Transportation
Jane Covington, State Government & Community Affairs
(Jane is based in Nashville)
3/1/10

Jane has been with CSX 15 years. Based in Nashville, she handles government affairs for TN, AL, and MS. Company policy currently is for staff in her position to handle public agency requests; the volume of them is such as to be impossible to manage for operating personnel.

Updating since 2004 discussions: Nashville is the center of 5 spokes of the CSX wheel, with north/south volumes the heaviest. In particular, it lies on the western corridor leg of the CSX core system triangle, which corridor runs from Chicago through Nashville to Jacksonville. This corridor has received major investments since 2004, adding 10,000 foot sidings wherever practical to enlarge line capacity; this effort is now complete, and while it is not double-tracking (which is not physically possible in their southern territory), it is a step in that direction. Nashville is thus an important place on the network from a global perspective. However, it continues to function principally as a through terminal; she expects the company would be open to this changing to some degree if there were a major business opportunity.

Capacity: No facilities have been closed in recent years anywhere in TN. Radnor yard (the main hub facility in Nashville) will still be at capacity when traffic volumes return (as it was several years ago). CSX efforts to alleviate this to some degree in fact were stymied: Radnor is effectively landlocked. It contains a TDSI (Total Distribution Services, Inc.) automobile handling area, which CSX attempted to move to a new facility in Smyrna. This would have freed space at Radnor, and reduced drayage distances for serving the auto assembly plant. The new facility included an access road designed to bypass residential neighborhoods. Permitting efforts with City of Smyrna went on for a year and ultimately failed; specific issues concerned truck travel on a main road enroute to the interstate. A CSX-sponsored traffic study was rejected; TDOT followed with its own study with similar findings. CSX feels it did everything it was asked, and modified its plans multiple times. The project has now been taken off the list for the CSX capital committee [meaning they have moved on to other things].

Local issues: condos have been built on top of the CSX Kane Ave. yard. Developers seem to have had trouble selling them: residents complain about the train noise, and proximity to the yard itself is a drawback. Other condos have gone up by Centennial Park, also near rail lines. There were other issues about painting a rail bridge downtown. [*Interviewers note: the point here and above is that planning support to maintenance of the local rail option is lacking. This works against encouragement of private*

investment.] CSX feels they do and should work hard to be a good neighbor, and feels they have made some progress in explaining their point of view e.g. with the state representative whose territory includes Radnor.

Traffic: down obviously with the recession. Company has been seeing sequential volume growth (month-to-month) and security analysts predict more. The Saturn plant remains open but is not working. The important Nashville local business is autos and intermodal; the rest is one-to-two carloads traffic. Nashville industrial development has not been oriented toward cultivation of concentrated, trainload volumes.

Jane supplied the following supplemental information concerning CSX operations and business in Nashville. She says it is several years old but essentially accurate for today's conditions (or as they will be as the economy recovers):

- Nashville serves as a major hub for CSX Transportation, the largest railroad east of the Mississippi. Its service supports the operations of Nashville-area companies such as Visteon Industries, Ford, GM, Nissan, Phillips Metal Services, and many others.

- Nashville is also the headquarters of CSXT's Nashville Operating Division, which encompasses 1,377 track miles and has an annual operating budget in excess of $81 million.

- Freight to and from major U.S. cities, including Chicago, Louisville, Evansville, Birmingham, Chattanooga and Memphis, converges at CSXT's Radnor Yard in Nashville.

- Approximately 880 CSXT employees are involved with various phases of Nashville-based operations each day. At Radnor Yard, employees classify approximately 3,000 railcars of freight carried by close to 80 CSXT trains moving in and out of the city.

- CSXT Nashville Division has 1,292 route miles, and 1,377 miles of track. It handles daily: 8 intermodal, 7 auto, 14 coal, and 100 merchandise (carload) trains.

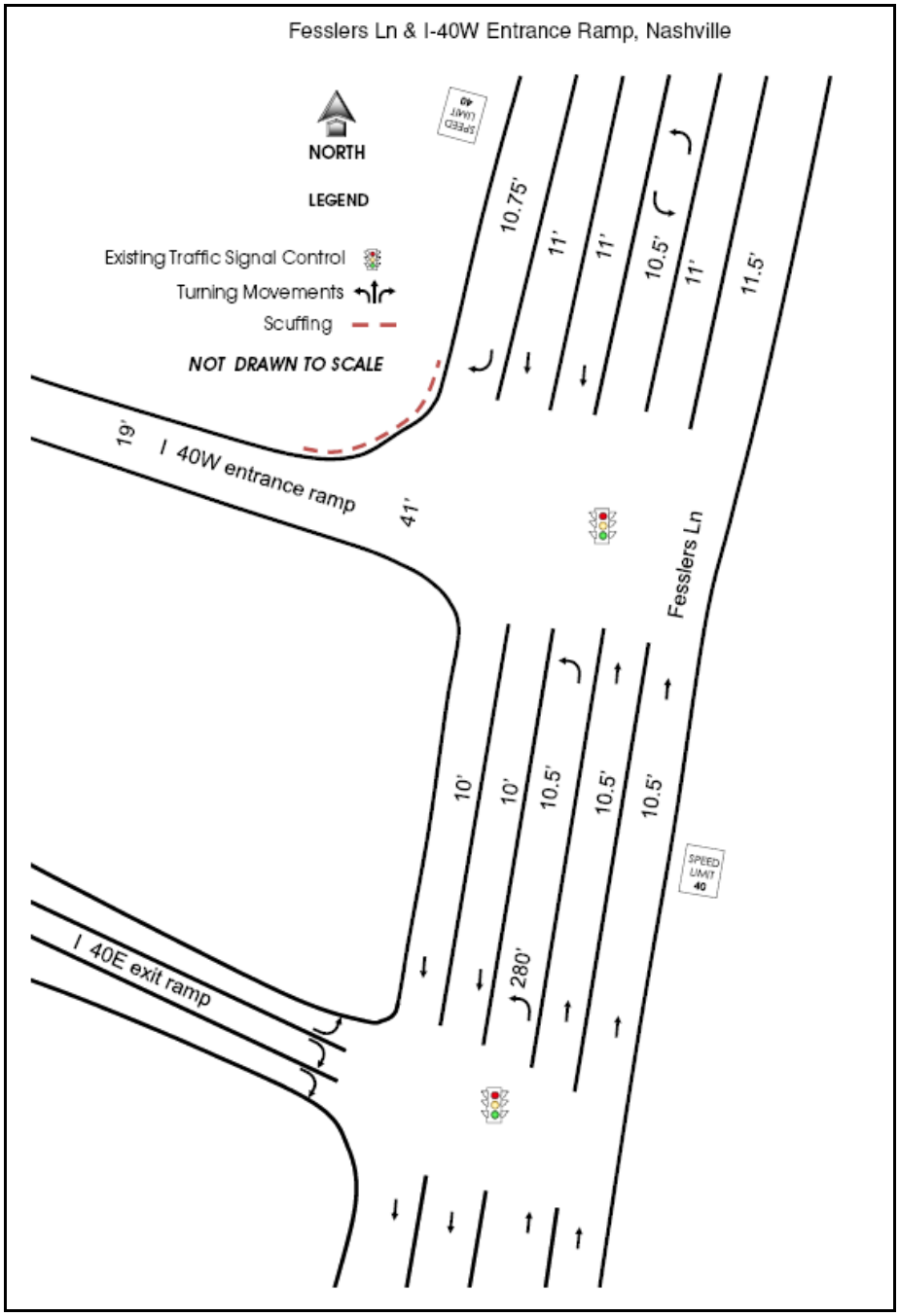
APPENDIX B

Field Observations

Fesslers Lane and I-40West On-ramp Intersection (Nashville, TN):

OBSERVATIONS

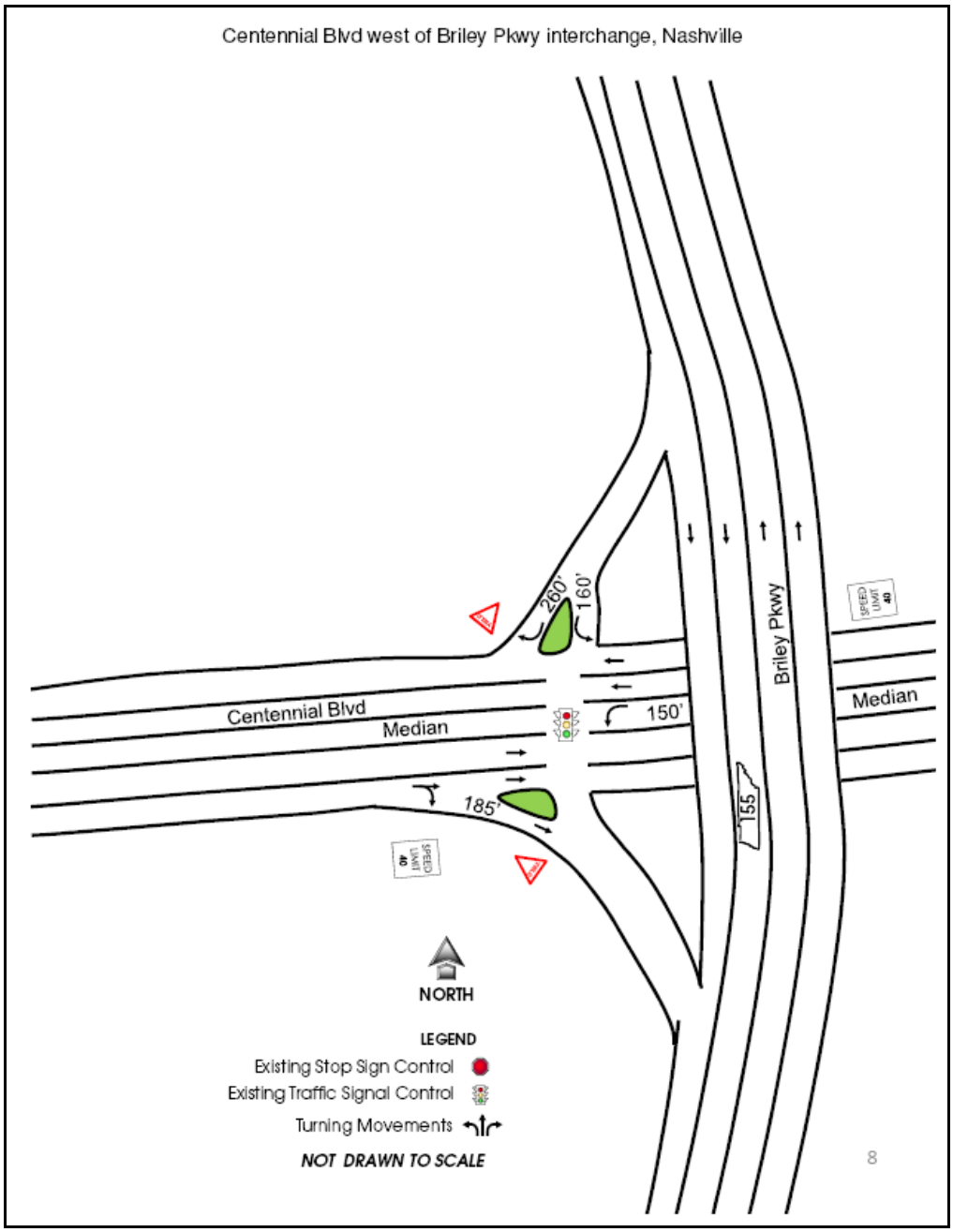
This is a signalized intersection with 2-phase operation and adequate lane widths. Scuffing and/or tracing were observed on the southbound Fesslers Lane curb radius.



Centennial Boulevard west of Briley Parkway Interchange (Nashville, TN):

OBSERVATIONS

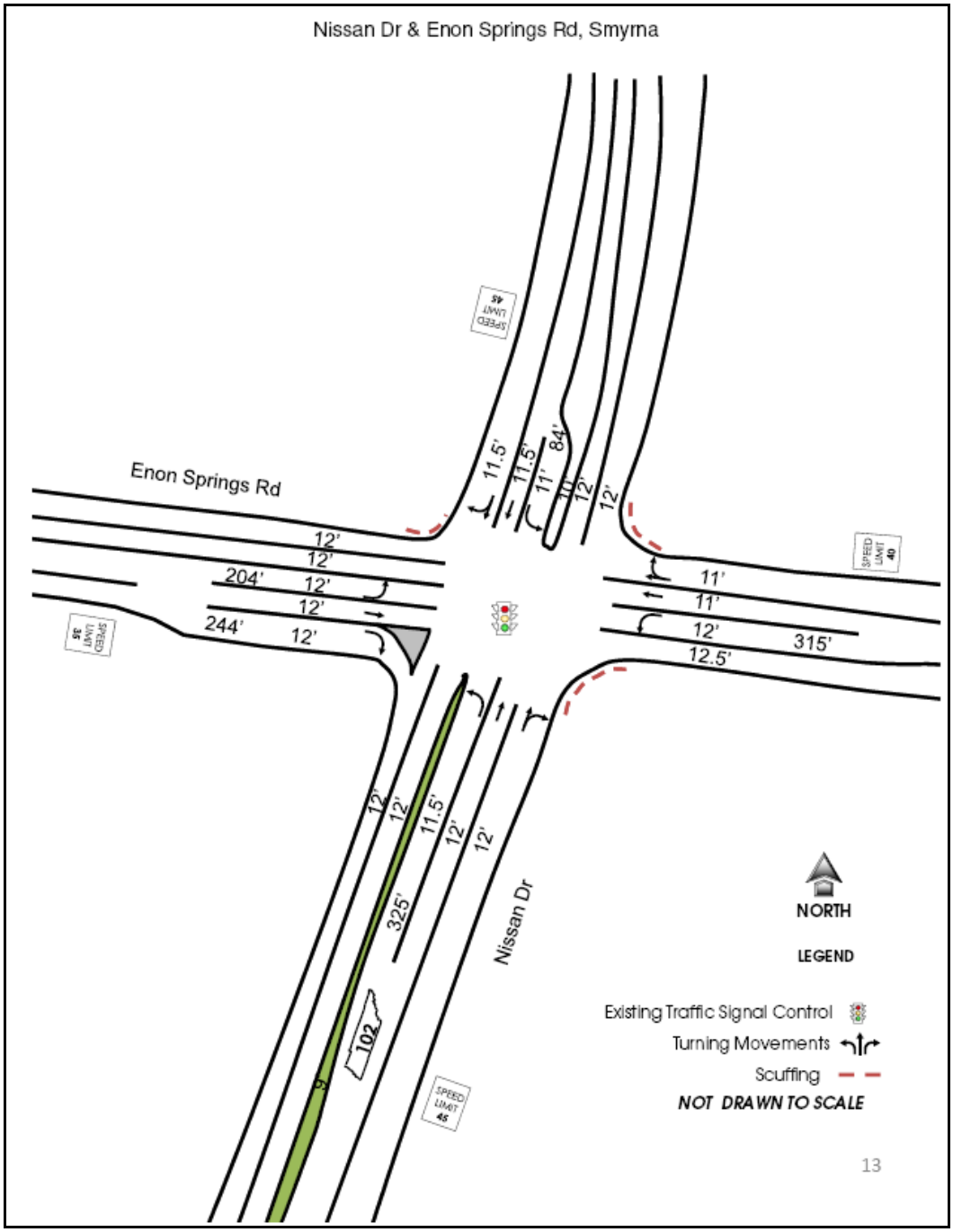
This is a signalized intersection with possibly 3-phase operation and adequate lane widths. Scuffing was not observed on the intersections radii. The Briley Parkway off-ramp provides channelized right-turns with Yield signs at Centennial Boulevard. Eastbound Centennial Boulevard provides channelized right-turns with Yield signs at the Briley Parkway on-ramp.



Nissan Drive and Enon Springs Road Intersection (Smyrna, TN):

OBSERVATIONS

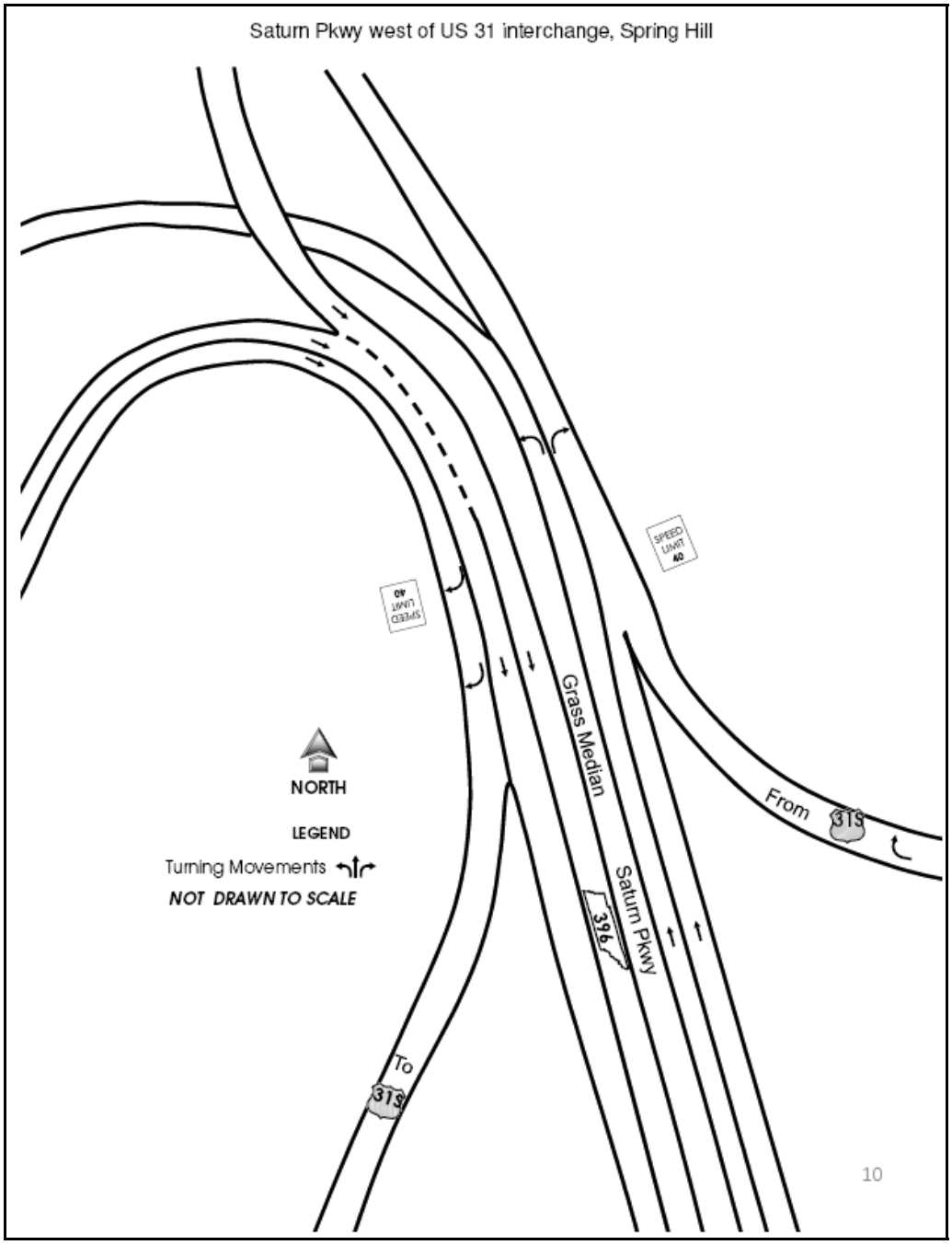
This is a signalized intersection with 8-phase operation plus right-turn overlap and adequate lane widths. Scuffing and/or tracing were observed on the northeast, northwest, and southeast corners of the intersection. There are no “Only” pavement markings or signs indicating exclusive right-turn “trap lanes” on westbound Enon Springs Road.



Saturn Parkway and US-31 Intersection (Spring Hill, TN):

OBSERVATIONS

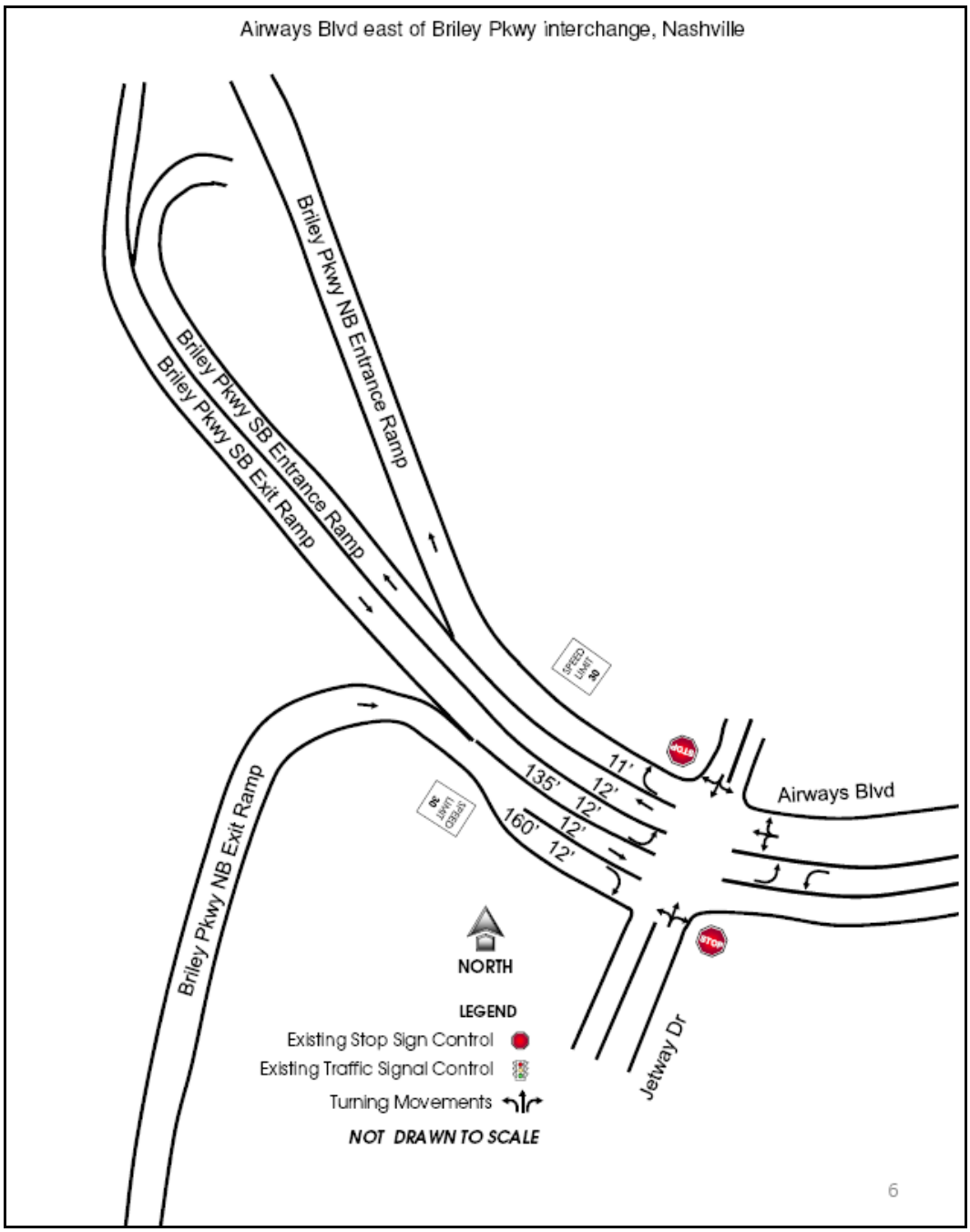
The interchange at Saturn Parkway and US 31 consists of directional ramps. The study area is between the GM Plant access road and the US 31 interchange. The current configuration adequately accommodates existing truck movements.



Airways Boulevard east of Briley Parkway Ramps Intersection (Nashville, TN):

OBSERVATIONS

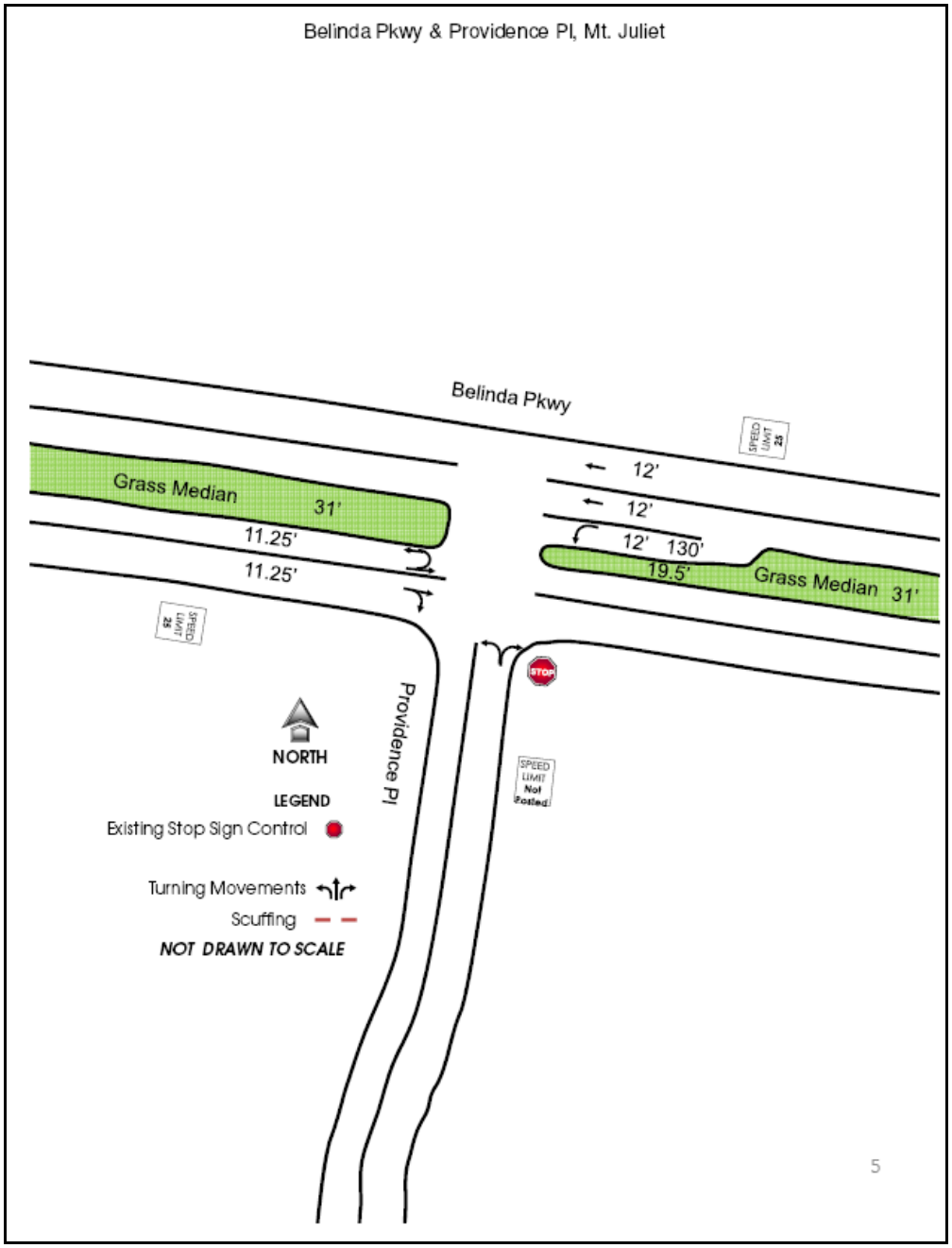
The FedEx Express shipping center is located at the intersection of Airways Boulevard and Jetway Drive. Northbound Briley Parkway becomes a trap lane at Jetway Drive.



Belinda Parkway and Providence Place Intersection (Mt. Juliet, TN):

OBSERVATIONS

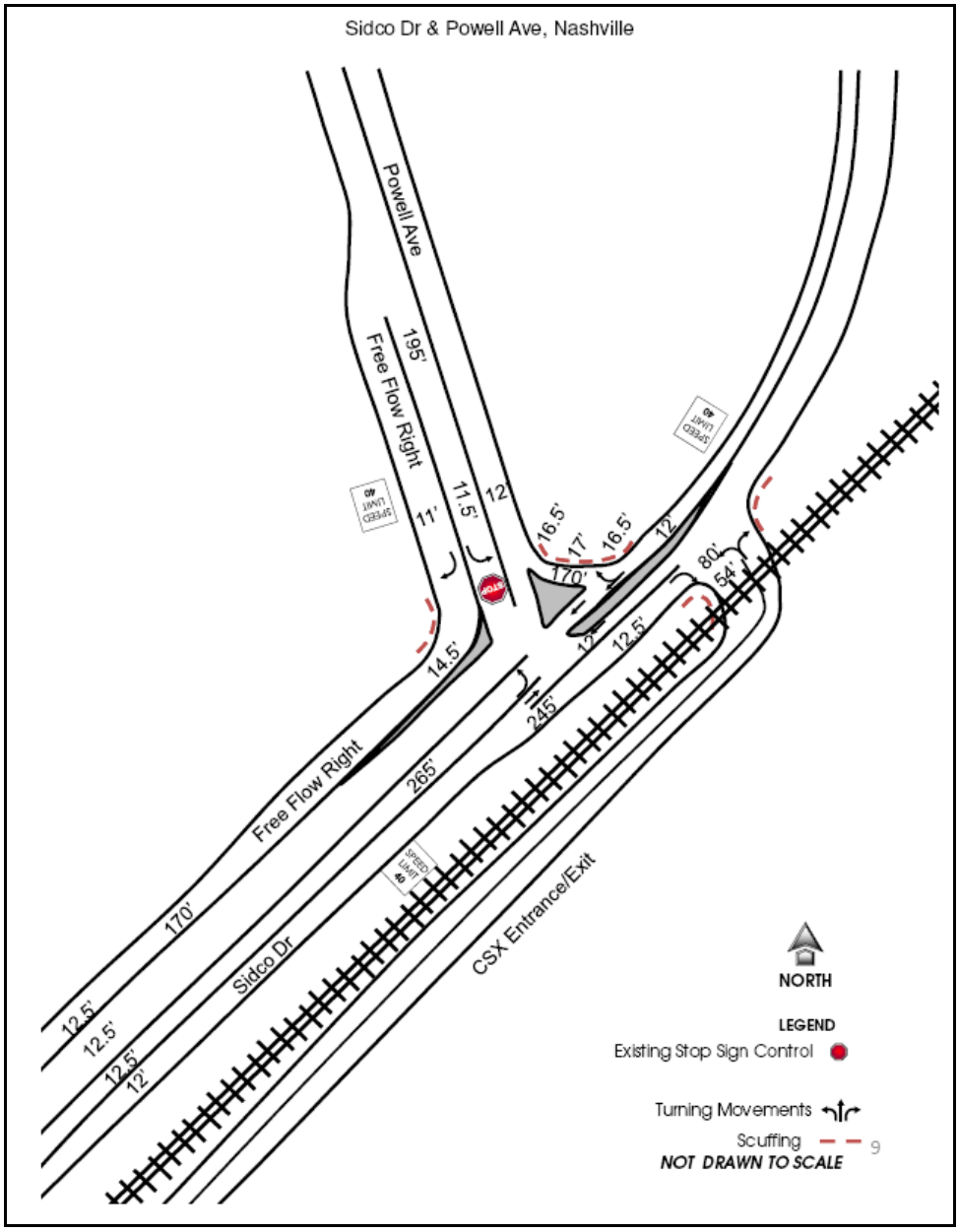
The posted speed limit at the intersection of Belinda Parkway and Providence Place is 25 miles per hour. There are adequate lane widths and no scuffing observed at the intersection radii. Westbound Belinda Parkway has a left-turn lane at the intersection. Hourly volumes are not significant at this time to warrant separate left- and right-turn lanes on Providence Place or separate right-turn lanes on Belinda Parkway.



Sidco Drive and Powell Avenue Intersection (Nashville, TN):

OBSERVATIONS

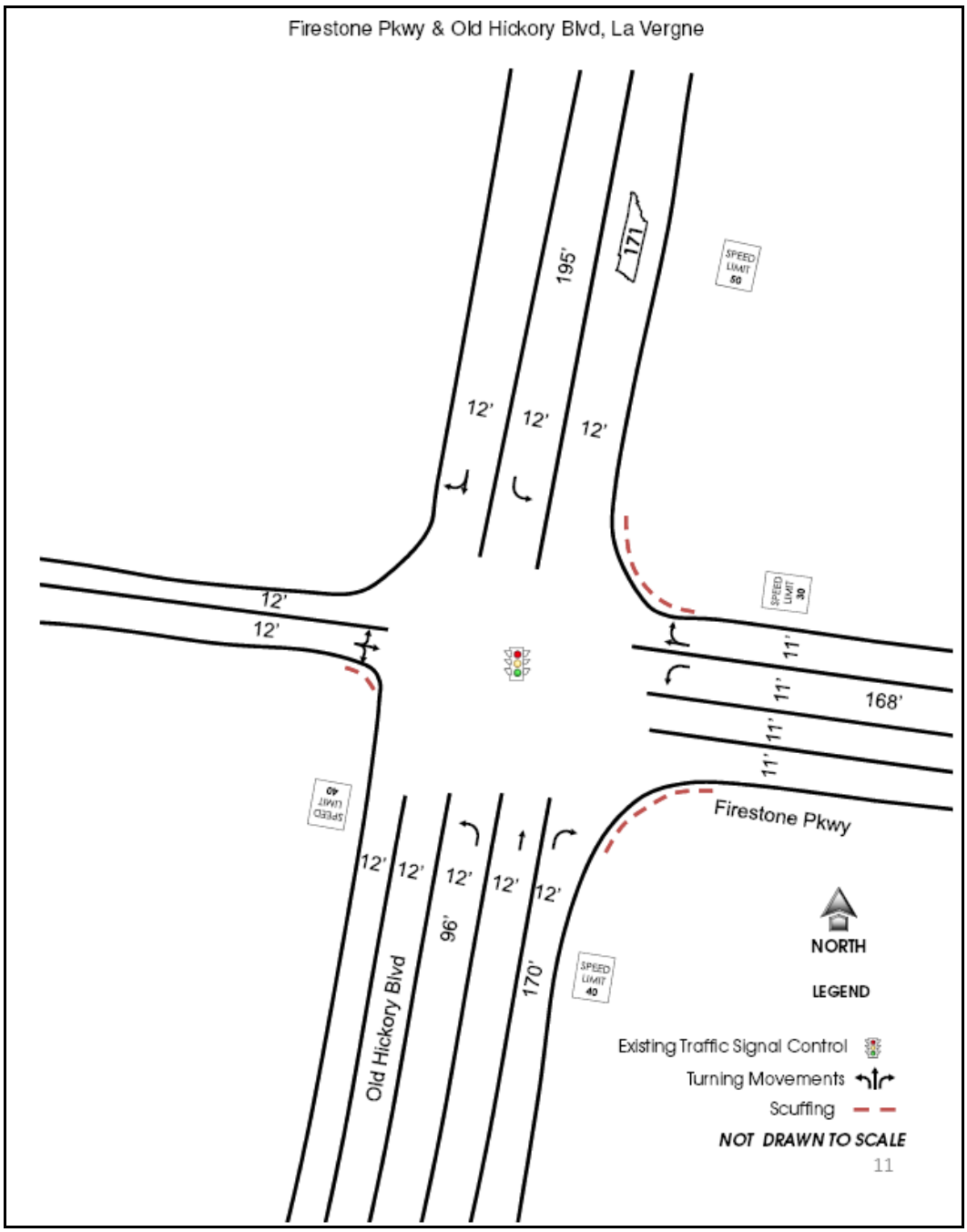
The intersection of Sidco Drive and Powell Avenue has adequate lane widths and operates with Stop control. A skewed side street approach exists along with a free-flow right-turn from Powell Drive to Sidco Drive. Scuffing was observed on the Powell Avenue curb radii. The entrance to a CSX rail yard is southeast of the intersection. Double yellow striping at the CSX entrance technically prohibits left-turn movements onto Sidco Drive. However, it is obvious by the worn pavement markings that drivers are violating this restriction.



Firestone Parkway and Old Hickory Boulevard Intersection (LaVergne, TN):

OBSERVATIONS

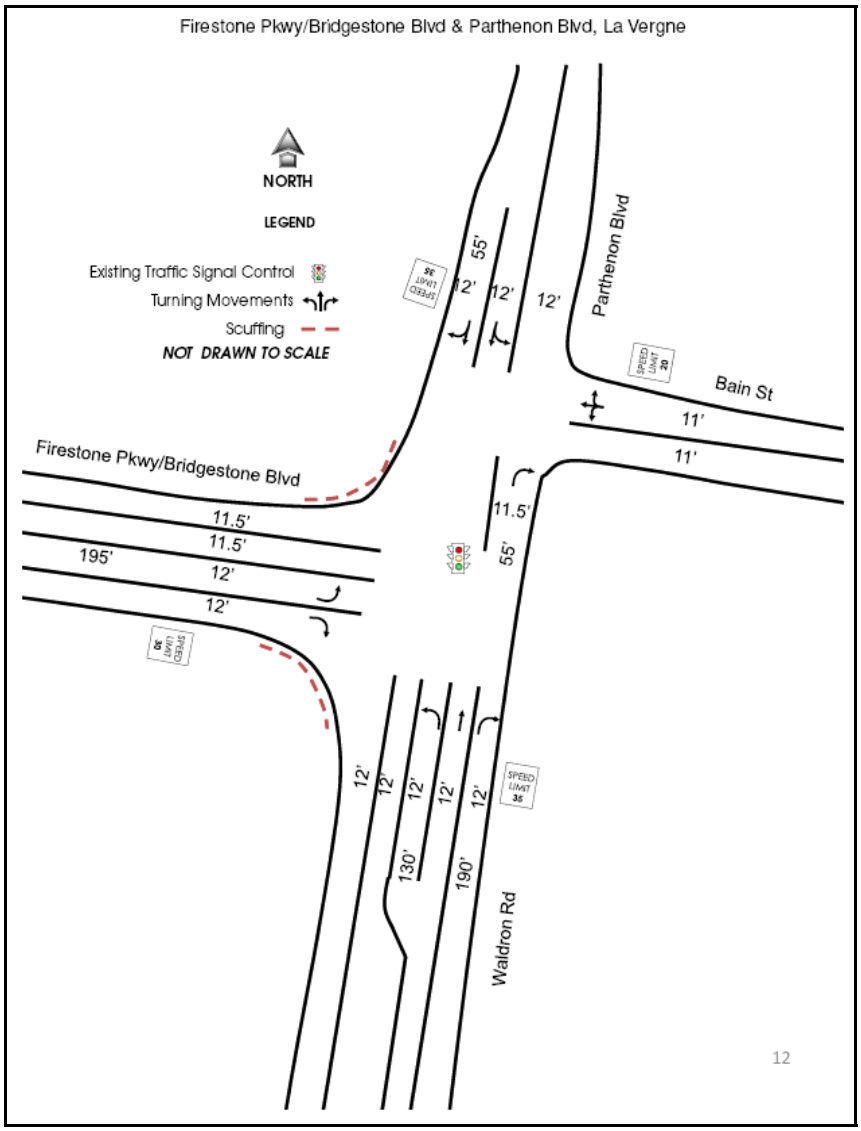
The intersection of Firestone Parkway and Old Hickory Boulevard consists of a signalized intersection with 6-phase operation. There are adequate lane widths at the intersection and scuffing/tracing was observed on the eastbound private driveway, northbound Old Hickory Boulevard, and along westbound Firestone Parkway turn radii.



Firestone Parkway/Bridgestone Boulevard and Parthenon Boulevard Intersection (LaVergne, TN):

OBSERVATIONS

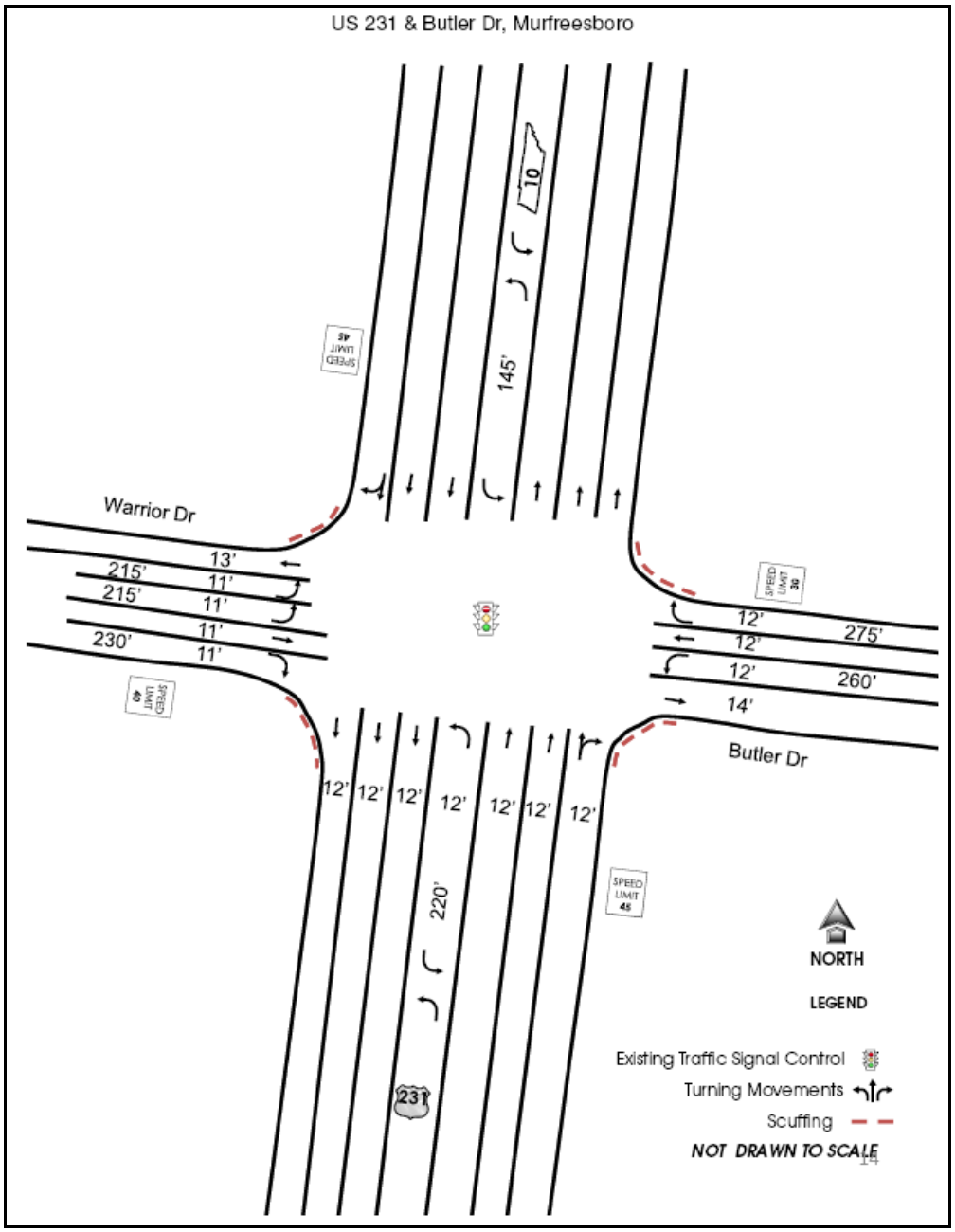
This is a signalized offset intersection that possibly contains a split phase operation. The intersection transitions from a 2-lane to a 5-lane cross-section and it contains adequate lane widths. Scuffing and tracing was observed on the radii for Bridgestone Boulevard. Hourly volumes are not significant at this time to warrant a protected left-turn phase on Waldron Road/Parthenon Boulevard. The intersection contains a right-turn on red restricted. The northbound Waldron Road has exclusive right-turn lane signage for "Right Lane Must Turn Right" and arrow markings, but no "ONLY" markings on the pavement. The private drive connection opposite of Bridgestone Parkway has no signal indication provided.



Butler Drive and US-231 Intersection (Murfreesboro, TN):

OBSERVATIONS

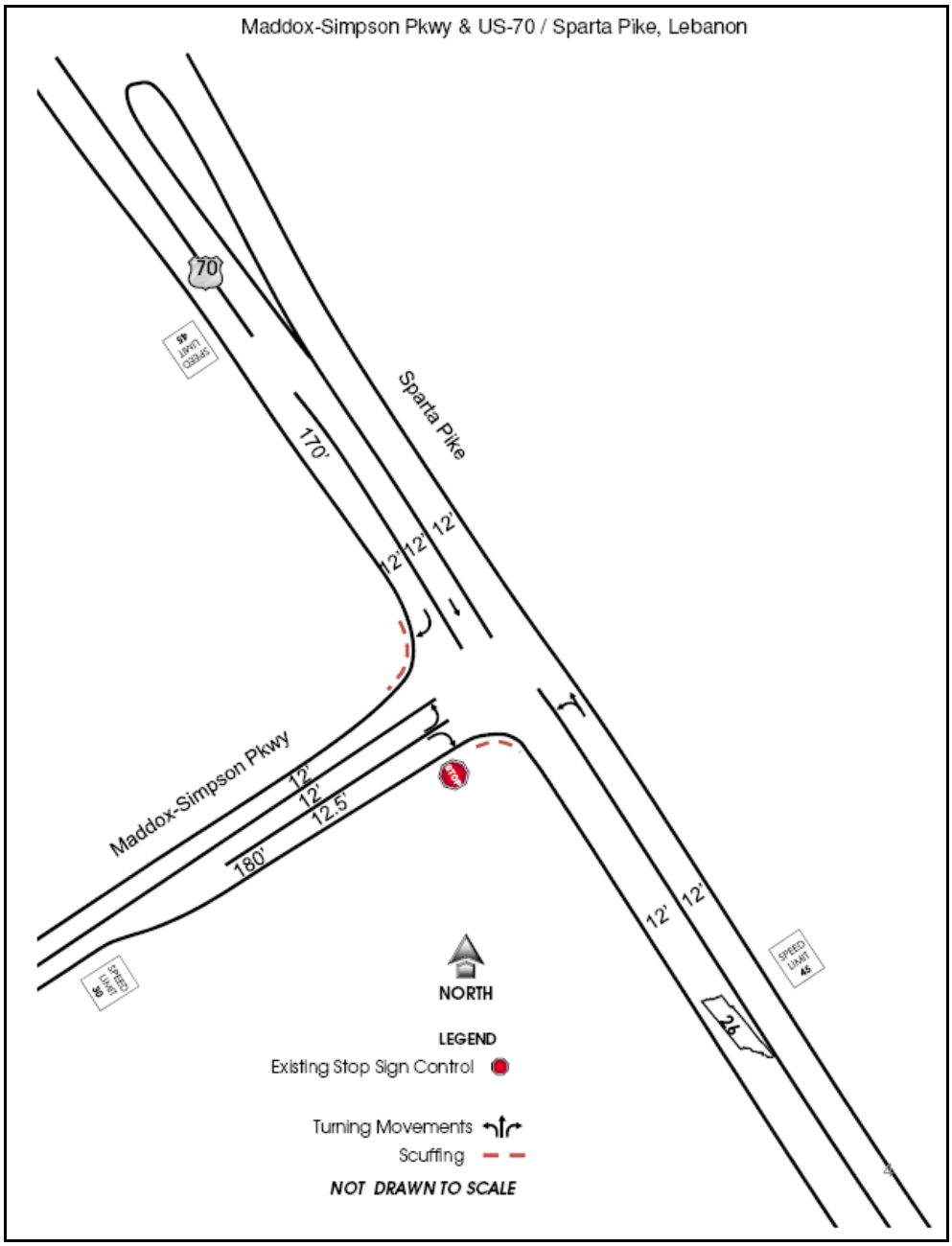
The intersection of Butler Drive and US-231 Intersection contains a signalized intersection with 8-phase operation. Adequate lane widths are provided at this intersection and scuffing was observed on all intersection radii. The interchange at Exit 81 along I-24 is located just north of this intersection. Most of the large commercial vehicles travel north and south along US-231, but other large commercial vehicles turn from Warrior Drive and Butler Drive to access the I-24 interchange.



Maddox-Simpson Parkway and US-70/Sparta Pike Intersection (Lebanon, TN):

OBSERVATIONS

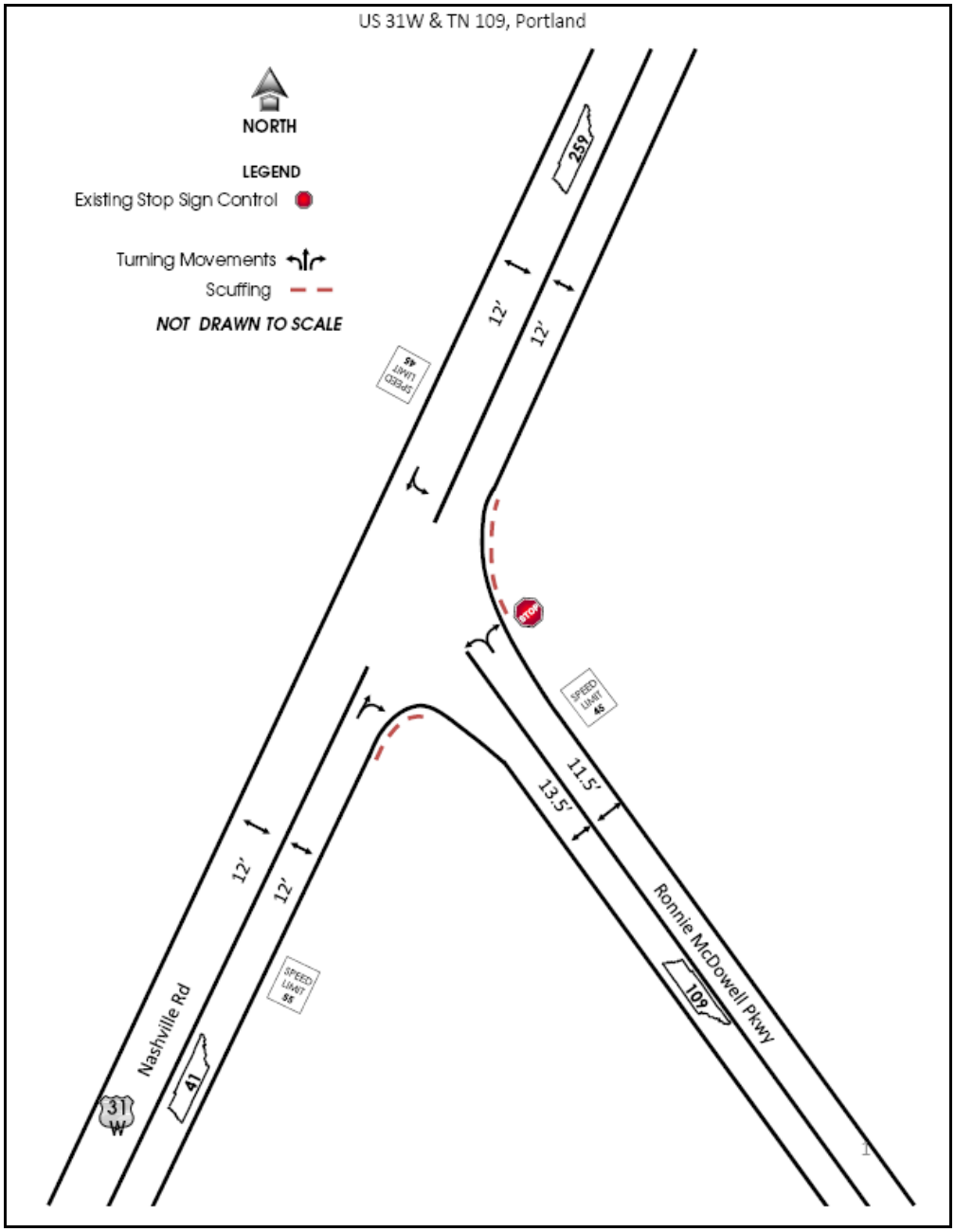
The intersection of Maddox-Simpson Parkway and US-70/Sparta Pike is operating with Stop control. The intersection contains adequate lane widths and scuffing was observed on the eastbound turn radius of Maddox-Simpson Parkway. The interchange at Exit 239 along I-40 is located north of this intersection. There is truck stop access between the I-40 eastbound off-ramp and Maddox-Simpson Parkway. Large commercial vehicles exit I-40 to access Uncle Pete's Truck Stop which is adjacent to this intersection.



TN-109 and US-31 Intersection (Portland, TN):

OBSERVATIONS

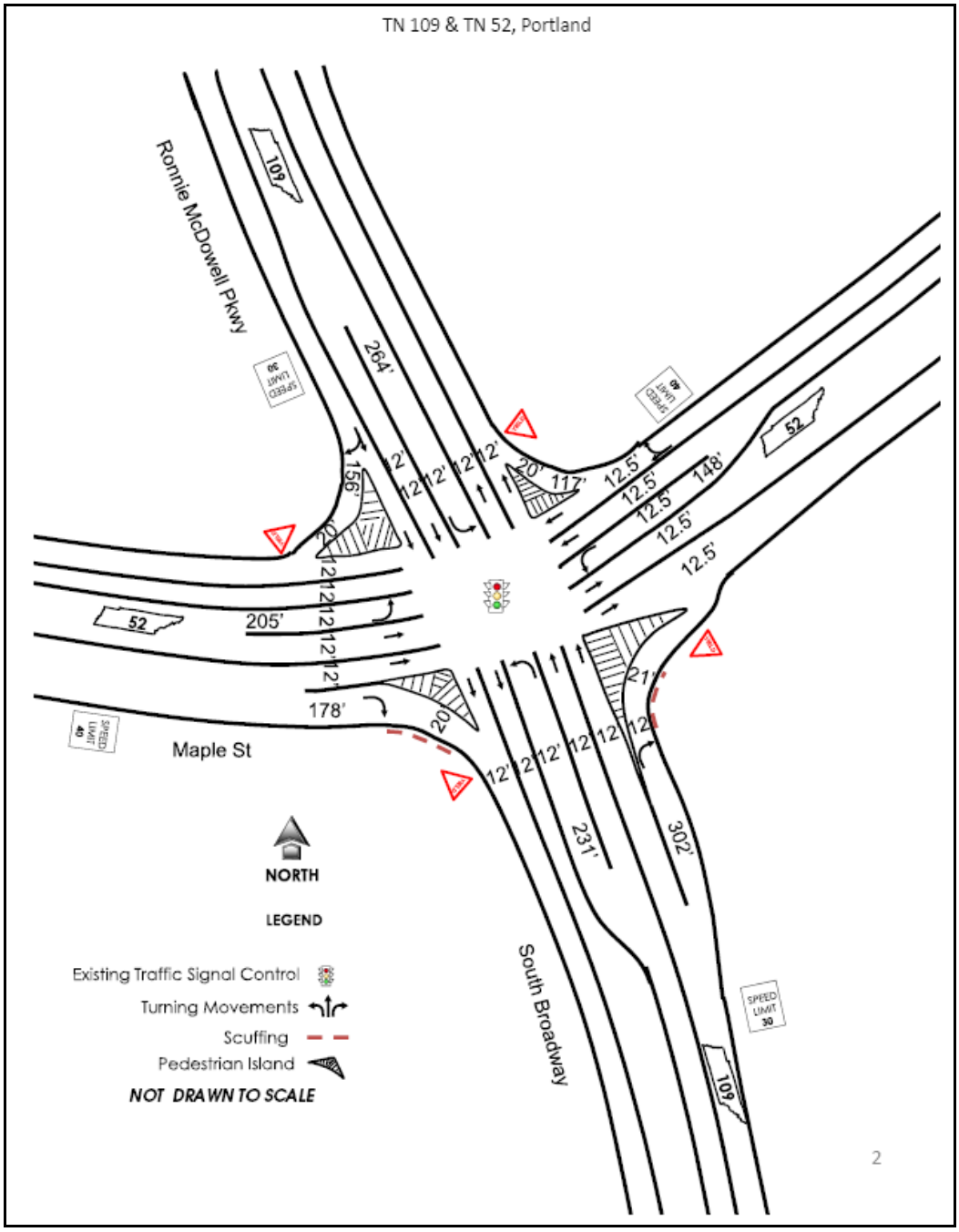
The intersection of TN-109 and US-31 consists of a skewed approach angle. Curb scuffing was observed on both turn radii and the intersection. The intersection contains single lane approaches with approximately 12-foot lane widths. Stop control is located on TN-109 and TN-259 is located approximately 200 feet to the north of the studied intersection. Numerous commercial parcels have access points to US-31W, TN-109, and TN-259 in the vicinity of the intersection.



TN-109 and TN-52 Intersection (Portland, TN):

OBSERVATIONS

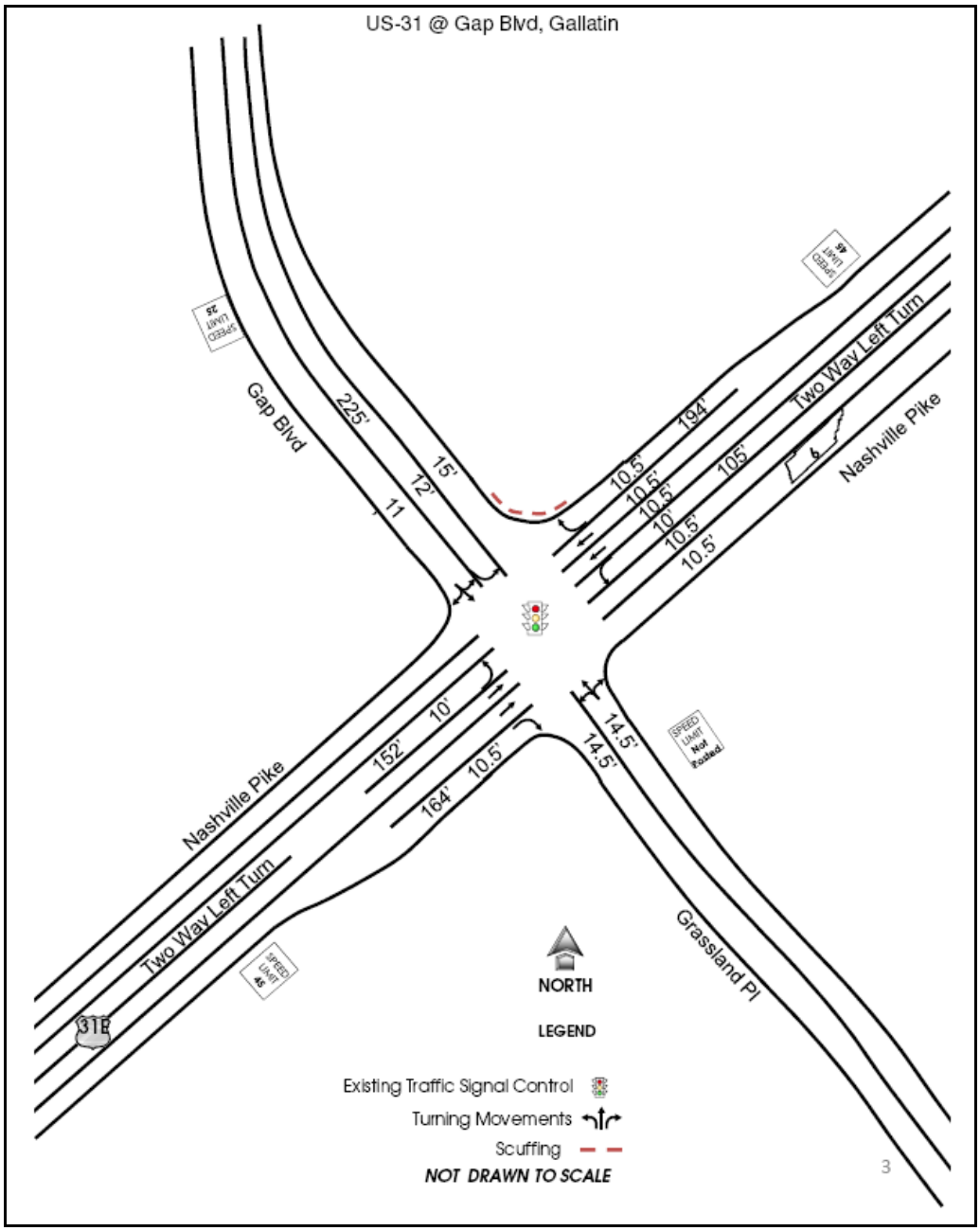
TN-109 and TN-52 intersection contains an 8-phase operation signalized intersection. Adequate lane widths are provided and a left-turn lane is provided on all approaches. The right-turn lanes are channelized on all of the approaches with Yield control. Scuffing/tracing was observed on the southeast and southwest corners of the intersection.



Gap Boulevard and US-31 Intersection (Gallatin, TN):

OBSERVATIONS

The intersection of Gap Boulevard and US-31 contains a signalized split-phase operation. There are adequate lane widths at the intersection, but the lane widths are less than standard along US-31E. Scuffing/tracing was observed on the southwest bound US-31E turn radius. There are currently no pavement markings or signs indicating a right-turn lane on eastbound US-31E.



NASHVILLE REGIONAL FREIGHT & GOODS MOVEMENT STUDY

Technical Memo #4: Projected Freight Flows Overview

June 2010

Submitted to: **Nashville Area Metropolitan Planning Organization**

Submitted by: **Wilbur Smith Associates**

NASHVILLE AREA
Metropolitan Planning Organization

NASHVILLE REGIONAL FREIGHT & GOODS MOVEMENT STUDY

PHASE II

TECHNICAL MEMO #4:
PROJECTED FREIGHT FLOWS OVERVIEW

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Introduction

Based on the results of the analysis performed in the Existing Trends and Conditions section of the Nashville Regional Freight and Goods Movement Study (Phase II) and analysis of future outputs from the freight model, the Projected Freight Flows Overview looks at trends and changes from the 2007 base year data to 2035 freight data in terms of mode, direction, commodities, etc. The organization of this Technical Memo #4 is outlined below.

ORGANIZATION OF THIS REPORT

This report is organized into the following sections:

The Influence of Freight Growth on Supply Chain Management and the Freight Transportation System

This section provides a brief view of the "day in the life" of a supply chain professional in planning for modal selection. As growth in volume and type of commodity is experienced, the supply chains necessary to satisfy consumer needs may shift. This shift influences the freight transportation system. Planning should accommodate changes in supply chain methods and identify future needs in modal diversity and implementation. The commodity utilized reflects the results of projected growth for the Nashville MPO region.

The Future of Freight in the Nashville Region

This section includes an analysis of the future freight flows. This will be measured in terms of projected freight tonnage increases by mode and by projected truck volumes from the freight model. By comparing current (2007) and future (2035) Transearch freight flow data acquired by the Tennessee Department of Transportation (TDOT), freight movement trends begin to emerge.

Influences on the Future of Freight Movement

Several key development possibilities within the modes offer opportunities to influence the projected movements presented. These represent considerations that require continued monitoring by the MPO to gauge implementation and impact of these occurrences on modal selection and diversion capacities.

The Influence of Freight Growth on Supply Chain Management and the Freight Transportation System

Future commodity trends are significant in numerous areas beyond the growth and decline of commodity movement by a given mode. The ability to predict the presence of increased levels of secondary traffic (traffic along routes not classified as arterials or main routes) in comparison to a possible decrease in non-metallic minerals, positions the planner to assess changes in the future freight transportation system. Concurrent with the economic development forces in the area, the planner can predict modal needs that may not be available currently. To capitalize on this ability requires an understanding of the fundamentals of modern supply chain management and the associated requirements.

Supply chain management (SCM) is the management of a network of interconnected businesses involved in the ultimate provision of product and service packages required by end customers.[1] This chain may be merely from two points in the same industrial park to multiple locations, utilizing numerous modes, and traversing thousands of miles. A leading factor in the growth of national and, more so, modern global SCM has been advancements in information technology and its proliferation at the most basic levels of production. For decades, SCM professionals have sought the ability to track real-time movement of materials and goods. With this ability in place, inventory management needs and other cost intensive practices can be minimized or eliminated. These technologies include bar-coding individual items and complete orders and RFID and other types of tracking technologies assigned to containers, trucks, ships, and other transport related equipment. The near or instant communication between the various entities within the manufacturing and transport provider network allows the means of production and distribution to prepare appropriate staffing and materials to meet the consumers' needs.

Taking into account the ability to closely track, inventory, and monitor shipments, we can see how the SCM professional can select the most appropriate and cost efficient method of transport for a shirt manufactured in Asia to an individual looking to purchase that item in Nashville. Interaction with private sector representatives may identify other ideal scenarios and shortcomings in the current transportation system to fulfill those scenarios.

With the purchase of the last shirt at HIJ Stores, the stores information technology places a replacement order for that item. That order, collected with others for HIJ Stores, totals 10,000 shirts and is placed with the shirt manufacturer in Asia. The manufacturer advises the SCM professional that they will ship on July 17th, making the products available for loading on the cross oceanic mode on the 20th. It is possible that had this occurred in the early spring, the need to reduce cost may be the overriding consideration. However, the knowledge that fall and winter fashions will begin to arrive at stores by September 1st, the transportation and distribution must be completed before that date to ensure that the item

[1] Harland, C.M. (1996) Supply Chain Management, Purchasing and Supply Management, Logistics, Vertical Integration, Materials Management and Supply Chain Dynamics. In: Slack, N (ed.) Blackwell Encyclopedic Dictionary of Operations Management. UK: Blackwell.

is available to be sold "in season." Because the item has a perishable quality, there is a defined need to balance transit time with cost. The initial transportation leg carries the completed order from Asia to the west coast of the U.S. The two alternatives are air and water. Air cargo provides the timeliest and most reliable service. Water borne is reliable, but has a considerably longer travel time and is much less cost intensive than air. Water transit has a scheduled eleven day passage, providing the remaining thirty-one days to reach the shelves of the local HIJ Stores. The SCM selects water transit due to the ability to endure the longer transit times and the need to reduce expenses.

Planning for a July 31st arrival at the west coast port, the next step is to determine transportation from the port to the company's distribution center in Memphis, Tennessee. Again, air cargo is an option, but now rail and truck transport directly to the distribution center is available. The rail option will allow the shipment, within its original container, to be transported from a rail yard close to the port to a rail yard near the distribution center (DC). Truck will be required to transport the container from the port to the rail yard and again from the rail yard to the distribution center. The elapsed time from container availability to delivery at the distribution center will be five days for rail transit and two days for the truck movements for a total of seven days. This option is selected because it typically provides the lower cost.

Within the truck only mode, there are two options available: container drayage or traditional truck movement. Container drayage would travel directly from the port to the distribution center, providing the most rapid ground transit time. This option could take as few as 40 hours. Employing the drayage operator in this fashion places a burden on the operator which he may not be prepared to undertake. The container and chassis are typically "dropped" or remain at the destination for further handling by the receiver; therefore, the drayage driver is not only presented with the need to find a revenue generating activity to return to the point of origin, but this move must also provide a trailer or similar equipment in which to perform the move.

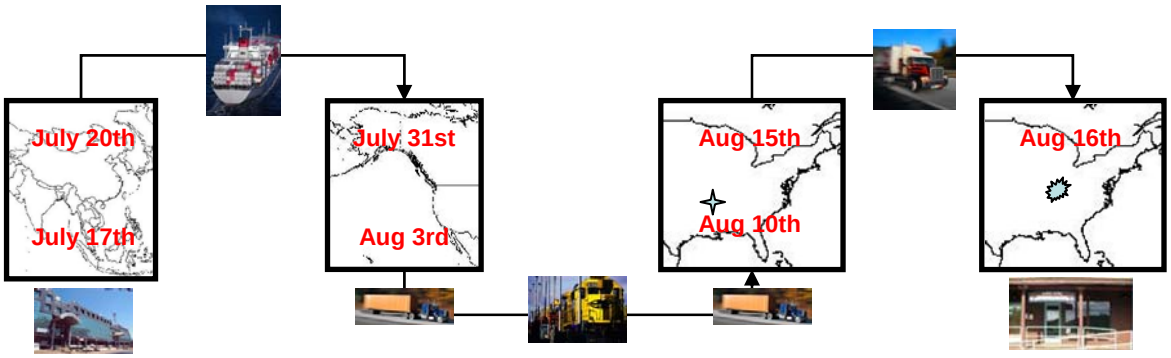
This selection would be the more expensive of the two truck choices. The second truck only choice would be to engage a "transload" company to unload the container and load the shipment into a standard trailer. Then a traditional truckload motor carrier could provide this or with a similar transit time as the drayage carrier. With many "transload" providers operating near or at the port itself, this choice may require one day for transload and the same two days truck transit for a three day total move. The cost would be below that of drayage, yet may be more expensive than the rail option. The SCM again selects the lowest cost option due to the ability to endure the longer transit time and the need to reduce expenses. The lowest cost option consists of trucking the container to the rail yard close to the port, moving the container by rail cross-country to the rail yard close to the distribution center in Memphis, and trucking the container from the rail yard to the distribution center. The total elapsed time as previously indicated is seven days for delivery to the distribution center.

The last significant transport segment would be the movement from the distribution center in Memphis to the store in Nashville. Air is an option, providing same day transit.

Truck could provide a range of transit times from same day to several days, with a common next day service. Rail may be an option but would possibly provide pricing similar to truck with two or more days transit. Pricing for air is the most expensive while truck and rail have similar rates. The SCM selects truck for this leg of the supply chain due to the proximity of Memphis to Nashville along with its ability to deliver the shirts prior to the September 1st deadline and its lower cost.

The SCM's supply chain may take the form illustrated in **Figure 1**.

Figure 1: Supply Chain Example



As in this example, the complexities presented to the SCM professional may be summarized as:

- *Marketplace dictates modal selection*: In the competitive marketplace, the need to generate differentiation is a tenet for those products and services that do not present a leading edge characteristic or embody a perceived or real exclusivity. Transportation may assist in this endeavor by placing product "first" in front of the consumer or generate the "deep well" of availability of a product. This latter being the ability to provide the user or consumer with the variations desired and being responsive to the timeliness of the need.
- *Modal selection typically reflects value of the material or goods being transported*:
    - Raw materials and those with a low value and/or consumption rates requiring goods to be received in bulk, can be expected to utilize water and rail. These modes are designed to move bulk at low cost to the freight owner, though transit times are generally the longest. These transit times are best accepted by the SCM professional when travel distances are the greatest.
    - As value increases and consumption rate is not as dependent on bulk but availability of the item being shipped, the need to utilize faster and more travel time sensitive modes is necessary. Here, the value of the goods

restricts capital availability for the freight owner, as greater capital is captured in the goods in transit, and time in transit effectively costs the freight owner in lost productivity of the dollar invested.

- Commodities where bulk is advantageous to pricing and availability, yet is not a factor in consumption, such as finished goods, electronics, and where value's impact on cash flow by restricting the ability or desire to maintain high levels of inventory, the desired mode shifts to truck. Within the truck mode, freight may be moved in smaller bulk sizes, through smaller yet large shipment sizes, down to an individual box or parcel, effectively, in order to fill the need of the consumer.
- As value continues to increase, as in specialty electronic components or the perishable characteristics of the cargo place limits on the "shelf life" of a product, as in some medicinal or food products, the mode may pass thru dedicated truck to the air cargo mode. This end of the transportation spectrum places higher values on speed and timeliness and represents the costliest solution to freight transport.

Though expected modal selection criteria may be generalized, the SCM professional must contend with factors that are not directly quantifiable to the value and "shelf life" of the product or commodity itself. The qualitative influences, and those quantitative that are related to other aspects of the business, may include:

- Perceived need by the consumer based on local or regional forecasts
- Incidents along the pre-determined transportation path, such as labor unrest or localized natural or man-made disasters
- Competitive pressures resulting from product innovation or supply-demand shift
- Internal commodity or product design innovation
- Cash flow or capital investment availability
- Capacities and pricing of a mode or segment of that mode
- Manufacturer or distributor needs, in response to demand
- Business model dictates such as planned obsolescence

As projections indicate increases in secondary traffic, as illustrated in the supply chain example, the SCM may recommend a distribution center in Nashville. Utilizing this example, the ability to provide direct, intermodal rail service from the west coast to Nashville may be needed not merely to service this transaction, but possibly all traffic inbound to the distribution center.

Another factor for the SCM to consider is the widening of the Panama Canal, projected to be completed in 2014. Global transportation and supply chains will be impacted by this project. This same need for direct intermodal rail access shifts from the west to the east

coast, as water borne cargo moves from the Port of Los Angeles/Long Beach to those in the southeast.

The robust nature of modern supply chains provide for numerous applications of varying modal selection. A similarly robust evaluation of the projected 2035 tonnage and commodity in the Nashville region is required to fully benefit from the analysis.

The Future of Freight in the Nashville Region

Nashville's freight infrastructure is projected to carry around 400 million tons of freight in 2035 compared to 2007 volumes of around 300 million tons. The Nashville region is currently serviced by all modes of goods movement including highway, rail, air, and barge facilities. Nashville is situated at the convergence of three major U.S. interstate highways: I-40, I-65, and I-24 as discussed in detail in the Existing Conditions report (Technical Memo #3). With a central location in the East-Central United States, it can be expected that freight traffic volumes in the Nashville region will continue to grow. According to the Transearch dataset, freight tonnages impacting the Nashville region are anticipated to increase 35 percent between 2007 and 2035. This compares to a 124 percent expected growth for the combined Richmond and Tri-Cities MPO's in Virginia (from 2004 to 2035) and a 78 percent projected growth for the Atlanta Regional Commission (ARC) MPO (from 2004 to 2030). In today's global economy, improving freight mobility in metropolitan transport networks can result in substantial cost savings to regional business and ultimately increase the Nashville region's economic competitiveness.

Future growth is closely related to economic development and quality of life issues that deal with the externalities associated with increasing goods movement demands. The Nashville region's status as a crossroads in the transportation networks of the Eastern U.S. makes freight transportation a key component of current and future economic health. Transportation and material moving occupations employ almost 9 percent, ranking third, of those employed across all occupations within the Nashville MSA (**Exhibit 1**). Though geography heavily influences the dominance of this industry and employment sector, increasing levels of delay and reliability concerns pose a threat to corridor usage through the region. Alternative routings, where currently not selected due to circuitous miles, become viable as transit times deteriorate.

EXHIBIT 1 – EMPLOYMENT AND WAGES BY OCCUPATION, NASHVILLE MSA

Occupation Title	Employment	Median Hourly	Mean Hourly	Mean Annual
All Occupations	**773,500**	**$15.00**	**$18.88**	**$39,280**
Office and Administrative Support Occupations	136,290	$14.24	$15.23	$31,670
Sales and Related Occupations	81,120	$11.51	$16.09	$33,460
Transportation and Material Moving Occupations	**68,380**	**$12.72**	**$14.42**	**$29,990**
Food Preparation and Serving Related Occupations	67,360	$8.10	$9.01	$18,740
Production Occupations	66,180	$14.72	$16.68	$34,690
Management Occupations	48,980	$34.86	$41.32	$85,940
Healthcare Practitioner and Technical Occupations	46,810	$25.31	$29.81	$62,010
Education, Training, and Library	37,270	$19.27	$20.91	$43,500

Occupation Title	Employment	Median Hourly	Mean Hourly	Mean Annual
Occupations				
Installation, Maintenance, and Repair Occupations	32,340	$18.47	$19.58	$40,720
Construction and Extraction Occupations	31,910	$15.43	$16.74	$34,820
Business and Financial Operations Occupations	30,030	$24.85	$27.74	$57,710
Building and Grounds Cleaning and Maintenance Occupations	20,730	$9.79	$10.70	$22,260
Healthcare Support Occupations	18,330	$11.31	$12.25	$25,480
Protective Service Occupations	17,060	$14.17	$16.52	$34,350
Computer and Mathematical Science Occupations	15,860	$28.24	$29.20	$60,740
Personal Care and Service Occupations	14,910	$9.33	$10.80	$22,470
Arts, Design, Entertainment, Sports, and Media Occupations	13,120	$16.96	$22.16	$46,100
Architecture and Engineering Occupations	9,710	$28.58	$29.49	$61,350
Community and Social Services Occupations	9,190	$16.72	$17.63	$36,680
Life, Physical, and Social Science Occupations	4,120	$22.06	$24.13	$50,190
Legal Occupations	3,470	$31.30	$39.80	$82,790
Farming, Fishing, and Forestry Occupations	320	$10.41	$11.72	$24,380

Source: US Bureau of Labor Statistics, 2008

The key industries in the Nashville region fit a profile of service sensitivity with regard to freight transportation. Mobility along all links of the regional transportation network is essential for optimal function of regional business supply chains. Delays in freight transport carry business and social costs, including:

- Higher probability of inventory and production failures
- Risks of product degradation
- Inflated job site expenses
- Congestion at loading docks or staging areas
- Lower labor productivity
- Under utilized capital assets; and
- Risks to individual business viability

The efficient flow of freight is critical not only on interstate facilities, but at every stage of the supply chain. This is why this section will provide a detailed discussion and analysis of anticipated growth in freight by commodity, mode, and geography.

In 2007, approximately 55 million tons of freight originated or terminated in the region annually, with 82 percent of this volume moving by truck. The ability for freight to be

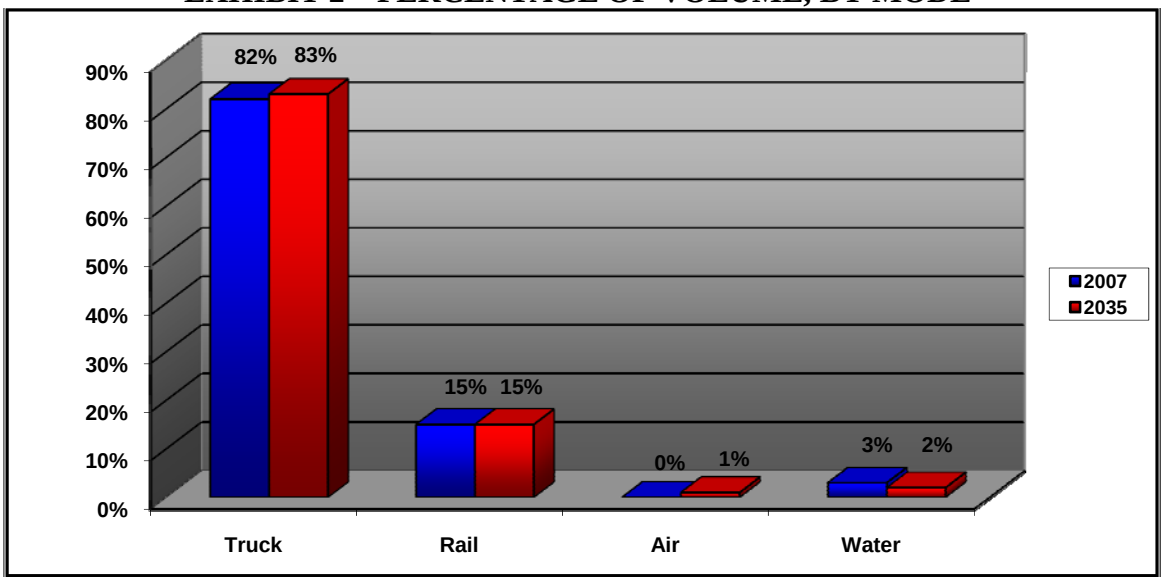
transported timely and efficiently is impacted by both mobility on, and accessibility to the regional transportation network. Localized congestion within the region provides a finite number of sufficient corridors with which to accommodate the increases in population and freight volume. The lack of sufficient mobility leads to transport inefficiencies, which are manifested by way of delayed delivery times and higher costs to both the shipper and, ultimately, consumers.

2035 FREIGHT FLOW DATA

Nashville's freight transportation system is projected to carry 400 million tons, of freight in 2035 (**Exhibit 4**). This represents a 35 percent increase over 2007's total volume of 300 million tons (**Exhibit 3**).

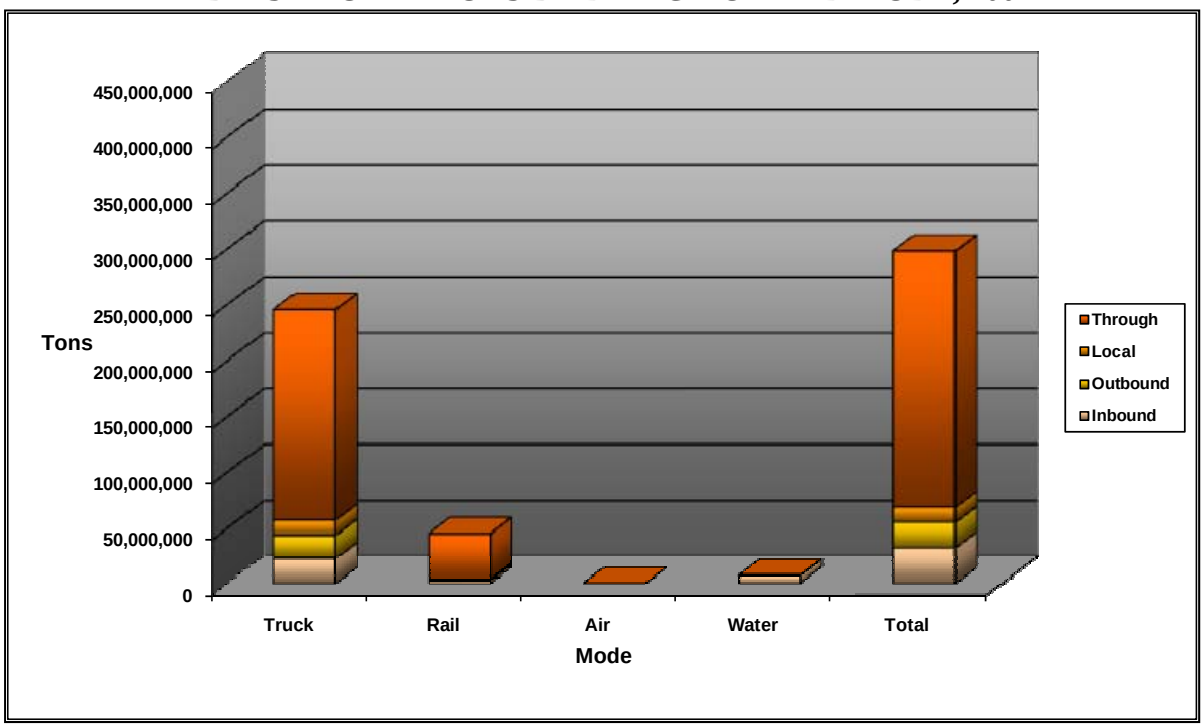
While all of the four modes of transport – truck, rail, water, and air – increased in the amount of total tons transported, water saw a slight decrease in the percentage of total freight tonnage from 3 percent of total tons in 2007 to 2 percent in 2035. Trucking saw the biggest percentage increase from 82 percent of total tonnage in 2007 to 83 percent in 2035, and air saw the smallest percent increase from .02 to .05 percent of total freight tons. Rail remains the same at 15 percent of total freight tons in both 2007 and 2035. In 2035, trucking is still expected to represent the majority of freight volumes carried in the region with 335 million tons (**Exhibit 2**). For comparison, **Exhibit 3** shows the 2007 total tons by direction and mode and **Exhibit 4** shows the 2035 total tons by direction and mode.

EXHIBIT 2 – PERCENTAGE OF VOLUME, BY MODE



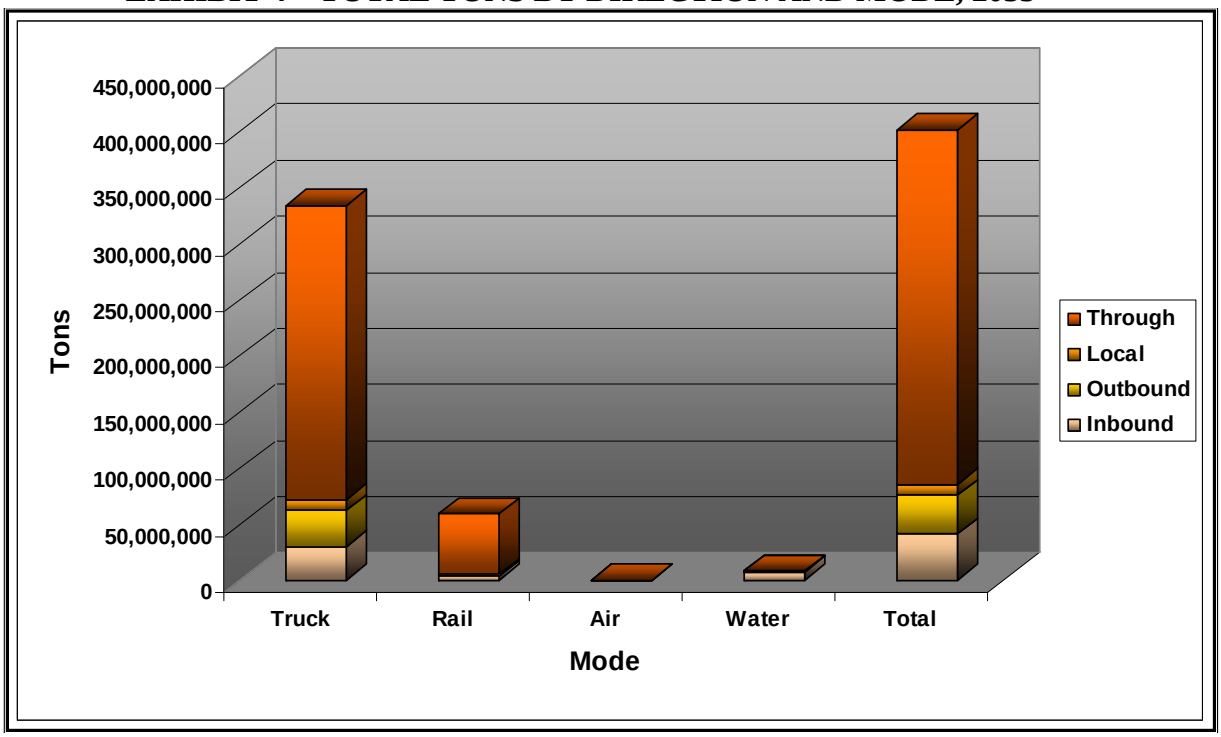
Source: Transearch Data

EXHIBIT 3 – TOTAL TONS BY DIRECTION AND MODE, 2007



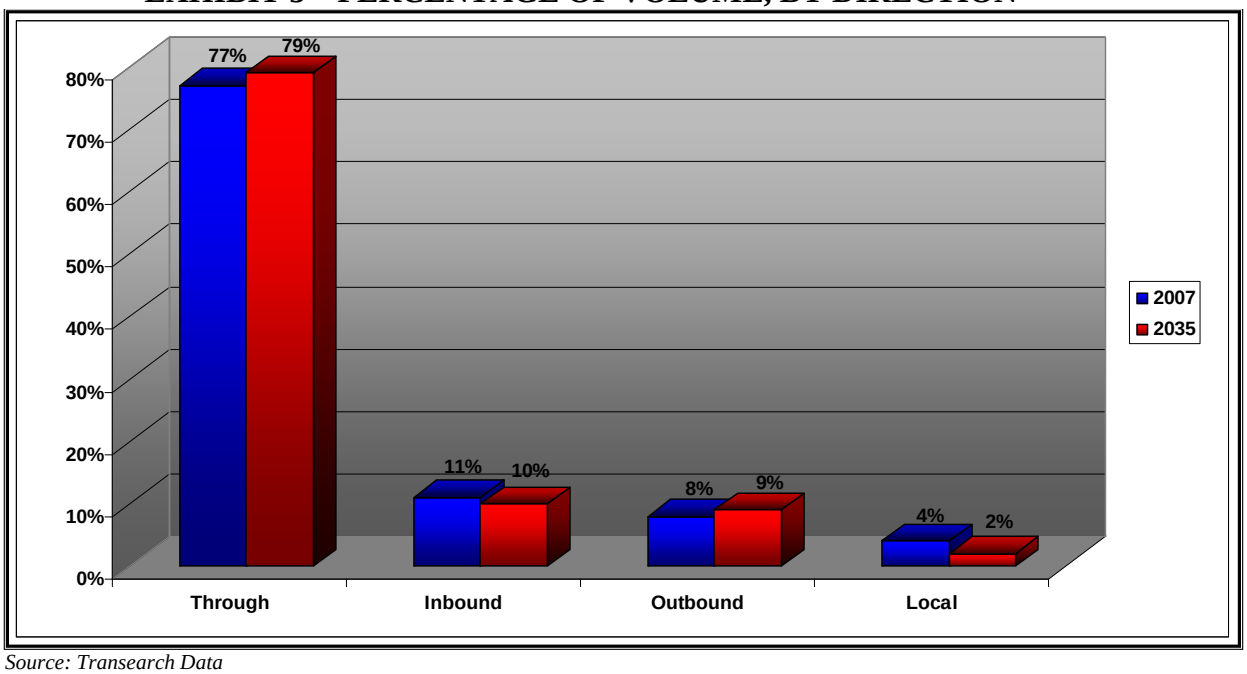
Source: Transearch Data

EXHIBIT 4 – TOTAL TONS BY DIRECTION AND MODE, 2035



Source: Transearch Data

EXHIBIT 5 – PERCENTAGE OF VOLUME, BY DIRECTION

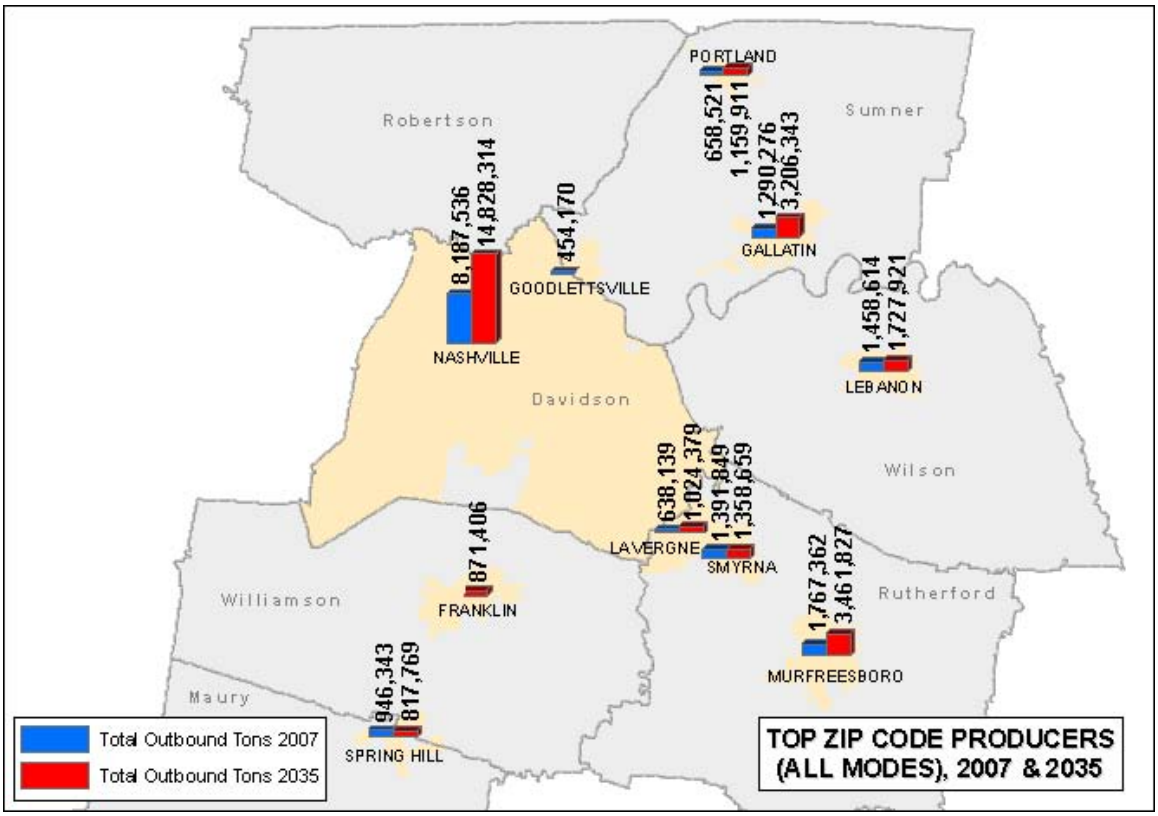


Source: Transearch Data

Through freight is also expected to increase in 2035 from 77 percent to 79 percent (**Exhibit 5**), with a substantial portion of the total freight traffic traversing the Nashville region currently classified as through traffic, with no origin or destination in the area. A 2 percent increase represents a substantial increase in through traffic. Just as in 2007, through freight is a significant portion of truck and rail tonnage combined (316 million tons). Since the percent of rail tonnage did not increase from 2007 to 2035, the majority of the increase in through freight can be attributed to through truck traffic. Both inbound and local freight are projected to decrease while outbound freight is expected to increase. By 2035, inbound freight is anticipated to decrease 1 percent, local movements by 2 percent, and outbound increases by 1 percent. This would indicate an anticipated increase in regional exports.

While the majority of total freight in the Nashville region is expected to remain as through traffic in 2035, a comparison of the 7 county top commodities from 2007 to 2035 reveals trends about where this freight is shifting to or from in terms of the amount of inbound and outbound freight by mode. **Exhibit 6** shows the top producers for all modes in 2007 and 2035. Nashville and Murfreesboro remain the top 2 producers for the Nashville MPO region as they are anticipated to remain the two cities with the highest population and employment.

EXHIBIT 6 – TOP PRODUCERS (ALL MODES), BASED ON ZIP CODE, 2007 & 2035

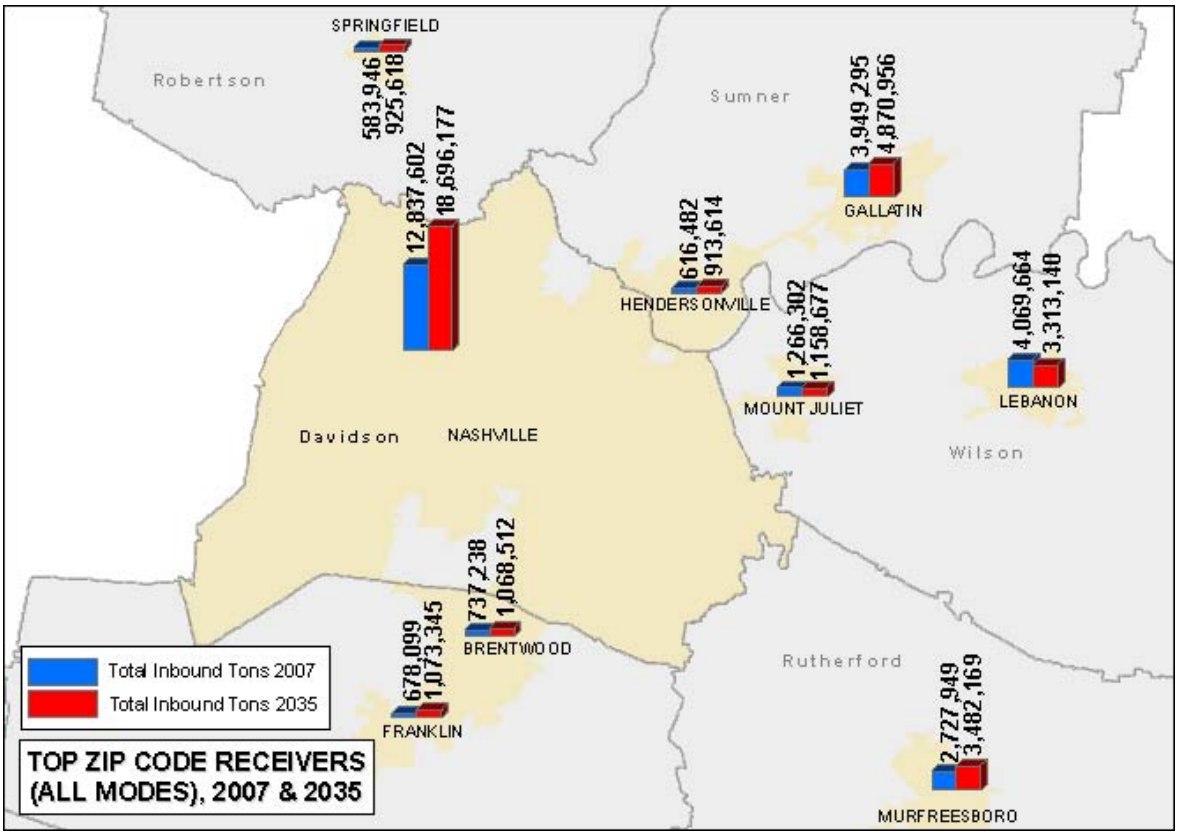


Source: Transearch Data

Total outbound tons in the Nashville region is projected to increase by 81 percent from 2007 to 2035. Gallatin and Murfreesboro are anticipated to experience the highest percentage increase with 149 percent and 96 percent, respectively. Smyrna, Spring Hill, and Goodlettsville are expected to lose the highest amounts of outbound freight. Smyrna drops to a fifth ranking in 2035, Spring Hill drops to a ninth ranking, and Goodlettsville no longer is ranked in the top nine, replaced by Franklin.

Exhibit 7 illustrates the top receivers for all modes in 2007 and 2035. In 2007 and 2035, Nashville is projected to continue to experience stronger attraction than production levels. Gallatin is anticipated to increase by less than 1 million tons over the nearly 30 year span, with Lebanon expected to decrease by more than 700,000 tons. Murfreesboro is projected to rise to third place by 2035, while Mount Juliet decreases by 100,000. Total inbound tonnage is projected to increase 32 percent from 2007 to 2035.

EXHIBIT 7 – TOP RECEIVERS (ALL MODES), BASED ON ZIP CODE, 2007 & 2035



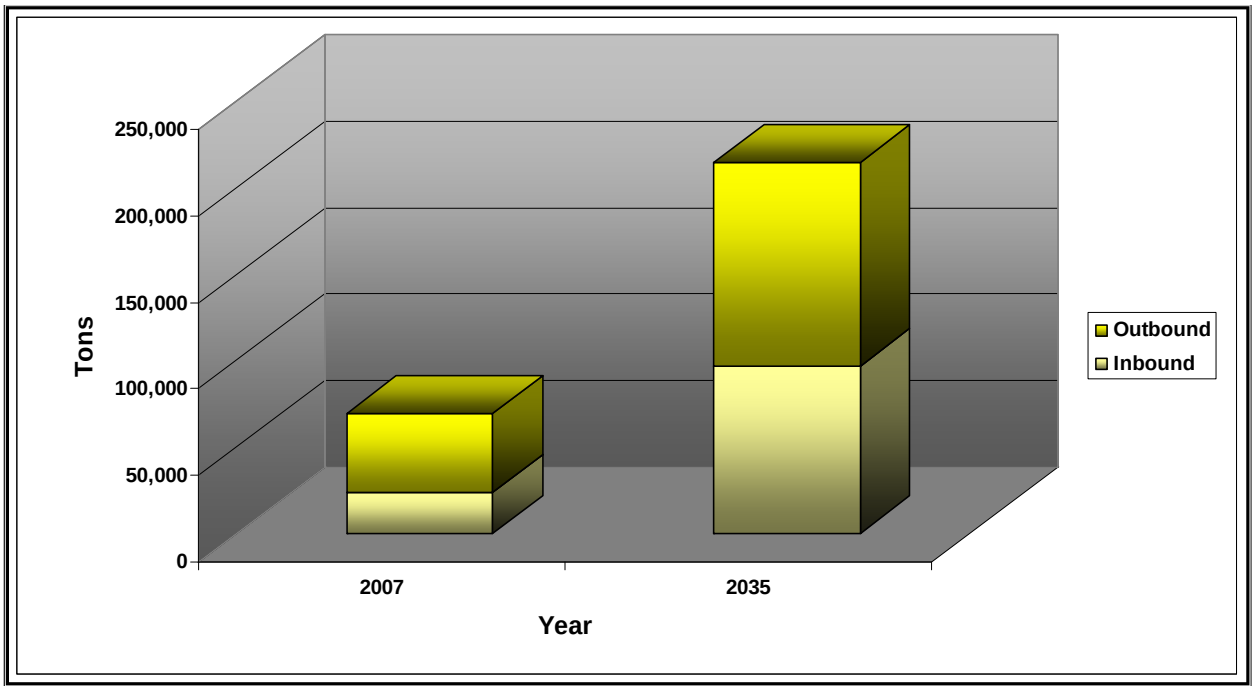
Source: Transearch Data

The Nashville region is expected to experience an increase in the amount of goods movement from 2007 to 2035. To further understand the impact on the transportation system, a modal review is provided.

AIR

While air continues to transport less than 1 percent of the total freight, it is anticipated to increase significantly over current levels. The distribution of inbound and outbound air is expected to shift with the percentage of inbound air increasing from 34 to 45 percent and outbound air decreasing from 66 to 55 percent (**Exhibit 8**).

EXHIBIT 8 – AIR FREIGHT TONNAGE IN THE NASHVILLE REGION, 2007 & 2035



Source: Transearch Data

The Nashville International Airport (BNA) transported almost 70,000 tons of freight annually in 2007, representing .02 percent of the total freight transported in 2007. This is expected to triple to 214,498 tons of freight in 2035, representing .05 percent of total freight tons transported in the Nashville region. In 2007, approximately 55 percent of the cargo tonnage at the Airport was domestic air freight and about 45 percent was international air cargo.

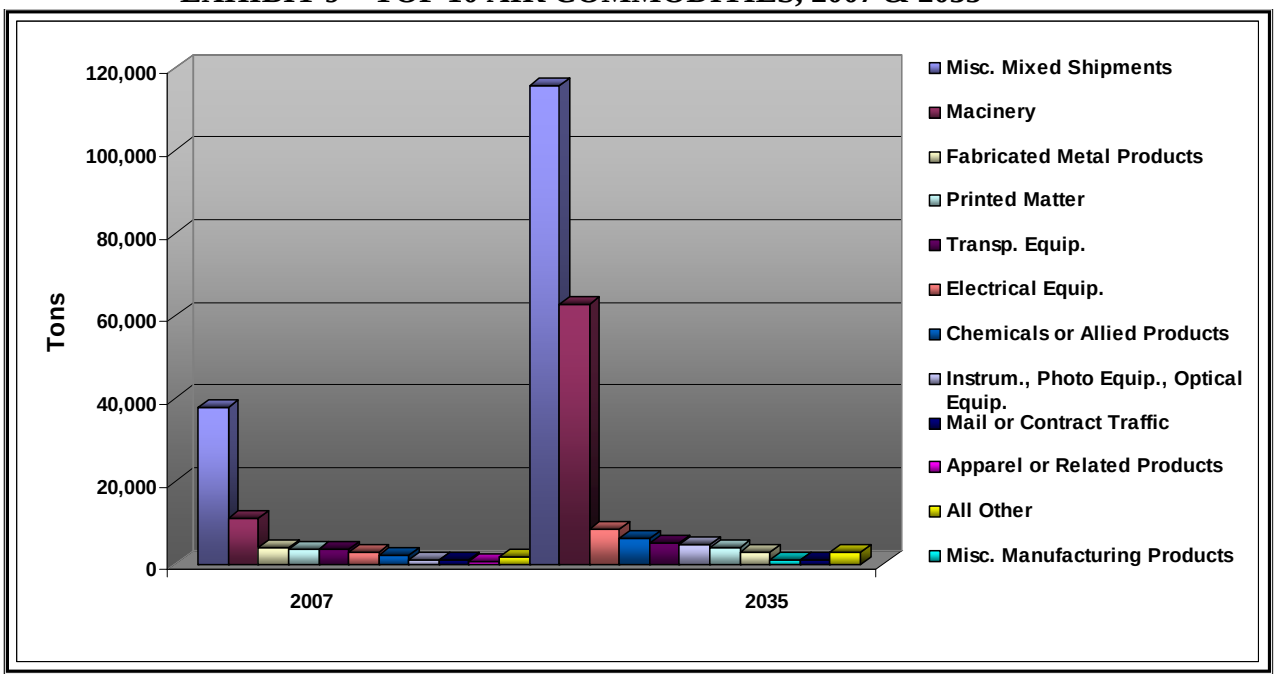
BNA's 30 Year Master Plan projects a growth rate higher than historical due to the combination of the Nashville Airport's initiatives to address latent demand for improved cargo facilities and services and Nashville's central geographic location and high-quality roadway infrastructure. Long-term development can be adequately accommodated on the west side of the airport. Future plans for the west side and the northwest quadrant of the airport include the development of new air cargo buildings, aircraft maintenance hangars, and the necessary aircraft ramp to support both operations. Cargo and Aircraft Maintenance Projects include:

- Expanded and additional cargo apron, new remain overnight apron, deicing pad, and cargo facilities
- 2 major aircraft apron expansions on the Northwest quadrant and West side for aircraft maintenance
- Utilities and infrastructure development in the old terminal site and the Northwest quadrant site

- Relocation of the existing electrical vault (formerly located under the old ATC tower) on the west side to a new location adjacent to the current cargo complex.[2]

In 2007, the major commodities transported by carriers at the Air Cargo Link complex were comprised mostly of small mixed shipments. Other key commodities were machinery, fabricated metal parts, printed material, and transportation equipment specifically motor vehicle parts and accessories. Almost half of the freight moving outbound from the region is characterized as "miscellaneous mixed shipments" which is indicative of integrated express carrier traffic such as FedEx Express. Total airborne tonnages, in 2035, will increase by 144,999 total tons with inbound air freight increasing 11 percent and outbound air decreasing 11 percent. Compared to 2007 commodities, electrical equipment, chemicals or allied products, and instrument, photo and optical equipment is expected to move up the list while mail or contract traffic is expected to shift down slightly. Apparel or related products is replaced with miscellaneous manufacturing products. **Exhibit 9** shows the top 10 air commodities for both 2007 and 2035.

EXHIBIT 9 – TOP 10 AIR COMMODITIES, 2007 & 2035



Source: Transearch Data
**Machinery is mostly electronic data processing equipment.*
**Printed matter is mostly blankbook, loose leaf bind and manifold business forms.*
**Transportation Equipment is largely motor vehicle parts or accessories.*
**Electrical equipment is a mix of household laundry equipment, miscellaneous electronic components, and miscellaneous household appliances.*
**Fabricated Metal Products include metal stampings, fabricated metal products not elsewhere classified (NEC), metal cans.*

Air transport requires the utilization of truck transport to move commodities between freight generators and the air cargo facility which impacts local truck movement.

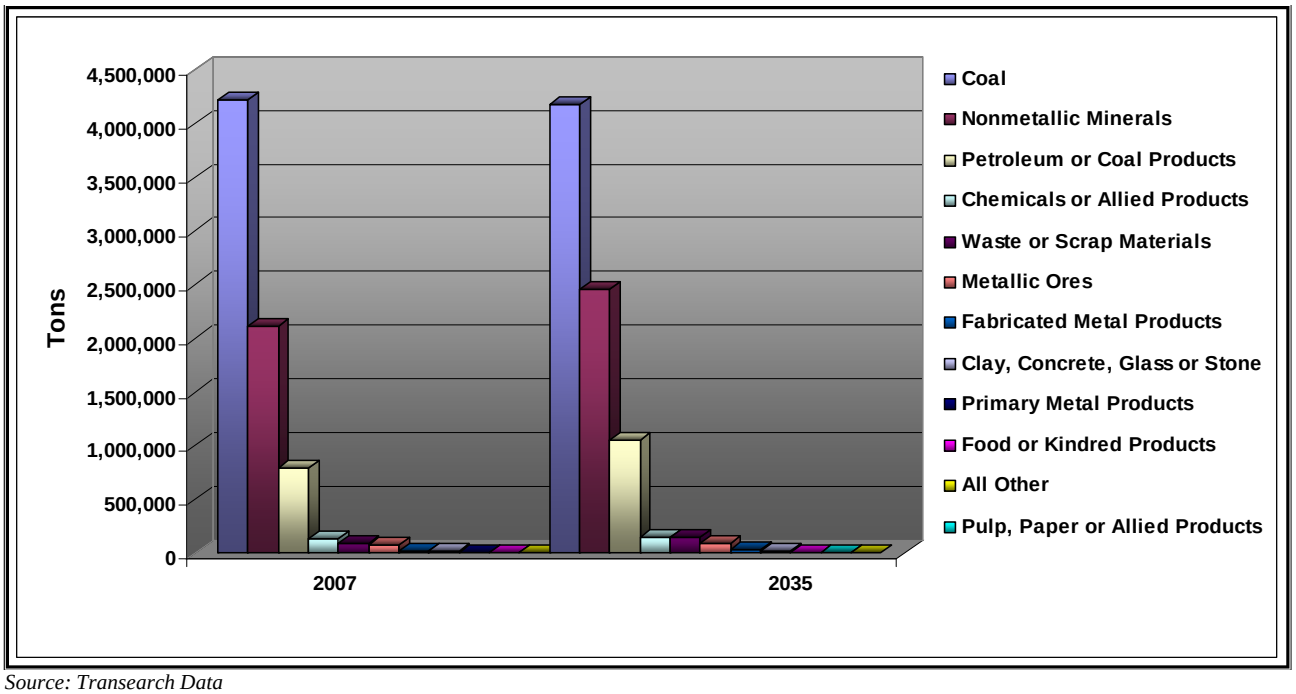
[2] "Master Plan Update", Metropolitan Nashville Airport Authority, June, 2005.

However, even by 2035, the associated truck movement, with air cargo, will contribute little to the congestion of the region, in comparison to truck only freight flows on the roadways. This combination of factors has driven efforts to promote intermodal transportation development that incorporates aviation.

WATER

In 2007, water freight tonnage accounted for approximately 3 percent of the total tons of freight in the Nashville region with approximately 7.5 million tons with the majority (96 percent) of the total tons being shipped inbound (appx. 7.2 million tons) to either Nashville or Gallatin. Water freight transport is constrained by the available docking and inland waterways available for cargo shipments. For this reason, a significant change in waterway freight is not expected unless focus is shifted to further increase the capacity of the inland waterways along the Cumberland River. **Exhibit 10** illustrates total water freight tonnage in the Nashville region for 2007 and 2035.

EXHIBIT 10 – WATER FREIGHT TONNAGE IN THE NASHVILLE REGION, 2007 & 2035



Source: Transearch Data
*Nonmetallic minerals are mostly gravel and sand.
*Petroleum or coal products are mainly petroleum refining products.
*Chemicals are mostly fertilizers and cyclic intermediates or dies.
*Metallic ores are mostly iron and bauxite or other alum ores.
*Fabricated metal products here represent mostly fabricated plate products, Fab metal NEC, and fabricated structural metal products.

In both 2007 and 2035, the two largest commodities for waterway freight are coal and nonmetallic minerals, accounting for 85 and 81 percent of the total water freight in the Nashville region, respectively. This is very common in the water freight community due to the fact that heavy, non-perishable goods are most compatible with water movement. While all four modes of transport are expected to increase in the amount of total tons

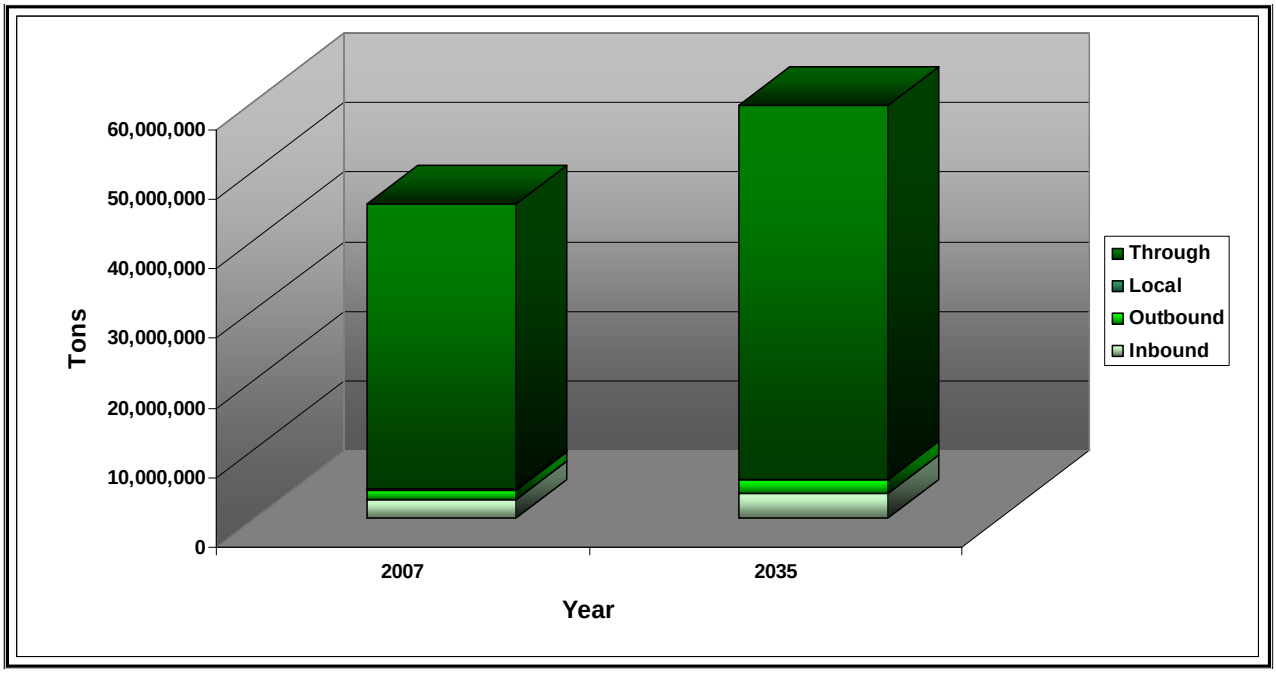
transported, water is the only mode that is expected to see a slight decrease as a percentage of total freight tons in the Nashville region from 3 percent in 2007 to 2 percent in 2035. As projected, coal actually decreases by over 43,000 tons while most of the other commodities experience a slight increase. Primary metal products are not expected to make the top 10 commodities list in 2035.

Waterway freight system conditions are expected to remain adequate, and allow the river to continue as a low-cost method of supplying basic and heavy bulk goods to the Nashville region. The 1 percent decrease in water tonnage and 1 percent increase in truck tonnage as a percentage of total freight transported by all modes for 2035 suggests that some of the freight carried by water today may be shifting to trucks – further adding to truck volumes.

RAIL

Rail is expected to continue to carry 15 percent of the total freight tonnage for the Nashville region. Though retaining the same percentage of total tonnage, rail volume is projected to increase by 15 million tons or 35 percent in 2035. **Exhibit 11** compares 2007 and 2035 rail freight tonnage for the Nashville region.

EXHIBIT 11 – RAIL FREIGHT TONNAGE IN THE NASHVILLE REGION, 2007 & 2035

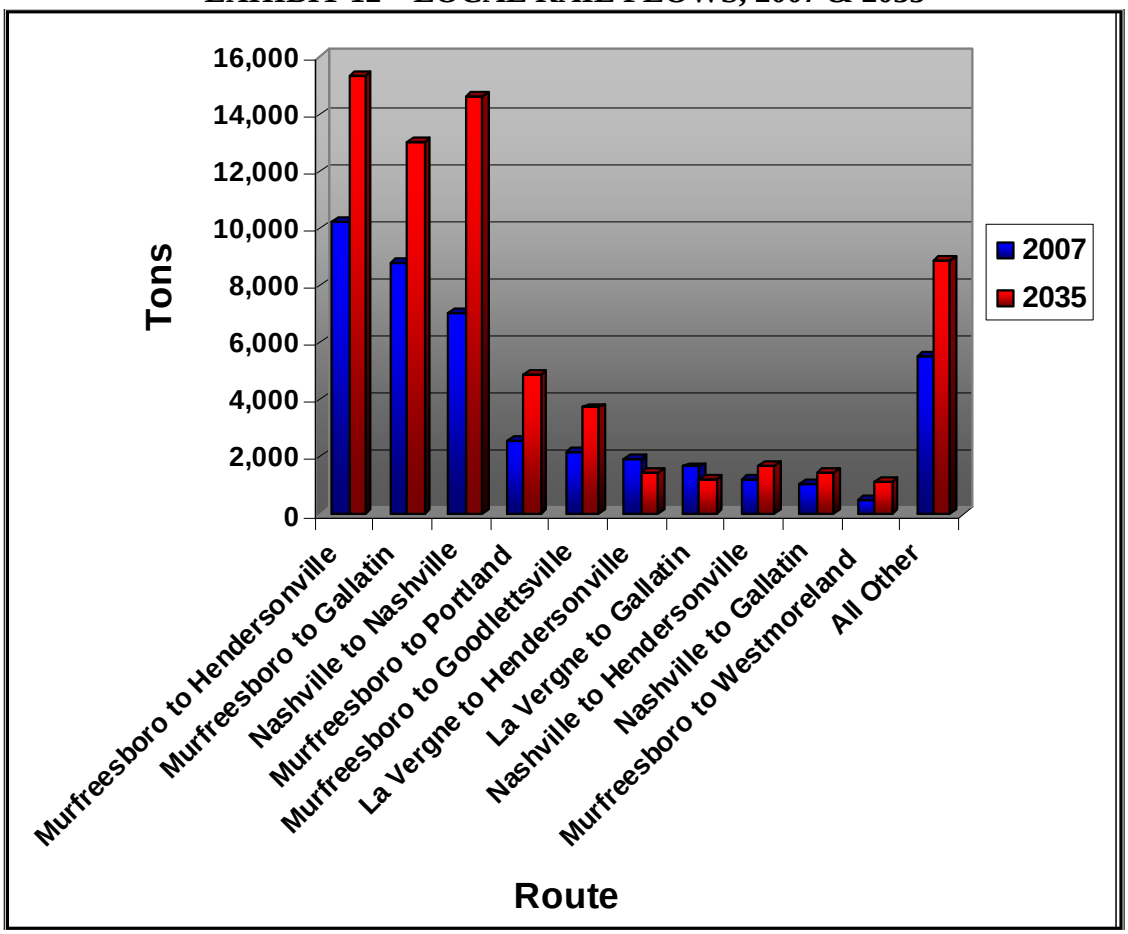


Source: Transearch Data

Rail freight tonnage is expected to increase in all directions with local movement experiencing the largest percent increase from 2007 to 2035 (57 percent). As projected, inbound, outbound, and through rail movements increase over 30 percent. The large proportion of rail freight that is transported through the Nashville region remains the

same in 2035 with 91 percent. Like truck traffic, the large amount of through rail freight can be attributed to Nashville's position as a crossroads for rail as it is for the highway. Additionally, this reflects the business plans of major Class I rail lines, where limited yard space has prompted a planned decrease in regional inbound and outbound service in favor of through service. **Exhibit 12** compares local rail flows for 2007 and 2035.

EXHIBIT 12 – LOCAL RAIL FLOWS, 2007 & 2035



Source: Transearch Data

As projected, rail freight originating in LaVergne decreased from 2007 to 2035 to both destinations in Hendersonville and Gallatin while all other categories increased. Nashville to Nashville rail flows should expect to see the second largest percentage increase from 2007 to 2035 with 108 percent.

Typical of rail movements, direct access is limited by the extent the infrastructure extends into the area. This is far less than truck, but does provide greater mobility than air or water. At a county level, Davidson and Rutherford are the major producers and consumers of rail freight. At a more regional level, top origins and destinations do not vary much between 2007 and 2035 (**Exhibit 13** and **14**).

EXHIBIT 13 – OUTBOUND RAIL FREIGHT TONNAGE IN THE NASHVILLE REGION, 2007 & 2035

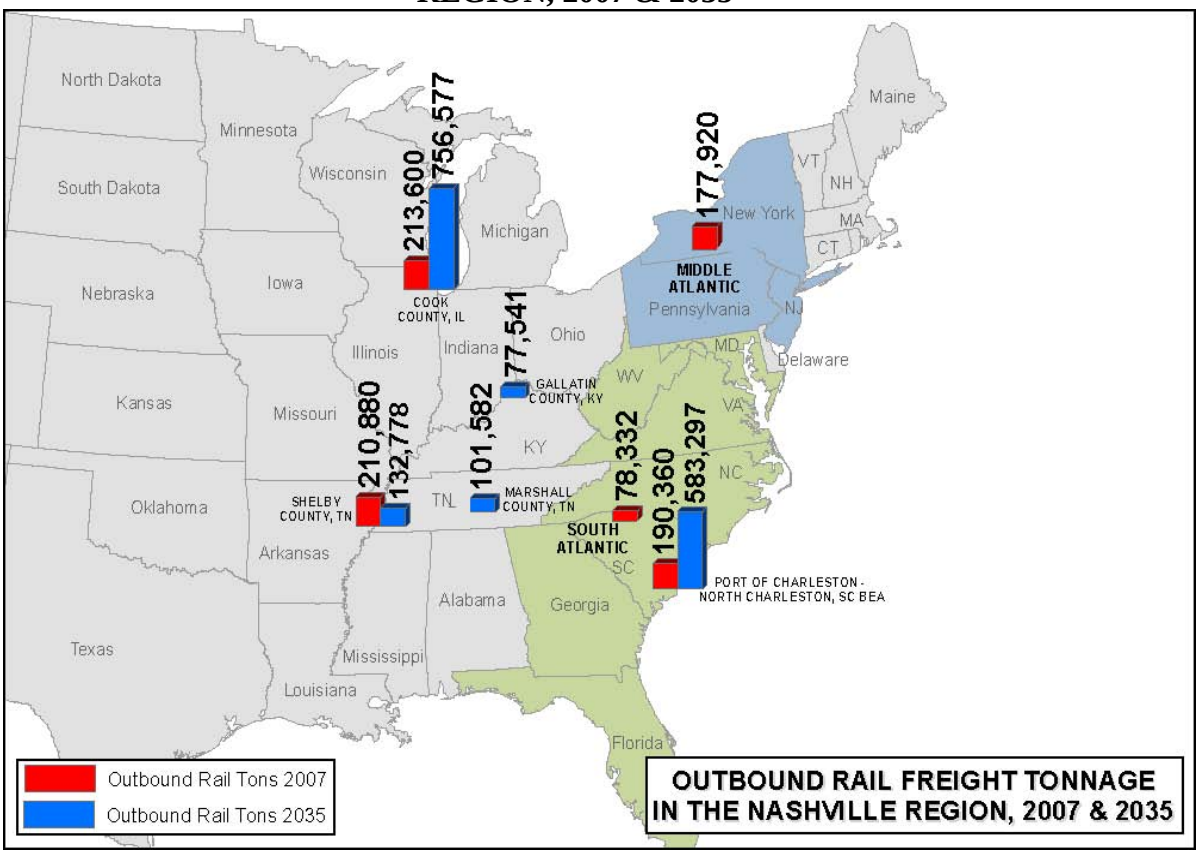
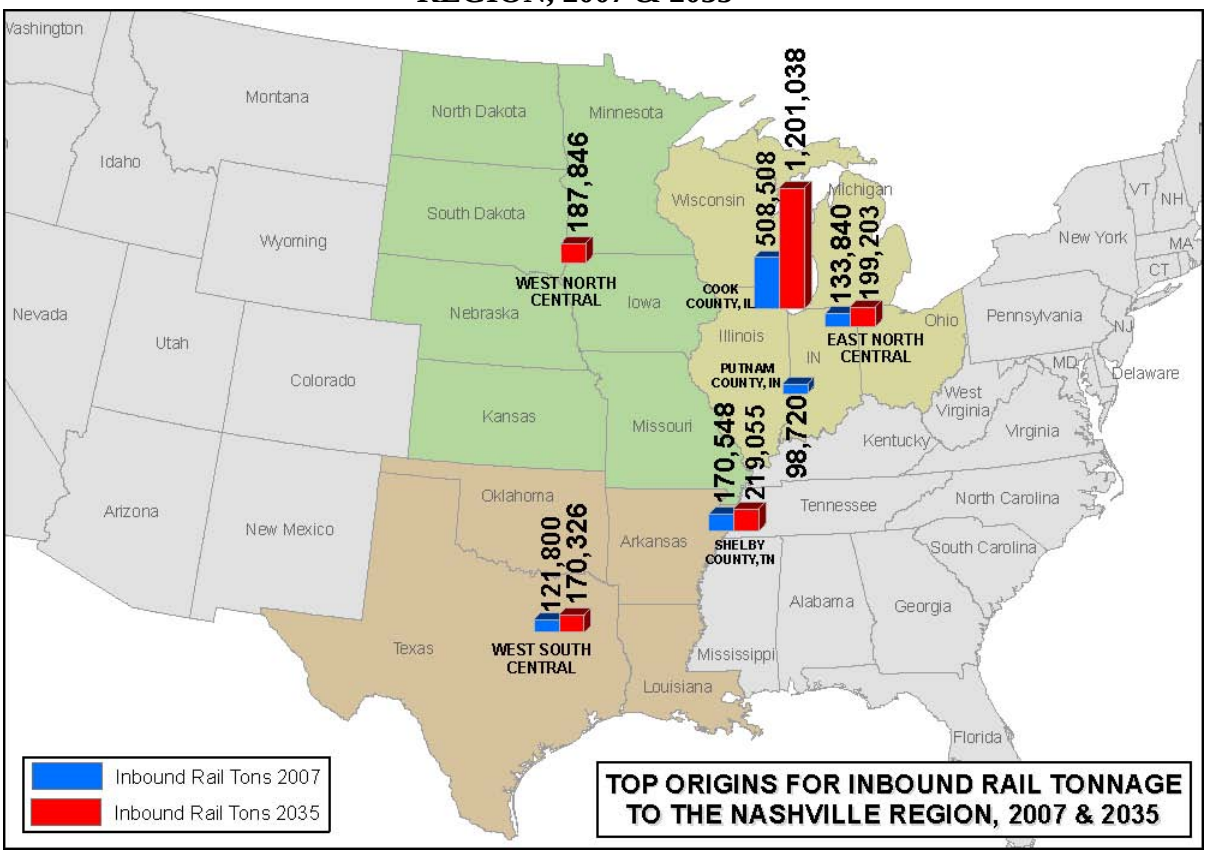


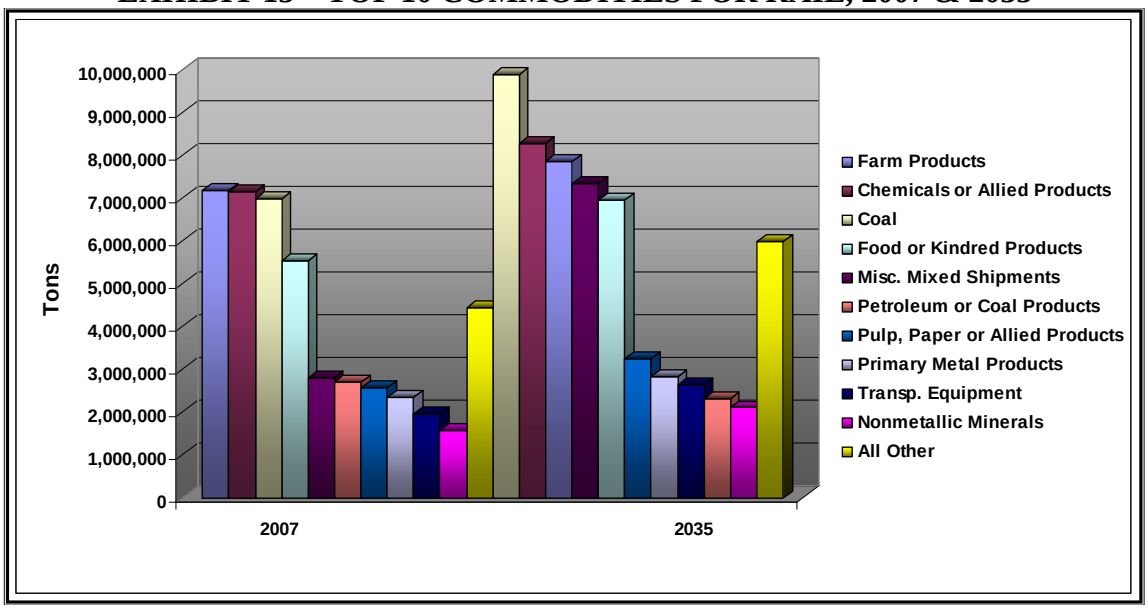
EXHIBIT 14 – INBOUND RAIL FREIGHT TONNAGE TO THE NASHVILLE REGION, 2007 & 2035



Cook County, IL, specifically the rail yards associated with the Chicago metropolitan area, dominate the inbound and outbound movements for the Nashville region; currently and projected for 2035. This dominance partially represents the metro-to-metro exchange of goods. The greater segment represents the increased presence of continental and global trade dependence in the future economy. Chicago provides continuing rail service to both NAFTA partners and to coastal U.S. facilities. These in turn serve as gateways to international goods exchange. The Middle Atlantic, South Atlantic, East North Central, West South Central, and West North Central are defined by census regions.

Marshall County, Tennessee is expected to see 5 percent of outbound rail tons in 2035. There is a CSX line running through Marshall County and transports mostly chemicals. Gallatin County, Kentucky is a top rail destination in 2035 exporting 2.8 percent of total outbound rail tons to the Nashville region. Metal or tailings are mostly transported from Gallatin County. Putnam County, Indiana, outside Indianapolis, is not a particularly huge rail hub but receives Portland Cement from the Nashville region.

EXHIBIT 15 – TOP 10 COMMODITIES FOR RAIL, 2007 & 2035



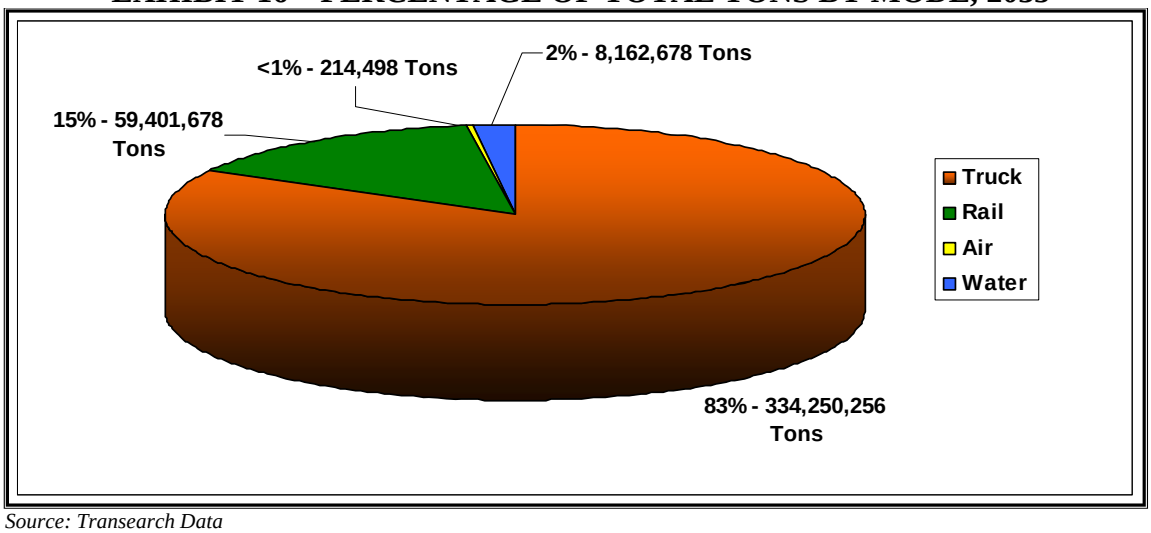
Source: Transearch Data

The top 10 commodities transported by rail are shown in **Exhibit 15**. The top 3 are expected to remain the same from 2007 to 2035, but coal replaces farm products as the top commodity. While the top 10 commodities remain the same, the overall total rail tons are anticipated to increase by 31 percent. A large amount of "miscellaneous mixed shipments" suggests intermodal movement of many different commodities to make up a container. Since a lot of the rail freight going through the region in 2007 consists of the same commodities that are moving locally, it suggests that there is potential for further expansion. Value-added production could increase in the region easily since the infrastructure and market already exists with reasonable transportation.

TRUCK

The amount of freight tons transported by truck is expected to increase by 2035 and remain the main mode of freight transport in the Nashville region, accounting for the majority of freight volumes carried inbound, outbound, locally, and through the area. Of the over 400 million total tons of freight expected to be handled in 2035, 83 percent will be transported by truck (**Exhibit 16**).

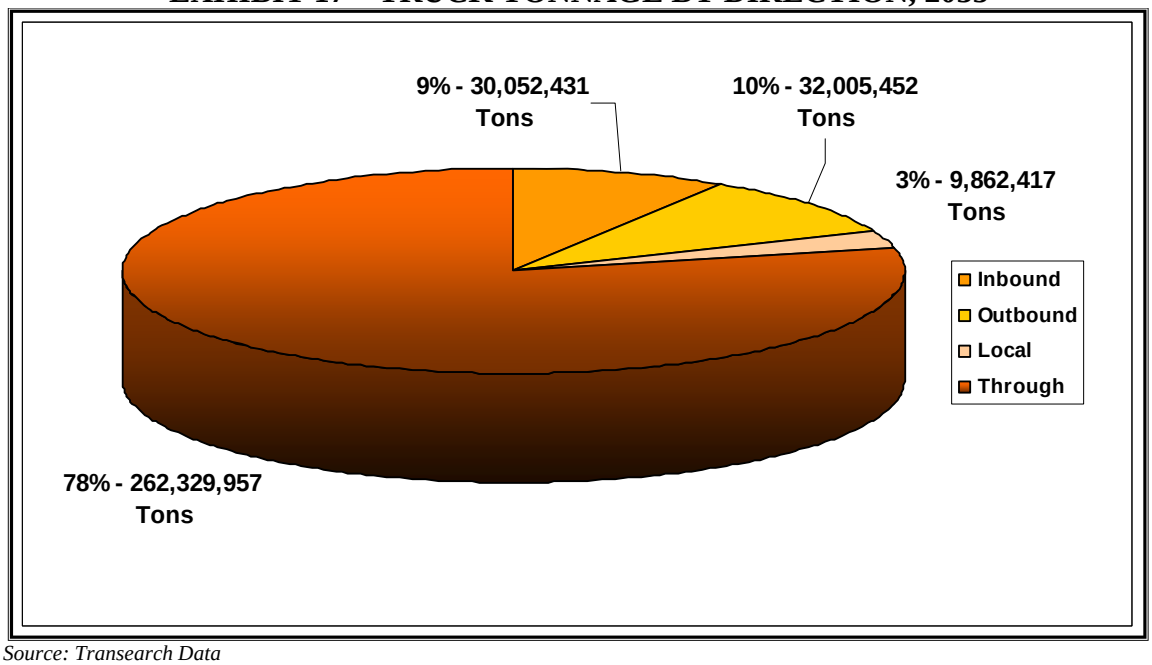
EXHIBIT 16 – PERCENTAGE OF TOTAL TONS BY MODE, 2035



Source: Transearch Data

While the percentage of total tons carried by trucks is expected to increase 1 percent, the percentage of through truck tons is expected to increase 2 percent by 2035 (**Exhibit 17**). This represents a significant portion of truck traffic that uses the region's roadways without any freight originating in or coming to the Nashville region.

EXHIBIT 17 – TRUCK TONNAGE BY DIRECTION, 2035



Source: Transearch Data

In addition to through traffic increasing, outbound truck tons are also expected to increase from 9 to 10 percent of total truck tons. Inbound freight is expected to remain at 9 percent while the percent of local freight tons are expected to decrease from 6 to 3 percent. The

large percentage of through truck traffic will continue to place significant wear and tear on the region's roadways.

The top 10 commodities transported by truck are shown in **Exhibit 18**. Truck Units are similar to trucks. They are calculated from tons based off of conversion between tons and the average truck size. Secondary traffic is primarily warehousing and distribution centers, but also rail intermodal drayage and air freight drayage. Food is primarily prepared or canned feed, animal byproducts (inedible), malt liquors, soft drinks, and frozen poultry. Chemicals are mostly agricultural, potassium, plastic mater, or synthetic fibers and adhesives. Nonmetallic minerals are dominated by broken stone or riprap. Fabricated metal products are mostly metal stampings, fabricated plate products, and valves or pipe fittings.

Secondary traffic, remaining the top commodity into 2035, increasing from nearly 18 percent to 29 percent of the total truck tons. Food or Kindred Products is maintained as the second top commodity, with only a 0.4 percent change. Chemical or allied products replace nonmetallic minerals, the third top commodity. Clay, concrete, glass, or stone and primary metal products drop several places, while rubber or miscellaneous plastics moves up four spots. Farm products and lumber or wood products do not make the top 10 commodities list for 2035 and are replaced with electrical equipment and transportation equipment.

EXHIBIT 18 – TOP 10 COMMODITIES FOR TRUCK, 2035

2035 Top Commodities	Truck Tons	Truck Units
Secondary Traffic	96,516,245	4,788,851
Food Or Kindred Products	39,072,369	1,711,833
Chemicals Or Allied Products	23,852,216	1,137,442
Fabricated Metal Products	18,736,189	1,040,265
Nonmetallic Minerals	18,501,531	761,056
Rubber Or Misc Plastics	16,596,784	1,399,598
Electrical Equipment	16,584,102	985,699
Transportation Equipment	13,883,514	991,557
Clay, Concrete, Glass Or Stone	12,245,474	745,225
Primary Metal Products	12,094,282	480,744
All Other	*66,167,549*	*7,754,932*
Total Truck Tons	**334,250,256**	**21,797,202**

The top inbound origins and outbound destinations for freight moving by truck associated with the region are identified in **Exhibits 19** and **20**. Shelby County is the top destination and origin for both 2007 and 2035. Memphis Metropolitan area is a leading distribution locale. With extensive deconsolidation and consolidation activities, this relationship between the metro regions should be expected.

EXHIBIT 19 – OUTBOUND TRUCK TONNAGE, LEADING ZONES NASHVILLE REGION, 2007 & 2035

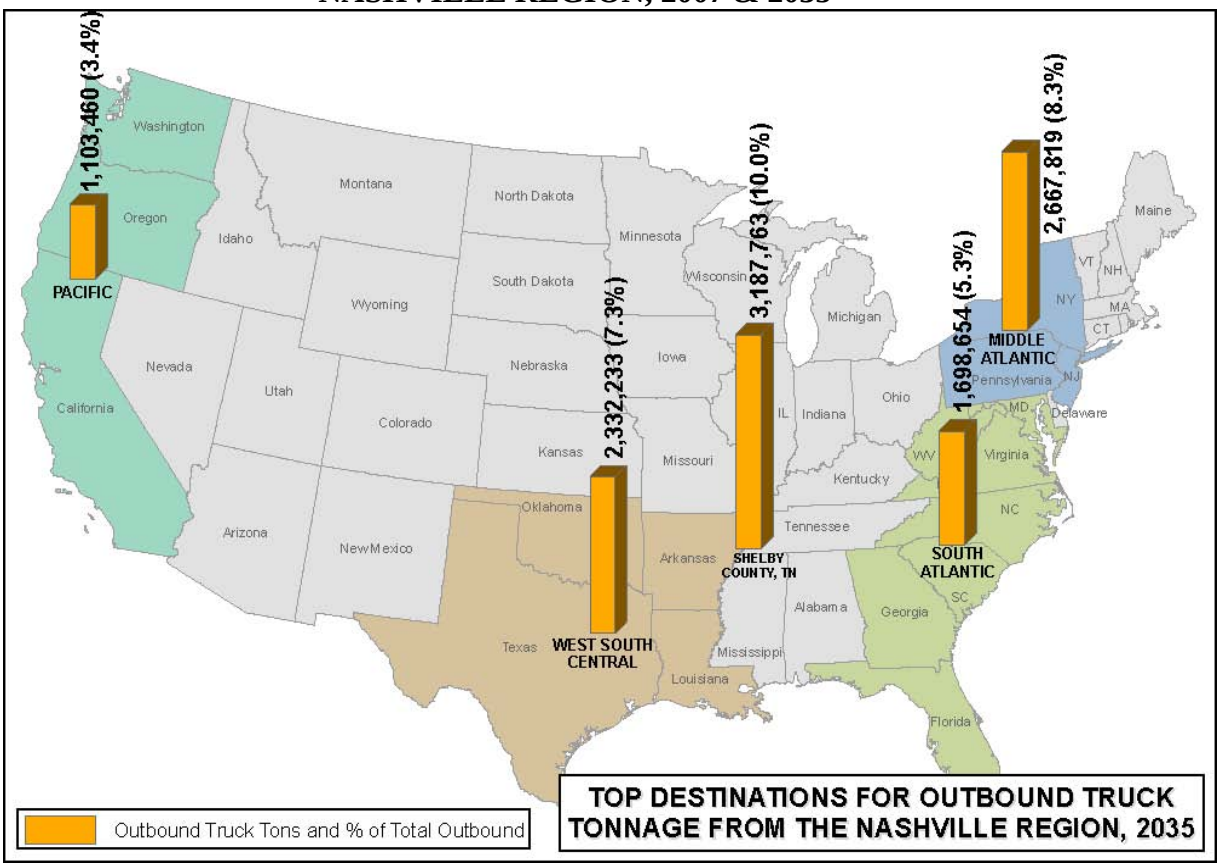
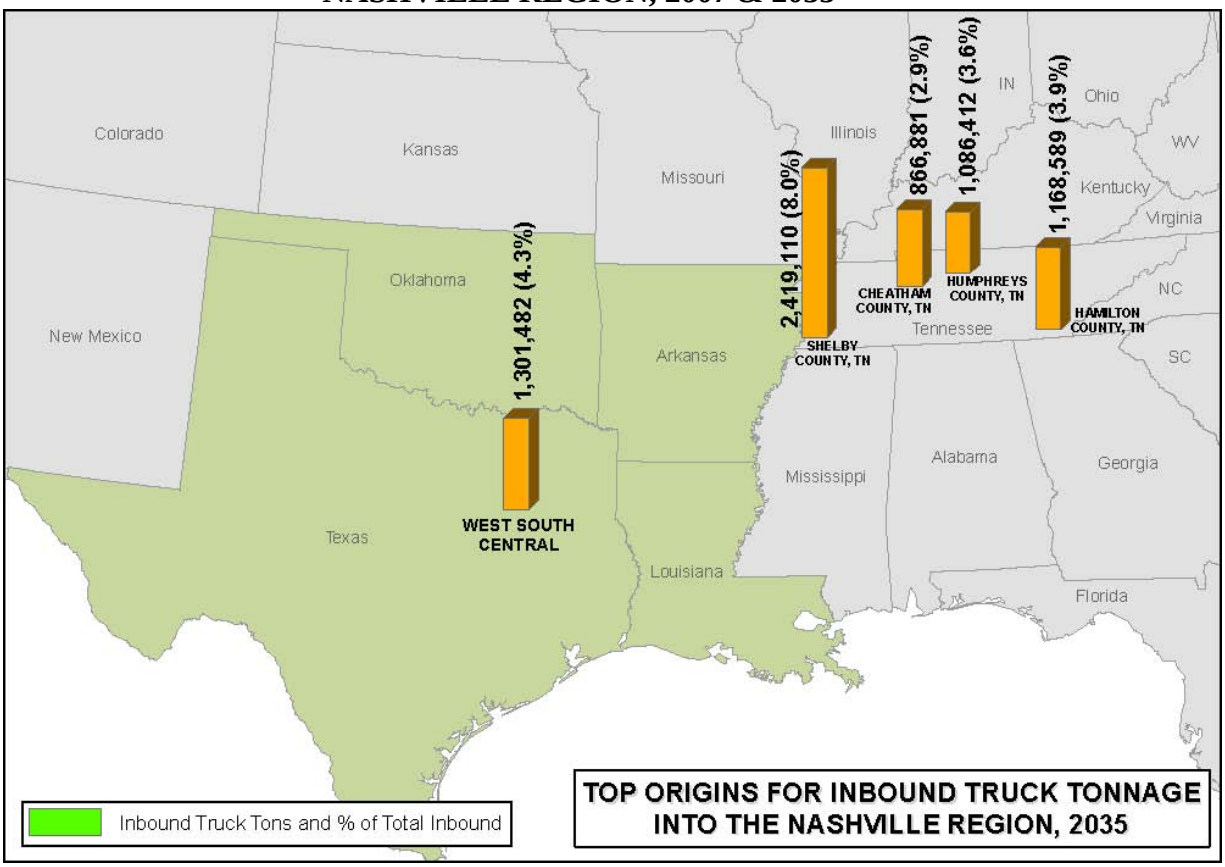


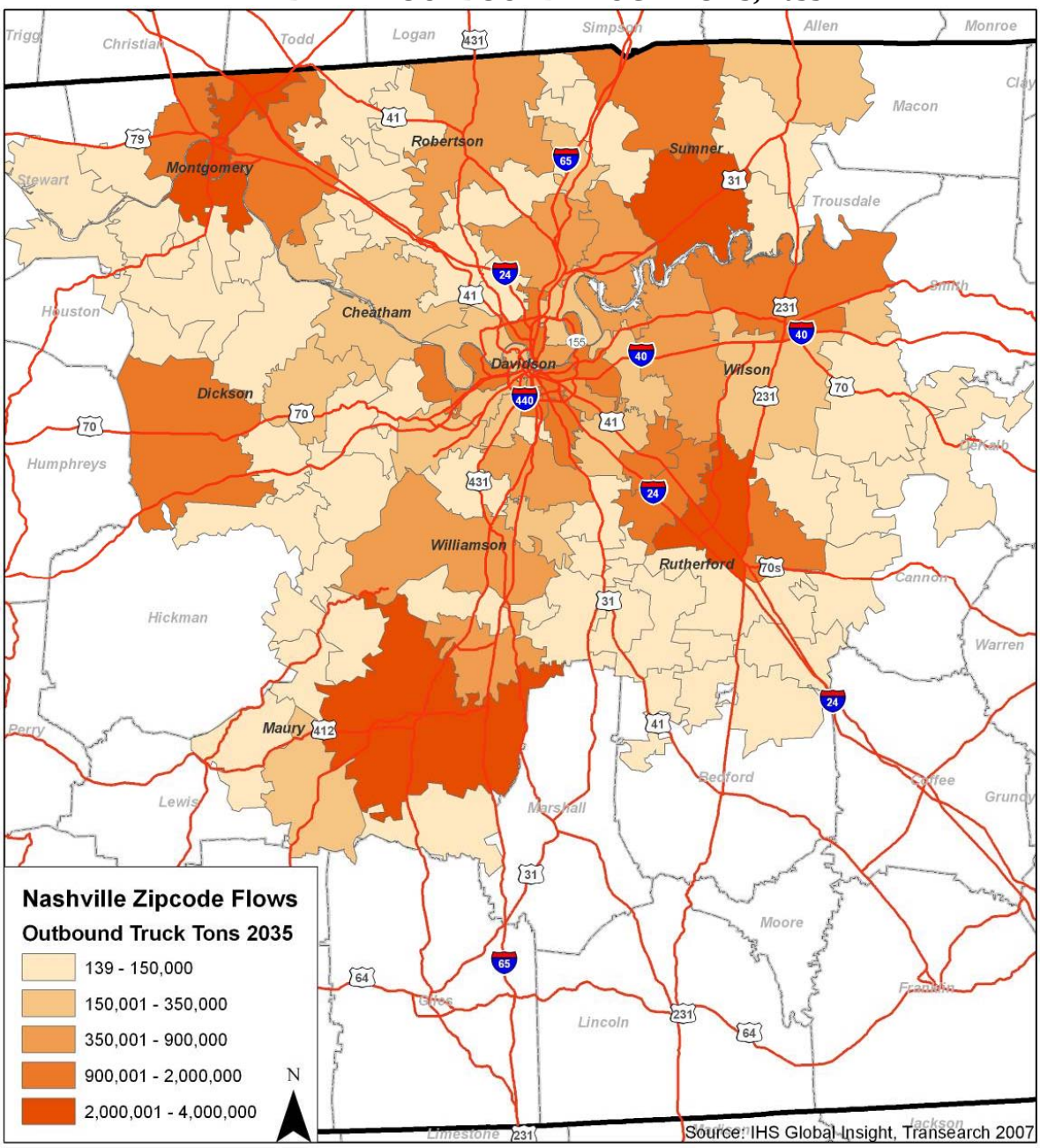
EXHIBIT 20 – INBOUND TRUCK TONNAGE, LEADING ZONES NASHVILLE REGION, 2007 & 2035



**Geographic regions are defined in Exhibit 11*

A key observation is the non-proportional growth in those zip codes identified as leading zip codes in 2007. These continued to exhibit growth whereby little to no growth was found in those identified as weak producers in 2007 (**Exhibit 21**).

EXHIBIT 21 – OUTBOUND TRUCK TONS, 2035



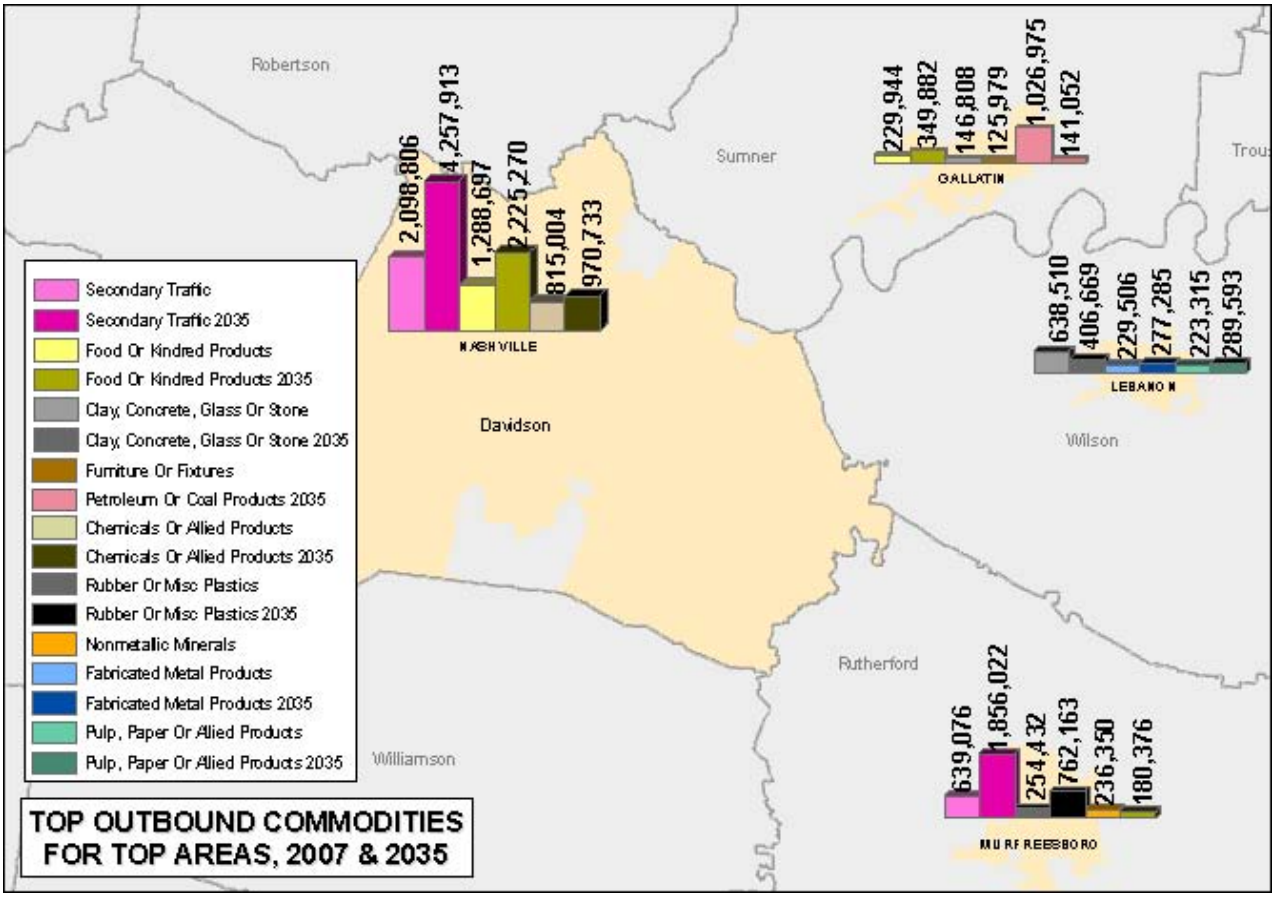
The areas with the greatest outbound truck volume change are Nashville, Murfreesboro, Gallatin, Columbia, and Franklin. These areas are not synonymous with those areas projected to experience the highest growth rate between 2007 and 2035; Fairview, Nolensville, Brentwood, and Franklin. In 2035, the top outbound truck areas are Nashville, Columbia, Murfreesboro, and Gallatin. The actual top zips for outbound truck tons in 2035 are:

- 38401 (Columbia)

- 37066 (Gallatin)
- 37129 (Murfreesboro)
- 37214 (Nashville)

Top outbound commodities, by zip code, remained the same in 2035, with warehousing and distribution, broken stone or riprap, rail intermodal drayage, motor vehicle parts or accessories, asphalt paving blocks or mix, tires or inner tubes, ready-mix concrete, primary forest materials, and distilled or blended liquors. **Exhibit 22** shows the top outbound commodities for top areas in 2007 and 2035.

EXHIBIT 22 – TOP OUTBOUND COMMODITIES FOR TOP AREAS, 2007 & 2035



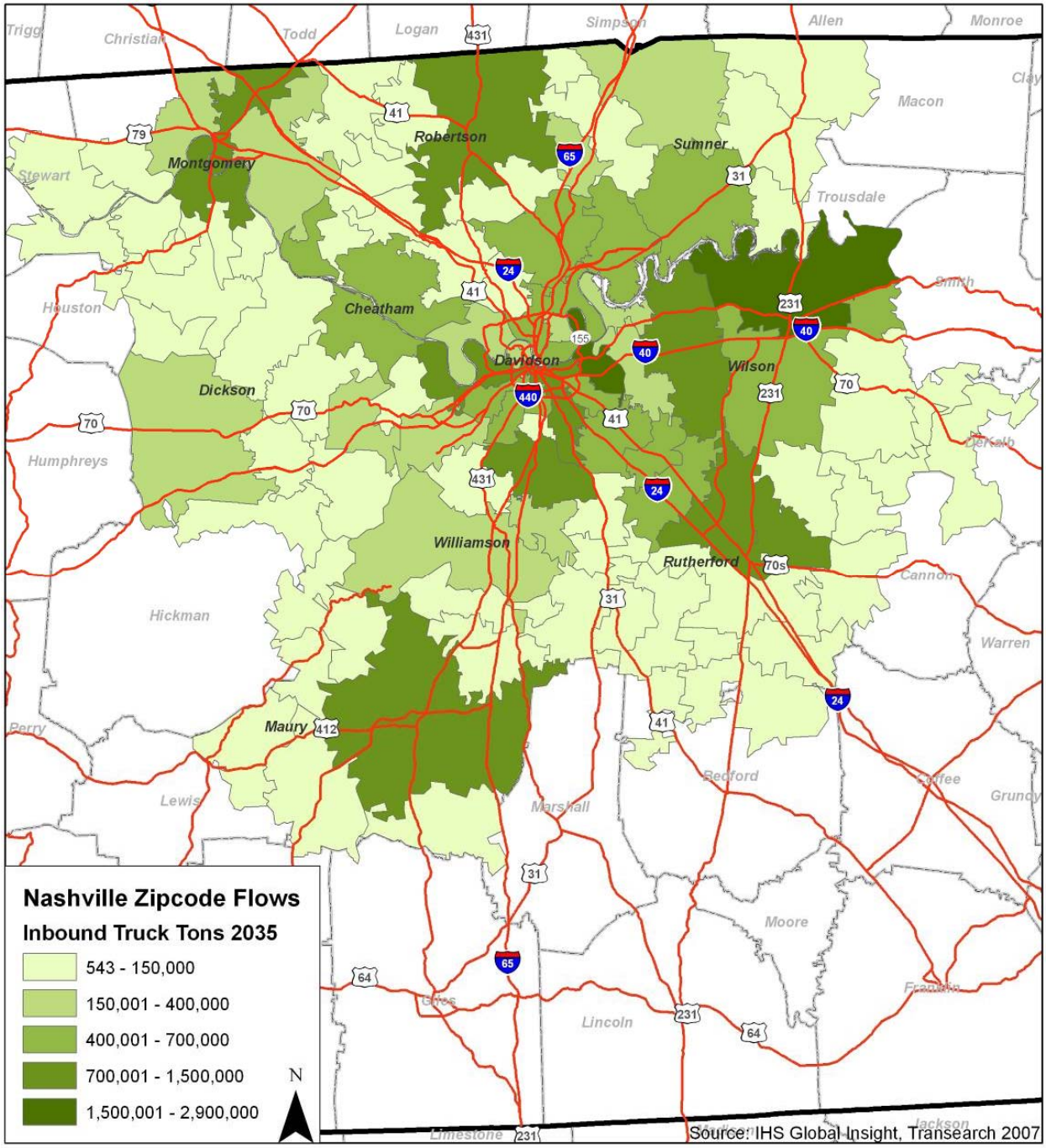
Source: Transearch Data

Murfreesboro continues to maintain the same top three commodity types in 2035 as in 2007. Overall growth for the area continues to place Murfreesboro as the second largest producing area. The projected change in volume, for the top two areas occurs within the secondary traffic commodity type; increasing from 103 percent for Nashville to 190 percent for Murfreesboro, from 2007 levels. Lebanon is projected to decrease in volume, to a ranking of fourth, while Gallatin, supported by higher volumes in petroleum and coal, is elevated to third. For those zones not in the top four, Columbia sees growth in

secondary traffic, advancing over transportation equipment – a commodity noted in decline in many geographic areas.

In comparison, 2035 projected growth exhibits a different pattern for inbound movements. Growth is found near Nashville and areas surrounding the northern zip codes associated with Gallatin (**Exhibit 23**).

EXHIBIT 23 – INBOUND TRUCK TONS, 2035

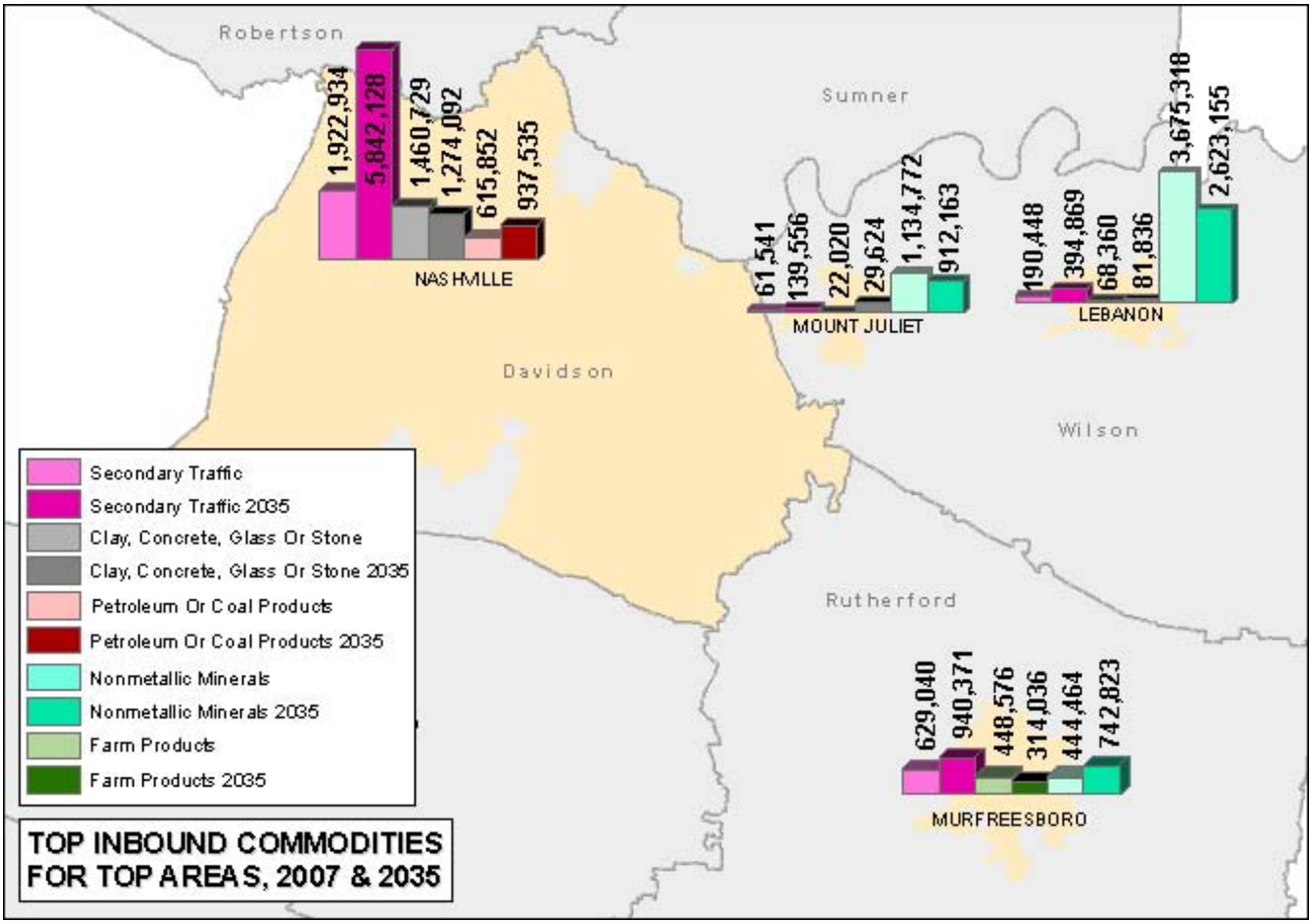


Areas with the largest change in inbound tonnage are Nashville, Murfreesboro, Franklin, Springfield, and Brentwood. The largest compound annual growth rates are from Santa Fe, Westmoreland, Whites Creek, Portland, and Antioch. The top inbound truck areas in 2035 are Nashville, Lebanon, and Murfreesboro. The actual top zips are:

- 37087 (Lebanon)
- 37214 (Nashville)
- 37203 (Nashville)

The only commodity not on the list from the top 2007 inbound commodities is electrometallurgical products (the use of electric and electrolytic processes to purify metals or reduce metallic compounds to metals). **Exhibit 24** shows the top inbound commodities for 2035.

EXHIBIT 24 – TOP INBOUND COMMODITIES FOR TOP AREAS, 2007 & 2035



Source: Transearch Data

With the expectation that through movements will be most closely assigned to interstate travel, the MPO's understanding of the impact of non-through movements is important to the planning process. A clear understanding of these movements will provide insight into future improvements and policies to enhance not only the freight transportation system but the economic development of the region. In 2007, Davidson County accounted for the

majority of local inbound and outbound traffic in the Nashville region, which is to be expected given the fact that Davidson County is the "hub" of the region in terms of population, employment, and the cross-roads point of the Interstate system.

Movement associated with the "final mile", those portions of the selected truck route providing access to the freight generator, typically occur on collector and local roads and typically employ a greater number of drivers with knowledge of area roadways. Travel along local and collector roadways may be an attempt to reduce mileage or travel time between stops, increase productivity, or result as an alternative to a delay occurring on the arterial or interstate systems. Top local truck flows for 2007 and 2035 are shown in **Exhibit 25**.

EXHIBIT 25 – TOP LOCAL TRUCK FLOWS, 2007 & 2035

Origin Area	Destination Area	Truck Tons 2007		Origin Area	Destination Area	Truck Tons 2035
Nashville	Lebanon	1,883,507		Gallatin	Lebanon	2,736,781
Gallatin	Lebanon	826,031		Gallatin	Mount Juliet	949,741
Lebanon	Lebanon	658,773		Nashville	Lebanon	620,904
Nashville	Nashville	641,911		Spring Hill	Nashville	371,802
Nashville	Mount Juliet	581,683		Columbia	Franklin	350,247
Spring Hill	Nashville	490,465		Columbia	Brentwood	232,478
Columbia	Columbia	452,646		Nashville	Mount Juliet	215,817
Columbia	Franklin	406,360		La Vergne	Franklin	197,094
Murfreesboro	Murfreesboro	383,078		Franklin	Lebanon	172,803
Columbia	Brentwood	340,965		Nashville	Franklin	160,297
All Other		***7,099,888***		***All Other***		***3,851,332***
Total Local		**13,765,307**		**Total Local**		**9,859,296**

By 2035, it is projected that intra-area movement (where origin and destination are the same) will have much less impact as a contributor to local truck flows. In 2007, three intra-area movements are noted (Exhibit 25). These do not appear in the 2035 projections. An additional shift is the dominance of the Gallatin area to produce truck trips. Involved in the second heaviest O-D pairing for local movements in 2007, it participates as the origin for the top two O-D pairings in 2035. **Exhibit 26** lists the top locally traded truck commodities in 2007 & 2035.

As shown in this exhibit, nearly all top locally traded truck commodities are expected to decrease in 2035, in some cases substantially. In fact, the total volume of truck tons for these commodities is expected to decrease by 40%. The only top commodities expected to increase are Miscellaneous Field Crops, Warehouse & Distribution Center, and Rail Intermodal Drayage to Ramp.

EXHIBIT 26 – TOP LOCALLY TRADED TRUCK COMMODITIES 2007 & 2035

Commodity (STCC4)	**Truck Tons 2007**	**Truck Tons 2035**
Broken Stone Or Riprap	9,216,216	6,848,869
Ready-mix Concrete, Wet	1,687,765	1,162,804
Gravel or Sand	1,247,782	410,353
Motor Vehicles	218,881	65,742
Miscellaneous Field Crops	184,922	278,193
Warehouse & Distribution Center	180,543	285,606
Motor Vehicle Parts or Accessories	148,565	92,008
Rail Intermodal Drayage to Ramp	125,596	204,999
Grain	82,202	41,098
Concrete Products	77,304	47,648
All Other	*593,471*	*421,975*
Total Local	**13,765,307**	**9,859,296**

Influences on Future Freight Movement

The four modal options available to the freight community within the MPO as noted, are projected to increase significantly between 2007 and 2035. Across the various modes, truck tonnage is projected to increase the most at 36 percent. This is followed closely by rail at 31 percent, water at 9 percent, and air at 8 percent. Much of this traffic is through and impacts the MPO through facility and system usage without significant regional benefit. Shifting technologies and modal variations have the ability to influence all four directions of movement and the mode selected in each.

AIR

Air cargo tonnage is primary handled by cargo only operators. Their capabilities range from specialty cargo handlers to mixed freight carriers via capacity available for "belly" freight, carried in the cargo holds of passenger carriers. Two operational considerations may prove influential to this mode:

- Passenger airline aircraft fleet composition
- Utilization of land based transport

Passenger Airline Aircraft Fleet Composition:

Over the past decades, airline purchasing characteristics have shifted from larger, wide bodied, and high volume passenger aircraft on corridors less than 1000 miles to smaller regional aircraft. This reduction in airframe size has contributed to market share shrinkage by this carrier segment. Security measures taken in light of post-911 recommendations have limited access to over the counter shippers performing incidental freight movement. In combination, these have resulted in either the transitioning of this segment to move traditional air cargo conveyance or alternative, non-air transport methods.

Utilization of land based transport:

In the past twenty years, truck conveyance transit standards, extending into the less than truckload networks, have decreased travel times. This is evidenced where transit offerings in the 1980's were offered in multiple day ranges, and currently many of these have evolved to next day, day definite, and time definite services. Coupled with mixed freight air carriers purchasing or partnering with trucking assets, these have resulted in a significant segment of air cargo being transported by truck, in part of across the total movement. Continuing advances in truck transport capabilities may continue to foster a shift of air cargo to either be transported on truck as "air cargo" or move to truck only carriers.

WATER

Water borne cargo is typically associated with bulk commodity movement on barges in either short or long haul environments. Though with limited interest and success, conversion of water barge service to a container on barge (COB) or trailer on barge (TOB) operation is occurring. One of the prominent efforts is occurring in Alabama and Mississippi with expansion of dockside service at the Port of Mobile, extending through to the Tenn-Tom waterway. The successful implementation of both COB and TOB service on this line may prompt introduction and diversion of this service in other parts of the country, where applicable. Though no readily identified efforts exist, adoption of this modal variant has the capacity to divert a percentage of highway and rail traffic in the Nashville market.

RAIL

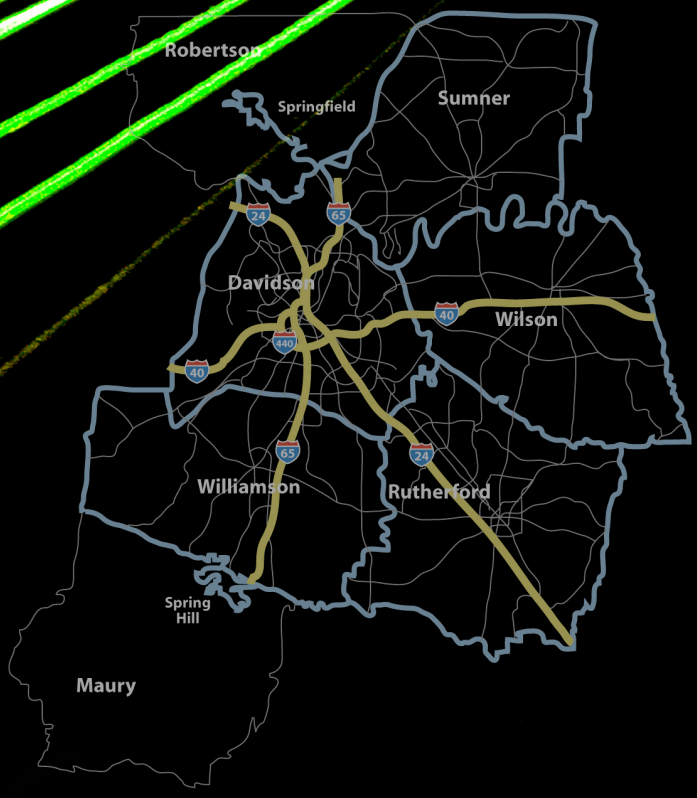
Rail diversion has gained increased support in the past decade, though this has equal detractors citing rail infrastructural capacity constraints, in light of proposed increased presence of passenger rail and desired business models by the Class I and Short line operators. This mode is due to be significantly influenced by the development of numerous projects, to provide service from the east coast ports to the Midwest by Class I carriers. Continued development of capacities to provide continental transit, independent of Nashville oriented routes, may lessen the impact of through volumes.

TRUCK

Traditional highway assets supporting truck movement are under increasing pressures to identify alternative infrastructural systems that will specifically expand truck capacity. Coalitions across the country are actively reviewing structural implementations such as dedicated truck lanes (DTL), increased length and weight regulations, and private sector equipment design programs. These capacity enhancements have the potential to reduce trip miles and load counts.

NASHVILLE REGIONAL FREIGHT & GOODS MOVEMENT STUDY

Technical Memo #5: Environment, Land Use, and Safety



October 2010

Submitted to: **Nashville Area Metropolitan Planning Organization**

Submitted by: **Wilbur Smith Associates**

NASHVILLE AREA
Metropolitan Planning Organization

NASHVILLE REGIONAL FREIGHT & GOODS MOVEMENT STUDY

PHASE II

TECHNICAL MEMO #5:
ENVIRONMENT, LAND USE, & SAFETY

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Introduction

The ability to carry freight and goods efficiently is critical to the success of a regional economy thus the reason for focusing on capacity issues of the regional freight infrastructure. However, perhaps just as important as the capacity of freight infrastructure are the factors that influence this capacity and the reliability of the transportation network. *Technical Memorandum #5 of the Nashville Regional Freight and goods Movement Study Phase II, Environment, Land Use, & Safety*, evaluates three of the factors affecting the capacity and reliability of the transportation network.

ENVIRONMENTAL/LAND-USE ISSUES

This section examines potential environmental and land use issues that may be associated with industrial and warehouse and distribution development in targeted areas. This assessment considers both the typical environmental concerns of increasing truck traffic (such as air quality and noise), but also industry-specific environmental concerns such as special requirements for the transport of hazardous materials or other environmentally sensitive freight operations. In addition, land use issues such as encroachment of incompatible uses on freight related development and considerations for land use controls to mitigate these types of issues are discussed.

SAFETY

Underlying measures of crash risk for heavy trucks and potential countermeasures for existing and emerging safety threats are identified through a review of Tennessee Department of Safety and Federal Motor Carrier Safety Administration truck crash data. A system-wide review of truck crash data enables a comparison between truck crashes in Nashville to national totals.

Environment and Land-Use Assessment

While the highway, rail, water, and air transportation modes all play a key role in moving freight to, from and through the Nashville region, the local flow of goods and services is dominated by the trucking sector. This flow supports retail distribution, manufacturing and warehouse distribution, construction activities, waste disposal services, and the pick-up and delivery of courier packages and shipments. Potential environmental and land use issues associated with these activities and industrial developments present a well defined set of key problem issues for freight performance. These problem issues were examined to consider both environmental concerns of increasing truck traffic (such as air quality and noise) as well design related issues (such as incompatible land uses and truck maneuverability).

The design of the Nashville Region's neighborhoods, streets, buildings and shopping centers, as well as the location of manufacturing and industrial sectors within the area, must allow for safe and efficient interaction between the movement of people, freight, goods and services. By carefully integrating freight transport into local and regional land use planning through appropriate design standards and the freight village concept, the Nashville region can enhance its ability to influence urban form and ultimately ensure a high quality of life, improved environmental conditions, and an economic advantage for the Nashville Region.

LAND USE PLANNING FOR FREIGHT

Industrial location patterns are critical to freight transport demand and general freight transportation systems. Successful planning and zoning efforts should strike a balance between competing land-uses while accommodating freight transportation. Moreover, it is important for those who shape urban design through municipal and regional policies and plans to provide guidance for accommodating freight related activities. When structured appropriately, such guidance can help reduce the sprawl of freight activities by developing goods and trade-related distribution facilities within existing transportation corridors and zones. Working to accommodate freight transport through proper land use placement can also help ensure a balance between the movement of people and the movement of goods across key corridors in the region and create an environment that enhances economic competitiveness and sustainability. Key areas of concern with regards to land use conflicts impacting freight mobility are discussed below.

Encroachment

Freight intensive land uses generate commerce through the production or storage of goods. To ensure these goods are efficiently distributed, the location and design of industrial and warehouse and distribution developments must allow and promote the efficient movement of these goods. In order to accommodate the efficient movement of freight and goods, the proper transportation facilities and land uses need to be in place.

Locating Warehouse and Distribution (W&D) facilities along major corridors and protecting them from encroachment by less intense uses is particularly important since there is a large number of land uses that are non-freight uses in the Nashville area.

Commercial and residential developments frequently encroach on industrial locations resulting in reduced accessibility to freight terminals and reduced efficiency of freight networks. Encroachment of non-freight was mentioned several times throughout the stakeholder interview process. To address this, local governments should actively work to guide W&D center development to appropriate locations for sustainable freight movement by taking into account modal accessibility needs and adjacent land uses. For freight system users and operators, access to transportation and freight facilities (e.g., W&D centers, intermodal yards, air cargo ramps, and other facilities) is very important, and will frequently dictate where and how they locate. Freight facilities frequently locate where transportation corridors converge. Considering adjacent land uses is not only important to the location of these developments, but should be considered to preserve and protect both freight, residential, and commercial uses.

Noise is just one of many issues arising from the encroachment of residential areas on freight areas. Noise abatement policies can restrict deliveries before and after certain times of the day in areas where there is a residential population, often preventing drivers from arriving at a location before or after rush hour. These land-use conflicts are commonplace and are becoming increasingly problematic in locations where freight traffic can no longer access established industrial areas due to neighborhood restrictions, no-truck routes requiring a circuitous approach, and heavy congestion along previously adequate access routes.

Incompatible Land Uses

It is important to facilitate the effective coordination of freight related development with residential and other non-freight land uses so that the potential for conflicts between land uses and transportation activities decrease. Industrial development patterns and locations should strike a balance between competing uses while still accommodating freight movement needs. Land uses are not mutually exclusive and must interact with the transportation network while supporting the quality of life and mobility of residents.

There is a diverse mix of commercial and residential development throughout the Nashville study area requiring that existing and/or future freight intensive development reflect the delicate balance between the dynamics of land use design and the safe and efficient movement of freight. It is particularly important to consider the effects freight related developments can have on their surrounding environment such as noise pollution, decreased air quality, lighting issues and pollution, and increasing truck traffic. The planning process should proactively pursue integration of compatible land uses and adequate buffering while promoting freight mobility. This can be accomplished by looking at existing and future land uses as well as current zoning policies that focus on potential conflicts that exist while considering the relationship between freight and non-

freight uses. Proper planning can ease the transition from high–intensity uses to less intense land uses through the use of landscaping buffers and transitioning.

Land Use Buffers and Transitions

Zoning Buffers can be utilized to address incompatible uses when any commercial, industrial, or office zoning district abuts a residential district. A Zoning Buffer is an area of natural vegetation or man-made construction which is intended to provide a visual and dimensional separation between dissimilar land uses. When a natural zoning buffer is impossible or undesirable, a structural zoning buffer can be required. A structural buffer is a visual screen created through construction of a decorative masonry wall, earthen berm, or combination of a wall with an earthen berm, which may be supplemented with vegetation, so as to present an opaque visual separation when viewed from one side to the other throughout the year. These buffers are generally at least 50' in depth to ensure proper screening with specific information pertaining to the design of these zoning buffers. This is another excellent provision that seeks to protect against undesirable combination of land uses.

In order to accommodate the need for transitions and buffering, local plans and regulations should provide for the screening and design of industrial activities and associated uses. For example, requirements for outdoor storage or accessory uses on a property zoned for industrial uses should be contained entirely within a building, properly screened, or appropriately setback from the property line. Other design requirements for industrial zones may include:

- Screening of dumpsters
- Posting of a street address
- Building material
- Exterior lighting
- Landscaping
- Heating and air unit screening
- Screening of detention areas
- Screening of truck loading areas
- Design requirements for parking garages
- Design requirements for parking lots and driveways

In the absence of proper land use regulations, a property may or may not be in agreement with the character of a neighboring property, which contributes to adjacent incompatible land uses. Land use transitions simply involve gradually reducing the intensity of uses and developments so that the appropriate character of an area is preserved and industrial development does not directly abut residential development, for example. Other examples include residential developments springing up next to active agricultural lands with potential airborne pesticides and chemicals, or the location of a truck stop with its light pollution and idling truck emissions next to what had been a quiet rural residential area. Not only are adjacent incompatible uses nuisances to each other as one encroaches upon

the established character of another, but they concern landowners who fear that their property values will decline.

Hazardous or noxious uses

In addition to the standards for the design of industrial uses, specific requirements should also address prohibiting certain hazardous or noxious uses in certain areas. Industrial uses such as asphalt plants and concrete plants, petroleum or bulk storage facilities, and scrap yards and junkyards are not appropriate everywhere but are necessary and should be planned for. Within the provisions for these particular uses, requirements for adjoining routes should also be incorporated. For instance, local streets and streets in recorded subdivisions should not be used as part of any truck traffic route giving access to the facility. The entrance or entrances should be directly off a state or federal highway or a major or minor county thoroughfare as typically shown on a land use or thoroughfare plan. This is an important provision for these particular uses and should possibly be listed as a provision for all potential truck producing uses. Another example of a specific use could be applied to quarries or mining operations. These provisions should outline stringent restrictions and distance requirements for quarries. A list of noxious manufacturing or industrial activities not allowed could also be provided.

FREIGHT VILLAGES

Commercial and industrial subdivisions and Planned Industrial Parks are another provision that especially pertain to freight producing developments. The freight village concept is a class of industrial park designed and built for productive logistics, with multimodal service, information systems support, goods staging and consolidation functions, and attractive industrial or distribution space. More broadly, it is a commercial/industrial zone where freight-intensive businesses have clustered or are encouraged to cluster, and that can be supported and managed for logistical efficiency. At least as important, freight villages are locations where industrial development is targeted, not only as suited to freight-dependent businesses, but in preference to other areas.

Volume concentration in freight usually builds service economies, whereby transportation costs and time performance are both improved. Dense pockets of business establishments speed pickup and delivery operations, reduce empty repositioning, and help construct stem or linehaul movements with high levels of utilization. Commercial concentration also eases the management burden on public transportation officials trying to raise freight performance. Villages become the points where:

- Building codes and zoning are stressed for adequate accommodation of freight vehicles, including dock space and staging aprons;
- Freightways are specifically designed and managed to reach inside the village with fast access;

- Local streets are kept free of obstruction and encroachment, and parking or waiting areas are sufficient and held clear;
- Off-peak operations may be developed in ways that address their startup inefficiency for pickup and delivery, by attempting to coordinate shipping hours between businesses in the same zone;
- Transportation information like traffic advisories, construction activity, and route alternatives is readily available.

The Association of State Highway Transportation Officials (AASHTO) has determined the linkage between land use and transportation support decisions must become closer in order for transportation performance to be efficient, competitive, and sustainable. Freight zones and designed villages become points where infrastructure investment and management resources are devoted to produce such performance, and where the zone characteristics themselves contribute to the result. This cannot happen equally well everywhere, and the capability of the MPO to foster productive logistics is diluted if it cannot be focused. Freightways and freight village initiatives can be undertaken independently, but they are mutually supportive and more effective if done together.

State Route 840 Freight Village

The area on the eastern edge of Nashville along State Route 840 at the Gladeville, Tennessee exit, between the Nashville Super Speedway and State Route 109 exits, provides an excellent example of an opportunity to implement a freight village. In recent months, this area of the region has become a hot bed of W&D facilities with companies such as Aldi, Nissan, and Big G Express locating distribution centers in the area (see photos below). The one downside to this development as a freight village is the lack of other modes of freight movement, such as rail or air, in the immediate area.

Exhibit 1 – Warehouse Development at Couchville Pike Exit, SR 840

Exhibit 2 – Aldi Distribution Facility

Exhibit 3 – Nissan Redistribution Facility

State Route 840 is an ideal location for continued development of the freight village concept and the additional clustering of W&D facilities. This area offers wide roads and large turning radii, ideal for maneuvering trucks, ample dock and unloading bays, and immediate access to SR 840 where it is only an additional 10 miles from connections to I-40 east, 15 miles to I-24, and 35 miles to I-65. In December 2012, SR 840 is slated to provide access to I-40 going west to Memphis as the remaining portion of the entire 78-mile route is complete from Highway 100 to Columbia Pike (SR 6).

The Nashville East Logistics Center houses the Couchville Pike Business Center, located at the intersection of Couchville Pike Road and SR 840, Wilson Commerce Center distribution warehouse (see picture below); a new Nissan redistribution facility; the Big G Express Gladeville Terminal; TACLE Seating U.S.A, SR 840 Business Center; Aldi, Inc.; Rockdale; and Wilson Sporting Goods to name a few.

Exhibit 4 – Wilson Commerce Center

There also appears to be available space for additional tenants in many of the facilities. Due to its strategic location and access to all major Interstates in the Nashville region, this area should continue to develop with freight intensive uses and encourage warehouse, distribution, and manufacturing facilities to continue clustering around the Gladeville interchange. This area not only offers ample access and infrastructure for freight related development but it also provides an alternative route for through freight traffic, away from downtown Nashville. This will help alleviate congestion in the downtown loop.

Exhibit 5 – Available Space in Nashville Region

Zoning for Freight Villages

With a mix of freight and non-freight uses within the Nashville area, it is important that transportation infrastructure and sound land use planning be in place to ensure the movement of freight is safe and efficient while respecting surrounding land uses, like residential uses. Freight intensive uses within the Nashville region should continue to be concentrated along major corridors and surrounded by a mix of complimentary uses and transitions from more intense to less intense uses. Freight related development should be properly buffered from residential development to prevent encroachment on freight intensive areas. Likewise, increasing the density of freight related developments within close proximity to truck routes allows for the most efficient use of the needed infrastructure to accommodate this type of development. This can be achieved by creating a separate and distinctive zoning classification that is specific to "warehousing and distribution" (WD).

The WD zoning classification is often used to support freight intensive developments. This classification can be used to cluster warehouse and distribution activities around specific areas that make operational sense. Such clustering can also provide the basis for the development of the freight village. The creation of a zoning classification specifically designed to accommodate W&D developments would greatly enhance the ability of the Nashville area to properly locate these types of developments along with proper buffering and transitional uses. Freight generators and WD zoning designations should not be placed in large open areas with inadequate access to truck routes.

There are many benefits to defining a specific zoning classification for freight village types of development. The model definition of a freight village is where:

- All modes are represented;
- Land prices are not as high as general commercial properties;
- Adequate land is developable;
- Facilities are accessible by local arterials for local distribution;
- Facilities have good access to interstate routes and freeways for regional and national distribution;
- Accessible to rail facilities, directly tied to a Class I railroad main line;
- Accessible to an airport (with frequent service to domestic and international cities); and,
- Accessible to a port offering a wide variety of materials handling options.

A critical function of the zoning is to prevent encroachment on the WD area. WD areas tend to start out in low cost areas that are generally undeveloped. However, these areas are eventually encroached upon because they offer low cost real estate along main arterials, and are accessible. Once encroachment occurs, land values escalate and traffic conditions deteriorate, making it too costly for WD-type operations and hence forcing relocation. Migration of WD activities presents a problem from a planning standpoint,

and it becomes costly to reinvest in the kind of infrastructure suited for heavy duty vehicles. Zoning tools can help prevent encroachment on WD areas, reducing migration.

FREIGHT AND THE DEVELOPMENT REVIEW PROCESS

Most new developments in urban areas, such as shopping centers, distribution centers, and office centers, are subject to a development review process. Typically, the review is conducted by the local planning jurisdiction, at the city or county level. The review board typically looks at the impacts that a proposed project or development will have on land use, traffic, accessibility and other factors. As part of the review process, the developer or project sponsor conducts, among other things, a traffic impact study and outlines a site access plan. This development review process also presents an opportunity to understand the traffic patterns, specifically freight goods and services patterns to and from said developments. Understanding the travel flow patterns for heavy-duty vehicles allows transportation planners to approach planning from a systems and corridors approach. Thus, it is recommended that developers or project sponsors be required to also provide an overall concept plan or schematic that identifies the key routes that are expected to be utilized.

Critical to this process is the identification of local routes (typically under-designed for heavy vehicles) that are intended to be truck routes between key freight generation and attraction points. The process should identify the key linkages between the proposed development and:

- Warehouse / distribution centers that will supply the development
- Intermodal (airport, rail) centers
- Major highway corridors, and
- Other linkages

The purpose of the development review process as it relates to freight is to identify the local routes of preference for drivers of heavy-duty vehicles that will access the proposed development. Planners can use this information as part of the corridor planning process. On a longer time frame, once a substantial amount of data has been collected this way, planners will be able to identify the key routes for heavy duty vehicles, and to implement the appropriate operational and design standards.

It is cautioned that this process should not be viewed as a regulatory tool, but rather as an intelligence gathering tool. In other words, this should not be viewed as a way to limit heavy duty traffic to a few routes. This would be detrimental to operations, unless the proposed routing plan will improve operations by directing heavy-duty vehicles to adequately designed corridors with sufficient operational advantages. Instead, this process should be used to ensure the proper infrastructure is in place to accommodate anticipated freight needs.

DESIGN GUIDELINES FOR FREIGHT INFRASTRUCTURE

The ability of goods to be transported in an efficient manner depends on a well functioning commercial transport system. Land use is important to freight movement because zoning and planning policies provide the guidelines for accommodating freight development and its supportive uses; however, the transportation network provides the infrastructure essential for freight mobility. The transportation network surrounding and accessing the Nashville Region is vital to the efficient movement of freight and goods.

Increasing roadway capacity and operational improvements to the transportation corridors that share a significant amount of truck traffic in the region will improve access to the freight facilities along major corridors. Favorable access to freight intensive developments also involves sufficient road geometrics that facilitate smooth traffic flow and reduce the number of bottlenecks throughout the region's transportation system. The ability to move freight freely within the region is critical to attracting new industry, and the freight, goods and services transport system is vital to the mobility and productivity of the region. As a result, an efficient and cost effective transport system is important to the competitive position of businesses and industries competing in the local and global economy. The following are recommendations to facilitate the continued ability of the region's transportation system to efficiently support logistics activities.

Key Truck Corridors

Nashville has a well developed network of roadways and truck routes that play specific roles in network distribution of goods. These routes are also responsible for human transport and shared by local traffic. The interaction between freight and regular passenger vehicles is a concern among both residents and freight distributors. The interface between trucks and passenger vehicles can be discouraged by identifying key truck corridors as well as alternative routes. By properly signing truck routes and indicating an alternative course for local drivers, the interaction between truck and regular traffic can be minimized.

A list of designated truck routes should be incorporated into area plans and designed to handle the higher percentage of trucks and their heavier weights. For example, truck routes should be designed to have greater turning radii and wider shoulders to accommodate the difficult turning movements that must be made by trucks. Deficiencies on the identified key truck corridors should be addressed either with operational improvements (signalization improvements and ITS implementation are two potential examples) or with roadway improvements such as geometric improvements or additional capacity. There are also design strategies that can be implemented to improve corridor deficiencies on local roadways used by heavy trucks. Key truck corridors in the area should be designed with higher Pavement Condition Rating (PCR) values to

accommodate the greater load weights that are placed on the facilities. These recommendations along with others are explained in further detail below.

Design Standards for Freight Infrastructure

Officially recognized infrastructure and operational design guidelines implemented by all jurisdictional bodies within the region are a fundamental element of effective freight and goods movement planning. Following are a few guidelines recommended to enhance Nashville's freight movement capacity.

Design Guidelines for Roadway Elements - Truck traffic causes a disproportionate amount of roadway wear in comparison to passenger vehicle traffic. More substantial pavement sections should be used to accommodate the greater serviceability, reliability, and equivalent single axle loads (ESAL's) that will be needed for these routes. Designated truck routes should be designed to higher lane and curb lane widths, as well as shoulder widths. Pavement Condition Rating (PCR) values, as well as intersection radii should also be designed for a significantly higher volume of freight traffic than other facilities.

Signalization Guidelines - Special traffic signalization considerations should be made near freight facilities. Signal timing plans along freight corridors should be adjusted to account for the larger size and slower acceleration of trucks. It is essential that there exist inter-jurisdictional cooperation with respect to coordination of signal timing so that the maximum benefit of this strategy may be realized.

Signage - Guidelines for the design and placement of signs can facilitate the efficient movement of goods, especially for drivers not familiar with the area. This applies to roadway identification signs, as well as directional signs along a roadway. Areas that do not specify guidelines regarding the placement of address signs consequently produce many businesses and residences that either lack address signs altogether or place signs in locations that are difficult to see from the street, making it difficult for unfamiliar delivery drivers to locate individual stops. This can result in delivery trucks having to stop several times to find the right location, which adds to congestion problems, VMT, fuel consumption and air pollution.

Incorporating Trucks into Traffic Design

Truck turning radii on narrow roads and narrow roads with roadside ditches are impending issues facing shippers and carriers. For a large truck, and especially for a driver unfamiliar with the surroundings, ditches can be hazardous; a solution might be a program to cover the trenches with grates, in heavily traveled freight zones. The same problem of road width is exacerbated in a different form by the encroachment of structures on the right of way. Traffic design issues often contribute to a less reliable freight network. By developing a defined network and understanding the specific freight

roles played by the highways, roadway improvement strategies are likely to be more successful. There are several common areas of need for roadway design standards for truck activities:

- Intersection Design
- Cross-Section and Geometric Design
- Signalization
- Separation

Intersection Design – affects accessibility through delayed right turns due to oncoming traffic. To avoid oncoming traffic, trucks may be forced to "cut corners" onto curbs, while in other instances "curb hopping" may be attributed to lane-dividing medians. In either case, when forced onto curbs or medians while negotiating a right turn, trucks run the risk of load shifts and damage to the goods they carry.

Left turning requirements can be accommodated by the use of offset turn lanes where vehicles are held back to a stop line some yards short of an intersection. This creates a wider turning space for commercial vehicles negotiating the corner, and lanes like this were cited by motor carriers as sensible management for narrow road widths, in districts with significant truck activity. One option to implement appropriate intersection design within the region would commence a general program to deploy such lanes, examining road widths in truck districts and introducing offsets where practical, over some defined period of time.

Cross-Section and Geometric Design – The geometry of a specific roadway, including the turning radii, lane widths, and other cross-sectional factors should be based upon the intended use or role of the facility. Interstate truck routes tend to accommodate large, as well as smaller trucks and, therefore, should be designed to accommodate those vehicles without creating significant traffic impacts. Local truck routes also need to accommodate larger and smaller truck sizes, and hence would have to be designed accordingly.

Signalization – Signal timing optimization is often performed using data collected from only one or two days and typically does not include truck volumes. Studies to develop better signal plans for heavily traveled truck corridors would benefit the study area. The spacing of traffic signals and the individual timing patterns, while accounting for light-vehicle mobility, in many instances fails to account for the time it takes heavy truck traffic to attain a reasonable speed or to stop. Abrupt starting and stopping by heavy trucks wastes fuel, increases transport costs, and diminishes air quality. Truckers must maintain tight delivery schedules so the less delivery schedules are impeded by inadequate signalization or intersection maneuverability, the greater the ability for truck drivers to make multiple deliveries with one trip.

Officially recognized infrastructure and operational design guidelines implemented by all jurisdictional bodies within the Region are a fundamental element of effective metropolitan freight and goods movement planning. Throughout the stakeholder input

process and the ground observations of operating conditions conducted by the consultant team, operational issues including the need for improved network management, updated design standards to accommodate newer commercial vehicle requirements and a properly signed regional truck route system. While these were not the only operational issues that arose, these three represent the most commonly identified needs across a spectrum of users.

Design Guidelines for Urban Development

Central business districts and corridors with high commercial activity tend to experience significant parking challenges, especially for trucks, and Nashville is no exception. This includes on-street parking (curbside) as well as off-street parking (on commercial properties). The inability to find parking near the delivery point slows down delivery for multiple-stop routes, the penalty being higher cost and diminished service (delivery services only serve areas that are viable from an economic standpoint). The decline in service ultimately impacts downtown business vitality. Interviews indicated that downtown Nashville, in particular, is experiencing such problems.

On Street Parking and *Curbside Management* – Based on our interviews with operators of local truck fleets, most curbside parking, even for commercial purposes, is designed for smaller vehicles such as pickup trucks, vans, and single unit trucks. These spaces are not adequate for tractor-trailer combinations which are growing in use (the usage of twin trailers for downtown delivery is also increasing). Curbside Management can be enhanced using a variety of methods, including provision of larger curbside parking spaces, increased frequency of commercial curbside spaces, designation of commercial curb parking during peak periods, and peak hour pricing mechanisms to regulate parking behavior.

Off-Street Parking – The other area of concern is the adequacy of parking on properties that attract significant truck traffic. This includes commercial retail strips, shopping malls, hotels and recreational areas, convention centers, office parks, and warehouse and distribution areas. Given the fact that W&D areas are typically designed with truck traffic in mind, it is the areas that are more retail and commercial oriented that provide the biggest challenge in terms of onsite parking management.

One strategy is the use of *building codes* to specify truck bays and docks for loading purposes. The construction of truck bays and docks adds to the cost of constructing facilities, and unless the facility is built for a specific truck purpose, there is a tendency to cut these costs. In other words, office buildings, shopping malls and other retail centers which are not principally truck centers, but do attract truck traffic as a consequence of their business, typically do not invest in sufficient truck bays. Building codes where truck traffic is generated should specify the criteria for the number of bays required based on square foot of floor space. These criteria should vary based on the use: office space, retail strip malls, and shopping malls should have different metrics. It is important to note that the

criteria for these facilities are considerably less intensive than W&D facilities. In other words, building codes for W&D facilities are not applicable to commercial areas.

CONCLUSION

The Nashville region encompasses a mix of freight and non-freight uses as well as an extensive transportation network. These elements offer both challenges and opportunities for local planners and stakeholders to consider as the area continues to evolve and develop. Along with this evolution comes the potential for conflicts between residential and industrial development; it is important for planners and policy makers to consider this relationship when updating regulations and plans. In order for freight transport to function in the most efficient manner possible, freight intensive developments must compliment and coordinate with surrounding land uses and the transportation system – including the road and rail network.

It is also important that Nashville develop in a manner that respects existing and potential residential and environmental areas. Incorporating freight villages and a separate WD zoning classification are some land use recommendations that will aid in this effort to coordinate the various land uses. Proper roadway design and infrastructure and exploring the potential for rail and intermodal facilities are other ways in which freight-conducive developments can coexist with surrounding land uses and utilize the road and rail system along major transportation corridors. By understanding the relationship between freight producing land uses and less intense land uses such as residential development, local planners and policy-makers can make an informed decision on decisions for creating a harmonious relationship between the varying land uses and for the transportation system in the area.

Safety

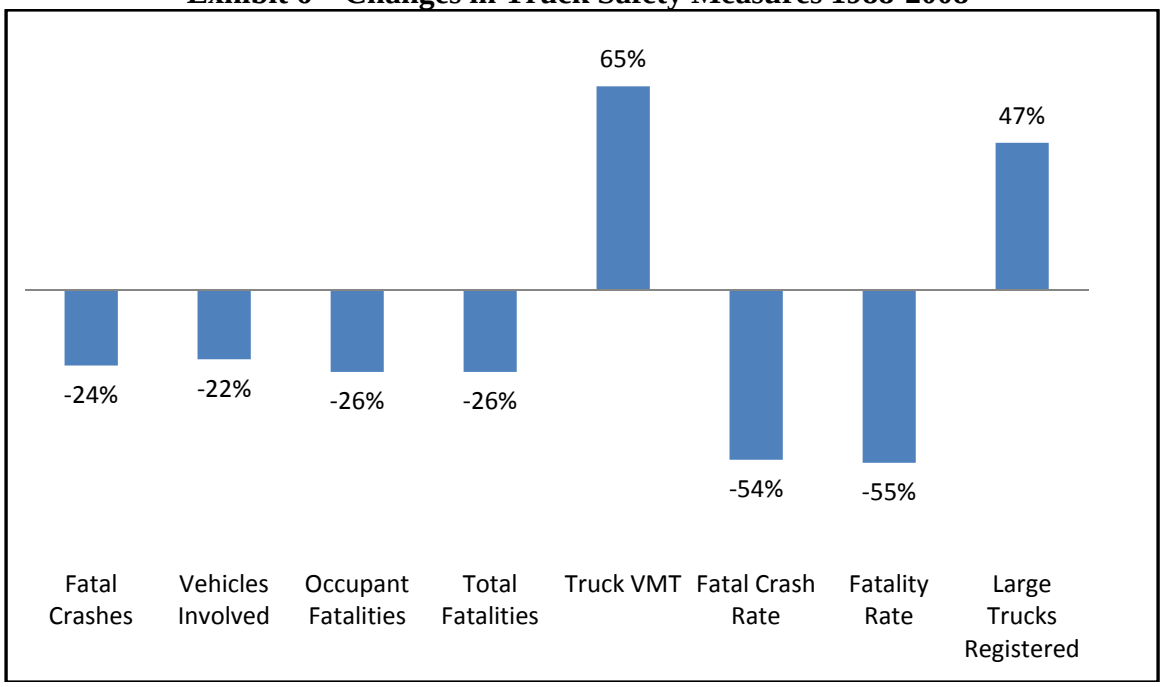
Safety is an important aspect of freight transportation and is a priority for both public officials and commercial freight carriers. A better understanding of the characteristics of truck crashes can result in policies and technology investments that can positively impact goods movement in the Nashville region.

This section presents information regarding the safety aspects of truck transportation in the Nashville area. The data presented were obtained from the Tennessee Department of Safety (TDOS) and various U.S. government sources, including crash databases maintained by the Federal Motor Carrier Safety Administration (FMCSA). The Fatality Analysis Reporting System (FARS) was used to analyze factors pertaining to fatal crashes and the Motor Carrier Management Information System (MCMIS) was generally accessed and queried using the FMCSA Analysis and Information Online (A&I Online) analysis tool. Crash data for the Nashville region was obtained from the FMCSA crash data file.

OVERVIEW OF U.S. TRUCK SAFETY TRENDS 1988 – 2008

Truck traffic in the U.S. has grown steadily over the past two decades, as has traffic related to passenger vehicles. Data collected by FMCSA show a number of trends regarding large truck crashes in the U.S. These are summarized in **Exhibit 6** and discussed below.

Exhibit 6 – Changes in Truck Safety Measures 1988-2008



Source: Federal Motor Carrier Safety Administration, Large Truck and Bus Crash Facts 2008.
Rates per 100 Million VMT

- More trucks on the road: The number of large trucks registered in the U.S. has increased nearly 50 percent since 1988, from over 6 million to just over 9 million.

- More truck miles: Vehicle miles traveled by trucks have increased by 65 percent. In 1988, trucks traveled just under 137 billion miles. In 2008, truck miles traveled increased to over 227 billion.

- Fewer trucks involved in crashes: The number of large trucks involved in fatal crashes has declined by 18 percent between 1998 and 2008, from 4,964 to 4,066.

- Fewer fatalities resulting from large truck crashes: In 1998, large truck crashes resulted in 5,679 fatalities in the U.S. By 2008, the number of fatalities resulting from large truck crashes had decreased by 26 percent, to 4,229.

- Crash rates reduced by half: The number of fatal crashes per million vehicle miles traveled (VMT) for large trucks decreased from 354 in 1988 to 164 in 2008. In the same period, fatalities per million VMT decreased from 412 to 186.

The decrease in truck crash rates in the past two decades has been dramatic, particularly in light of the increasing use of trucks to transport goods and the corresponding increase of truck VMT. However, trucks continue to account for a significant share of highway fatalities, and interest in safer goods transportation remains high.

Impacts of Truck Configuration, Size, and Weight

As trucks have grown larger, their ability to navigate older road configurations has decreased. For example, curves that could safely handle larger vehicles at the time of their initial design may be incapable of handling modern day large vehicles at comparable speeds.

Truck weight is also a significant factor in crashes for several reasons. Weight distribution in trucks can affect braking, and braking problems can lead to crashes. Additionally, heavier trucks have more kinetic energy, raising the chances of injuries or fatalities in an accident.[1]

The role of truck configuration is less understood. The American Association of State Highway and Transportation Officials (AASHTO) research indicates that the distribution of truck crash fatalities largely mirrors the distribution of truck types, with nearly 90 percent of crashes involving straight trucks or single semi-trailers. In 2005, triple trailers were involved in only four crashes; however, AASHTO notes that this may be due to

[1] *A Synthesis of Safety Implications of Oversize/Overweight Commercial Vehicles.* American Association of State Highway and Transportation Officials, 2010, pp. 37-38.

their being used largely on interstate highways. Another possible factor is that the largest vehicles are typically driven by the most experienced drivers.[2]

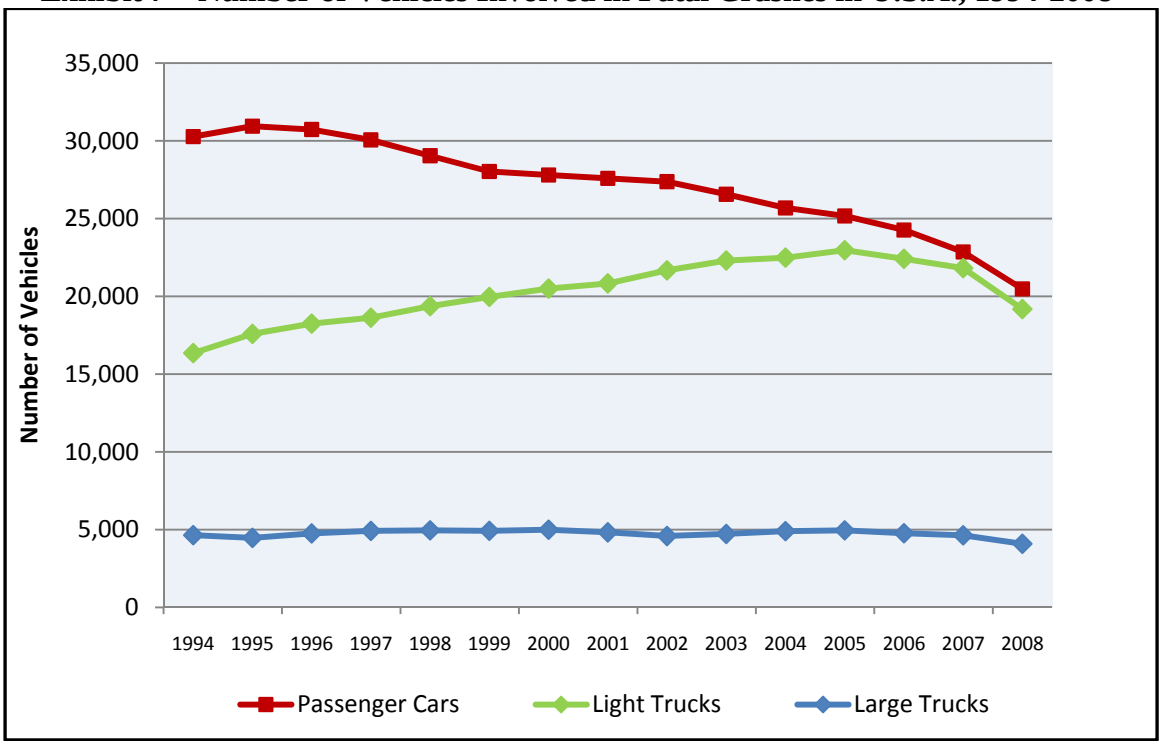
COMPARING TRUCK SAFETY IN THE U.S. AND TENNESSEE

As shown in **Exhibit 7** and **Exhibit 8**, vehicular travel has generally become safer in the U.S. for passenger cars, light trucks[3] and large trucks.[4] However, concerns regarding the safe operation of large commercial vehicles have often been considered a barrier in the U.S. regarding changes to federal policy that might allow the operation of larger and/or heavier commercial vehicles on national highway facilities.

Historically, fatal crashes involving commercial vehicles have been over-represented in crash statistics relative to other vehicle classes. While the number of large trucks involved in fatal crashes has remained relatively constant in the past decade (**Exhibit 7**), VMT by commercial vehicles have increased sharply over the same period. As a result, the commercial vehicle crash fatality rate has significantly declined in the last fifteen years (**Exhibit 8**), from a rate of 2.73 fatalities per 100 million vehicle miles of travel (VMT) in 1994 to 1.80 fatalities per 100 million VMT in 2008. This change represents a 34 percent decrease over the 1994-2008 period. Over the same period, the fatality crash rate for passenger vehicles declined 37 percent.

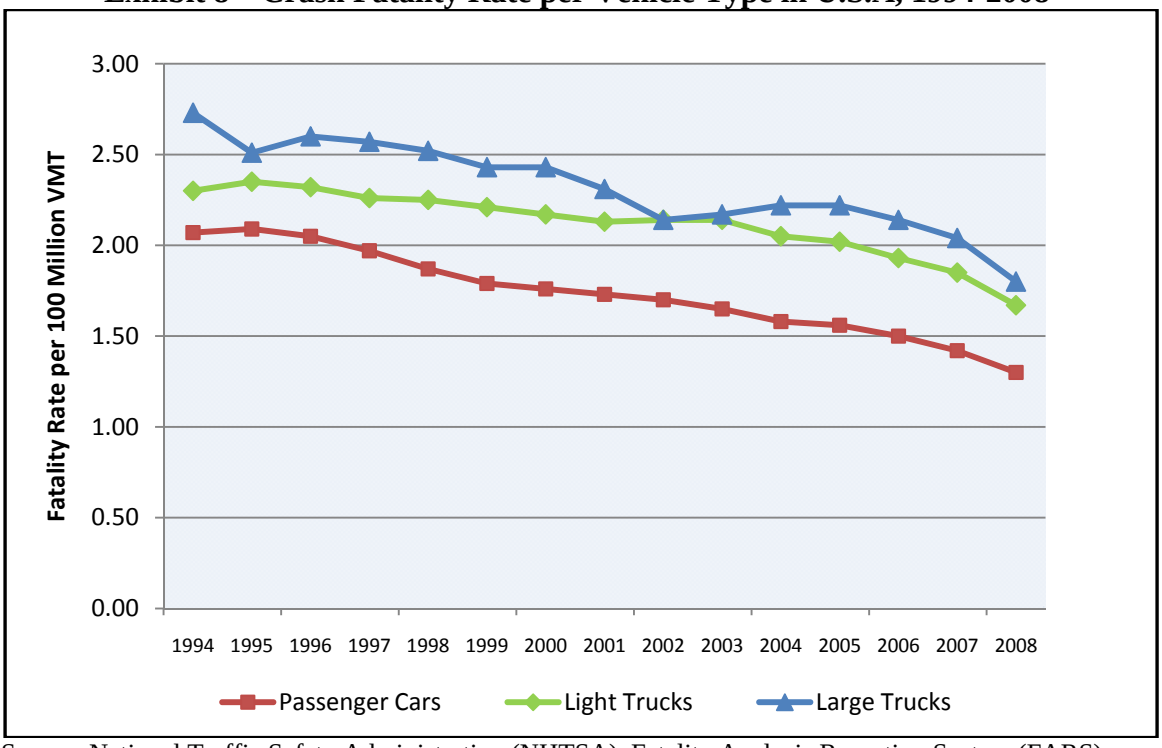
[2] *A Synthesis of Safety Implications of Oversize/Overweight Commercial Vehicles.* American Association of State Highway and Transportation Officials, 2010, p. 40.
[3] Light trucks include vans, sport utility vehicles and pickup trucks with 10,000 pounds gross vehicle weight rating (GVWR) or less.
[4] A large truck is defined as a truck with a GVWR greater than 10,000 pounds such as medium and heavy trucks.

Exhibit 7 – Number of Vehicles Involved in Fatal Crashes in U.S.A., 1994-2008



Source: National Traffic Safety Administration (NHTSA), Fatality Analysis Reporting System (FARS)

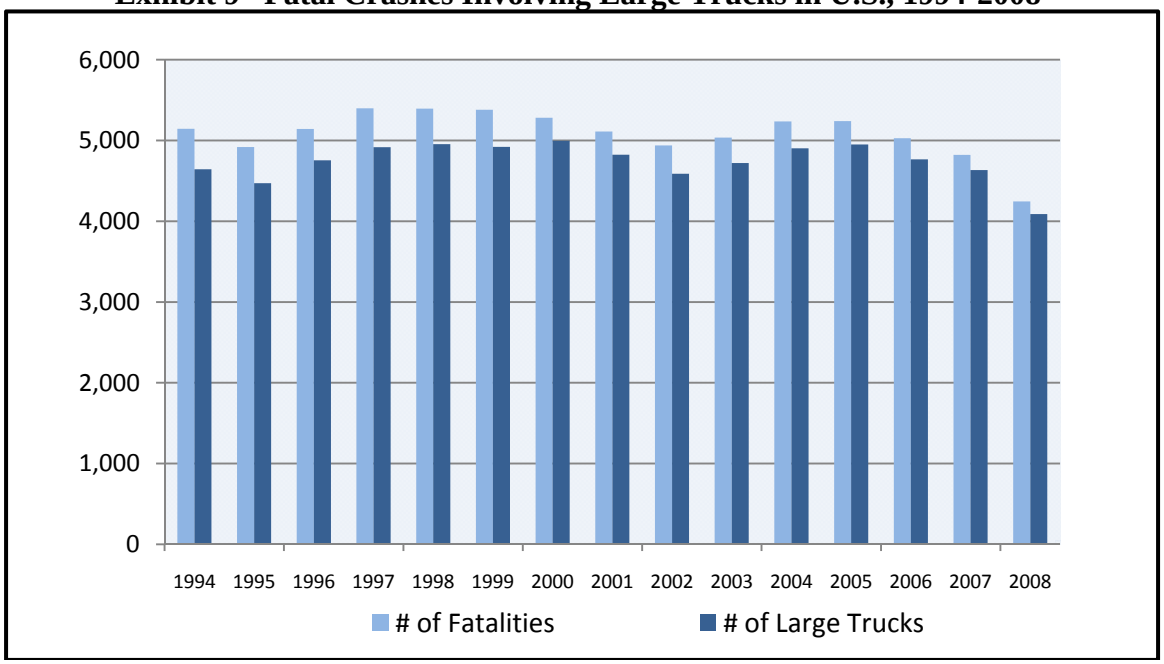
Exhibit 8 – Crash Fatality Rate per Vehicle Type in U.S.A, 1994-2008



Source: National Traffic Safety Administration (NHTSA), Fatality Analysis Reporting System (FARS)

Nationally, the number of fatalities resulting from large truck crashes in the U.S. has fluctuated over the past fifteen years, between a low of 4,245 fatalities in 2008 and a high of 5,398 fatalities in 1997 **(Exhibit 9**). Compared to the U.S., the number of fatalities resulting from large truck crashes in the state of Tennessee (**Exhibit 10**) has experienced more ups and downs, with the lowest number of fatalities in 2008 (i.e., 95 people killed) and the highest in 1999 (.i.e., 185 people killed).

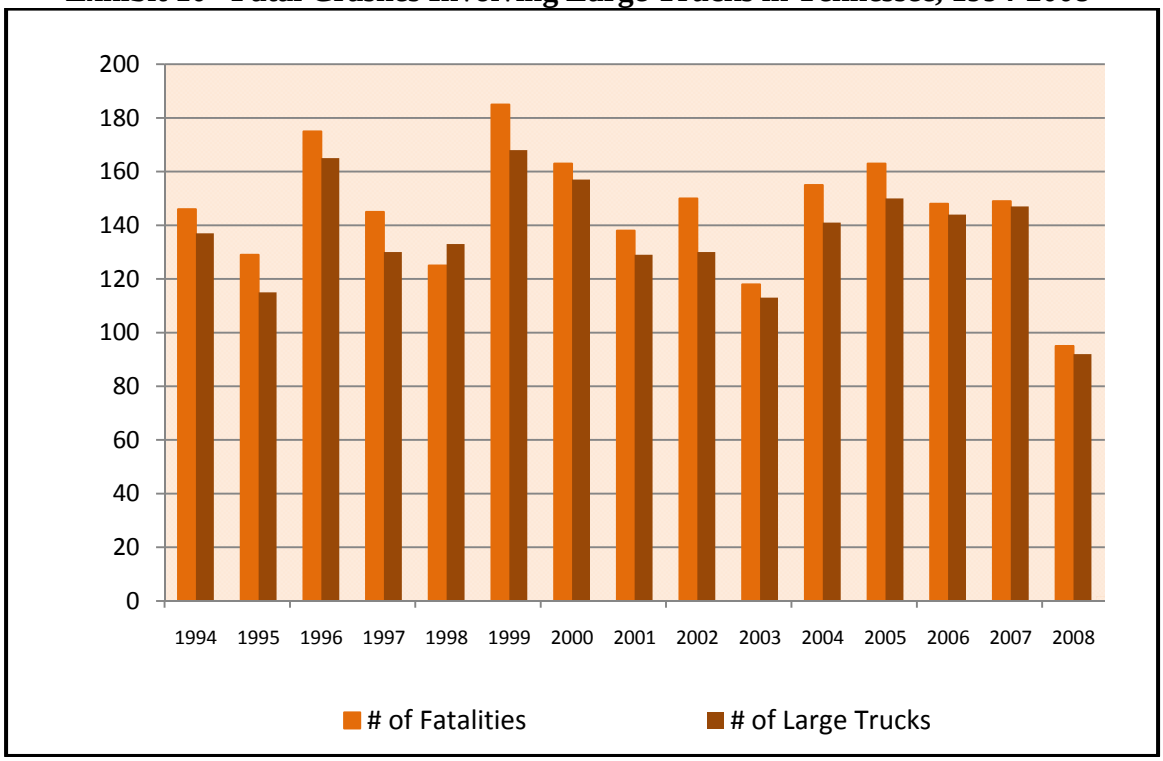
Exhibit 9 –Fatal Crashes Involving Large Trucks in U.S., 1994-2008



Source: National Traffic Safety Administration (NHTSA), Fatality Analysis Reporting System (FARS)

Over the most recent nine years of available data, from 2000 to 2008, the number of fatalities and fatal crashes decreased 20 percent and 18 percent, respectively, nationwide. Over the same time frame, Tennessee reported a higher decline in both the number of fatalities and fatal crashes involving large trucks, with 42 percent and 41 percent, respectively.

Exhibit 10 –Fatal Crashes Involving Large Trucks in Tennessee, 1994-2008



Source: National Traffic Safety Administration (NHTSA), Fatality Analysis Reporting System (FARS)

Exhibit 11 shows how commercial motor vehicle fatality rates compare for the 50 states. To account for fluctuation in fatality rates, the most recent six years of available data for each state, from 2003 to 2008, are averaged together. The states are shown in descending order of fatality rates. For the six years of data, Tennessee averaged 153 fatalities annually from commercial motor vehicle crashes. When normalized with commercial motor vehicle miles traveled, Tennessee ranks 31st, with 2.543 fatalities per 100 million VMT, eight percent higher than the national average of 2.348.

Exhibit 11 – Comparison of State Commercial Vehicle Fatality Rates 2003-2008

State	Fatalities per 100 million VMT	State	Fatalities per 100 million VMT
Utah	1.117	Rhode Island	2.366
Washington	1.620	Oklahoma	2.433
Connecticut	1.737	Louisiana	2.440
New Hampshire	1.752	Pennsylvania	2.449
Massachusetts	1.781	New York	2.452
North Dakota	1.806	Virginia	2.456
New Mexico	1.904	Missouri	2.461
South Dakota	1.908	Iowa	2.490
New Jersey	1.919	Delaware	2.515
Illinois	1.938	Texas	2.538
Vermont	1.947	**Tennessee**	**2.543**
Ohio	1.947	Kentucky	2.570
Arizona	1.984	Wisconsin	2.580
Idaho	1.997	Minnesota	2.625
California	2.003	Nebraska	2.636
Oregon	2.012	Georgia	2.685
Indiana	2.041	South Carolina	2.724
Maryland	2.076	Montana	2.748
Mississippi	2.096	Arkansas	2.908
Alaska	2.097	West Virginia	2.951
Maine	2.155	Florida	2.961
Michigan	2.191	Nevada	3.016
Wyoming	2.274	Colorado	3.052
North Carolina	2.348	Alabama	3.231
		United States	**2.348**

Source: Federal Motor Carrier Safety Administration

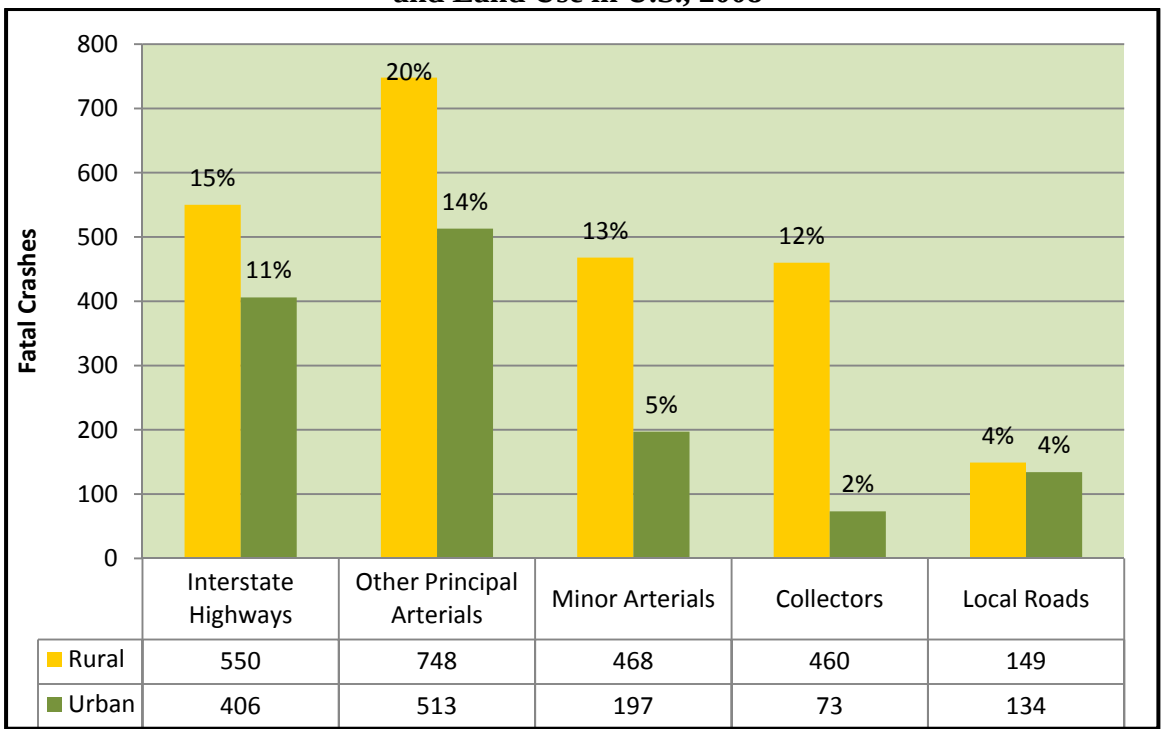
Factors Related to Commercial Vehicle Crashes

The table above shows differences in fatality rates between Tennessee, other states, and the U.S. as a whole. This section will examine some of the factors relating to differences in fatalities and crashes relating to commercial vehicles.

One well-documented factor for all vehicle types is that highway design and traffic engineering have significant implications for safe operations. **Exhibit 12** compares the number of fatal crashes involving large trucks in the U.S. by location (rural and urban area) and across highway functional classes for the year 2008. Almost two-thirds (64 percent) of all fatal crashes involving large trucks occurred on rural roads, about one-third (34 percent) occurred on rural and urban other principal arterials, and over one-

fourth (26 percent) occurred on rural and urban Interstate highways. The highest number of fatal crashes occurred on rural other principal arterials, that is, 20 percent. Conversely, urban collector routes have reported the lowest number of fatal crashes, accounting for only two percent of all fatal crashes involving large trucks.

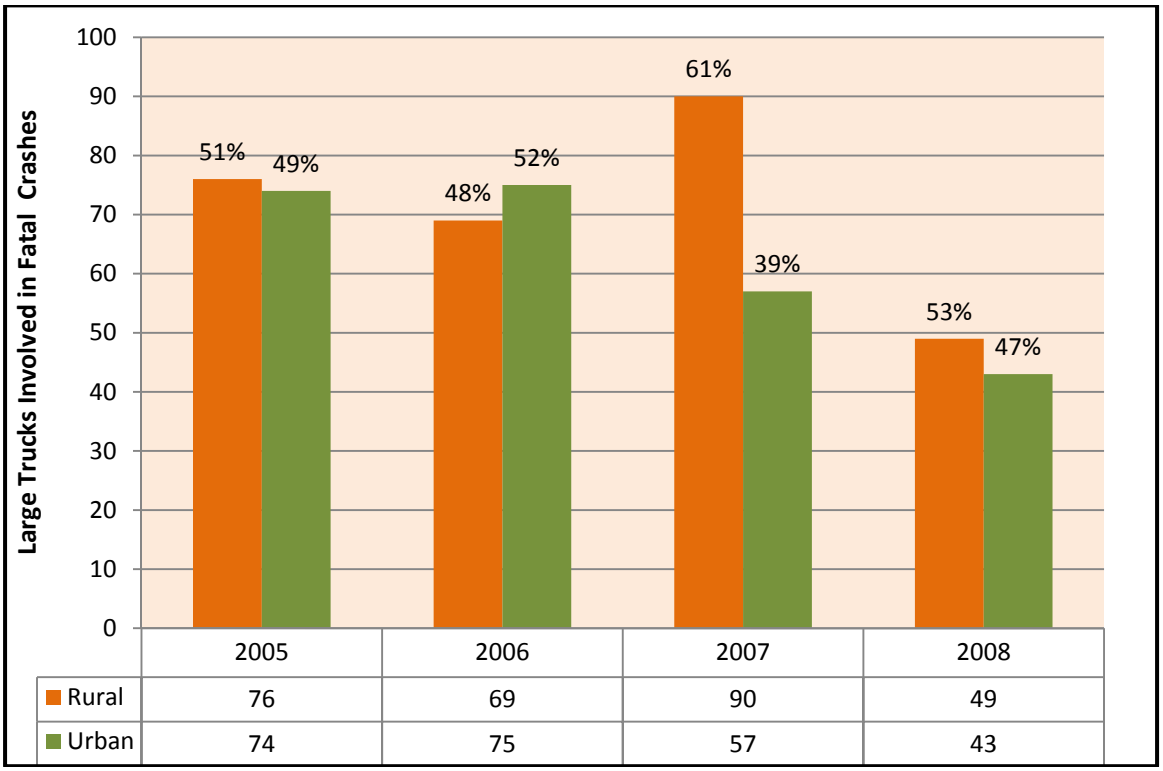
Exhibit 12 – Fatal Crashes Involving Large Trucks by Roadway Functional Class and Land Use in U.S., 2008



Source: National Traffic Safety Administration (NHTSA), Fatality Analysis Reporting System (FARS)

Exhibit 13 compares the number of large trucks involved in fatal crashes by location (urban versus rural) in Tennessee between 2005 and 2008. With the exception of 2006, a greater share of large trucks involved in fatal crashes has occurred in Tennessee's rural areas. This finding is consistent with the share of rural fatal crashes nationwide. As abovementioned, about 64 percent of fatal crashes involving large trucks occurred on U.S. rural roads in 2008.

Exhibit 13 - Large Trucks Involved in Fatal Crashes by Land Use in Tennessee, 2005-2008



Source: National Traffic Safety Administration (NHTSA), Fatality Analysis Reporting System (FARS).

To estimate the large trucks involved in fatal crashes per 100 million vehicle miles traveled by large trucks in Tennessee's urban and rural areas in the 2005-2008 period, the following steps were undertaken:

Step 1 – For the study years, obtain the annual vehicle-miles for rural and urban roads in the state of Tennessee (**Exhibit 14**).

Exhibit 14 - Annual Vehicle Miles (in millions) by Land Use and Roadway Functional Class in Tennessee, 2005-2008

Year	Rural						
	Interstate	Other Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local	Total
2005	9,074	5,334	5,605	3,126	2,900	3,181	29,220
2006	9,095	5,539	5,178	3,041	2,827	3,223	28,903
2007	9,094	5,647	5,342	2,972	2,842	3,204	29,101
2008	8,686	5,360	5,089	2,928	2,762	3,160	27,985
Year	**Urban**						
	Interstate	**Other Principal Arterial**	**Minor Arterial**	**Major Collector**	**Minor Collector**	**Local**	**Total**
2005	11,095	1,810	11,431	8,490	2,967	5,801	41,594
2006	11,207	1,794	11,369	8,510	3,000	5,813	41,693
2007	11,442	1,925	11,355	8,520	2,984	5,852	42,078
2008	11,414	2,000	10,953	8,194	2,977	5,946	41,484

Sources: Federal Highway Administration (FHWA), *Highway Statistics 2005*, *Highway Statistics 2006* *Highway Statistics 2007*, and *Highway Statistics 2008*

Step 2 – For the study years, estimate the annual large-truck VMT by land use in Tennessee. Based on the available data, the distribution of annual vehicle distance traveled by large trucks in Tennessee by roadway functional class (**Exhibit 15**) is used to allocate the annual large-truck VMT to urban and rural areas. To account for the urban and rural roads that are not captured in the FHWA statistics, the allocation factors are normalized to the unit. The adjusted allocation factors are shown in **Exhibit 16**.

Exhibit 15 - Distribution of Annual Vehicle Distance Traveled by Large Trucks in Tennessee by Roadway Functional Class in 1999

Roadway Functional Class	Large Trucks
Rural Interstate	31.4
Rural Other Principal Arterial	9.6
Rural Minor Arterial	7.0
Urban Interstate	8.2
Urban Other Freeways & Expressways	5.5
Urban Other Principal Arterial	7.6
Urban Minor Arterial	9.4

Source: Federal Highway Administration (FHWA), *Highway Statistics 1999*

Exhibit 16 - Adjusted Allocation Factors per Land Use

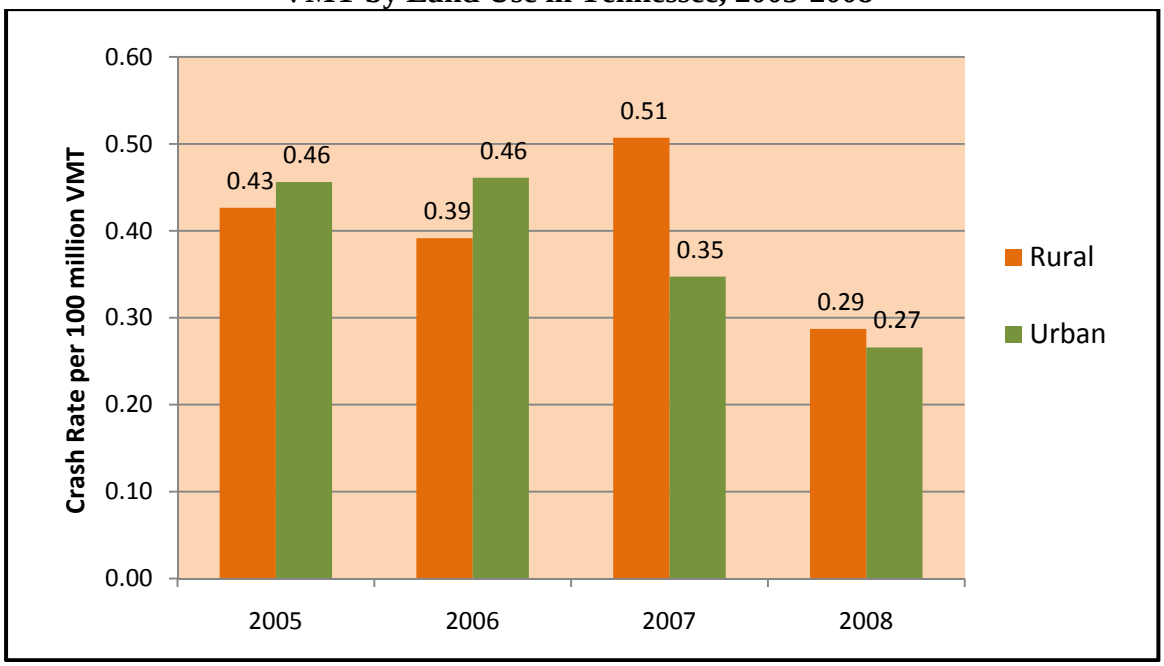
Land Use	Allocation Factor (%)	Adjusted Allocation Factor (%)
Rural Roads	48	61
Urban Roads	31	39

Source: Developed by Wilbur Smith Associates based on Highway Statistics published by the Federal Highway Administration

Step 3 – For each year within the analysis period and land use (urban and rural), divide the number of large trucks involved in fatal crashes (**Exhibit 13**) by the estimated annual large-truck VMT.

Exhibit 17 shows the large trucks involved in fatal crashes per 100 million VMT by location (urban versus rural) in Tennessee between 2005 and 2008. As can be noted, the number of large trucks in fatal crashes per 100 million vehicle miles traveled by large trucks declined from 0.43 in 2005 to 0.29 in 2008 on rural roads and from 0.46 in 2005 to 0.27 in 2008 on urban roads. These trends represent a decrease of 42 percent in Tennessee urban road's crash rate and 33 percent in Tennessee rural roads' crash rates over the 2005-2008 period.

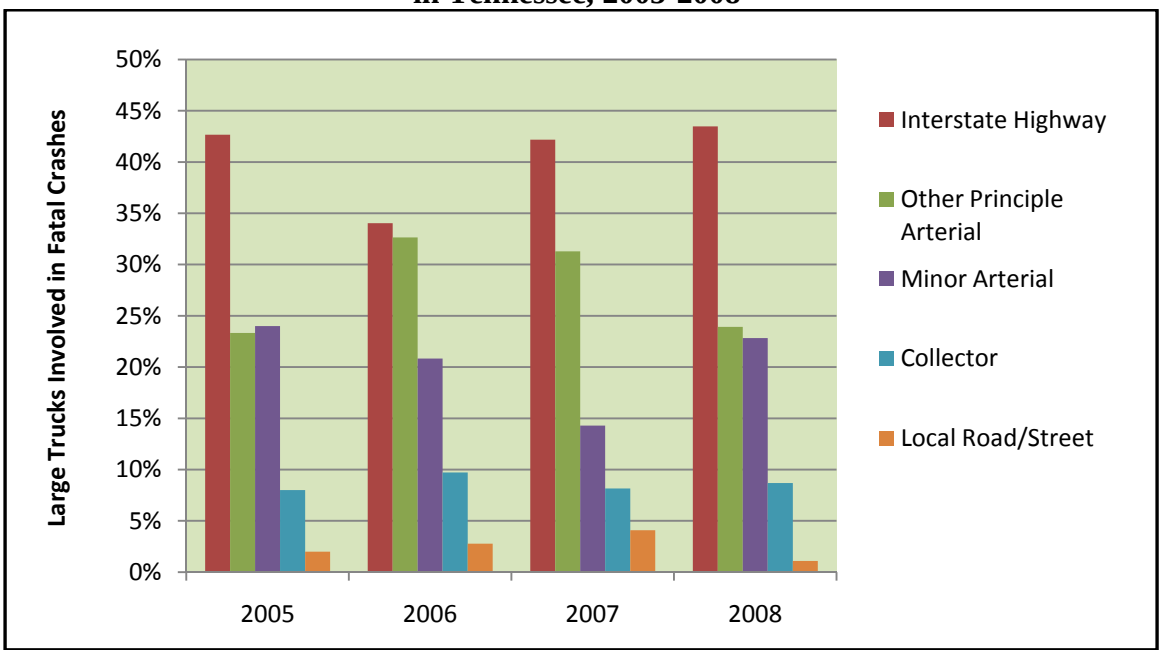
Exhibit 17 - Estimated Large Trucks Involved in Fatal Crashes per 100 Million VMT by Land Use in Tennessee, 2005-2008



Sources: Developed by Wilbur Smith Associates based on data from (a) the Federal Motor Carrier Safety Administration (FMCSA), Analysis and Information System, and (b) the Federal Highway Administration (FHWA), Highway Performance and Monitoring System (HPMS).

Exhibit 18 shows the percentages of large trucks involved in fatal crashes by roadway functional class between 2005 and 2008 for Tennessee. From 2005 to 2008, the number of large trucks involved in fatal crashes dropped from 150 to 92, down by nearly 40 percent. For all four years, the greatest share of fatal truck crashes in Tennessee occurred on Interstate highways. Crashes on other principle arterials peaked in 2006, the same year that crashes on Interstates dipped below 40 percent. The share of fatal crashes on minor arterials ranged from just under 15 percent to nearly 25 percent. For all four years, the share of fatal crashes was less than ten percent for collector roads and less than five percent for local roads.

Exhibit 18 – Large Trucks Involved in Fatal Crashes by Roadway Functional Class in Tennessee, 2005-2008



Sources: National Traffic Safety Administration (NHTSA), Fatality Analysis Reporting System (FARS); Federal Motor Carrier Safety Administration (FMCSA), Motor Carrier Management Information System (MCMIS); Federal Highway Administration (FHWA), Highway Performance and Monitoring System (HPMS).

To estimate the large trucks involved in fatal crashes per 100 million vehicle miles traveled by large trucks by highway functional class in Tennessee over the 2005-2008 period, the following steps were undertaken:

Step 1 – For the study years, obtain the annual vehicle-miles for Interstate highways, other principal arterials and minor collectors in the state of Tennessee (**Exhibit 14**).

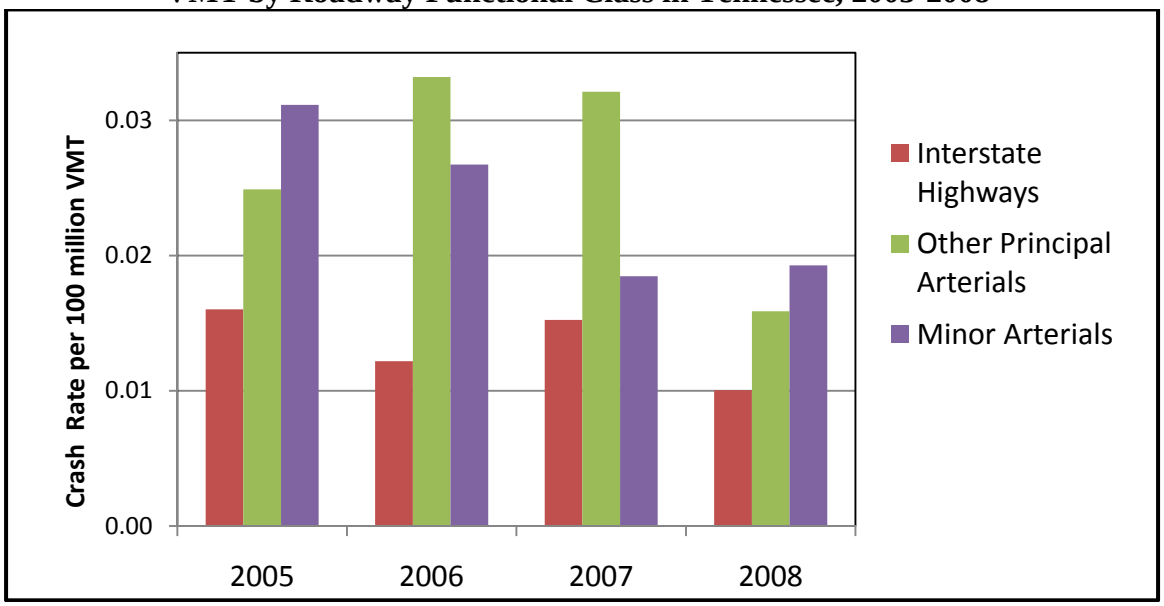
Step 2 – For the study years and selected roadway functional classes, estimate the annual large-truck VMT. Based on the available data, the distribution of annual vehicle distance

traveled by large trucks on the selected roadway functional classes (**Exhibit 15**) is used to allocate annual large-truck VMT to the corresponding highway functional class.

Step 3 – For each year within the analysis period and selected roadway functional class, divide the number of large trucks involved in fatal crashes (**Exhibit 18**) by the estimated annual large-truck VMT.

Exhibit 19 shows the large trucks involved in fatal crashes per 100 million VMT by roadway functional class between 2005 and 2008 for Tennessee. For all roadway functional classes, the number of large trucks in fatal crashes per 100 million vehicle miles traveled by large trucks declined in 2008 compared to 2005, with minor arterials experiencing the highest decrease (down by 38%).

Exhibit 19 - Estimated Large Trucks Involved in Fatal Crashes per 100 Million VMT by Roadway Functional Class in Tennessee, 2005-2008



Sources: Developed by Wilbur Smith Associates based on data from (a) the National Traffic Safety Administration (NHTSA), Fatality Analysis Reporting System (FARS); the Federal Motor Carrier Safety Administration (FMCSA), Motor Carrier Management Information System (MCMIS); and Federal Highway Administration (FHWA), Highway Performance and Monitoring System (HPMS).

Other potentially interesting information obtained from FMCSA regarding truck crashes that occurred during 2008 in Tennessee includes the following:

- Seventy-four percent of fatal truck crashes in 2008 are attributed to carriers domiciled outside of Tennessee. Carriers based in Arkansas, North Carolina, Georgia, Alabama and Mississippi are most often involved in fatal crashes in Tennessee.

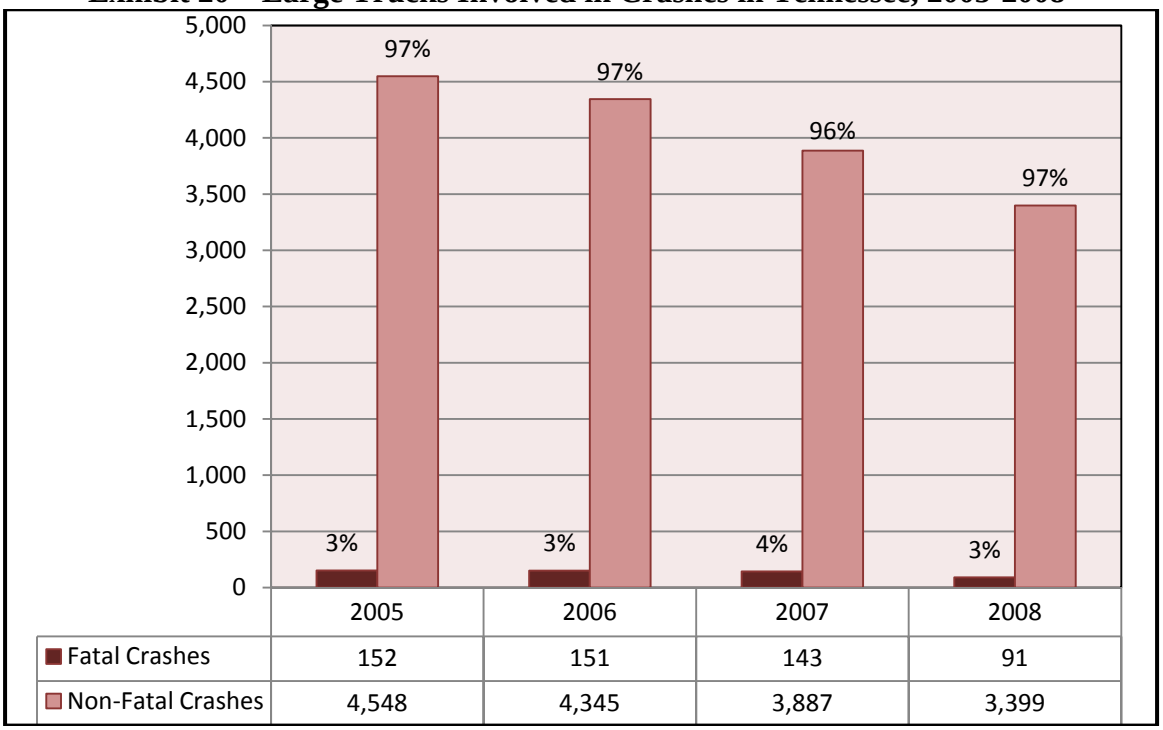
- The percentage of fatal truck crashes in Tennessee involving drivers younger than 26 years old is slightly lower than the national rate. Only 4.7 percent of the drivers involved in fatal crashes in Tennessee in 2008 were 26 or younger. Nationally, 5.2 percent of fatal crashes involved drivers 26 or younger.

- Drivers aged 56 to 65 are involved in nearly 28 percent of fatal crashes. Nationally, this group is involved in just over 16 percent of fatal crashes.

TENNESSEE TRUCK CRASH PROFILE

This section examines the available data for traffic and crashes in Tennessee. **Exhibit 20** shows the number of fatal and non-fatal crashes involving large trucks in Tennessee from 2005 to 2008. From 2005 to 2008, the number of large trucks involved in fatal crashes dropped from 152 to 91, down by 40 percent, while the number of large trucks involved in non-fatal crashes declined by 25 percent, from 4,548 to 3,399. It can be also noted that the number of fatal truck crashes in Tennessee declined significantly in 2008 relative to the three previous years.

Exhibit 20 – Large Trucks Involved in Crashes in Tennessee, 2005-2008

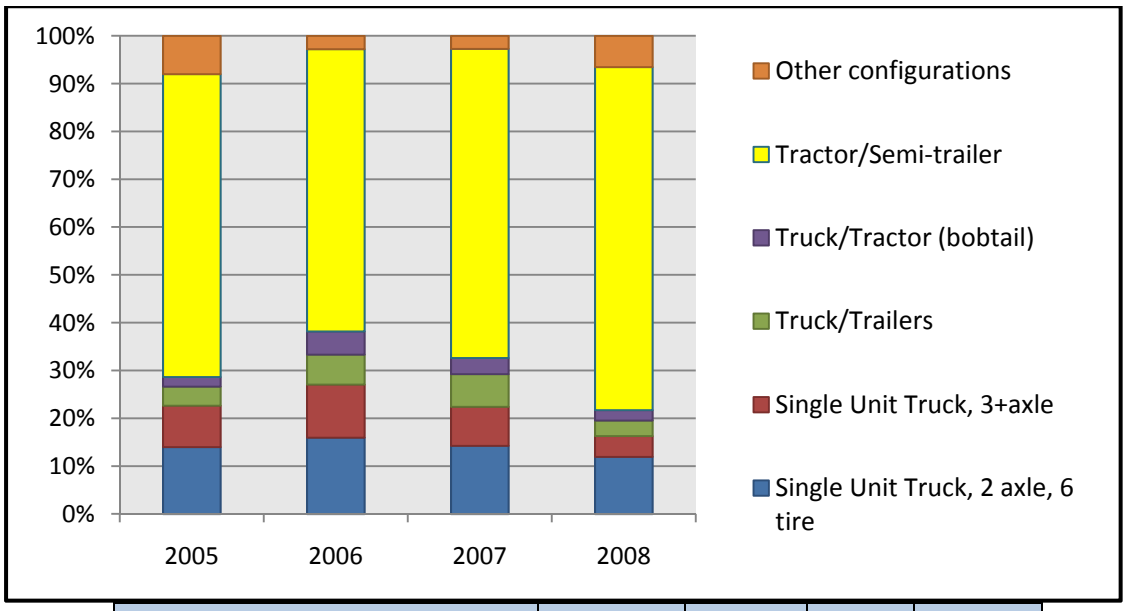


Source: Federal Motor Carrier Safety Administration (FMCSA), Motor Carrier Management Information System (MCMIS)

Exhibit 21 shows the distribution of vehicle configurations of trucks involved in fatal crashes in Tennessee from 2005 to 2008. For all four years, tractor/semi-trailer

configurations account for the largest shares, with 72 percent of all large trucks involved in fatal crashes in 2008. Conversely, truck/tractor (bobtail) configurations represent the smallest share in all four years, with only two percent in 2005 and 2008.

Exhibit 21 – Configurations of Large Trucks Involved In Fatal Crashes in Tennessee



Vehicle Configuration	2005	2006	2007	2008
Single Unit Truck, 2 axle, 6 tire	21	23	21	11
Single Unit Truck, 3+axle	13	16	12	4
Truck/Trailers	6	9	10	3
Truck/Tractor (bobtail)	3	7	5	2
Tractor/Semi-trailer	95	85	95	66
Other configurations	12	4	4	6
Total =	**150**	**144**	**147**	**92**

Sources: National Traffic Safety Administration (NHTSA), Fatality Analysis Reporting System (FARS); Federal Motor Carrier Safety Administration (FMCSA), Motor Carrier Management Information System (MCMIS);

To estimate the large trucks involved in fatal crashes per 100 million vehicle miles traveled by vehicle configuration (single unit trucks and combination trucks) in Tennessee over the 2005-2008 period, the following steps were undertaken:

Step 1 – For the study years, obtain the annual vehicle-miles for the state of Tennessee (**Exhibit 22**).

Exhibit 22 - Annual Vehicle-Miles (in millions) in the State of Tennessee, 2005-2008

Year	Total VMT
2005	70,814
2006	70,596
2007	71,179
2008	69,469

Sources: Federal Highway Administration (FHWA), *Highway Statistics 2005, Highway Statistics 2006 Highway Statistics 2007,* and *Highway Statistics 2008*

Step 2 – For the study years, estimate the annual large-truck VMT by vehicle configuration based on available national data (**Exhibit 23**). This information is used to allocate annual VMT to vehicle configurations in Tennessee (**Exhibit 24**).

Exhibit 23 - Annual Vehicle-Miles (in millions) by Vehicle Configuration in the U.S., 2005-2008

Year	Total VMT (in millions)		Allocation Factors	
	Single Unit Trucks	Combination Trucks	Single Unit Trucks	Combination Trucks
2005	78,495.66	144,027.64	0.026	0.048
2006	80,344.22	142,169.23	0.027	0.047
2007	82,013.99	145,046.29	0.027	0.048
2008	83,950.52	143,507.48	0.028	0.049

Source: Federal Highway Administration (FHWA), *Highway Statistics 2005, Highway Statistics 2006 Highway Statistics 2007,* and *Highway Statistics 2008*

Exhibit 24 - Estimated Annual Vehicle-Miles (in millions) by Vehicle Configuration in Tennessee, 2005-2008

Year	Total VMT (in millions)	Large-Truck VMT (in millions)		
		Single Unit Trucks	Combination Trucks	Total
2005	70,814	1,870	3,432	5,302
2006	70,596	1,893	3,351	5,244
2007	71,179	1,938	3,428	5,366
2008	69,469	1,976	3,377	5,353

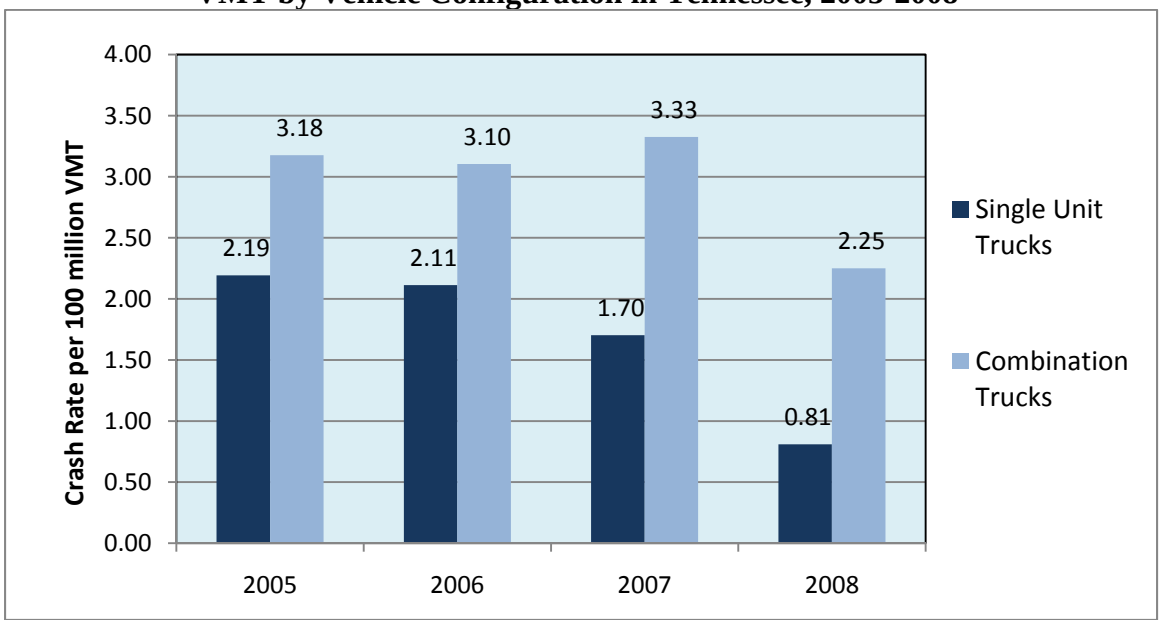
Source: Developed by Wilbur Smith Associates based on Highway Statistics published by the Federal Highway Administration (FHWA)

Step 3 – For each year within the analysis, divide the number of single unit trucks involved in fatal crashes in Tennessee (**Exhibit 21**) by the estimated annual single-unit-truck VMT.

Step 4 – For each year within the analysis period, divide the number of combination trucks involved in fatal crashes in Tennessee (**Exhibit 21**) by the estimated annual combination-truck VMT.

Exhibit 25 shows the large trucks involved in fatal crashes per 100 million VMT by vehicle configuration in Tennessee between 2005 and 2008. For single unit trucks, the number of large trucks in fatal crashes per 100 million vehicle miles traveled by these trucks has declined every year; this represents a decrease of 63 percent in 2008 compared to 2005. Conversely, the crash rate for combination trucks increased in 2007 but, compared to 2005, the rate decreased by 29 in 2008.

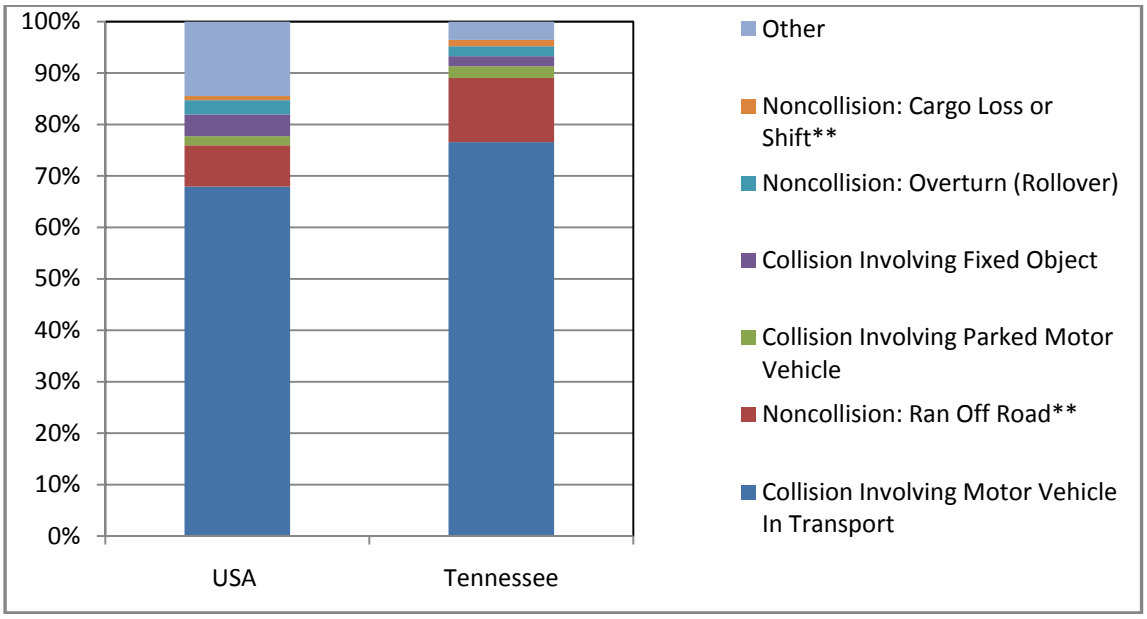
Exhibit 25 - Estimated Large Trucks Involved in Fatal Crashes per 100 Million VMT by Vehicle Configuration in Tennessee, 2005-2008



Note: Single unit trucks include single unit truck, 2 axle, 6 tire and single unit truck, 3+ axles. Combination trucks include truck/trailers, truck/tractor (bobtail), tractor/semi-trailer, and other configurations.
Sources: Developed by Wilbur Smith Associates based on data from (a) the National Traffic Safety Administration (NHTSA), Fatality Analysis Reporting System (FARS), (b) the Federal Motor Carrier Safety Administration (FMCSA), Motor Carrier Management Information System (MCMIS), and (c) the Federal Highway Administration (FHWA), Highway Performance and Monitoring System (HPMS).

Exhibit 26 compares percentages of truck crashes in Tennessee and the U.S. as a whole by first event type. Because of the relatively small percentage of fatal crashes, the exhibit includes both fatal and nonfatal crashes. About 77 percent of crashes in Tennessee begin with a collision involving a motor vehicle in transport; nationally, less than 68 percent of crashes begin this way. Ran-off-road collisions are nearly twice as common in Tennessee as they are nationally.

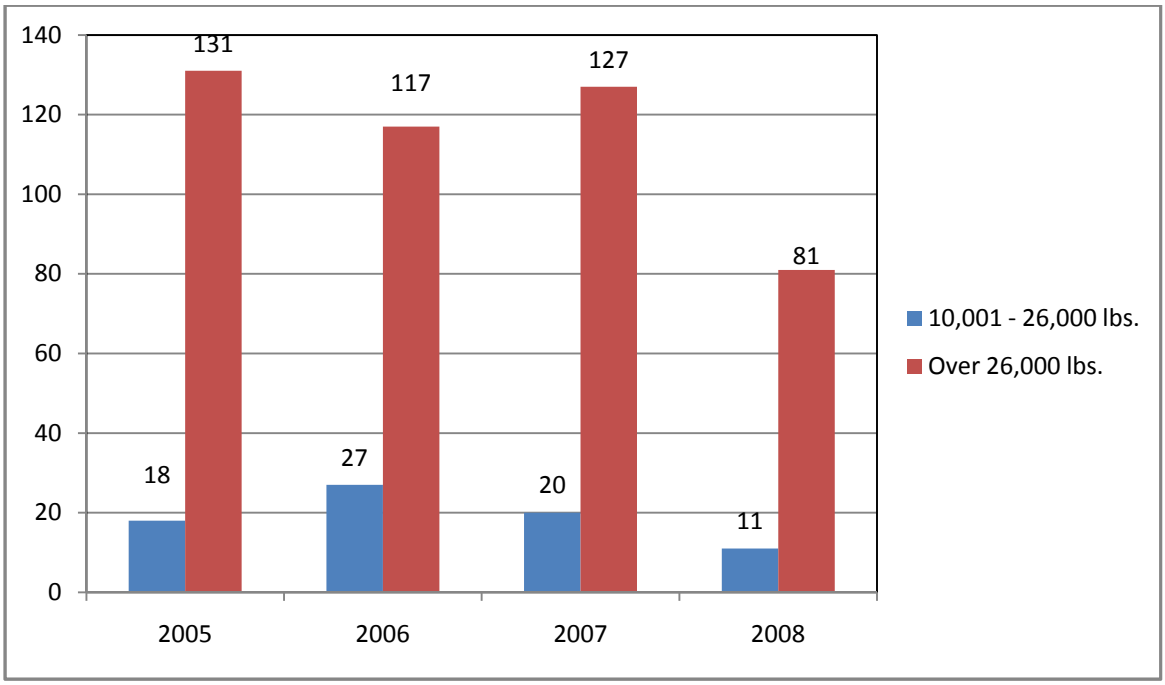
Exhibit 26 – Large Trucks Involved in Fatal and Non-Fatal Crashes in 2008 by First Harmful Event



** These categories are not coded in the FARS database
Sources: National Traffic Safety Administration (NHTSA), Fatality Analysis Reporting System (FARS); Federal Motor Carrier Safety Administration (FMCSA), Motor Carrier Management Information System (MCMIS).

Exhibit 27 shows the numbers of large trucks involved in fatal crashes in Tennessee by gross vehicle weight (GVW) from 2005 to 2008. Although trucks over 26,000 pounds account for the overwhelming majority of fatal crashes during the four years, their numbers appear to be declining; the number of large trucks with over 26,000 pounds involved in fatal crashes declined by 38 percent in 2008 compared to 2005. From 2005 to 2006, the number of lighter trucks crashing increased by 50 percent but this trend reversed in the last reported years; from 2007 to 2008 the number of lighter trucks involved in fatal crashes declined by 45 percent.

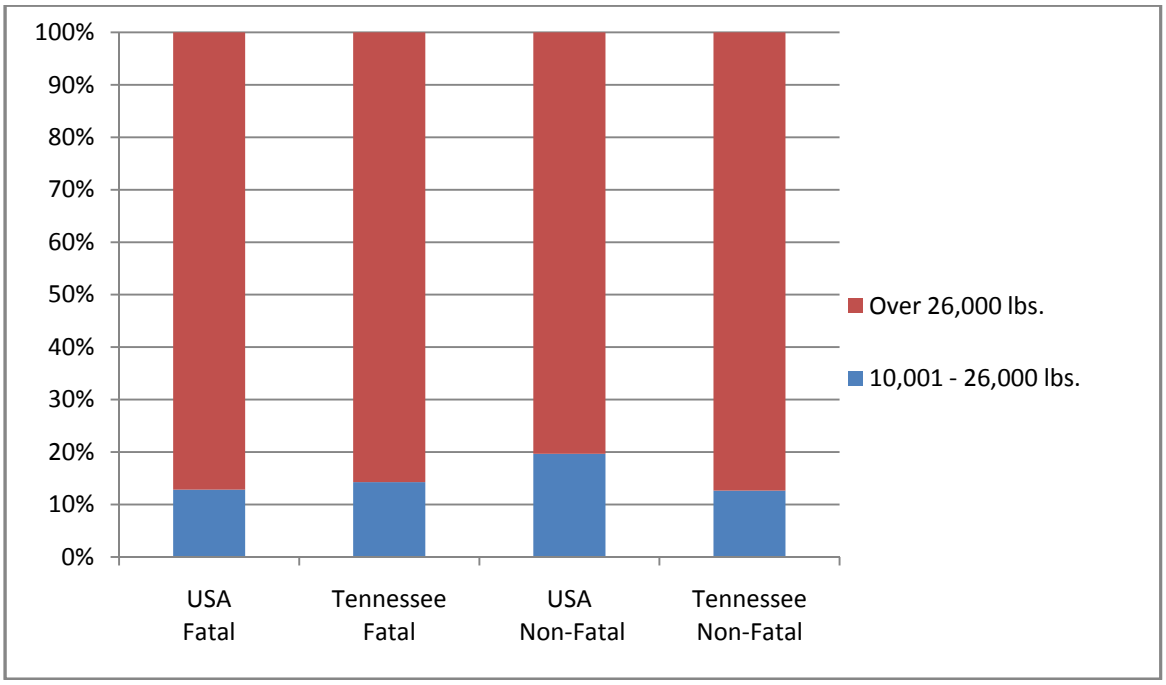
Exhibit 27 – Large Trucks Involved in Fatal Crashes by Weight in Tennessee, 2005-2008



Sources: National Traffic Safety Administration (NHTSA), Fatality Analysis Reporting System (FARS); Federal Motor Carrier Safety Administration (FMCSA), Motor Carrier Management Information System (MCMIS).

Exhibit 28 compares the relative shares of large trucks involved in crashes by vehicle weight and fatality between Tennessee and the U.S. as a whole in 2008. Compared to national percentages, Tennessee had a slightly lower share of fatal crashes that involved trucks over 26,000 pounds but a much higher share involved in nonfatal crashes.

Exhibit 28 – Shares of Large Trucks in Fatal Crashes by Gross Vehicle Weight 2005-2008

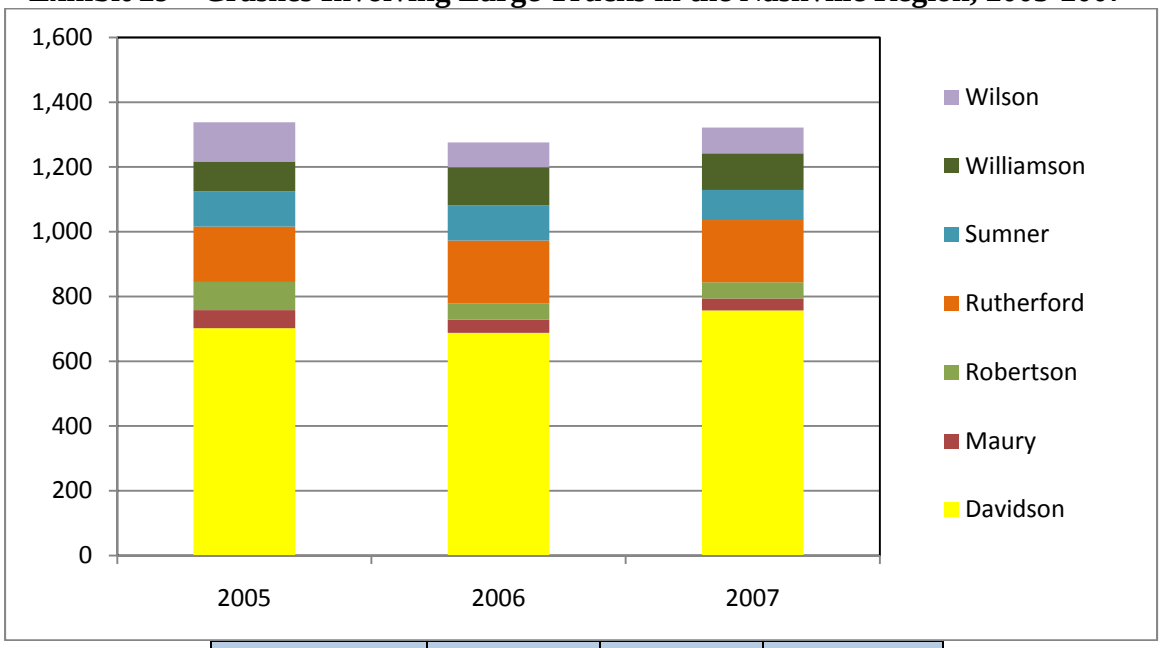


Source: FARS & MCMIS. Vehicles with unknown GVW or GVW under 10,000 lbs excluded.

LARGE TRUCK CRASHES IN THE NAHSVILLE REGION

Exhibit 29 shows the frequency of crashes involving large trucks in the Nashville region for the years 2005 to 2007. The total number of crashes is generally consistent over the three years for which data are available. For all three years, over half of all truck crashes in the region occurred in Davidson County. This is to be expected given the much higher volumes of traffic and the more urban transportation setting. Growing numbers of crashes are observed in Williamson and Rutherford counties.

Exhibit 29 – Crashes Involving Large Trucks in the Nashville Region, 2005-2007

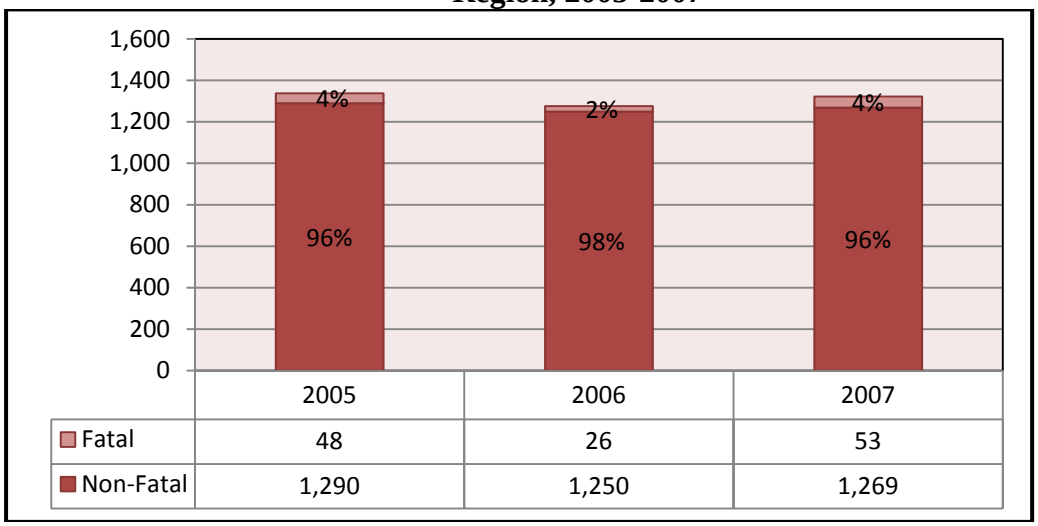


County	2005	2006	2007
Davidson	702	688	757
Maury	56	41	37
Robertson	87	49	50
Rutherford	171	195	192
Sumner	109	108	93
Williamson	92	118	113
Wilson	121	77	80
Total =	**1,338**	**1,276**	**1,322**

Source: FMCSA Crash Database

Exhibit 30 shows the numbers of fatal and nonfatal crashes involving large trucks in the region over the three years for which data are available. The total number of crashes in the region declined in 2006 (1,267) compared to 2005 (1,338), but it increased by nearly four percent in 2007 (1,322). It can be also noted that the numbers of fatal crashes, ranging from two to four percent of all crashes in the reported years, doubled in 2007 compared to that in 2006.

Exhibit 30 – Fatal and Nonfatal Crashes Involving Large Trucks in Nashville Region, 2005-2007



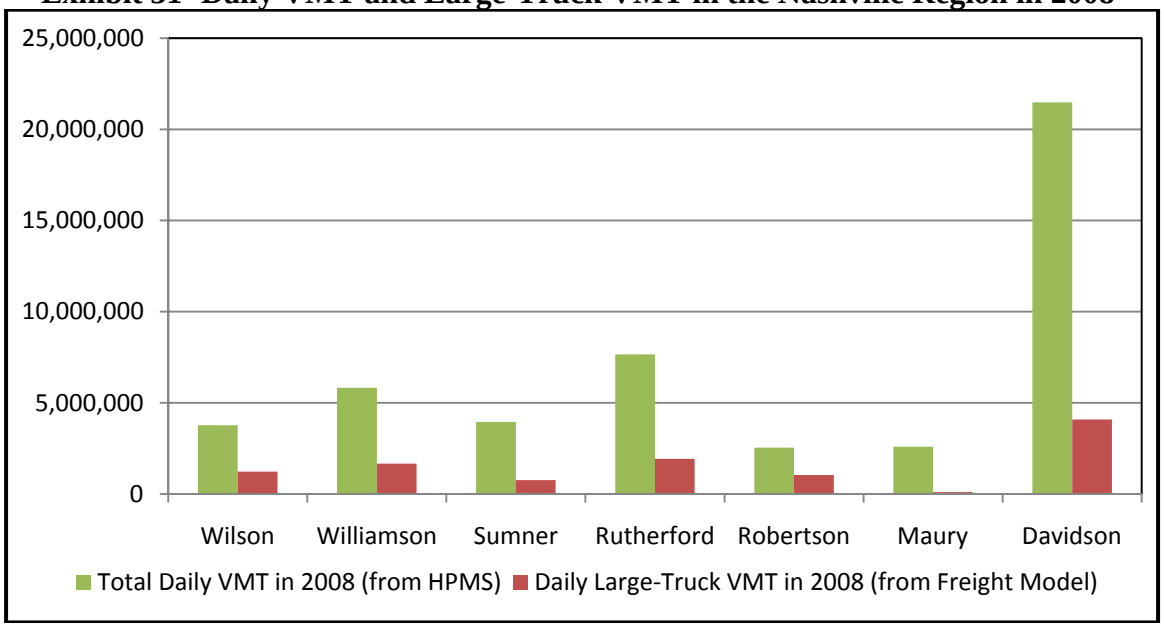
	2005	2006	2007
Fatal	48	26	53
Non-Fatal	1,290	1,250	1,269

Source: FMCSA Crash Database

To estimate the commercial vehicle crash rate in the Nashville region for the three years for which crash data are available, the following steps were undertaken:

Step 1 – Obtain the total daily VMT and large-truck VMT in 2008 for each county within the Nashville region (**Exhibit 31**).

Exhibit 31- Daily VMT and Large-Truck VMT in the Nashville Region in 2008



Source: Developed by Wilbur Smith Associates based on data from (a) the Federal highway administration (FHWA), Highway Performance Monitoring System (HPMS) and (b) the Regional Freight Model developed as part of this study.

Step 2 – For each county in the Nashville region, multiply the total daily VMT in 2008 by 365 to obtain the total annual VMT in 2008.

Step 3 – For each county in the Nashville region, multiply the daily large-truck VMT by 365 to obtain the annual large-truck VMT in 2008.

Step 4 – Estimate the contribution of large trucks to the total annual VMT in 2008. These shares are used to estimate the annual large-truck VMT for the selected years for each county in the Nashville region.

Step 5 – For the selected years and each county in the Nashville region, divide the number of traffic crashes involving large trucks (**Exhibit 29**) by the estimated annual large-truck VMT.

Exhibit 32 presents the crash rates per 100 million VMT traveled by large trucks in the Nashville region. As can be noted, for the three selected years, the county with the highest rate is Maury while the counties with the lowest rates are Wilson, Williamson, and Robertson. Roberston, Wilson, and Maury counties have experienced the greatest decline in their normalized crash rate over the 2005-2007 period while crash rates have increased in Williamson, Davidson, and Rutherson counties over the study period.

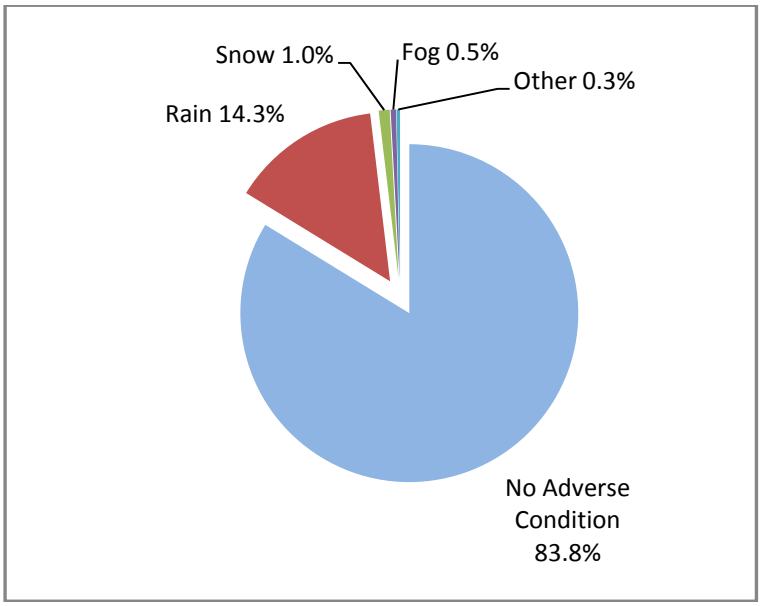
Exhibit 32 – Estimated Crash Rate per 100 Million VMT by Large Trucks in the Nasville Region

County	2005	2006	2007	Change (2005-2007)
Wilson	27.6	16.8	16.8	-39.2%
Williamson	17.1	20.9	18.9	10.3%
Sumner	42.1	42.0	34.0	-19.3%
Rutherford	27.0	28.8	28.2	4.6%
Robertson	22.1	12.6	12.3	-44.5%
Maury	137.4	103.2	91.8	-33.2%
Davidson	47.8	46.7	50.8	6.1%
Nashville Region =	35.5	33.1	33.3	-6.1%

Sources: Developed by Wilbur Smith Associates based on data from (a) the Federal Motor Carrier Safety Administration (FMCSA), Crash Data, and (b) the Federal Highway Administration (FHWA), Highway Performance and Monitoring System (HPMS).

Exhibit 33 shows the weather conditions noted during truck crashes over the three years' worth of data in the Nashville region. For over 80 percent of the crashes, no adverse weather was noted. Rain was noted during 14 percent of crashes. Other weather conditions were observed for less than 2 percent of the crash records.

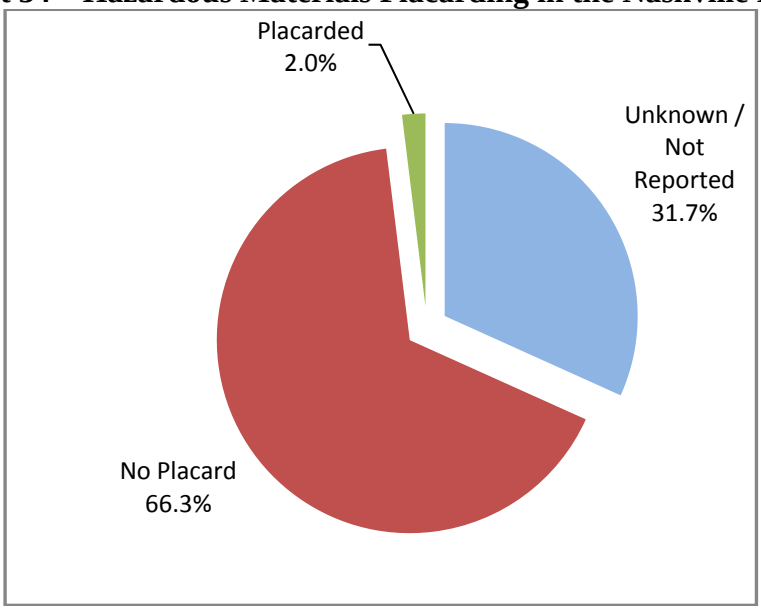
Exhibit 33 – Weather Conditions During Truck Crashes in the Nashville Region, 2005-2007



Source: FMCSA Crash Database

Exhibit 34 shows the frequency of notations of hazardous materials placards in crash records in the Nashville region. While only 2 percent of all crashes were identified as involving vehicles with hazmat placards, the status of the cargo was not noted for nearly one-third of truck crashes in the Nashville region.

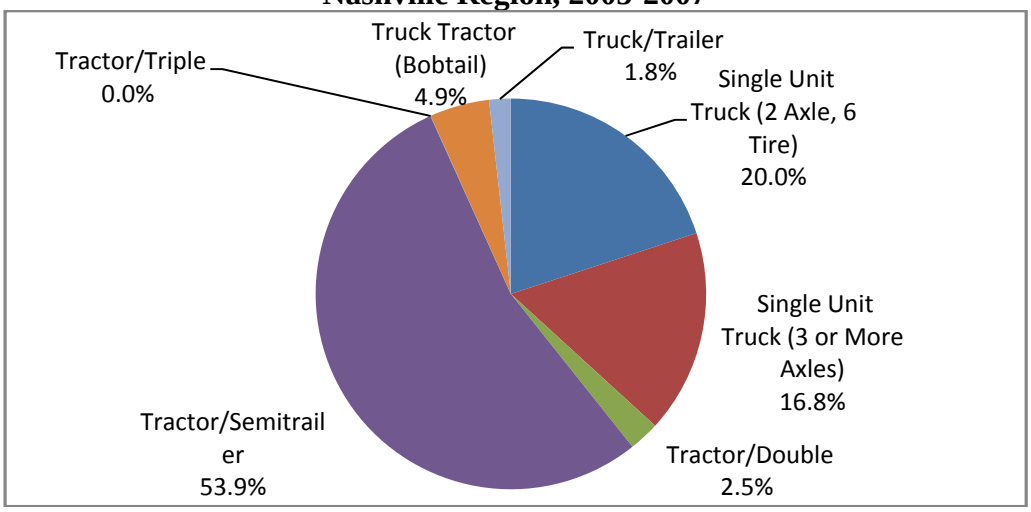
Exhibit 34 – Hazardous Materials Placarding in the Nashville Region



Source: FMCSA Crash Database

Exhibit 35 shows the configuration of large trucks involved in crashes in the Nashville region. Combination unit trucks represented 63% (2,356) of the total large trucks involved in crashes in the region (i.e., 3,728). Tractor/semi-trailer configurations were involved in over half of the crashes in the three years of data. Most of the rest of the crashes involved single unit trucks with varying axle configurations. Double trailers accounted for just 2.5 percent of crashes, and a single crash in the three years examined involved a triple trailer.

Exhibit 35 – Large Trucks Involved in Crashes by Vehicle Configuration in the Nashville Region, 2005-2007



Source: FMCSA Crash Database

To estimate the large trucks involved in fatal crashes per 100 million vehicle miles traveled by vehicle configuration (single unit trucks and combination trucks) in the Nashville region over the 2005-2007 period, the following steps are conducted:

Step 1 – For the study years, estimate the annual large-truck VMT by vehicle configuration based on available national data (**Exhibit 23**). This information is used to allocate annual large-truck VMT to vehicle configurations in the Nashville region (**Exhibit 36**).

Exhibit 36 - Estimated Large-Truck VMT by Vehicle Configuration in the Nashville Region

Year	Large Truck VMT (in millions)		
	Single Unit Trucks	Combination Trucks	Total
2005	1,330	2,441	3,771
2006	1,393	2,466	3,859
2007	1,434	2,535	3,969
2008	1,458	2,492	3,950

Source: Developed by Wilbur Smith Associates based on Highway Statistics published by the Federal Highway Administration (FHWA)

Step 2 – Divide the number of single unit trucks involved in crashes in the Nashville region in a given year by the estimated annual single-unit-truck VMT in that year.

Step 3 – Divide the number of combination trucks involved in crashes in the Nashville region in a given year by the estimated annual combination-truck VMT in that year.

Exhibit 37 shows the large trucks involved in crashes per 100 million VMT by vehicle configuration in the Nashville region over the 2005-2007 period. For both vehicle configurations, the normalized crash rates have declined over time. Over the 2005-2007 period, the crash rate associated with single trucks has declined by seven percent while the crash rate associated with combination trucks has decreased by nearly four percent.

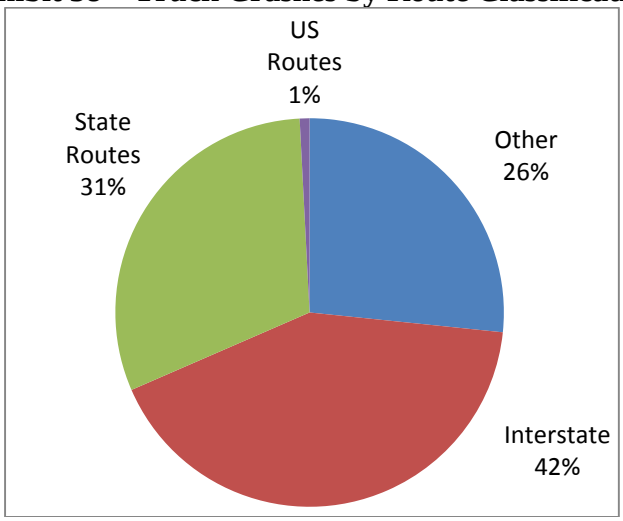
Exhibit 37- Estimated Large Trucks Involved in Crashes per 100 Million VMT by Vehicle Configuration in the Nashville Region, 2005-2007

Vehicle Configuration	2005	2006	2007	Change (2005-2007)
Single Unit Trucks	34.4	32.8	31.9	-7.2%
Combination Trucks	32.2	31.9	31.0	-3.7%

Sources: Developed by Wilbur Smith Associates based on data from (a) the Federal Motor Carrier Safety Administration (FMCSA), Crash Data, and (b) the Federal Highway Administration (FHWA), Highway Performance and Monitoring System (HPMS).

Counts of truck crashes by route classification are shown in **Exhibit 38**. Interstate highways have the largest share of crashes, with 42 percent of all truck crashes occurring on interstate highways. State routes accounted for 31 percent of crashes. U.S. routes were identified as the crash location on just one percent of crashes; however, this may be due to incomplete notations in the data used.

Exhibit 38 – Truck Crashes by Route Classification

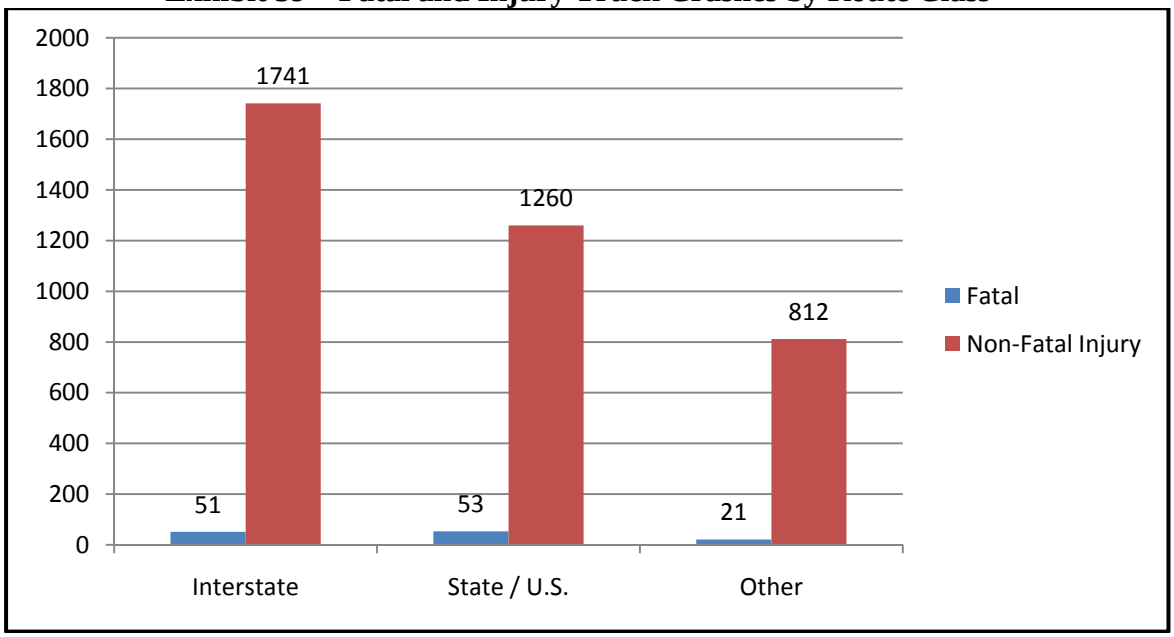


Source: Tennessee Department of Transportation

Exhibit 39 shows the shares of fatal and injury truck crashes in the Nashville region by route designation. While the largest share of crashes occurs on interstate highways, a greater share of fatal crashes occurs on state and U.S. routes. Other routes, including local streets and arterials, have a ratio of fatal to nonfatal injury crashes that is comparable to interstate routes. This does not mean that the local streets are safer than the interstate routes, however, because the interstates likely log greater shares of truck miles traveled.

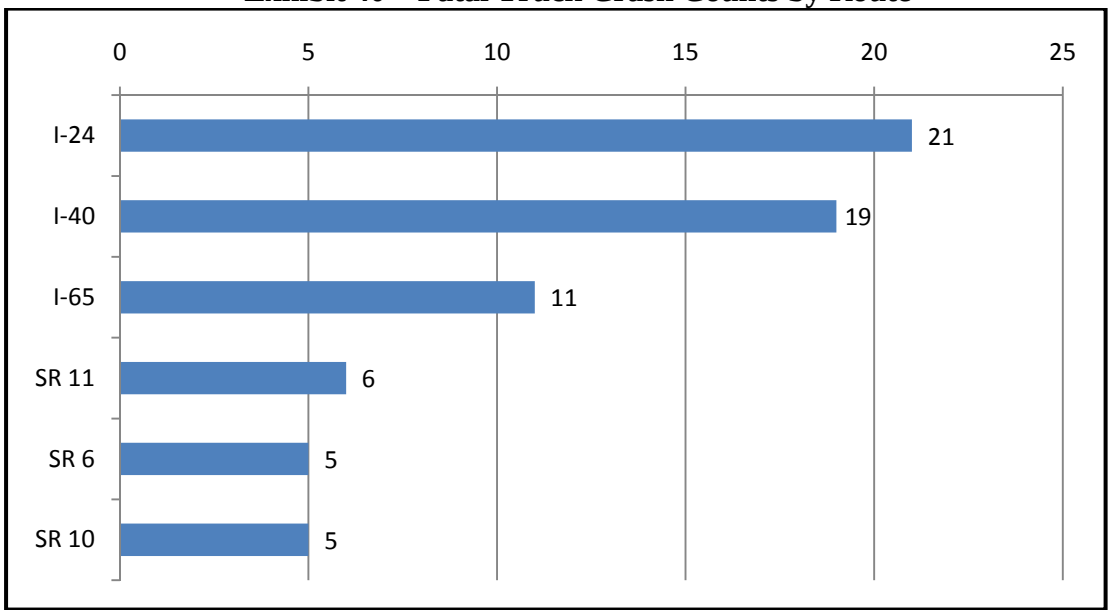
Exhibit 40 shows the most frequently recorded routes for fatal crashes. Interstate 24 recorded 21 fatalities during the five most recent years for which data were collected. Interstate 40 had 21 fatalities during the same period, and Interstate 65 had eleven. State routes 11, 6, and 10 were the next most frequent locations for fatal crashes.

Exhibit 39 – Fatal and Injury Truck Crashes by Route Class



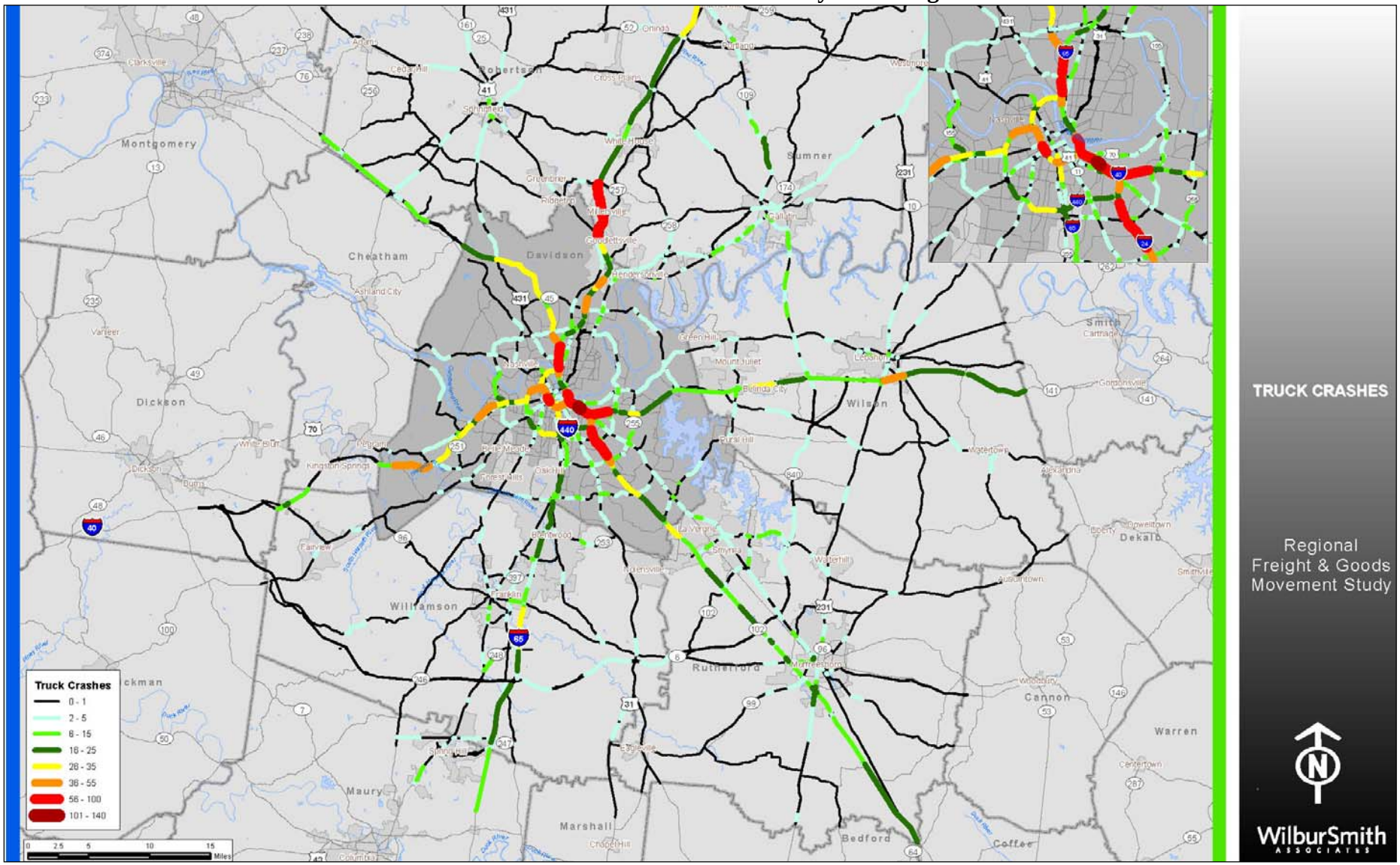
Source: Tennessee Department of Safety Crash Database, 2005-2009

Exhibit 40 – Fatal Truck Crash Counts by Route



Source: Tennessee Department of Safety Crash Database, 2005-2009

Exhibit 41 – Truck Crash Counts by Route Segment



The map in **Exhibit 41** shows the numbers of truck crashes on the Nashville region's road system. The highest number of crashes shown in dark red on the map was recorded on a section where Interstate 24 shares the pavement with Interstate 40, between Nashville International Airport and downtown Nashville. The sections of Interstate 24 that includes the Cumberland River crossing also showed high numbers of truck crashes, as did the I-24 section between I-440 and SR 255. On Interstate 65, the section that runs concurrent with Interstate 24 north of the Cumberland River recorded high numbers of crashes. Crash counts were also high on the section near downtown Nashville that runs concurrent with I-40 and on the section north of Nashville between Long Hollow Pike and Louisville Highway (US 31W).

CONCLUSIONS

As a freight hub for both the state and the nation, truck safety in the Nashville region generally reflects national trends. From this analysis, a number of conclusions regarding truck safety in Tennessee and the Nashville region can be drawn, as discussed below.

Declining Fatality Rates: Although the number of fatalities relating to large truck crashes nationally has been holding steady, the rates of crashes per million truck VMTs have been declining.

Increasing Shipment of Goods by Trucks: As Tennessee and the U.S. become more integrated into the global economy, shipment of goods by truck has increased. This has meant that while the rate of fatalities has declined, the increase in truck VMTs has meant that fatalities have increased.

Higher Crash Rates in Tennessee: The fatality rate for commercial vehicle crashes in Tennessee is slightly higher than the national average, but over twice the fatality rate of Utah, the state with the lowest rate. This may be due to higher speeds and a high share of out-of-state truck traffic resulting from Tennessee's central location and the emergence of manufacturing and logistics industries that depend on non-local shipments.

Motor vehicles in transport: Motor vehicles in transport have high crash rates both nationally and in Tennessee. Their large share of crashes suggests that efforts to reduce crashes must necessarily address motor vehicle transporters.

Declined Crash Rates in Tennessee's urban and rural roads: Over the 2005-2008 period, it is estimated that the number of large trucks in fatal crashes per 100 million vehicle miles traveled by large trucks declined by 42 percent in urban areas (from 0.46 in 2005 to 0.27 in 2008) and by 33 percent in rural roads (from 0.43 in 2005 to 0.29 in 2008).

Central role of Davidson and Maury Counties: Although other counties in the region are experiencing rapid growth, Davidson County continues to account for a majority of truck crashes, likely due to its central location, the density of its freight shippers and receivers, and greater levels of traffic congestion. When normalized with commercial motor vehicles miles traveled (VMT), Davidson County's crash rate has increased over the 2005-2007 period and Maury County is the county with the highest rates in the three study years.

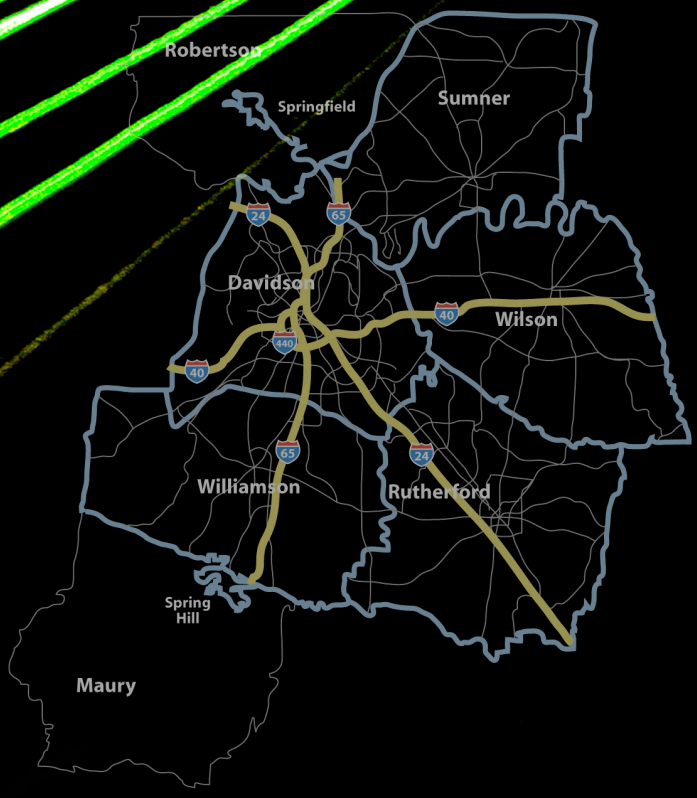
Identify approaches for good and bad weather: One third of truck crashes occurred during rain, when visibility and braking are often impaired. However, over half of crashes in the Nashville region occurred when no adverse weather was identified.

Need for improved hazmat records: Although only two percent of all crashes were identified as involving vehicles with hazmat placards, for nearly one third of truck crashes in the Nashville region, the FMCSA database records did not specify whether hazardous materials were involved or if the vehicle bore a hazmat placard.

Need for increased emphasis on single units and semi-trailers: Although much debate centers on the safety of double and triple trailers, single-unit trucks and semi-trailers accounted for over 90 percent of truck crashes. However, when normalized with commercial motor vehicles miles traveled (VMT), in Tennessee, the number of single-unit-trucks in fatal crashes per 100 million vehicle miles traveled by this type of configuration has declined every year, representing a decrease of 63 percent in 2008 compared to 2005. Over these four years, the Tennessee's crash rate for combination trucks increased in 2007 but, it decreased by 29 percent in 2008 compared to that in 2005. In the Nashville region, crash rates associated with single and combination trucks have also declined over the 2005-2007 period.

NASHVILLE REGIONAL FREIGHT & GOODS MOVEMENT STUDY

Technical Memo #6: Capacity Analysis/Regional Needs Assessment



October 2010

Submitted to: **Nashville Area Metropolitan Planning Organization**

Submitted by: **Wilbur Smith Associates**

NASHVILLE AREA
Metropolitan Planning Organization

NASHVILLE REGIONAL FREIGHT & GOODS MOVEMENT STUDY

PHASE II

TECHNICAL MEMO #6:
CAPACITY ANALYSIS/REGIONAL NEEDS ASSESSMENT

Funding for this document was provided in part by the U.S. Department of Transportation Federal Highway Administration and the Tennessee Department of Transportation.

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Introduction

Based on results of the analysis performed in the Existing Trends and Conditions section of the Nashville Regional Freight and Goods Movement Study (Phase II) and outputs from the latest travel demand model with integrated freight components, the Evaluation of Capacity/Regional Needs Assessment is intended to document and review the congestion level in the existing and future scenarios from both regional and corridor perspectives. In addition to the overall roadway congestion evaluation, the congested corridors with high freight traffic are identified and evaluated to help the region make informed decisions on meeting future demands.

Organization of This Report

This report is organized into the following sections:

Overall existing and future congestion in the region

This section briefly reviews overall congestion in the Nashville region based on results from the latest travel demand model with integrated freight components. The congestion levels in both 2008 and 2035 are reviewed by different facility types and time periods of the day.

Congestion and freight traffic

To better understand the impact of freight traffic in the region, this section documents the findings of locations where congestion is coupled with high truck percentages in both 2008 and 2035 scenarios. In addition, the overall freight mobility and its trend between 2008 and 2035 at the regional level are examined to shed some light on the infrastructure need to enhance freight movement efficiency in the future.

Key corridors in the region to meet future demands

The focus in this section is to identify deficient segments in the region where congestion levels are not acceptable, i.e., the volume to capacity ratios are greater than one. This section is intended to provide guidance on additional capacity to meet future demands.

Overall Existing and Future Congestion in the Region

The Nashville travel demand model was updated by integrating freight modeling components to better reflect the existing and future freight traffic levels. Detailed information regarding the integration of freight modeling components is available in the goods movement model technical memorandum. This documentation serves as an evaluation of the results from the updated Nashville travel demand model.

A typical intuitive way of describing congestion is to categorize roadway segments into different levels of service (LOS) ranging from "A" to "F". Level of service "A" represents little or no delay/congestion. On the other extreme, level of service "F" indicates extreme traffic delays and the most congested conditions. Generally, LOS "A" and "B" represent good conditions. LOS "C" and "D" represent the average. LOS "E" and "F" represent poor conditions. In planning level analyses, volume to capacity ratios (V/C) on roadway segments are widely used to approximate the congestion level and levels of service in a regional network. The typical volume to capacity ratio ranges for level of service are listed as follows:

- V/C less than 0.50: LOS "A" or LOS "B" (good)
- V/C between 0.50 and 0.70: LOS "C" (average)
- V/C between 0.70 and 0.85: LOS "D" (average)
- V/C between 0.85 and 1.0: LOS "E" (poor)
- V/C greater than 1.0: LOS "F" (poor)

The Nashville regional congestion level in both 2008 and 2035 is illustrated in Figure 1 through Figure 6. Due to fluctuations in traffic during a given time of day, congestion is reported among different peak hour periods, i.e., AM peak, PM peak and non-Peak hours, in both 2008 and 2035 scenarios.

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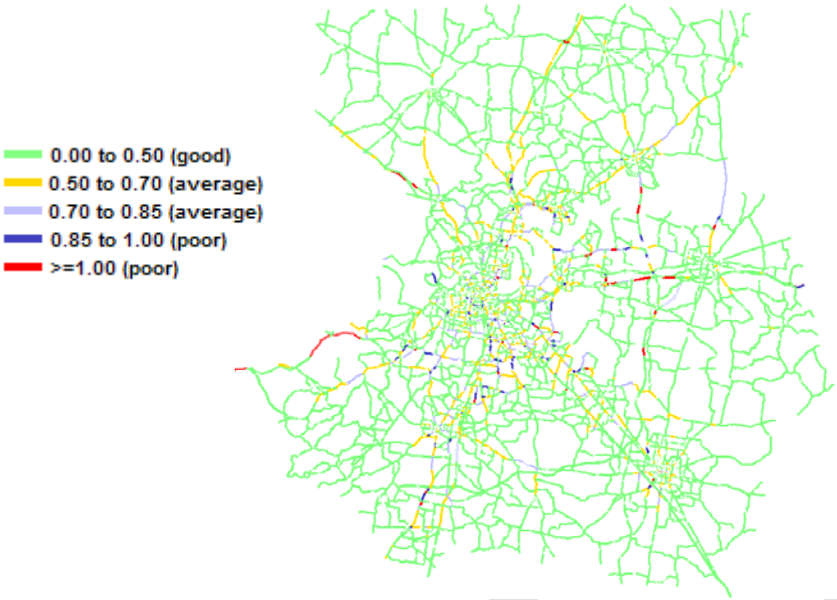

Figure 1 – 2008 AM Peak V/C Ratios in the Nashville Region

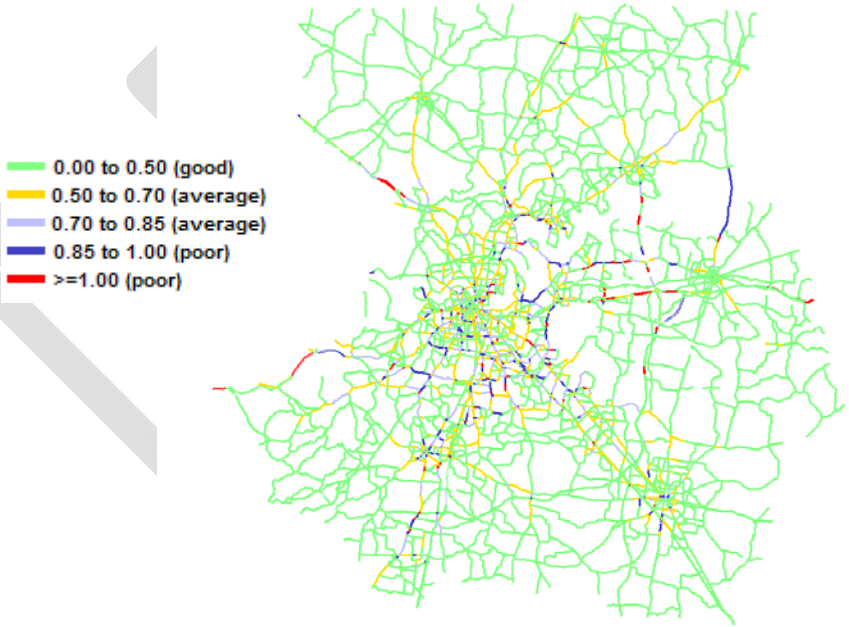

Figure 2 – 2008 PM Peak V/C Ratios in the Nashville Region

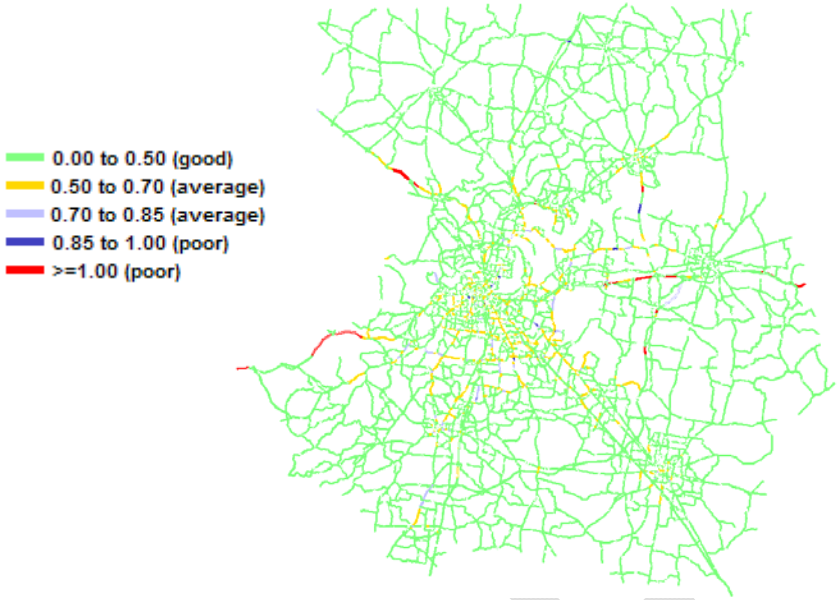

Figure 3 – 2008 Non-Peak V/C Ratios in the Nashville Region

As expected, the 2008 PM peak scenario shows wider congestion compared with 2008 AM peak scenario. Even though the 2008 non-peak hour scenario has less congestion in downtown Nashville, it still shows sporadic congestion throughout the region.

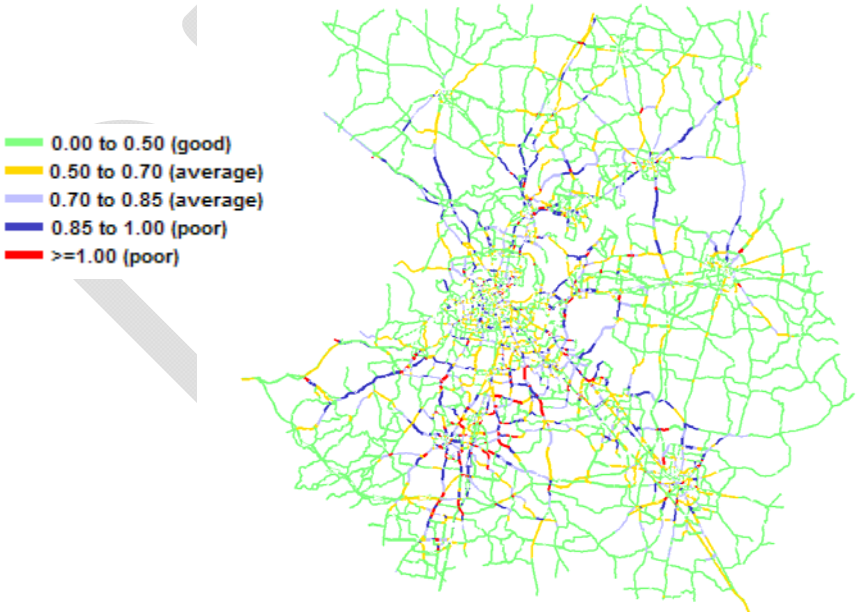

Figure 4 – 2035 AM Peak V/C Ratios in the Nashville Region

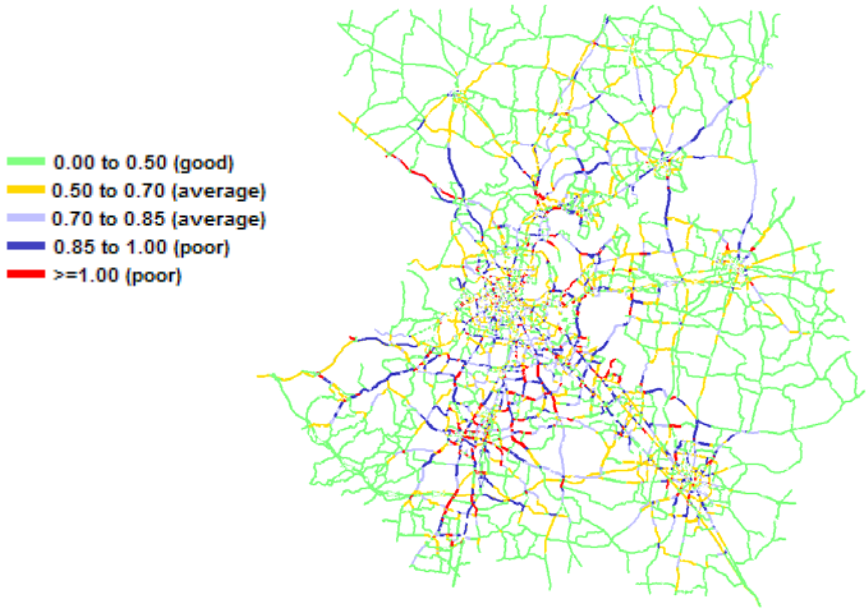

Figure 5 – 2035 PM Peak V/C Ratios in the Nashville Region

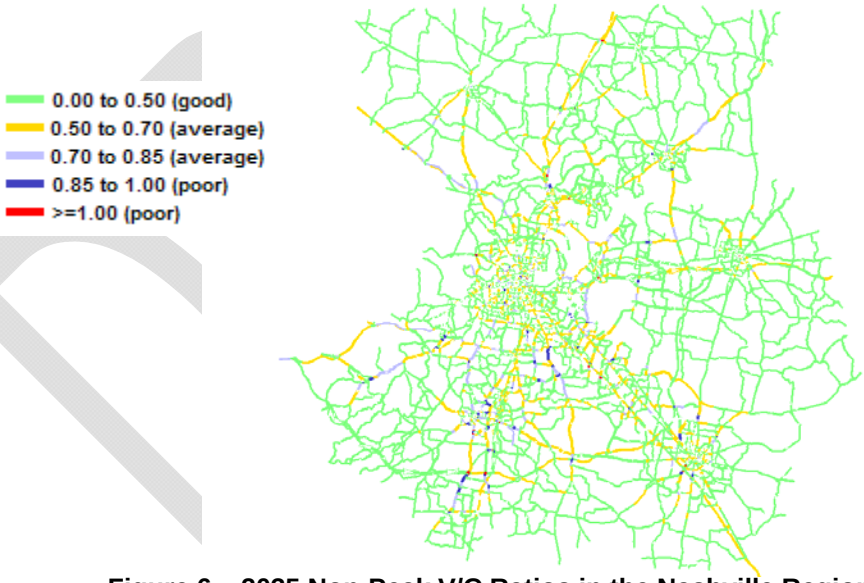

Figure 6 – 2035 Non-Peak V/C Ratios in the Nashville Region

In 2035 scenarios, the pattern with PM peak as the most congested time period and non-peak as the least congested time period repeats. In contrast with 2008 scenarios, congestion levels in the region intensify as evidenced by more purple and red colors (i.e., poor conditions) emerging at the outskirts of downtown Nashville, especially around the City of Franklin and City of Murfreesboro areas. Figure 7 shows that the percentages of congested roadways (V/C > 0.85) in the region will increase substantially during AM and PM peak hours. More specifically, roughly 189 miles (4.1%) out of the region's 4,656

mile modeled roadways are experiencing poor LOS in 2008. In 2035, 667 miles (13.6%) out of the region's 4,889 mile modeled roadways will experience poor LOS. The total mileage of roadways which will witness poor LOS in the region is more than tripled from 2008 to 2035.

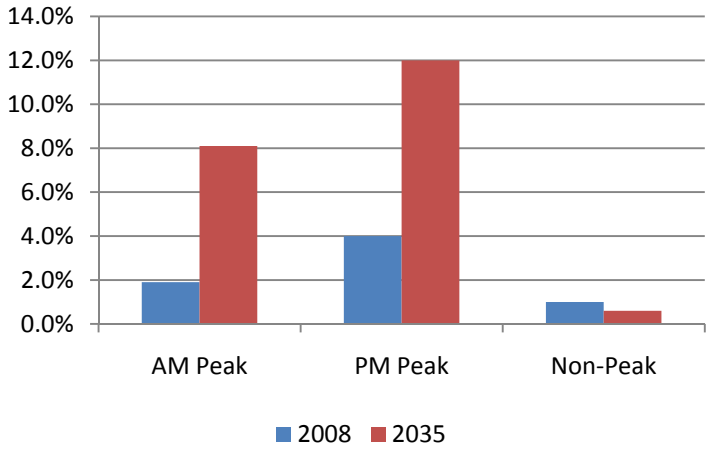

Figure 7 – Percentages of Congested Roads in the Nashville Region

An interesting fact from Figure 7 is that the percentages of congested roadways during non-peak hours decreased from 1.0% in 2008 to 0.6% in 2035. This may imply that the proposed infrastructure improvements and land development in the next 25 – 30 years will induce more traffic during peak hours than non-peak hours.

It is common sense that the intended transportation function varies by different facility types. For example, interstates mainly serve trips entering and leaving urban areas with the longest average trip distances. The magnitude of congestion levels varies as well on different facility types.

Table 1 through Table 6 documented the V/C ratio distribution on different facility types based on results from the travel demand model. For the sake of simplicity, the thirteen facility types being used in the travel demand model are regrouped into the following three groups. Group One includes Interstate, Freeway and Expressway. Group Two includes Principal Arterial, Major Arterial, and Minor Arterial. Group Three includes the remaining classifications.

Figure 8 through Figure 10 summarize the congestion (V/C > 0.85) distribution among the aforementioned three groups in both 2008 and 2035 scenarios. It is safe to conclude that congestion mainly occurred on Group One and Group Two routes throughout the day in 2008. Despite the increase of Group Three route congestion in 2035, Group One and Two routes will still constitute the majority of congested routes in the region. All groups in 2035 will witness increasing congestion during AM and PM peak hours compared with 2008 scenario. The percentages of congested Group Two and Group One routes are the

highest and lowest respectively during 2035 AM and PM peak hours. The biggest congestion increase between 2008 and 2035 comes from Group Two routes, which coincides with the observation that congestion is spreading more into non-interstate arterials in 2035.

Table 1 – V/C Ratio Distribution by Facility Type in 2008 AM Peak Hour

Facility Type	V/C ratio					Sum
	0-0.5	0.5-0.7	0.7-0.85	0.85-1.0	>1.0	
Interstate	7.8%	2.9%	1.0%	0.2%	0.6%	12.5%
Freeway	0.9%	0.2%	0.0%	0.0%	0.0%	1.1%
Expressway	3.3%	0.2%	0.1%	0.0%	0.0%	3.6%
System-System Ramp	1.2%	0.1%	0.0%	0.0%	0.0%	1.3%
On-Ramp	1.8%	0.1%	0.0%	0.0%	0.0%	1.9%
Off-Ramp	1.6%	0.2%	0.1%	0.0%	0.0%	1.9%
Principal Arterial	3.9%	1.4%	0.5%	0.1%	0.0%	5.9%
Major Arterial	5.1%	1.5%	0.8%	0.2%	0.1%	7.7%
Minor Arterial	10.1%	2.6%	1.3%	0.3%	0.1%	14.4%
Collector	33.6%	1.5%	0.5%	0.2%	0.1%	35.9%
Local	13.7%	0.1%	0.0%	0.0%	0.0%	13.8%
Transit-Only	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sum	83.0%	10.8%	4.3%	1.0%	0.9%	100.0%

Table 2 – V/C Ratio Distribution by Facility Type in 2008 PM Peak Hour

Facility Type	V/C ratio					Sum
	0-0.5	0.5-0.7	0.7-0.85	0.85-1.0	>1.0	
Interstate	6.0%	3.3%	2.0%	0.4%	0.7%	12.4%
Freeway	0.8%	0.2%	0.1%	0.0%	0.0%	1.1%
Expressway	2.9%	0.4%	0.1%	0.1%	0.1%	3.6%
System-System Ramp	1.1%	0.2%	0.0%	0.0%	0.0%	1.3%
On-Ramp	1.8%	0.1%	0.0%	0.0%	0.0%	1.9%
Off-Ramp	1.4%	0.2%	0.1%	0.1%	0.0%	1.8%
Principal Arterial	3.5%	1.3%	0.8%	0.4%	0.1%	6.1%
Major Arterial	4.2%	1.9%	0.8%	0.6%	0.2%	7.7%
Minor Arterial	8.8%	3.1%	1.5%	0.8%	0.1%	14.3%
Collector	32.7%	2.1%	0.9%	0.3%	0.1%	36.1%
Local	13.5%	0.2%	0.0%	0.0%	0.0%	13.7%
Transit-Only	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sum	76.7%	13.0%	6.3%	2.7%	1.3%	100.0%

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Table 3 – V/C Ratio Distribution by Facility Type in 2008 Non-Peak Hour

Facility Type	V/C ratio					Sum
	0-0.5	0.5-0.7	0.7-0.85	0.85-1.0	>1.0	
Interstate	8.6%	2.9%	0.1%	0.1%	0.7%	12.4%
Freeway	1.1%	0.1%	0.0%	0.0%	0.0%	1.2%
Expressway	3.4%	0.1%	0.1%	0.0%	0.1%	3.7%
System-System Ramp	1.2%	0.1%	0.0%	0.0%	0.0%	1.3%
On-Ramp	1.8%	0.0%	0.0%	0.0%	0.0%	1.8%
Off-Ramp	1.6%	0.2%	0.0%	0.0%	0.0%	1.8%
Principal Arterial	5.0%	0.9%	0.1%	0.0%	0.0%	6.0%
Major Arterial	6.5%	0.9%	0.2%	0.1%	0.0%	7.7%
Minor Arterial	12.5%	1.3%	0.4%	0.0%	0.0%	14.2%
Collector	35.0%	0.8%	0.2%	0.0%	0.0%	36.0%
Local	13.8%	0.1%	0.0%	0.0%	0.0%	13.9%
Transit-Only	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sum	90.5%	7.4%	1.1%	0.2%	0.8%	12.4%

Table 4 – V/C Ratio Distribution by Facility Type in 2035 AM Peak Hour

Facility Type	V/C ratio					Sum
	0-0.5	0.5-0.7	0.7-0.85	0.85-1.0	>1.0	
Interstate	6.8%	2.9%	1.8%	1.6%	0.2%	13.3%
Freeway	0.8%	0.1%	0.2%	0.1%	0.0%	1.2%
Expressway	3.2%	0.9%	0.2%	0.0%	0.0%	4.3%
System-System Ramp	1.0%	0.2%	0.1%	0.0%	0.0%	1.3%
On-Ramp	1.7%	0.1%	0.0%	0.0%	0.0%	1.8%
Off-Ramp	1.4%	0.2%	0.1%	0.1%	0.1%	1.9%
Principal Arterial	2.6%	1.8%	0.9%	0.5%	0.1%	5.9%
Major Arterial	3.1%	1.9%	1.4%	0.9%	0.3%	7.6%
Minor Arterial	6.1%	3.2%	2.3%	1.8%	0.5%	13.9%
Collector	27.2%	4.0%	2.6%	1.2%	0.5%	35.5%
Local	12.3%	0.4%	0.4%	0.1%	0.1%	13.3%
Transit-Only	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sum	66.2%	15.7%	10.0%	6.3%	1.8%	100.0%

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Table 5 – V/C Ratio Distribution by Facility Type in 2035 PM Peak Hour

Facility Type	V/C ratio					Sum
	0-0.5	0.5-0.7	0.7-0.85	0.85-1.0	>1.0	
Interstate	3.4%	4.5%	2.9%	1.7%	0.7%	13.2%
Freeway	0.6%	0.2%	0.1%	0.1%	0.1%	1.1%
Expressway	2.0%	1.9%	0.3%	0.2%	0.0%	4.4%
System-System Ramp	0.9%	0.2%	0.1%	0.1%	0.0%	1.3%
On-Ramp	1.6%	0.2%	0.1%	0.0%	0.0%	1.9%
Off-Ramp	1.2%	0.3%	0.1%	0.1%	0.1%	1.8%
Principal Arterial	1.9%	1.8%	1.2%	0.7%	0.3%	5.9%
Major Arterial	2.1%	2.2%	1.6%	1.3%	0.5%	7.7%
Minor Arterial	4.5%	3.5%	2.8%	2.3%	0.9%	14.0%
Collector	24.6%	5.0%	3.3%	1.7%	0.9%	35.5%
Local	11.7%	0.9%	0.3%	0.2%	0.1%	13.2%
Transit-Only	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sum	54.5%	20.7%	12.8%	8.4%	3.6%	100.0%

Table 6 – V/C Ratio Distribution by Facility Type in 2035 Non-Peak Hour

Facility Type	V/C ratio					Sum
	0-0.5	0.5-0.7	0.7-0.85	0.85-1.0	>1.0	
Interstate	4.8%	7.3%	1.2%	0.1%	0.0%	13.4%
Freeway	0.8%	0.3%	0.0%	0.0%	0.0%	1.1%
Expressway	3.4%	1.0%	0.0%	0.0%	0.0%	4.4%
System-System Ramp	1.0%	0.2%	0.0%	0.0%	0.0%	1.2%
On-Ramp	1.8%	0.1%	0.0%	0.0%	0.0%	1.9%
Off-Ramp	1.5%	0.2%	0.1%	0.0%	0.0%	1.8%
Principal Arterial	4.2%	1.5%	0.2%	0.0%	0.0%	5.9%
Major Arterial	4.9%	1.9%	0.7%	0.2%	0.0%	7.7%
Minor Arterial	9.5%	3.2%	1.0%	0.2%	0.0%	13.9%
Collector	32.2%	2.5%	0.6%	0.1%	0.0%	35.4%
Local	13.0%	0.2%	0.1%	0.0%	0.0%	13.3%
Transit-Only	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sum	77.1%	18.4%	3.9%	0.6%	0.0%	100.0%

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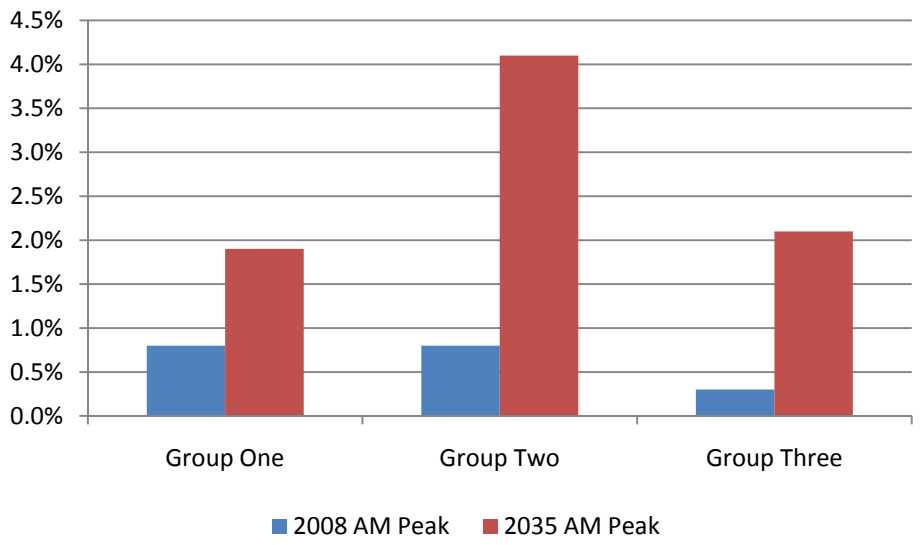

Figure 8 – Percentages of Congested Roadways by Functional Classification in AM Peak Hours

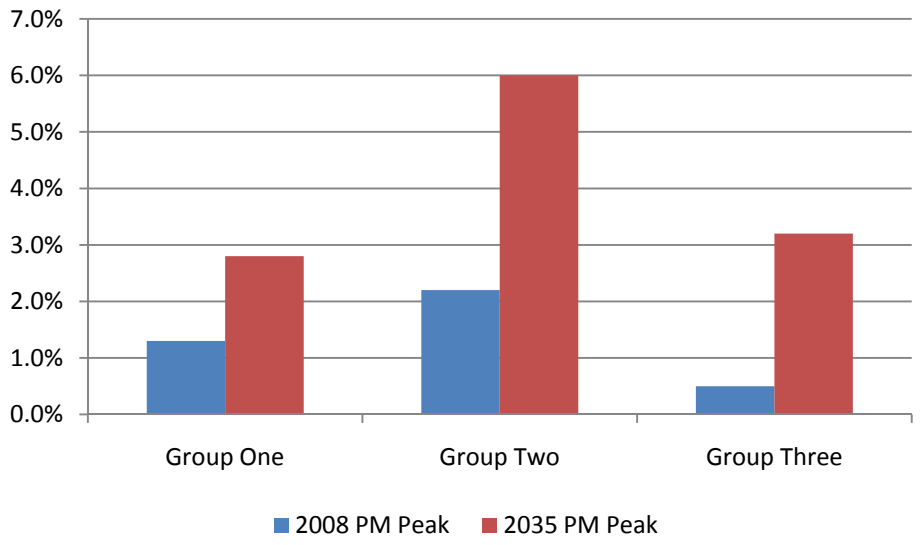

Figure 9 – Percentages of Congested Roadways by Functional Classification in PM Peak Hours

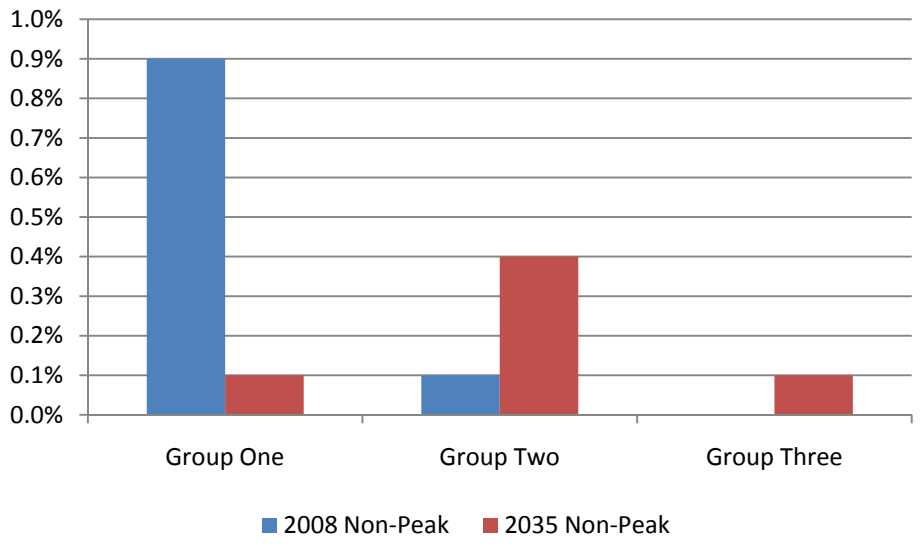

Figure 10 – Percentages of Congested Roadways by Functional Classification in Non-Peak Hours

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Congestion and Freight Traffic

The largest metropolitan area in the state, Nashville, is a regional economic and transportation center. There are four major interstates (i.e., I-40, I-24, I-65 and I-440) and a major CSX freight rail facility in the region. Freight transportation is a key component in the regional transportation system.

Based on the travel demand model with integrated freight components, the truck percentages in the region are summarized in Table 7 and Table 8. On a daily basis, the truck percentages in the region will increase from 13.0% in 2008 to 14.4% in 2035.

Table 7 – 2008 Nashville Regional Truck Percentages

	Daily	AM Peak	PM Peak	Non Peak
Multi Unit	6,178,726	993,740	1,345,162	3,839,824
Single Unit	2,441,477	582,871	488,345	1,370,261
Commercial	5,611,980	1,292,497	1,498,087	2,821,396
Passenger Cars	94,990,256	23,399,022	30,712,772	40,878,462
Total	109,222,438	26,268,129	34,044,366	48,909,943
Truck Percentage	13.0%	10.9%	9.8%	16.4%

Table 8 – 2035 Nashville Regional Truck Percentages

	Daily	AM Peak	PM Peak	Non Peak
Multi Unit	9,994,128	1,590,728	2,158,125	6,245,275
Single Unit	3,693,085	879,764	735,753	2,077,569
Commercial	8,526,181	1,963,810	2,265,977	4,296,395
Passenger Cars	132,409,608	33,258,818	42,861,429	56,289,361
Total	154,623,003	37,693,120	48,021,283	68,908,600
Truck Percentage	14.4%	11.8%	10.7%	18.3%

In order to assess the overall freight mobility and level of service, maps (Figure 11 and Figure 12) showing locations with above regional average truck percentages and high V/C ratios (i.e., V/C > 0.85) are produced to visualize key freight corridors in the regional context. As illustrated in Figure 11 and Figure 12, key freight corridors will experience increased congestion from 2008 to 2035. In 2008, congested key freight corridors are mainly concentrated on interstates. In addition to the magnitude increase of congested interstates with high truck percentage, the 2035 scenario shows that congestion spreads into major arterial freight corridors such as US 31 in Franklin, SR-65/US 431 in Whites Creek and Old Hickory Blvd. east of Brentwood.

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Figure 11 – Roadway Segments with V/C > 0.85 and Above Average Truck Percentages in 2008

Figure 12 – Roadway Segments with V/C > 0.85 and Above Average Truck Percentages in 2035

Table 9 and Figure 13 are intended to shed some light on the relationship between the regional congestion and freight traffic. Although the percent of roadways with above regional average truck percentages decreases from 35.1% in 2008 to 31.8% in 2035, the percent of congested roadways with above regional average truck percentages increases significantly from 2.0% in 2008 to 6.6% in 2035. Further, out of the 189 miles of congested roadways in 2008, 95 miles (50.3%) are coupled with above regional average truck percentages. The same percentage only slightly decreased to 48.4% in 2035 (Figure 13), which means that freight traffic continues to be a major contributor to the overall congestion in the region.

On the other side, out of 1,633 miles of roadways with above regional average truck percentages, 95 miles (5.8%) are congested in 2008. However, this percentage jumped to 20.7% in 2035 (Figure 13). In other words, there is a total of 323 miles of congested roadways among the 1,557 miles of roadways with above regional average truck percentages in 2035. Simply put, significantly more freight traffic will be subject to congestion across the region in the coming 25 to 30 years. The regional level of service experienced by the freight traffic will very likely decrease over the following years if no measures are taken to improve capacity to serve freight movement.

Table 9 – Mileage Comparison between 2008 and 2035

	2008		2035	
Total mileage in the region	4,656	100.0%	4,889	100.0%
Total mileage with V/C >= 0.85 in the region	189	4.1%	667	13.6%
Total mileage with above regional average truck percentages in the region	1,633	35.1%	1,557	31.8%
Total mileage with V/C >= 0.85 and above regional average truck percentages region	95	2%	323	6.6%

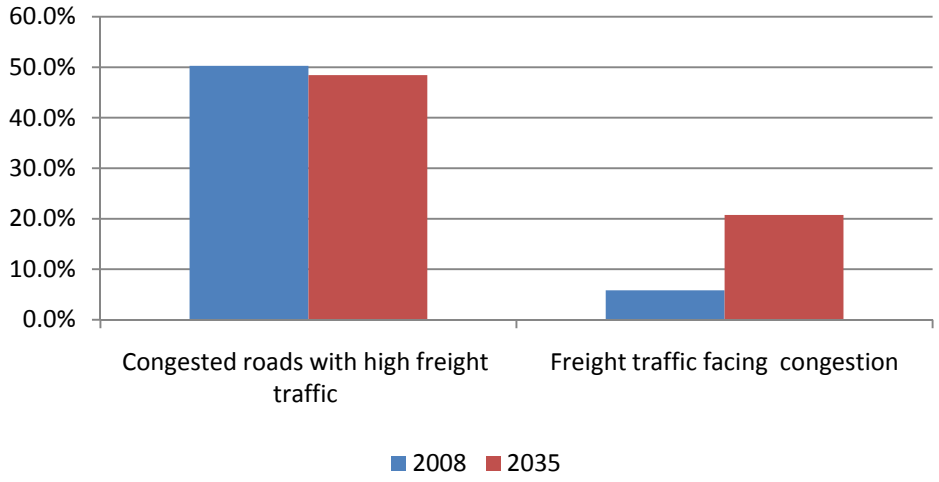


Figure 13 – Congestion and Freight Traffic

Key Corridors in the Region to Meet Future Demands

This section builds on the key findings from the previous two sections. It was found in Section One that the percentages of congested roads during peak hours in the region will increase in the next 25 to 30 years, and Group One and Group Two roadways will still constitute the majority of congested routes in the region. Section Two revealed that the regional level of service experienced by the freight traffic will likely decrease over the following decades if no measures are taken to improve capacity to serve freight movements. Thus, this section will focus on identifying deficient segments in the region where congestion levels are not acceptable, i.e., the volume to capacity ratios are greater than one.

Based on the latest travel demand model with integrated freight component, Figure 14 and Figure **15** and Table 10 and Table **11** illustrate the identified roadway segments with V/C > 1.0 and higher than regional average truck percentages in 2008 and 2035.

Table 10 – Major Deficient Corridors with Above Average Truck Percentages in 2008

Roadway Name	From	To
I-40	SR-265	SR-840
I-40	Bobo Road	SR-141
I-40	McCrory Lane	SR-46
SR-840	SR-452	SR-265
SR-109	US-70/SR-24	Odoms Bend Road
I-24	US-431/SR-65	SR-49

Figure 14 – Roadway Segments with V/C>1.0 and Above Average Truck Percentages in 2008

Table 11 – Major Deficient Corridors with Above Average Truck Percentages in 2035

Roadway Name	From	To
I-24	SR-49	SR-45
I-65	Cowan Street	US-31W/SR-41
I-24	Haywood Lane	SR-266
I-40	US-70/SR-24	Old Hickory Blvd.
US-31/SR-6	Holly Tree Gap Road	SR-397
SR-96	Downs Blvd.	North Chapel Road
I-440	US-31/SR-6	US-41/SR-1
SR-386	I-65	US-31E

Figure 15 – Roadway Segments with V/C > 1.0 and Above Average Truck Percentages in 2035

The lists in Table 10 and Table 11 are intended to identify major deficient corridor segments for freight traffic in the region in terms of traffic operational efficiency. Most of the listed corridors are part of the Nashville regional freight highway system described in the Existing Trends and Conditions section of the Nashville Regional Freight and Goods Movement Study (Phase II). The main location and direction of bottlenecks seemingly shift from east-west corridors (e.g., I-40) in 2008 to north-south corridors (e.g., I-24 and I-65) in 2035.

The average speeds on major transportation corridors in the region are shown in Table 12. The average speeds on all freight corridors in 2035 will be lower than in 2008. Among interstates, I-24 has the largest drop (-10.6%) in travelling speeds between 2008

and 2035. The largest speed drop (-11.2%) among non-Interstates occurs on SR-109. The gamut of the listed corridors is illustrated from Figure 16 to Figure 26.

Table 12 – Average Travel Speeds on Major Freight Corridors in 2008 and 2035

Corridor Name	2008	2035	Difference
I-24	58.7	52.5	-10.6%
I-65	57.3	51.8	-9.6%
I-40	59.4	55.2	-7.1%
I-440	51.3	50.4	-1.8%
SR-840	63.5	58.5	-7.9%
US-231/SR-10	42.6	41.1	-3.5%
SR-109	41.9	37.2	-11.2%
SR-45	41.5	40.0	-3.6%
SR-96	44.0	39.6	-10.0%
SR-6	43.0	40.0	-7.0%
Old Hickory Blvd.	39.6	37.0	-6.6%

Figure 16 – Location of I-40

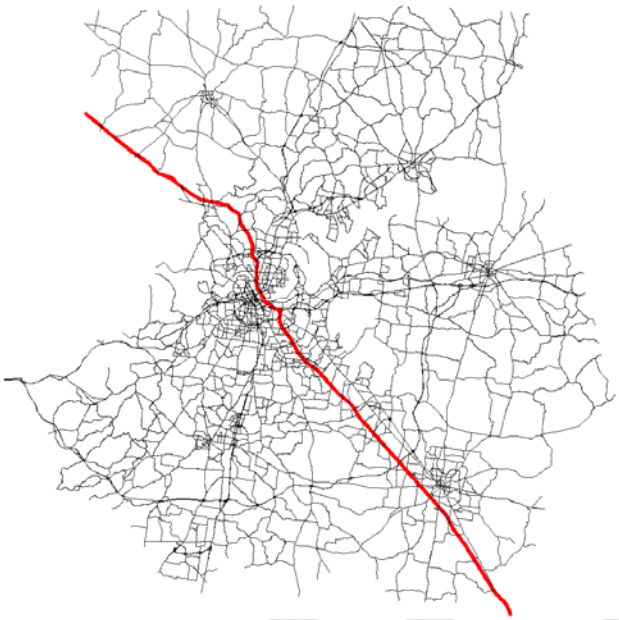


Figure 17 – Location of I-24

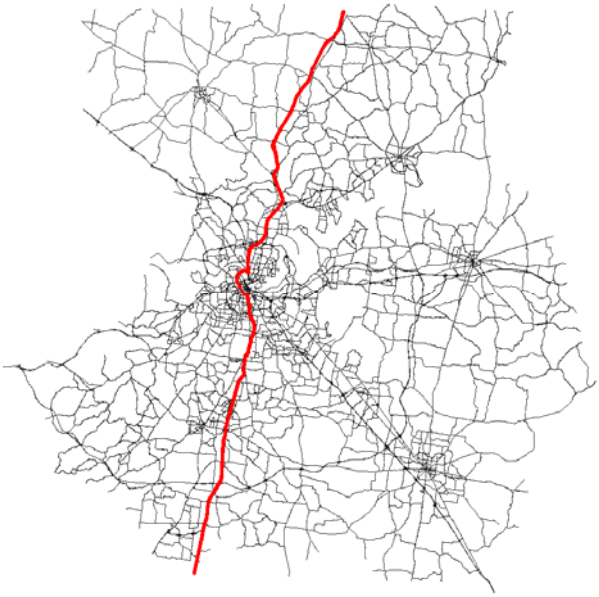


Figure 18 – Location of I-65

Figure 19 – Location of I-440

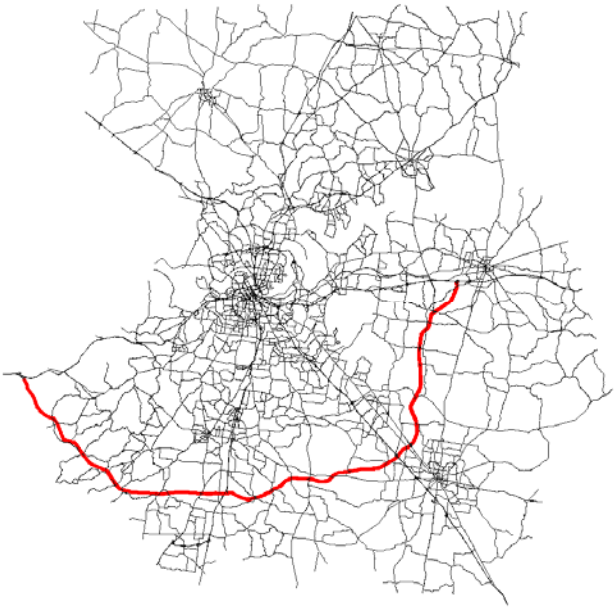


Figure 20 – Location of SR-840

Figure 21 – Location of US-231/SR-10

Figure 22 – Location of SR-109

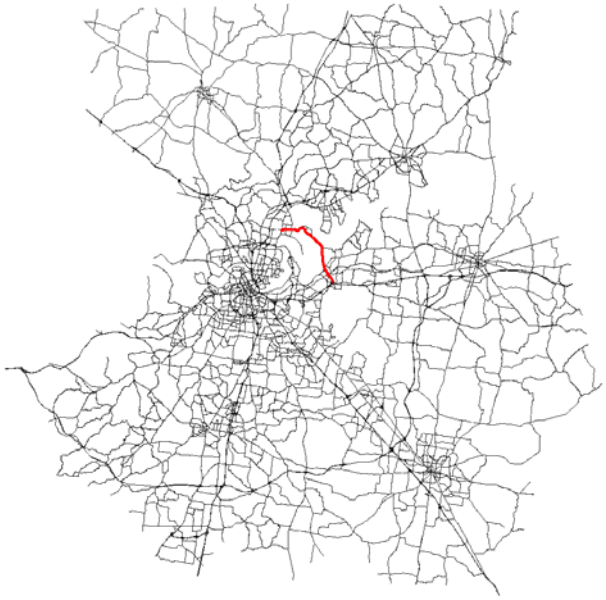


Figure 23 – Location of SR-45

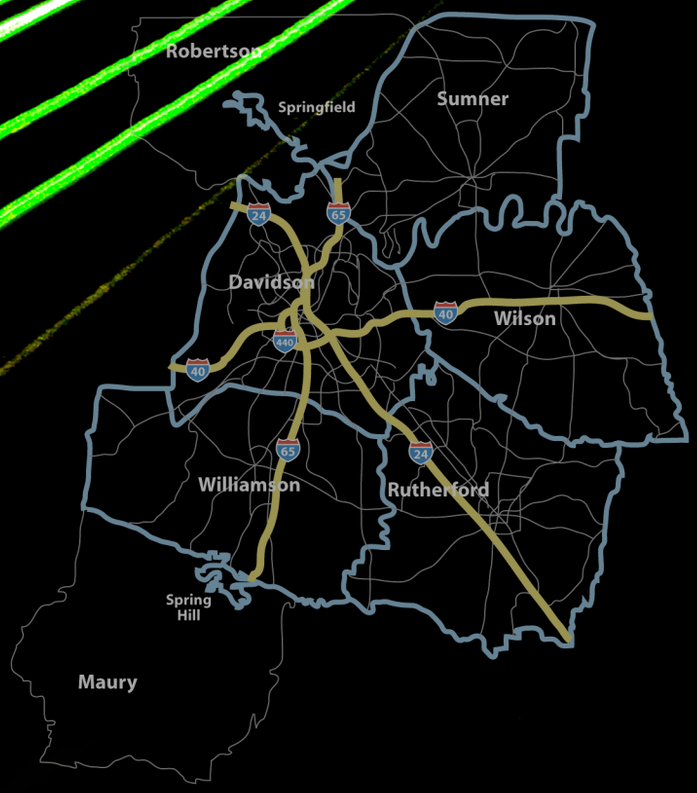
Figure 24 – Location of SR-96

Figure 25 – Location of SR-6

Figure 26 – Location of Old Hickory Blvd.

NASHVILLE REGIONAL FREIGHT & GOODS MOVEMENT STUDY

Technical Memo #7: Policy and Project Recommendations



February 2011

Submitted to: **Nashville Area Metropolitan Planning Organization**

Submitted by: **Wilbur Smith Associates**

NASHVILLE AREA
Metropolitan Planning Organization

NASHVILLE REGIONAL FREIGHT & GOODS MOVEMENT STUDY

PHASE II

TECHNICAL MEMO #7:
POLICY AND PROJECT RECOMMENDATIONS

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Introduction

The purpose of this technical memorandum is as follows:

1. Identify projects that address issues put forward by stakeholders or identified through field or technical analysis during the course of the Nashville Regional Freight and Goods Movement Study Phase II.
2. Provide an initial "fatal flaw" analysis to screen policies and projects that do not appear to warrant further investigation. In this case, subsequent evaluation that appears in this technical memorandum has either determined that the policy or project is infeasible, calls into question whether the issue raised represents a problem, or raises significant questions as to whether the policy or project will produce benefits to the region.

The next technical memorandum will evaluate projects based upon the criteria put forward by the Nashville Freight Advisory Committee.

POLICIES AND PROJECTS

Potential projects have been identified through a variety of sources, including stakeholder outreach, Phase I study analysis, MPO Long Range Transportation Plan, other studies, field observation, traffic modeling and capacity analysis. To simplify project review and presentation, alternatives have been classified into the following:

- Economic Development
- Policy
- Rail Operations/Infrastructure
- Maritime Infrastructure
- Long-Term Roadway Infrastructure
- Short-Term Roadway Infrastructure and Operations

Economic Development Projects
In these projects, the Nashville region and its constituent counties and municipalities seek to attract or build upon existing freight-related employment in areas such as air cargo, rail, warehousing and distribution. Other freight projects could make the region more desirable to a range of potential employers, but projects within this category have a direct connection between the freight project and a specific economic development initiative.

Policy Projects
Policy projects do not require an investment per se; rather, they typically are a modification of a rule or regulation on a local level. In other cases, they represent a stance that the Nashville region will take on an issue to be decided elsewhere related to freight.

Rail Operation/Infrastructure Projects: These are projects that are intended to change the operation or infrastructure of a rail line. However, it should be noted that all rail lines within the region are privately owned and therefore will require coordination and cooperation with the railroads.

Maritime Infrastructure/Operations: These are projects that improve the access to or enable a new maritime service. These projects would require the construction of infrastructure to facilitate the service.

Long-Term Roadway Infrastructure
These are road projects that will likely require a full environmental review process or other requirements that will lengthen the implementation process. They include the construction of new highways, bridges, and major roadway widening projects.

Short-Term Roadway Infrastructure or Operations
These include improvements to intersections, signalization, and other roadway projects that may not require an extensive environmental review process. These projects tend to be less costly to implement and therefore could potentially be constructed in a shorter time frame.

ECONOMIC DEVELOPMENT PROJECTS

EXHIBIT 1 is a listing of potential economic development projects. The nature of these projects is discussed in more detail below.

EXHIBIT 1 – POTENTIAL ECONOMIC DEVEOPMENT PROJECTS

Project	Source
Smyrna/Rutherford County Airport Economic Development	Stakeholder Input
Port-related Economic Development	Stakeholder Input

Smyrna/Rutherford County Airport Economic Development

The Smyrna/Rutherford County Airport has room to expand. It has an 8,000-foot runway that can handle 747 jets. The airport has 1,700 acres with 500 remaining to be developed and the area surrounding the airport is relatively uncongested. The nearby Nissan automotive manufacturing plant uses the airport, although not often, for emergency deliveries of machinery and parts to keep their assembly lines from otherwise shutting down. The availability of the airport was a factor in the plant's site selection. The airport has an advantage in that the automotive industry in general is a significant user of air cargo and has been a growth industry within the region and within central Tennessee.

On the other hand, competition is fierce. The airport competes with Nashville, Memphis, Louisville, and Atlanta, which could hinder the likelihood of major additional air cargo business. The more likely scenario is increased use of the airport for niche just in time deliveries such as those typically generated by the automotive industry. One such possibility could be with the General Motors plant in Spring Hill, TN once the plant resumes production of engines in 2012.

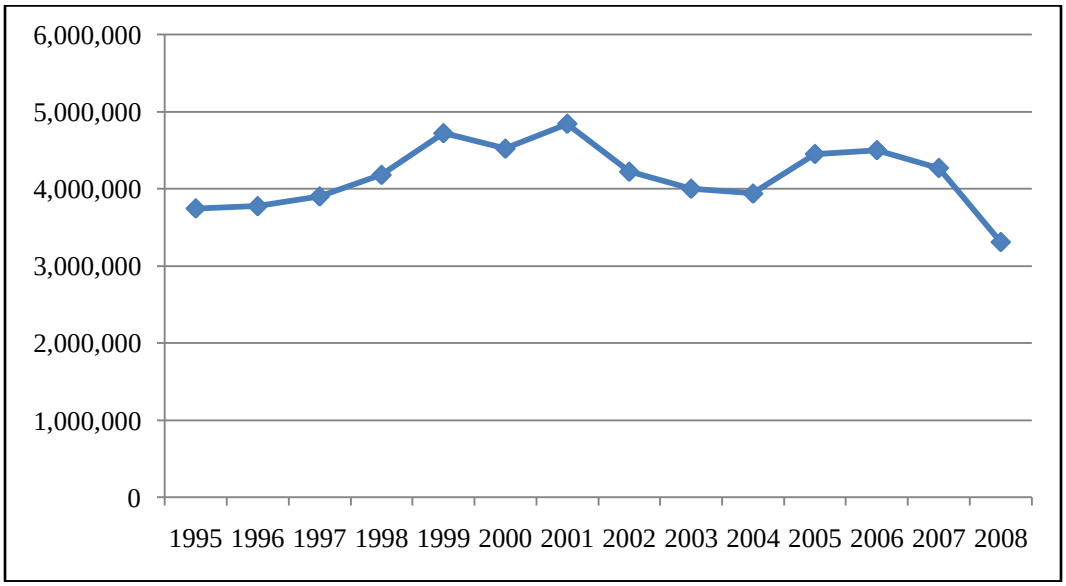
It is recommended that the Smyrna/Rutherford County Airport commence a detailed study either on its own or in conjunction with other airports or governmental entities to determine its potential market expansion, including businesses that may want to locate near the airport in order to benefit from the airport's services

Port-Related Economic Development

A representative from Ingram Barge Company mentioned that there is plenty of space available along the Cumberland River for barge-related development. As noted in Technical Memo #4: Projected Freight Flows Overview, water freight is somewhat constrained by the available docking and inland waterways available for cargo shipments. Therefore the availability of additional capacity could help to convince companies to locate within the area but data from the U.S. Army Corps of Engineers suggests that the volume of freight handled by barge facilities within the region has not consistently grown over the past 13 years. Further, water is the only mode of freight movement that is projected to see a decrease as a percentage of total freight tons in the Nashville region

from 3 percent in 2007 to 2 percent in 2035. This data indicates that a detailed study of the regional water port facilities should be considered. The study should focus on identifying strategies that will improve the efficiency of the existing facility's operations in terms of ingress and egress for both landside and water facilities. Further, there has been ongoing discussion of an additional port facility being located in the Clarksville area just a few miles from the Nashville MPO area. TDOT recently applied for a TIGER II grant to begin development of a port facility on the south bank of the Cumberland River. Several other specific potential projects will be discussed later in this technical memorandum.

EXHIBIT 2 – PORT OF NASHVILLE TONNAGE TRENDS



Source: U.S. Army Corps of Engineers Waterborne Commerce

POLICY PROJECTS

EXHIBIT 3 is a listing of potential policy projects. The nature of these projects is discussed in more detail below.

EXHIBIT 3 – POTENTIAL POLICY PROJECTS

Project	Source
Regional freight / land use plan, addressing encroachment & conflict issues	Stakeholder Input
Policy / legislation in support of transcontinental railroad mergers	Phase I of Study
Truck right-lane policy review	Stakeholder Input
Access management ordinance that addresses areas of concern regarding truck access to and from pickup and delivery locations, loading dock study / policy	Stakeholder Input
Toll studies	Phase I of Study
Dedicated truck lanes	Stakeholder Input

Truck route study	Phase I of Study
Elliston Place – Lack of loading area causing trucks to double park	Phase I of Study
South Royal Oaks Parkway truck restrictions	Stakeholder Input
1801 West End Avenue	Phase I of Study
Projects to be more "river friendly"	Stakeholder Input

Regional Freight / Land Use Plan, Addressing Encroachment & Conflict Issues

Land use issues are major components of both Phase I and Phase II of this study. Several stakeholders have complained about conflicts between freight and residential land uses. For example, CSX identified issues about residential construction near the Radnor Yard and the inability to navigate zoning issues to establish a new location for its auto handling operations in Smyrna. A representative from a small package delivery company complained about safety issues associated with a school near the company's terminal. Large housing developments are also planned near the company's terminal. Potential policy initiatives have been discussed in both Phase I and in Technical Memo #5 in greater detail and the following discussions are brief descriptions of those more detailed discussions. Among these are as follows (see Phase I study document and Technical Memo #5 for additional information):

- Establishment of buffer zones between industrial areas and other land uses
- Freight villages
- Development review process for freight
- Key truck corridors
- Design standards for freight infrastructure

<u>Buffer Zones</u>

Zoning Buffers can be utilized to address incompatible uses when any commercial, industrial, or office zoning district abuts a residential district. A Zoning Buffer is an area of natural vegetation or man-made construction which is intended to provide a visual and dimensional separation between dissimilar land uses. When a natural zoning buffer is impossible or undesirable, a structural zoning buffer can be required. A structural buffer is a visual screen created through construction of a decorative masonry wall, earthen berm, or combination of a wall with an earthen berm, which may be supplemented with vegetation, so as to present an opaque visual separation when viewed from one side to the other throughout the year. These buffers are generally at least 50' in depth to ensure proper screening with specific information pertaining to the design of these zoning buffers. This is another excellent provision that seeks to protect against undesirable combination of land uses.

The counties within the region all address the need to provide a buffer between competing or different land use designations. In each instance, specifics regarding the size and opacity of the buffer are designated. The following table presents the identified code and introductory verbiage. More detailed information is available upon further review of the ordinance.

COUNTY	CODE ID	CODE LABEL	GENERAL CODE INFORMATION
Davidson	17.24	LANSCAPING, BUFFERING, AND TREE REPLACEMENT	The purpose of this article is to protect the value and integrity of property from the potential adverse effects of noncompatible land uses. To that end, this article requires that landscape buffer yards be provided at the boundaries of selected zoning districts. The landscape buffer yard standards of this article are also employed by other chapters of this title to accomplish special screening and buffering objectives. The width of the landscape buffer yard and the intensity of plantings required may vary depending upon the relative intensities of the abutting zone districts or the activity itself. In most cases, the property owner may choose among a number of buffer yard widths and plantings to satisfy the requirement.
Robertson		BUFFER STRIP	A greenbelt planted strip not less than fifteen (15) feet in width. Such a greenbelt shall be composed of one (1) row of evergreen trees, spaced not more than forty (40) feet apart and not less than two (2) rows of shrubs or hedges, one on each side of the evergreen trees, spaced not more than five (5) feet apart and which grow to a height of five (5) feet or more after one (1) full growing season and which shrubs will eventually grow to not less than ten (10) feet.
Rutherford	13.02	LANDSCAPE AND BUFFER YARD REGULATIONS (amended March 11, 2010)	The purpose of this article is to provide landscaping regulations that will enhance the environment and visual character as development occurs within the county. The preservation of existing trees and vegetation, and the planting of new trees and vegetation will protect public and private investments, and promote high-quality development. Areas of transition will be created between land uses, in order to minimize adverse visual impacts, noise, light and air pollution.
Sumner	13.04	TRANSITIONAL BUFFERYARD DESIGN STANDARDS	The bufferyard and screening provisions are included in this section to improve the physical appearance of the community; to improve the environmental performance of new development by contributing to the abatement of heat, glare, or noise and by promoting natural percolation of storm water and improvement of air quality; to buffer potentially incompatible land uses from one another; and to conserve the value of property and neighborhoods within the City.
Williamson	7400	BUFFERYARD PERFORMANCE STANDARDS	A bufferyard is a combination of setback and visual buffer or barrier. It includes a yard or area together with the planting and/or barrier that are required to eliminate or reduce existing or potential nuisances. These nuisances can occur between adjacent zoning districts, between different development options within the same zoning district, along roads, or between uses. Potential nuisances are dirt, litter, noise, glare of lights, signs, and unsightly buildings or parking areas, or to provide spacing to reduce adverse impacts of noise, odor, or danger from fires or explosions.

COUNTY	CODE ID	CODE LABEL	GENERAL CODE INFORMATION
Wilson	3.55	SITE DEVELOPMENT AND LANDSCAPING STANDARDS for COMMERCIAL and INDUSTRIAL ZONE DISTRICTS (resolution # 04-12-17)	Where a commercial or industrial use of property abuts a residential or agricultural zone district; a landscape buffer area with a minimum width of 10' shall be incorporated along the edges of the property adjacent to the agricultural/ residential zone district. This buffer shall be planted entirely within the confines of the commercial industrial parcel. Furthermore, this buffer shall include broadleaf and coniferous evergreen and semi-evergreen species. Evergreen trees shall be planted at 30' centers with a 5' offset. Said trees shall be tall enough in height at time of planting to provide an effective screen. Other evergreen/semi-evergreen shrubs and /or small deciduous ornamental trees shall be planted in the buffer between each of the evergreen trees planted. Cedar trees should not be used unless they already exist on site due to their difficulty establishing trough transplant. The Planning Commission may allow existing vegetation to meet or partially meet this requirement if it is deemed that the existing vegetation meets the intent of this part. If loading/distribution/stock loading areas are visible from the road, a landscape area at least 10' wide shall be installed along the viewable sides of the loading dock and shall include trees and shrubs planted at 20' centers.

Nashville also requires buffers through land use policy by the designation of a land use transition or buffer. "This category includes uses that provide a transition from intense commercial activity to a more residential character. Uses should be residential in overall scale, character, and function, but may have a limited commercial or mixed-use component. In the absence of a directly applicable zoning district, these areas should be zoned OR20, or less intensive, to provide for limited commercial components. In addition, until a more appropriate zoning ordinance can be implemented, the Planned Unit Development and Urban Design Overlay options should be required for any development to help regulate size, use, and compatibility."[1]

Recommendations Regarding Buffer Zones:

- Standardize Buffer Zone Requirements: An effort should be made to maintain consistent ordinances across the region, thus providing freight interests with predictable requirements.
- Graduating Land Use Designation: With concentration of like designated parcels comes the ability to graduate land use and continue the lessening need for buffering. Identifying freight intensive activities, like industrial and warehouse and distribution facilities, and grouping them into locations conducive for freight movement (high level of access to primary regional roadways, access to intermodal facilities, etc.) can help reduce the need for buffering between incompatible uses. However, conscious efforts are required by local governments to prevent uses that are incompatible with freight, like residential, from being

[1] Land Use Policy Application: Land Use Categories and How to Use Them, MPC of Nashville and Davidson County, Tennessee, Adopted May 27, 2004

permitted in areas adjacent to the freight intensive areas. This can further be enhanced by future designation of parcels surrounding the established heavier freight intensive groupings as heavy or medium freight intensive only. This leads to the discussion of freight villages.

Freight Villages

The WD zoning classification can be used to support freight intensive developments. This classification can be used to cluster warehouse and distribution activities around specific areas that make operational sense. Such clustering can also provide the basis for the development of the freight village. The creation of a zoning classification specifically designed to accommodate W&D developments would greatly enhance the ability of the Nashville area to properly locate these types of developments along with proper buffering and transitional uses. Freight generators and WD zoning designations should not be placed in large open areas with inadequate access to truck routes.

There are many benefits to defining a specific zoning classification for freight village types of development. The model definition of a freight village is where:

- All modes are represented;
- Land prices are not as high as general commercial properties;
- Adequate land is developable;
- Facilities are accessible by local arterials for local distribution;
- Facilities have good access to interstate routes and freeways for regional and national distribution;
- Accessible to rail facilities, directly tied to a Class I railroad main line;
- Accessible to an airport (with frequent service to domestic and international cities); and,
- Accessible to a port offering a wide variety of materials handling options.

It is recommended that jurisdictions within the Nashville region adopt a freight village designation and coordinate on establishing specific areas that can be designated as freight villages. Preferably, these would be located in close proximity, not just to major highway connections, but also to intermodal locations. One potential location in Wilson County along State Route 840 is discussed in more detail in Tech Memo 5.

Development Review Process for Freight

As pointed out in Phase I of this study, the Metropolitan Planning Commission of Nashville and Davidson County has developed land use policy categories and guidance for how policies should be applied. The purpose of the policy guidance is to assist the "development of community (sub-area) plans and to provide direction for implementation tools such as zoning." The policy guidance has "Special District" categories that are to be applied to areas that are of narrow or specialized in function. Under the "Special

Districts" heading the policy guidance has two categories applicable to freight intensive land use: "Industrial and Distribution" and "Major Transportation."

Industrial and Distribution (IND) is a policy category designed to provide for existing and future areas of industrial and distribution development. Most types of industrial and distribution uses are found in this policy category including storage, business centers, wholesale centers and manufacturing. Certain support uses such as sales, service, and office facilities will also be present in IND areas. Key expectations for IND area development include:

- Good accessibility is essential for IND areas due to the high volumes of overall traffic generated by those uses and/or the high volumes of truck traffic they may generate.
- IND areas may emerge as a collection of unrelated developments or as a single industrial park. Because industrial parks make more efficient use of scarce industrial sites, their development is preferred in IND areas, although it is expected that individual uses will likely develop within the industrial park.

Major Transportation (MT) is a policy category designed to accommodate planned and existing major transportation facilities and their surrounding areas. Airports, rail switch yards, ports, and other uses of this type are considered major transportation facilities. MT areas also contain uses related to the primary transportation facilities, such as warehousing and distribution activities. Key expectations for MT area development include:

- Good accessibility is of particular importance to MT areas due to the high volumes of overall traffic generated by uses in these areas and/or the high volumes of large truck traffic they may generate.
- Special consideration should be given to the impacts of airports on surrounding neighborhoods and other noise-sensitive uses. Sub-area plans should be designed to mitigate the effects of airport noise by establishing less noise-sensitive policy under the flight paths, where practical.

Guidelines for Applying Major Transportation (MT) Policy include the following:

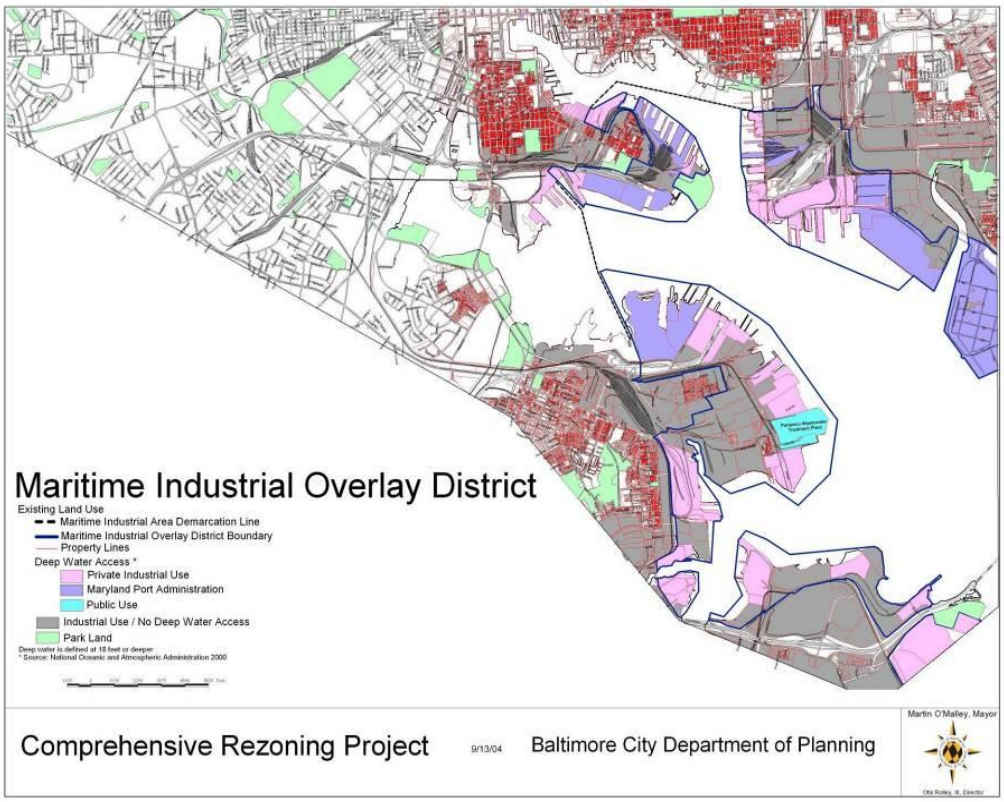
- Preferably, MT areas should have direct access to arterial streets with at least four lanes and also have access to the freeway system. Access through residential policy areas should be avoided.
- Since MT uses have exacting location requirements, and MT policy is likely to be applied to relatively few locations, application of MT policy should be favored over other potential land use categories that could be applied to areas surround major transportation facilities.[2]

[2] Metropolitan Planning Commission of Nashville and Davidson County: *"Land Use Policy Application: Land Use Categories and How to Use Them"* Adopted May 27, 2004.

Recommendations regarding review process for freight:

- Adoption of the two zoning categories just described, should be considered across the region in the Nashville Area to ensure consistent development patterns to accommodate freight. A review of policies and ordinances across the counties suggest that the Industrial District designation in Robertson County does include allowances for trucking and warehousing/distribution uses. Within the Industrial designation for land uses in Rutherford County, there is a Transportation subdesignation.
- Defined process for the re-designation of a freight intensive designated parcel to non-freight intensive uses (e.g. residential): The re-designation of a freight intensive designated parcel within a single jurisdiction may have unintended consequences to the other jurisdictions in the region or the region. It is recommended that proposed changes within each of the MPO's member jurisdictions be vetted to identify potential consequences. An MPO level entity serving this purpose would not supersede the local jurisdiction's authority unless structured to do so. The re-designation of a previously freight intensive parcel could prompt industries to relocate. A more regional perspective could enable the region to assess the impact of a re-designation on transportation networks, community quality of life issues, as well as the potential to remarket freight-intensive activities to other locations within the region. MPOs and RPOs in other regions entities have developed binding processes which bar certain parcels from being re-designated. The Baltimore Maritime Industrial Zone Overlay District (MIZOD) (**EXHIBIT 4**) designated that parcels adjacent to the Port of Baltimore must remain heavy industrial. The Nashville MPO may not be presented with such a clearly defined re-designation concern, yet the overall benefit of this process would be to link the region in a manner which fosters a regional approach to local jurisdictional growth needs, e.g. residential, economic, and transportation. This collaborative approach may provide a precedence to foster other regional initiatives to assist local jurisdictional in meeting their needs while promoting the regional view.

EXHIBIT 4: BALTIMORE MARITIME INDUSTRIAL ZONE OVERLAY DISTRICT



Source: City and Port of Baltimore

Policy / Legislation in Support of Transcontinental Railroad Mergers

This policy was proposed in Phase I of this study in response to the region's awkward location in the rail network. Nashville is too close to Memphis, where eastern and western rail carriers interchange. UP and BNSF handle a majority of rail traffic west of the Mississippi River, while CSX and NS handle the majority of U.S. rail traffic east of the Mississippi River. Because of interchange fees, it often does not make sense to haul product to/from western locations past Memphis via rail. If CSX were to merge with a western carrier, this problem could be minimized. The combined CSX/UP or CSX/BNSF would not need to interchange in Memphis and would more easily haul freight directly to and from Nashville.

Under the scenario of a transcontinental merger, CSX or NS would merge with UP or BNSF. The remaining two carriers would soon after merge to remain competitive with the new transcontinental railroad. Not all industry watchers agree that transcontinental railroad mergers are inevitable nor would be positive developments. The last two major railroad mergers were the UP purchase of the Southern Pacific Railroad (SP) in 1996 and the CSX/NS purchase of Conrail in 1999. Each of these mergers was accompanied by

extensive service disruptions. Some are skeptical of the feasibility of a carrier managing and attempting to integrate a combined rail network of a fully transcontinental carrier. Others fear the market power that two massive transcontinental rail carriers could exercise.

The Nashville region would unlikely gain competitive access to another carrier as a result of a transcontinental rail merger. In past mergers trackage rights were granted only in cases where shippers had been served by both carriers prior to the merger. Because Nashville is only served by CSX and no western carriers, it would be unlikely to gain new competitive access. It is recommended that this proposal be dropped.

Truck Right-Lane Policy Review

A stakeholder suggested that the policy of requiring trucks to use only the right lane on four-lane roadways should be reviewed. It is not recommended that this policy be pursued. Several studies in Texas and in Florida have found that truck lane restrictions do not significantly harm truck transit times nor harm highway operations. However, they can have safety benefits and reduce the frequency of improper lane changes.[3] Given that lane restrictions do little harm but generate benefits, there is little reason to eliminate them.

Truck Access to Pick Up and Delivery Locations

This concern was raised by a representative from a less-than-truckload motor carrier. He mentioned that downtown Nashville is difficult to maneuver and not conducive to using tractor-trailers. Roads are narrow with a lot of cross-traffic, and the area is congested. The company has a straight truck that they use when entering downtown but availability of loading docks is an issue. As mentioned in Phase I of this study, the publishing industry is important to the Nashville area and the industry is relatively concentrated in downtown Nashville. Delivery schedules for this industry are time-sensitive. It is important that less-than-truckload, small package, and other types of motor carriers have quick access to locations within downtown Nashville to serve time-sensitive industries such as publishing.

Cities and regions have implemented a variety of solutions to address the issue of urban goods movement. Among these are the following:

- Roadway Design – Cities look at specific problem areas where the volume of truck traffic is high and where intersections and roadway lanes are unable to

[3] Texas Transportation Institute for the Texas Department of Transportation and the Federal Highway Administration, *Monitoring of Texas Vehicle Lane Restrictions;* Renata Musa of Florida A&M University for the Florida Department of Transportation, *Safety and Operational Evaluation of Truck Lane Restrictions on I-75*, 2004.

properly accommodate trucks. These are addressed on a case by case basis. Problem locations are identified by traffic counts, stakeholder input, and observation. A similar exercise is included within the current study in that stakeholders have identified locations of potential roadway design problems. Other problem areas for trucks have been identified through traffic modeling or empirical observation by study team members.

- Building Codes/Enforcement – Cities have building codes that specify a required number of loading bays. Usually, this is expressed in loading bays per million square feet. These ordinances are established to ensure adequate off-street parking in downtown areas. A report for the City of Seattle, WA suggested additional regulations, such as separate dumpster areas (dumpsters often block loading areas), increased requirements for buildings that have restaurants or retail, incentives for buildings that provide above the minimum loading zones, and sharing loading bays across buildings.[4] It is also important that restrictions of parking in alleys be enforced. Carriers frequently find alleyways blocked by illegally parked cars and are unable to reach loading bays. A specific circumstance was mentioned in Phase I of this study, where Arcade Alley by 424 Church Street is often impassable for FedEx drivers. The alley is narrow, and the situation is made worse by parked cars.
- On-Street Loading Zones/Enforcement – Studies suggest that downtown areas should make available at least one on-street loading zone per block and more in "hot spots." Loading zones are best located near alleys or at street corners, where trucks can have access to the inside of city blocks and where they will not be hemmed in at the front and back by cars. Loading zones must be clearly marked and should be rigorously enforced. It must be clear for what vehicle types loading zones are intended. Loading zones should be at least 30 feet long. Some cities have been experimenting with systems to ensure adequate turnover of loading zones, such as metering systems. Other cities are considering loading zone monitoring systems, so that trucks would know when and where spaces are available for loading/unloading by an Internet site or other means. Loading zones in downtown Nashville were identified as an issue in Phase I of this study. For example, a FedEx driver mentioned that contractors and utility trucks often occupy loading areas, so that actual freight deliveries are blocked.
- Designated truck routes – Orlando, for example, has limited trucks entering the downtown to four north-south roadways. Trucks are required to keep on these roadways as close as possible to their pick-up or delivery location before accessing east/west roadways. The signal timing and road geometries on the

[4] Edwards & Kelsey, *Chicago Downtown Freight Study*

designated truck routes are better suited for trucks than other north-south roadways in downtown Orlando.

On and Off Street Loading Areas

The availability of loading spaces is a major issue in densely developed downtown areas. Within the region, this issue impacts downtown Nashville the most. The Metropolitan Government of Nashville and Davidson County has established the number of loading spaces required for each land use classification of the zoning code in Nashville Municipal Code: 17.20.130.

Land Use	Gross Floor Area (Square Feet)	Loading Spaces (10 by 25 feet)	Loading Spaces (10 by 50 feet)
Institutional,	10,000—99,999	1	0
educational, medical,	100,000—149,999	0	1
communication, office	150,000 and over	0	2
Commercial,	2,000—9,999	1	0
recreational and	10,000—25,000	0	1
entertainment	Over 25,000	0	2
Industrial,	0—1,999	1	0
transportation, utility,	2,000—10,000	0	1
waste management	Over 10,000	0	2
Other uses	Based on a recommendation from the traffic and parking engineer subject to approval by the zoning administrator.		

Other city ordinances specify the dimensions of loading areas, the setback of loading areas so that they do not interfere with off-street parking areas or public right-of-ways. Other ordinances dictate that vehicles are not to park within alleys, except to load or unload.

Recommendations regarding loading zones:
The MPO in coordination with participating local governments and agencies should consider a regional study that results in a recommended or “model” ordinance for on-street and off-street parking as it relates to loading and unloading freight and goods. This ordinance could then be used by local city and county governments as a starting point to customize for their own use.

Toll Studies

Two stakeholders suggested that construction of roadway infrastructure could be accelerated if new roads were funded by user fees. The extension of SR 840 around the northern half of the Nashville region was mentioned as a potential candidate. The policy of exploring toll options will be appropriate if Nashville is unable to fund transportation projects fast enough to keep up with demand through existing or alternate funding options. On the other hand, many people are resistant to tolling and consider it to be double taxation. Furthermore, tolling can sometimes create inefficient roadway usage patterns, where trucks travel on local roadways or circuitous routes to avoid tolls.

In 2007 Tennessee passed legislation to allow toll roads to be constructed as an alternative to the traditional "pay as you go" funding strategy. The legislation specifies that only new roads can be funded by tolls and no existing roads will be subject to tolling.

Data from the Texas Transportation Institute (TTI) suggests that the region's transportation investments have not been able to keep pace with the region's growth. Congestion in the region is worse than in similarly sized metropolitan areas and has become worse over the past several decades.[5] For example, of 31 metropolitan areas with populations between 500,000 and one million in 2007, the region had the fourth highest congestion. The average annual delay per traveler is 37 hours in Nashville compared to an average of 23 hours for similarly sized cities. The average annual delay has changed little since 1997 but is up from 20 hours in 1982.

Because of funding issues, the region commissioned the *Regional Transportation Funding – A Strategic Review* in 2002.[6] The report stated that transportation in the region is underfunded and that there is no dedicated transportation funding mechanism. Therefore, transportation must compete with other expenditures, such as education, etc. The report stated that the political climate is hostile to new taxes or tax increases. Five potential funding sources were put forward:

- County wheel tax
- Increased sales tax
- Vehicle emissions fees
- Regional option tax
- Development fees and benefit assessment district.

Further complicating funding of road projects in Tennessee is the fact that the gasoline tax of 21.4 cents per gallon has not increased since 1989. In 2010, the gasoline tax is expected to yield $659.4 million of which $393 million goes to TDOT for road maintenance and new projects. Due to the tax having not increased since 1989, the

[5] Texas Transportation Institute, *Urban Mobility Report*, July 2009
[6] ICF Consulting, *Regional Transportation Funding – A Strategic Review*, July 19, 2002

amount of funds available effectively gets reduced each year due to inflation costs related to road repair and new construction materials.

Dedicated Truck Lanes

This idea was mentioned by a logistics company. Dedicated truck lanes (DTL) are highway lanes that are restricted to trucks of three or more axles. They can be tolled or not. They can provide safety benefits, since for example, 98 percent of fatalities involving accidents between trucks and automobiles are the automobile occupants.[7] DTL's can also provide trucks with faster and more reliable transit times, and the potential to operate high productivity vehicles (HPVs). HPVs include trucks that have larger size or weight than would be permitted on mixed use facilities. It would be necessary to have more information on which specific roadway(s) would have DTLs in order to evaluate this project's potential, therefore, additional study specific to DTLs is recommended.

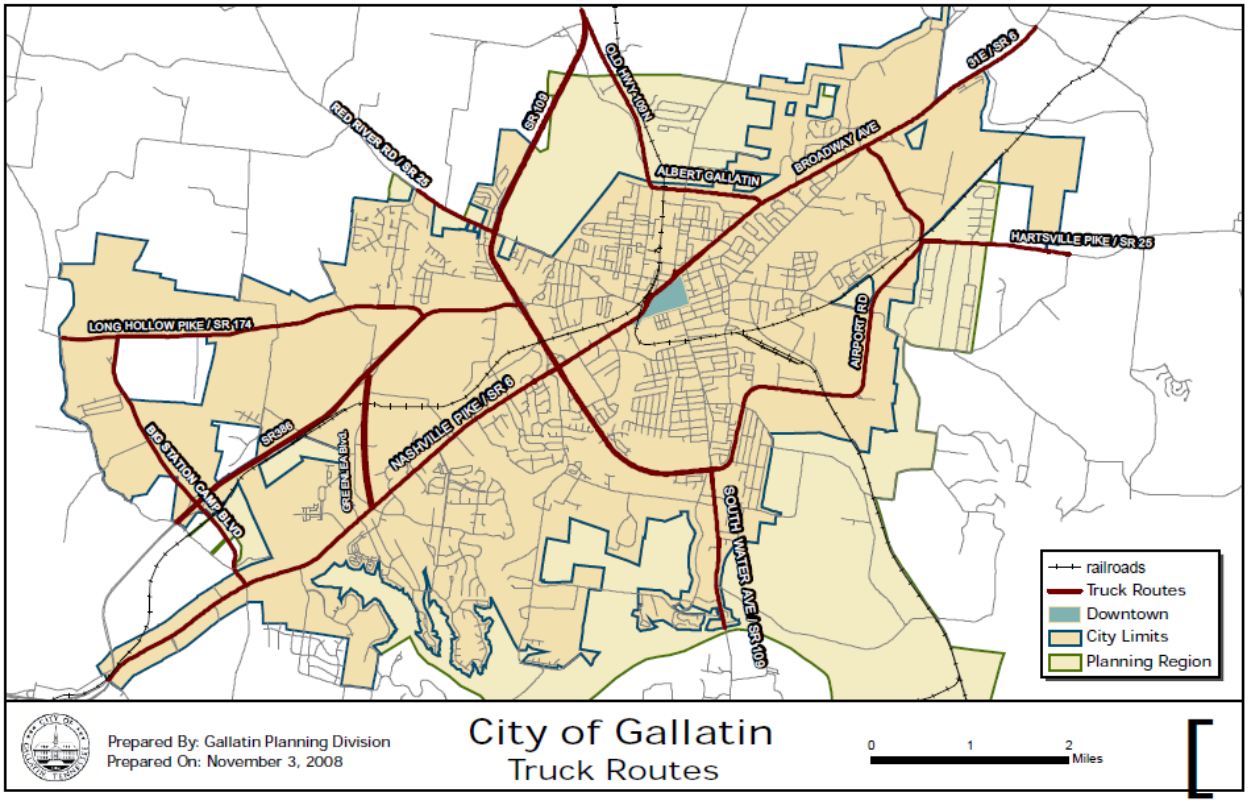
Truck Route Study

Truck route studies are often initiated by areas that currently have a patchwork of truck restrictions but would like a comprehensive solution to routing trucks within an area. Sometimes the studies are initiated in response to complaints about trucks passing through residential or other sensitive areas. Generally, the goal is to route truck traffic as efficiently on the best suited infrastructure as possible, but also to keep trucks out of sensitive areas. As noted in *Technical Memo 3: Existing Trends and Conditions* to this study, a designated truck route network requires data analysis, evaluating not only traffic, but safety data, road design, land use, and environmental justice issues. Cooperation among key players in the public and private sectors within the communities of the region is important. Establishing dedicated truck routes also entails developing a strategy regarding signage and communication of the truck route location, and local ordinances to enforce the truck routing.

The Nashville region has several smaller communities that have designated truck routes of some significance. Nashville and the inclusive jurisdictions of the region do not provide a truck route system. The City of Gallatin is one such municipality that does supply a system to the trucking community.

[7] Wilbur Smith Associates, *I-70 Dedicated Truck Lane Feasibility Study, Phase I Final Report*, June 2010

EXHIBIT 5: CITY OF GALLATIN TRUCK ROUTES



Recommendation regarding key truck corridors

The region should consider combining truck route systems of the various constituent communities to develop an overall regional truck route system.

Elliston Place: Double Parking Trucks

The study team in Phase I noticed that trucks tend to double-park on the center turn lane while making deliveries. This causes congestion, since cars must then turn from a single travel lane. The Phase I analysis suggested that the region conduct a study to determine alternate loading zone areas that can be identified, coordinate with vendors, store owners, and Metro Public Works. This study is still recommended.

South Royal Oaks Parkway, Franklin between Highway 96 and Mack Hatcher Parkway – Truck Restrictions

A representative from FedEx Freight felt that allowing trucks to use this roadway segment would allow truck traffic faster access to a truck bypass (SR 397/Mack Hatcher Parkway) and would alleviate traffic on Highway 96. The City of Franklin Municipal Code restricts trucks along this route. In order to accomplish the recommendation, the municipal code will need to be revised. The City of Franklin

should conduct a study of the impacts to local roads if they were to allow non-local delivery trucks to utilize routes other than those specified in the city code.

1801 West End Ave – Short Loading Dock

In Phase I of this study, a FedEx driver mentioned that the apron in front of the loading dock at this location is too short. Therefore, a 28-foot trailer blocks the travel lane on the Avenue. This requires cooperation from the private sector. It is due to an error in a site plan review and efforts to retrofit the loading dock should be made if the site is redeveloped in the future.

Projects to be More "River Friendly"

A representative from Ingram Barge Company mentioned that the region could be more "river friendly." The area does not have a port authority to coordinate port developments and to market the region's maritime infrastructure. On the other hand, the maritime activities in the region are dominated by a single company, Ingram Barge. The region may want to consider establishing a port authority, but preferable for a port authority would be to benefit a range of shippers and carriers instead of a single company.

The Nashville Metro Parks and Recreation Department and the U.S. Army Corps of Engineers worked with the Nashville Civic Design Center to create a Nashville Riverfront Redevelopment Master Plan. This study focused on riverfront development and recreational opportunities. Feedback from barge stakeholders suggests that riverfront redevelopment efforts have included involvement by the commercial operators on the Cumberland River, and several design suggestions to minimize conflicts between commercial traffic and others have been accepted. The region should continue to involve freight operators in these redevelopment efforts.

RAIL OPERATIONS/INFRASTRUCTURE PROJECTS

EXHIBIT 6 is a listing of potential rail projects. The nature of these projects, as well as their screening is discussed in more detail below.

EXHIBIT 6 – POTENTIAL RAIL PROJECTS

Project	Source
East/West line – cooperative use of infrastructure by the Class I roads thereafter might open a competitive rail corridor along I-40 and I-81.	Phase I of Study
Reintroduction of sprint train service on the Atlanta-Nashville-Chicago line	Phase I of Study
New east/west (I-40) rail corridor	Stakeholder Input
Vine Hill bulk commodity terminal for rock, sand, stone/aggregate shipment	Stakeholder Input
Radnor Yard alternatives	Stakeholder Input

East/West Line – Cooperative Use of Infrastructure by Class I Railroads

This idea was presented in Phase I of this study. Competitive access is a major issue for the Nashville region. The region would be better off if served by multiple Class I rail carriers. Shippers would have more shipping options and potentially better railroad rates. A case would need to be made to CSX that it would be in the company's best interests to grant another carrier access over its lines through a trackage or haulage rights agreement. Presumably, CSX would be forced to provide access as a result of a transcontinental railroad merger (unlikely as discussed before) or CSX would need to be granted inducement such that it would voluntarily provide access over its line. This proposal is probably not worth pursuing at this time as it is unlikely to occur due to the CSX lines in the region being capacity restrained.

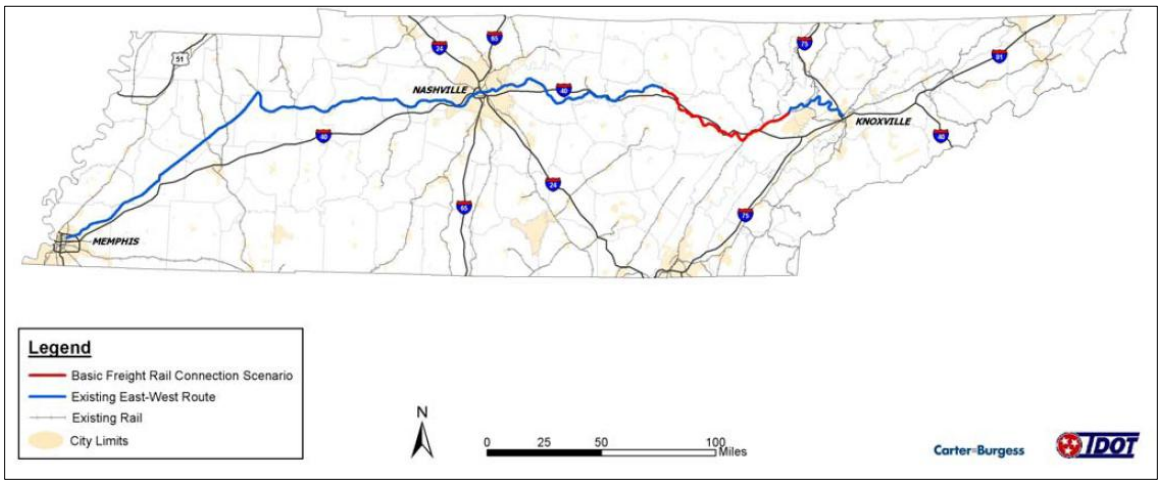
Reintroduction of Sprint Train Service

This idea was presented in Phase I of this study. "Sprint train" refers to highly expedited intermodal container rail service. These trains provide faster and more reliable service than what railroads typically offer. Railroads can charge a premium for this service, but it is also costly to railroads. These expedited trains must be given dispatching priority, thus slowing other trains. In 2004 Union Pacific Railroad walked away from providing expedited service to United Parcel Service (UPS) on the carrier's "Sunset Route" between Los Angeles and Chicago. The service was found to be too costly and to have deteriorated UP's ability to serve other shippers. A reintroduction of sprint train service between Chicago and Atlanta through Nashville would require discussions with CSX.

New East/West I-40 Rail Corridor

The concept of an east-west corridor was presented in the *2002 Tennessee State Rail Plan*, but was also mentioned by stakeholders in the current study. Two potential alignments were considered in the 2002 Rail Plan, the Basic Freight Rail Connection, and the Planning Horizon Connection.[8] The purpose of the Basic Freight Rail Connection is to propose an alignment that would make the maximum use of existing rail infrastructure and cost the least to implement. This alignment would require 46 miles of new construction, 15 miles of track improvement, and utilize approximately 23 miles of existing Norfolk Southern mainline between Algood and Oliver Springs. It would follow Interstate 40, running east-west through the communities of Algood, Monterey, Crossville, Crab Orchard, Rockwood, Harriman, Everton, Blair, and Kelley Town, to end in Oliver Springs, TN. The alignment would use dark territory operations. [9]

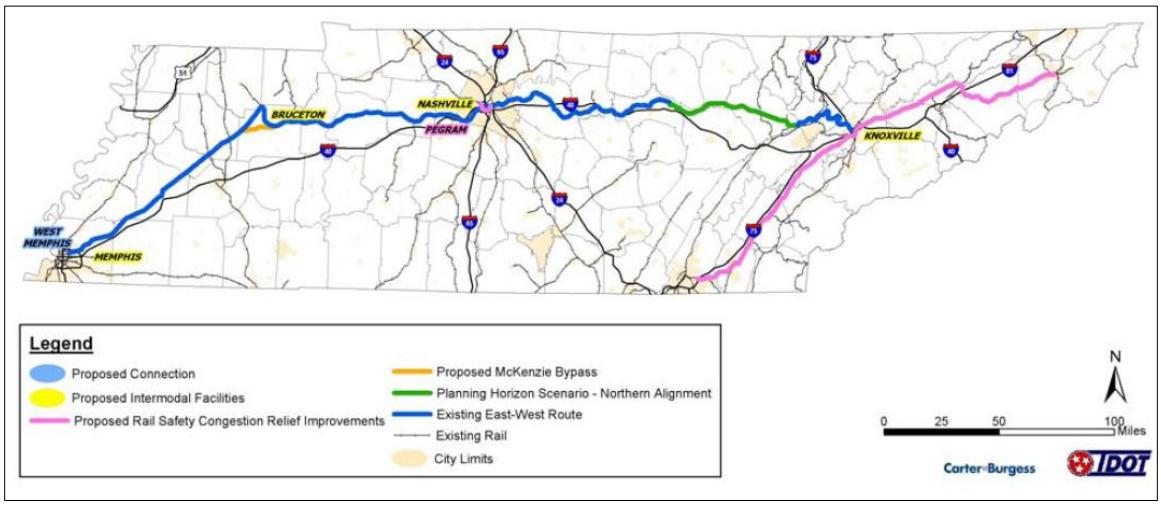
EXHIBIT 7 – BASIC FREIGHT RAIL CONNECTION



The Planning Horizon Connection is envisioned as an optimally configured corridor, which would provide higher speed and shorter distance when compared to other potential alignments. The corridor would be used for both passenger and freight operations and it would provide the opportunity for rail to compete with the interstate highway corridor in terms of speed, time, and comfort for both passenger and freight operations. The corridor would be a component of a multi-state effort resulting in a high capacity corridor running from Memphis through Virginia to points in the Northeast. The alignment would pass between Oliver Springs and Algood, TN with a bypass south of McKenzie. The entire route would operate with Centralized Traffic Control (CTC).

[8] Don Breazeale & Associates with Carter Burgess for the Tennessee Department of Transportation, *Task 8: Evaluation of Rail Infrastructure Proposals*, September 2002
[9] A series of rail miles ungoverned by signals. Trains in dark territory are typically directed by verbal authority from a dispatcher.

EXHIBIT 8 – PLANNING HORIZON CONNECTION



Multiple benefit/cost ratios have been put forward for the two east/west rail line scenarios. The 2002 TDOT Rail Plan calculated a benefit/cost ratio of 1.19 for the Basic Freight Rail Connection. This analysis focused on the benefits of shifting freight from the truck to the rail mode. Almost two thirds of the benefit would be derived by shipping cost savings as freight moves by rail at lower cost. Other benefits would be derived from improvements to rail operations, reduction in the cost of maintaining highways, accident cost savings, highway congestion relief, and state fees/revenues.

For the Planning Horizon Connection alternative, researchers presented a range of possible scenarios, depending upon the likely diversion of freight from truck to rail. The project was estimated to have a benefit/cost ratio in excess of one if at least 10 percent of potentially divertible for-hire truck traffic and five percent of potentially divertible private fleet traffic were to shift to rail. If 40 percent of potential for hire and 20 percent of potential private fleet truck traffic were to shift to rail, the benefit/cost ratio would exceed four. The anticipated benefits from the Planning Horizon Connection resulted not only from freight shifting from truck to rail but also as a result of rail passenger service that would be provided along the corridor.

TDOT later contracted with the University of Tennessee's Center for Business and Economic Research (CBER) to evaluate the benefit/cost findings of the 2002 Rail Plan. The CBER study was completed in July 22, 2005.[10] In addition to recalculating anticipated benefits of the Planning Horizon Connection alternative, the CBER study also allocated benefits to specific regions, including Memphis, Nashville, Knoxville, and Other regions. This study developed a detailed set of cost models and rules by which to identify traffic that would divert to rail. The models compared the relative costs to shippers of using the Trans-Tennessee Rail corridor compared to other transportation options, such as trucking freight along I-81 and I-40. If the Trans-Tennessee Rail

[10] *An Evaluation of the Tennessee Rail Plan's Treatment of the Trans-Tennessee Rail Routing*, Center for Business and Economic Research, College of Business Administration, The University of Tennessee, July 22, 2005.

corridor provided a less expensive option, traffic was assumed to divert to the corridor. The CBER study found that the projected benefits of the Planning Horizon Connection would be less than the costs of the project. With a three percent discount rate, the base case benefit/cost ratio would be 0.987, while the base case benefit/cost ratio using a seven percent discount rate would be 0.410. The study found that the Nashville region would derive less than 10 percent of the benefits of the project. Other scenarios were found to have worse benefit/cost ratios.

A more recent report by Younger Associates for a group of sponsors that include not only TDOT, but also several counties, chambers of commerce, and the Nashville and Eastern Rail Corporation found that a trans-Tennessee rail corridor would have a benefit/cost ratio in excess of one. Benefits outweigh the costs.[11] This study focused specifically on the construction of a rail line to close a 45 mile gap in rail service across the Cumberland Plateau. This analysis did not consider additional improvements to existing rail lines that were included as part of the Planning Horizon Connection in the 2002 Rail Plan.

Two scenarios were considered. The "Northern Alignment" is similar to the new rail line envisioned in the Planning Horizon Connection of the 2002 Rail Plan, but shorter. Since the rail plan, the Nashville & Eastern Railroad (NERR) has reestablished service to Monterey. The study team also identified a location where the new line could be shorted by connection to the NS in Lansing. The "Southern Alignment" is similar to the "Southern Improved Alignment" proposed in the TDOT after publication of the 2002 Rail Plan. This is similar to the alignment that appeared in the Basic Freight Rail Connection of the 2002 Rail Plan. However, it is "improved" because costs have been reduced by placing the alignment on the wide median of I-40 between US-70N near Monterrey and US-127 near Crossville.

The Younger Associates study used a "business strategy" approach to estimate the likely usage of the rail line were the connection to be built. By this approach, 243 responses were received to a survey that was sent to companies within the area surrounding the proposed alignment. The surveys, combined with expert judgment from NERR management, were used to assess the likelihood that prospective customers would use the new alignment. The study assumed that a new Triple Crown type facility would be built along the new alignment.[12] Through Triple Crown service, truck trailers are lifted onto sets of railcar wheels or "bogeys" to become part of a train. This type of equipment is referred to as "bimodal" because the same equipment is used in both rail and truck service. Bimodal terminals can be built with lower investment than traditional container on flatcar or trailer on flatcar (COFC/TOFC) intermodal terminals.

The Younger Associates study yielded a benefit/cost ratio of 1.37 for the Northern Alignment and a ratio of 1.91 for the Southern Alignment.

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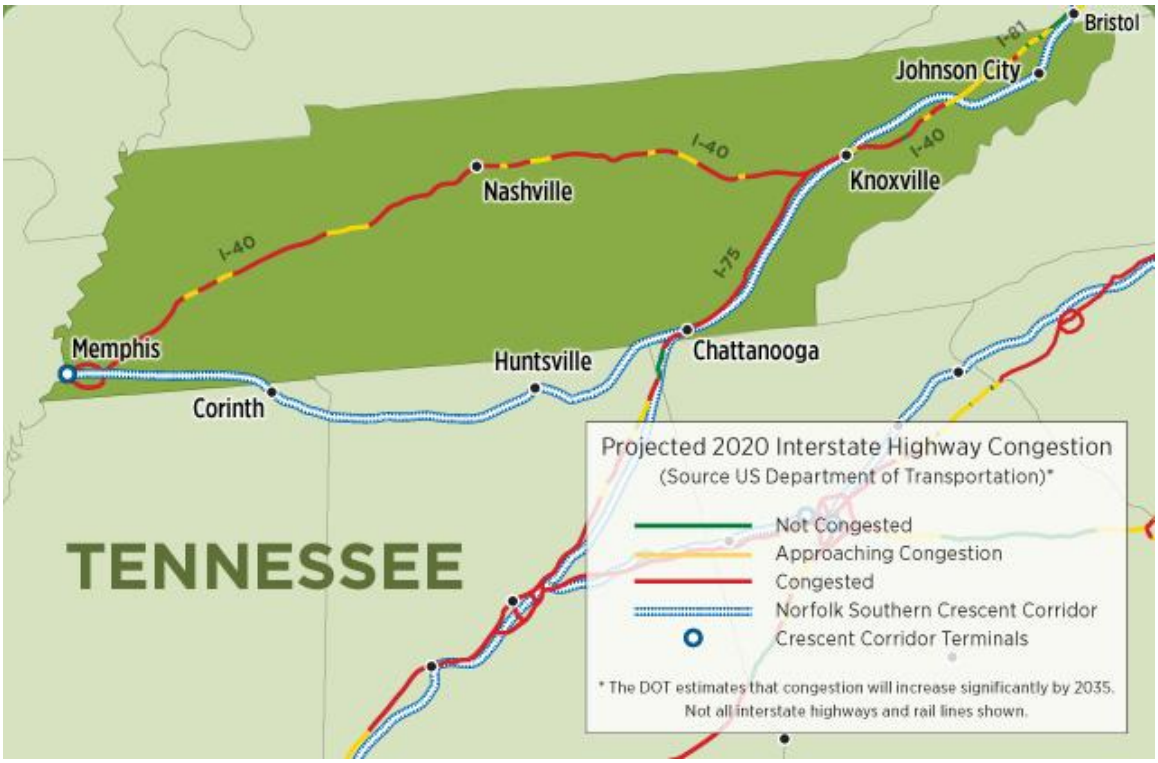
[11] *Analysis of Competitive Access Rail Extension Across the Tennessee Cumberland Plateau,* Younger Associates, January 2011.
[12] Triple Crown is a subsidiary of Norfolk Southern Corporation.

The *I-40/I-81 Corridor Feasibility Study, Task 4.0 Technical Memorandum* completed for TDOT in August 2008 mentioned a benefit/cost ratio of only 0.1 for the Planning Horizon Connection.[13] The low benefit/cost ratio was apparently derived by considering the entire $1.36 billion project cost but excluding all regional benefits or local highway benefits. Only those benefits occurring along the I-40/I-81 corridor were included. By contrast, the *I-40/I-81 Corridor Feasibility Study* assigned a benefit/cost ratio of 5.0 to the Crescent Corridor. The Crescent Corridor consists of a series of improvements to the existing NS rail line to the south of the proposed Trans-Tennessee Rail Corridor alternatives between Knoxville and Memphis.

EXHIBIT 9: NORFOLK SOUTHERN CRESCENT CORRIDOR IN TENNESSEE



Source: Norfolk Southern Corporation website

From the perspective of the Nashville region, a new Trans-Tennessee Rail Corridor would correct two major deficiencies to the region's rail network:

1. Lack of competitive access. Currently, CSX is the only Class I rail carrier that has access to the region. Competitive access would provide shippers with a wider range of transportation options and likely reduce average rail rates. Access in Nashville to the other major eastern Class I carrier, Norfolk Southern, would benefit local shippers. Currently, local shippers have access to markets on the CSX system. Cars can also be interchanged to the NS system, but interline service

[13] *I-40/I-81 Corridor Feasibility Study, Task 4.0 Technical Memorandum, Project Priorities – A Corridor Master Plan, Final Report*, August 2008.

can introduce delays and additional cost. Direct access to NS or access through the Nashville & Eastern would be preferable. Shippers generally enjoy lower rates at locations where multiple Class I railroads have access. For example, analyses of agricultural rail rates found that moving from a rail monopoly to duopoly at a corn-shipping point located 75 miles from water competition reduced rates by 17.4 percent.[14] Assuming an average revenue per ton of $30.72[15] on all inbound, and outbound traffic, and a lower rate reduction, say 10 percent, average savings would be $3.07 per ton. Multiplied by originating and terminating rail tonnage within the Nashville region, this would equal savings of about $13 million per year. These savings into perpetuity would have a net present value of about $433 million at a three percent discount rate and $186 million at a seven percent discount rate. However, these would only be "benefits" to the extent that CSX is forced to provide more efficient service in the face of competition. Rather it would represent transfer of pricing power from CSX to Nashville region shippers.

2. Absence of direct connection to the east. As an example, any shipper that currently would like to deliver commodities by rail from Nashville to Knoxville would need to use a highly circuitous rail connection, whereby trains run southwards through Stevenson, AL before turning northward through Chattanooga, TN and then to Knoxville. The Trans-Tennessee route would be at least 45 miles shorter. Direct access to Eastern Tennessee and to the NS Crescent Corridor significantly reduce the circuitry of rail routes to markets in eastern Tennessee, North Carolina, the Mid-Atlantic and the Northeast. According to data provided by IHS Global Insight to TDOT, the level of rail traffic between Nashville and locations that would be impacted by an eastern connection is now very low. Only about 301,000 tons travel by rail between the Nashville region and Virginia, North Carolina, the Mid Atlantic, and New England. However, this may in part be the result of poor rail connections. The presence of an eastern connection could open new rail opportunities for shippers within the Nashville region. Overall, the level of traffic between Tennessee and Virginia, North Carolina, the Mid Atlantic, and New England was about 6 million tons in 2007. With a new rail connect to the east, Nashville shippers may be able to benefit from new sources of supply and new customers that were not feasible to do business with before.

Conclusion: The Nashville region should support the creation of the Trans-Tennessee Rail Corridor initiative. Although not all of the impacts could be considered "benefits" per se, Nashville regional shippers would benefit from the competitive access that the

[14] James MacDonald, *Effects of Railroad Deregulation on Grain Transportation,* Commodity Economics Division, Economics Research Service, U.S. Department of Agriculture, 1989.
[15] Average revenue per ton from the Association of American Railroads, *Railroad Facts, 2009 Editions.*

project would supply, whether conceived as the Basic Freight Rail Connection or the Planning Horizon Connection. Some of the benefits may go beyond the diversion of traffic from truck to rail and result from new patterns of supply and demand that would be made available to Nashville region shippers. The region could try to have the segment between Knoxville and Nashville designated as part of the NS Crescent Corridor.

Vine Hill Bulk Commodity Terminal

The Nashville and Eastern Railroad (NERR) has a prospect to establish a truck/rail bulk transload facility at Vine Hill off of Visco Drive. The primary products handled would include rock and sand. NERR believes that a nearby zinc mine may be interested in using this facility. Total volume handled could be 250,000 tons per year, which would be diverted from the highway. Presumably, public involvement would include assistance with constructing the facility or roadway access to the facility.

Radnor Yard Alternatives

The space limitations at CSX Radnor Yard are potentially the region's most significant limiting factor in terms of the usage and growth of rail freight. One stakeholder mentioned that CSX has been deemphasizing Radnor Yard because it does not have enough room. Product is being trucked from Memphis or directly from ports because of space limitations at the rail yard. Currently, Radnor Yard is the area's only truck/rail container intermodal terminal, automobile loading/unloading area (Total Distribution Services, Inc. or TDSI), and a major railcar classification yard. The yard cannot be expanded because of the ownership and land use of adjoining properties.

In other metropolitan areas, rail carriers have moved their container intermodal terminals to the outskirts of cities in order to avoid congestion. One recent example of this tendency is the movement of the NS intermodal operations in Memphis from a landlocked location in the heart of Memphis to the city's outskirts in Fayette County. A potential project would include assistance to CSX in finding another location for some of the functions currently performed at Radnor Yard. The Nashville MPO should consider facilitating initial discussions with CSX to explore possibilities to relocate the intermodal ramp and TDSI. CSX has identified Smyrna as a logical location due to the high volume of intermodal traffic and the Nissan plant, which is a significant user of both intermodal and TDSI. A new site at the Nissan plant would require both a loop track and an entrance onto the CSX mainline. The movement of these facilities to a new combination yard would not only allow CSX to expand TDSI and intermodal operations to meet growing demand, but would also allow the classification yard at Radnor to expand into those areas formerly occupied by TDSI and the intermodal ramp.

MARITIME PROJECTS

Several potential maritime projects were put forward in the course of the study.

Project	Source
Rail access to Hailey's Harbor Terminal	Stakeholder Input
Container on Barge Service	Stakeholder Input

Rail Access to Hailey's Harbor Terminal

Hailey's Harbor Terminal is one of three public marine terminals within the Nashville area. It is located at mile post 180 of the Cumberland River. It is also located within close proximity to the Nashville & Western Railroad (N&W) rail line. The terminal handles about 400,000 tons of freight per year.

One stakeholder suggested that it would be a useful freight project to create a rail link between the Hailey's Harbor Terminal location and the nearby N&W line. A representative from Hailey's Harbor, Inc. confirmed that this would be a useful project and that the terminal would benefit from rail access. About 30,000 tons per year would enter and leave the terminal by rail if rail service were available. Most of this would be for local service. Significant state dollars have been spent to upgrade the N&W line, and the addition of this marine terminal to the shippers along the line could help to justify these expenditures.

EXHIBIT 10: HAILEY'S HARBOR MARINE TERMINAL

If a rail spur were built into the terminal, a "back of the envelope" estimate suggests that at least 1,600 feet of track would be needed for construction. At an estimated cost of $200 per foot plus a $150,000 turnout, the approximate total project cost would be $470,000.

Of course additional feasibility study and engineering is required to determine a more exact cost of construction.

Container on Barge

Another maritime opportunity mentioned for the Nashville region is container on barge. A variety of container on barge services could be offered. One logical service could be a container transfer between Memphis and Nashville. As containers arrive at the Memphis truck/rail intermodal ramps, they could be transferred to barge for furtherance to Nashville. Empty containers from Nashville could be repositioned by barge back to Memphis. Containers arriving at the CSX/CN intermodal ramp at the Frank C. Pidgeon Industrial Park in Memphis would particularly be well-situated for this type of transfer, since this intermodal ramp is located within close proximity to the International Port of Memphis. A Nashville – Memphis service could also be combined with an extension to the weekly Osprey Lines service between Memphis and New Orleans.

An analysis of relative costs suggests that a container on barge service between Memphis and Nashville could save shippers money. However, it is uncertain whether these savings would be sufficient to overcome the inconvenience of the service to shippers. Namely, instead of a requiring several hours to haul a container between the two regions, a container on barge service would require shippers to endure lead times of several days.

Discussions with drayage operators in the Memphis region suggest that it costs $600 plus 23 percent fuel surcharge (January 13, 2011), so $738 to ship a container from Memphis to Nashville. WSA estimates using barge operating expense data from the U.S. Army Corps of Engineers (USACE) suggests that the cost of the container on barge service to the shipper would be about $378 per container. This is based upon the following assumptions:

- 2,300 HP towboat
- Cost of operating towboat is $5,736 per day per USACE
- Cost of operating barge is $92 per day per USACE
- Operator profit margin is 10 percent
- Mileage is 475
- Average speed of barge is 7 mph
- Container capacity of barge is 72
- On average, loaded containers are two thirds of capacity, so 48 loaded containers per barge

While the resulting savings of $738 - $378 = $360 are substantial, the users of container on barge service would also need to bring their freights to the marine terminals by truck or rail. The viability of the service to shippers would depend upon the cost of transferring containers to the marine terminals.

One potential additional source of savings to shippers would be the potential to load containers above the legal limit for roadways. Generally, intermodal containers can be loaded with no more than 22.5 tons of freight for freight traveling over the road. According to a representative from Osprey Lines, their company can handle containers as heavy as 30 tons. Given that a 30 ton container does not cost much more to handle than a 22.5 ton container, this ability to put one third more freight into a container can provide shippers with savings. Shipping heavy containers would only be feasible if shippers can load containers at the marine facility, at an adjacent facility, or bring heavy containers by rail to the facility.

It is recommended that the Nashville region further investigate the potential of container on barge service on the Cumberland River. A study should be performed that investigates potential locations, the potential market, benefits, and the economic feasibility of such a service. Container on barge could also provide the region with a number of public benefits in addition to private benefits for shippers. Maritime transportation is the safest and most environmentally efficient freight mode. For example, inland marine can carry one ton of freight 576 miles on a single gallon of fuel compared to 413 for rail and 155 for truck.[16] Inland marine is responsible for 0.028 fatalities per billion ton-miles compared to 0.649 for truck and 4.231 for highway. Inland marine is responsible for 0.045 injuries per billion ton-miles compared to 5.814 for rail and 99.044 for truck.

LONG-TERM ROADWAY PROJECTS

EXHIBIT 11 is a listing of potential long-term roadway projects. The nature of these projects, as well as their screening is discussed in more detail below.

EXHIBIT 11 – POTENTIAL LONG-TERM ROADWAY PROJECTS

Project	Source
Completion of the State Route 840 loop	Stakeholder Input
Widen I-40 to six lanes between Nashville and Lebanon	I-40/I-81 Corridor Study
I-24 Alternative to Kentucky	Stakeholder Input

Completion of State Route 840 Loop

A number of stakeholders discussed the State Route840 loop. One felt that the partial completion of this roadway to date had contributed to urban sprawl. A major food retailer, which owns a distribution center within the Memphis region, felt that the completion of SR 840 to I-40W would be a major benefit. A representative of the Tennessee Trucking Association was skeptical that the northern portion of SR 840 would

[16] Texas Transportation Institute for the U.S. Department of Transportation Maritime Administration and National Waterways Foundation, *A Modal Comparison of Domestic Freight Transportation Effects on the General Public*, November 2007.

be built because of the water obstacles. However, this same individual felt that the construction of SR 840 (to I-40W) would help to keep through traffic out of downtown Nashville. This rerouting of through traffic would be a major benefit of the project. Two segments appear in the *Nashville MPO 2035 Regional Transportation Plan.* One is an 8.5 mile segment from Bending Chestnut Road to Thompsons Station Road. The right-of-way was acquired in November 2009. Estimated completion is October 2012. The second is a four mile segment from Thompsons Station Road to U.S. 31/State Route 6. Recently TDOT opened the portion of SR 840 from SR 100 to Pinewood Road in southwestern Williamson County. Ultimately, the entire southern loop of SR 840 from I-40 east to I-40 west will be complete and open to traffic in December of 2012 according to TDOT. This should prove beneficial in alleviating some of the through traffic that has no origin or destination inside the Nashville urban area.

In terms of the northern loop of SR 840 that was once discussed by TDOT and the MPO, this project has been put on indefinite hold due to the financial feasibility of the project. The northern loop is projected to cost well over $1 billion to complete in a time where funds are limited and there are many other higher priorities. However, this does not mean that the project should be forgotten. Rather, additional study should be conducted to follow up the September 2003 study conducted by the University of Tennessee Center for Transportation Research for TDOT. This study recommended that TDOT "step back" from the project and reconsider its merits. The report stated the following "In the opinion of the evaluation team, TDOT may want to "step back" and revisit the State Route 840 North project from the perspective of developing a project that is driven by identifiable transportation needs and realistic economic development goals. Since the project is still in a reasonably early stage, and given the anticipated high cost and potential for very significant environmental, social and economic impacts, such a "regrouping" action appears to be justified." It is recommended that this study reconsider SR 840 north and see if it is warranted based on the changes in regions travel characteristics (both freight and passenger related) and economic climate since the UT study was completed.

Widen I-40 to Six Lanes

The *I-40/I-81 Corridor Study* found a positive benefit/cost ratio for widening nine miles of I-40 between Nashville and Lebanon. A number of I-40 roadway widening projects appear in the *Nashville MPO 2035 Regional Transportation Plan*. The lanes added are intended to be HOV lanes. Within Wilson County, projects are proposed to widen I-40 on a 4.6 mile segment between SR 840 and US 70 and a nine mile segment between Mt. Juliet Road and SR-840. The plan also proposes widening the I-65/I-40 downtown loop to eight lanes in Davidson County, about 2.3 miles of roadway.

I-24 Alternative to Kentucky

An executive from a less-than-truckload motor carrier mentioned that there are no good alternatives to I-24 north to Kentucky.

SHORT-TERM ROADWAY PROJECTS

EXHIBIT 12 is a listing of potential short-term roadway projects. The nature of these projects, as well as their screening is discussed in more detail below.

EXHIBIT 12 – POTENTIAL SHORT-TERM ROADWAY INFRASTRUCTURE AND OPERATIONS PROJECTS

Project	Source
Email construction information system	Stakeholder Input
Fesslers Lane / I-40 West on-ramp intersection	Field Observations, Stakeholder Input
Signage – Nissan Drive / Enon Springs Road intersection	Field Observations, Stakeholder Input
Redesign Sidco Drive and Powell Avenue intersection	Field Observations, Stakeholder Input
Redesign Firestone Parkway / Bridgestone Boulevard and Parthenon Boulevard intersection	Field Observations, Stakeholder Input
Redesign Butler Drive and US 231 intersection	Field Observations, Stakeholder Input
Redesign TN 109 and US 31 intersection	Field Observations, Stakeholder Input
Redesign TN 109 and TN 52 intersection	Field Observations, Stakeholder Input
Improve signage at Gap Boulevard and US 31 intersection	Field Observations, Stakeholder Input
Old Hickory Blvd (TA Truck Stop) configuration review, Firestone Parkway	Stakeholder Input, Phase I of Study, Field Observations
Ellington Parkway improvements	Stakeholder Input
Expansion joint hazard, Hobson Pike at Priest Bridge	Stakeholder Input
Jefferson Pike at Murfreesboro Rd, La Vergne – Add signal	Phase I of Study
Heil Quaker Rd, Bridgestone Pkwy & Old Hickory – Add signal	Phase I of Study
Harding near Sidco Truck Terminal – Add signal	Phase I of Study
I-40 at White Bridge Road – Lane width	Phase I of Study
Mason Road, La Vergne – Poor roadway condition and width	Phase I of Study
8th Avenue Rail Bridge clearance	Phase I of Study
Tree branch and traffic light overhead clearances	Phase I of Study
Signal timing project: 109 at Gallatin	Phase I of Study
Briley Parkway resurfacing	Phase I of Study

Email Construction Information

A less-than-truckload motor carrier representative said that it would be tremendously useful if his company could be alerted by email of backups or pothole crews.

Intersection Design

The MPO staff and the Freight Advisory Committee identified specific intersections with large volumes of truck turning movements. The study team provided field observations at these intersections to determine if the roadway design and signage was adequate to accommodate the turning movements.

EXHIBIT 13 – FIELD OBSERVATIONS OF INTERSECTIONS

Project	Location	Description/Issue
Redesign Fesslers Lane/I-40 West On-Ramp Intersection	Nashville	Scuffing and/or tracing were observed on the southbound Fesslers Lane curb radius.
Redesign Nissan Drive and Enon Springs Road Intersection with adequate signage	Smyrna	Scuffing and/or tracing were observed on the northeast, northwest, and southeast corners of the intersection. There are no "Only" pavement markings or signs indicating exclusive right-turn "trap lanes" on westbound Enon Springs Road.
Redesign Sidco Drive and Powell Avenue Intersection	Nashville	Scuffing was observed on the Powell Avenue curb radii. The entrance to a CSX rail yard is southeast of the intersection. Double yellow striping at the CSX entrance technically prohibits left-turn movements onto Sidco Drive. However, it is obvious by the worn pavement markings that drivers are violating this restriction.
Redesign Firestone Parkway and Old Hickory Boulevard Intersection	LaVergne	The intersection of Firestone Parkway and Old Hickory Boulevard consists of a signalized intersection with 6-phase operation. There are adequate lane widths at the intersection and scuffing/tracing was observed on the eastbound private driveway, northbound Old Hickory Boulevard, and along westbound Firestone Parkway turn radii.
Redesign Firestone Parkway/Bridgestone Boulevard and Parthenon Boulevard Intersection	LaVergne	Scuffing and tracing was observed on the radii for Bridgestone Boulevard.
Butler Drive and US 231 Intersection	Murfreesboro	Adequate lane widths are provided at this intersection and scuffing was observed on all intersection radii.

Project	Location	Description/Issue
Maddox-Simpson Parkway and US 70 / Sparta Pike Intersection	Lebanon	The intersection contains adequate lane widths and scuffing was observed on the eastbound turn radius of Maddox-Simpson Parkway.
Redesign TN 109 and US 31 Intersection	Portland	Curb scuffing was observed on both turn radii and the intersection. The intersection contains single lane approaches with approximately 12-foot lane widths.
Redesign TN 109 and TN 52 Intersection	Portland	Scuffing/tracing was observed on the southeast and southwest corners of the intersection.
Improve signage at Gap Boulevard and US 31 Intersection	Gallatin	There are adequate lane widths at the intersection, but the lane widths are less than standard along US 31E. Scuffing/tracing was observed on the southwest bound US 31E turn radius. There are currently no pavement markings or signs indicating a right-turn lane on eastbound US 31E.

Old Hickory Blvd (TA Truck Stop) Configuration Review

A representative from a less-than-truckload motor carrier felt that the intersection between Bridgestone/Firestone Parkway and Old Hickory Boulevard needs to be improved. There should be two left turning lanes on Bridgestone/Firestone Parkway. This intersection was also mentioned by a FedEx Freight driver during Phase I of this study. Phase I of this project recommended that a study be conducted to consider geometric improvements to this intersection. The concept would be to provide an additional through lane on Old Hickory Boulevard in advance of the intersection and to provide a dual left turn from Bridgestone/Firestone Parkway.

Ellington Parkway Improvements

A representative of a trucking company felt that the Ellington Parkway's southern connection is a problem. There is no direct connection to I-24. Trucks traveling southbound on Ellington Parkway must exit to Spring Street before accessing I-24.

Expansion Joint Hazard, Hobson's Pike at Priest Bridge

A representative of a small package delivery company complained that an expansion joint where Hobson's Pike meets Priest Bridge makes a big bump. This could damage equipment or cargo.

New Traffic Light Projects

In Phase I of this study, a FedEx driver suggested adding a stop light at Jefferson Pike and Murfreesboro Road in La Vergne because the driver was finding it difficult to turn left. A representative of Menlo Logistics mentioned during Phase I of the study that it is very difficult to exit an industrial park at Heil Quaker Rd, Bridgestone Pkwy & Old

Hickory. Another stakeholder suggested adding a signal at the intersection of North Point Road and US 31 North. Allied Automotive Group requested a light at a truck terminal on Harding Place near Sidco Drive. Fifty trucks per day use the terminal and must cross a busy seven lane road to access I-65.

Roadway Width and Condition Projects

In Phase I of the study, a representative of FedEx Freight complained of the condition and width of Mason Road and Industrial Blvd in La Vergne. The same individual thought that the lanes were too narrow, and the concrete barriers too close on I-40 at White Bridge Road.

Overhead Clearance Projects

In Phase I of this study, CSX and M&W Transport pointed out that the 8th Avenue Rail Bridge is struck regularly by trucks. This significantly inconveniences CSX, since the bridge carriers a CSX mainline, which then must be shut down while the bridge is inspected each time a truck strikes the bridge. As a fast action project, Phase I proposed that the possibility of a vehicle height detection system be studied. This would provide trucks with additional warning of clearance problems. Phase I suggested that in the long-term, TDOT investigate the possibility of lowering the underpass to improve clearance. CSX has confirmed in the current phase of the study that the 8th Avenue Rail Bridge is still an issue. However, it is uncertain how frequently the bridge is struck and how long the CSX mainline must be closed if the bridge is struck. These variables would be useful in evaluating projects to decrease or eliminate the risk of collisions.

Allied Automotive Group, which is a carrier of automobiles, mentioned that trucks carrying SUVs are vulnerable to striking branches and traffic lights. The carrier suggested that the region be rigorous in its monitoring and maintenance of clearances.

Signal Timing Project – 109 at Gallatin

Averitt Express mentioned that TN 109 has mixed truck and passenger traffic at peak periods. The roadway was originally designed for passenger traffic but is now used as a truck bypass. The traffic lights may need to be retimed to account for the heavy usage by trucks.

Briley Parkway Resurfacing

In Phase I of the study, M&W Transportation rated Briley Parkway as the worst roadway in the region in wet driving conditions. The roadway surface becomes slick, although the M&W representative did not know why.

SHORT-TERM OR LONG-TERM ROADWAY PROJECTS

is a listing of issues that could require either short-term or long-term projects, depending upon the specific nature of the improvement. These projects are discussed in more detail below. Most of these projects relate to roadway capacity, most often congestion. The congestion problems are typically at their worst during peak rush hour periods.

EXHIBIT 14 is a listing of issues that could require either short-term or long-term projects, depending upon the specific nature of the improvement. These projects are discussed in more detail below. Most of these projects relate to roadway capacity, most often congestion. The congestion problems are typically at their worst during peak rush hour periods.

EXHIBIT 14 – SHORT-TERM OR LONG-TERM ROADWAY PROJECTS

Location	Type of Issue	Source
Various	Bridge weight restrictions	Stakeholder Input
I-65 at I-24 merge	Interchange merging problems	Stakeholder Input
I-65 Nashville to Spring Hill	Insufficient roadway capacity	Stakeholder Input
I-65 at exit 65	Interchange merging problems	Stakeholder Input
I-65 at I-440 merge	Interchange merging problems	Stakeholder Input
I-65/I-40 merge	Interchange merging problems	Phase I of Study/ Trimac Transport
I-24 toward La Vergne	Insufficient roadway Capacity	Stakeholder Input
I-24 at I-65 merge	Interchange merging problems	Stakeholder Input
I-24 at exit 56	Insufficient roadway capacity	Stakeholder Input
I-24 at exit 54	Insufficient roadway capacity	Stakeholder Input
I-24 and I-40 split, East and West	Interchange merging problems	Phase I of Study, TCW Distribution, et. al.
I-24 at SR 840	Lane Drop	Phase I of Study
I-40 from Bellevue exit to I-440	Insufficient roadway capacity	Stakeholder Input
I-40 from SR-265 to SR-840	Insufficient roadway capacity	Capacity modeling
Murfreesboro Road	Insufficient roadway capacity	Stakeholder Input
Fesslers Lane at highway merges	Interchange merging problems	Stakeholder Input

Fesslers Lane at bridges	Lane Drop	Stakeholder Input
I-440	Insufficient roadway capacity	Stakeholder Input
SR-840 from SR-452 to SR-265	Insufficient roadway capacity	Capacity modeling
Lebanon Road to Briley Parkway	Insufficient roadway capacity	Stakeholder Input
Beechcroft Road (SR 247)	Intersection blocked by CSX trains	Phase I of Study

Bridge Weight Restrictions

Several stakeholders mentioned issues with bridge weight restrictions. However, they did not mention specific bridges.

I-65 Congestion Problems

A representative from the Tennessee Trucking Association mentioned congestion issues between Spring Hill and the I-440 interchange with particular bottlenecks near the Murfreesboro Road exit and the I-440 interchange. Several stakeholders mentioned congestion on I-65 north of downtown. A representative from the Tennessee Trucking Association mentioned that the interchange between I-65 and I-440 is problematic because of crossing traffic. This representative suggested a flyover to mitigate the problem.

I-24 Congestion Problems

A logistics company mentioned I-24 congestion toward La Vergne. These concerns were seconded by a trucking company which considers I-24 east of the Nashville International Airport to be the worst bottleneck in the area. In Phase I of the study a representative from FedEx Freight mentioned the lane drop at the interchange with SR 840 as a chokepoint.

I-40 Congestion Problems

A trucking company remarked that I-40 is better than I-24 in most areas, except for between I-440 and Bellevue exit. Capacity analysis performed in Technical Memorandum #6 found that I-40 roadway capacity between SR-265 and SR-840 is deficient. This corridor is used by an above average percentage of trucks. It is an important roadway segment for freight because it runs parallel to Eastgate Boulevard where a number of freight-intensive businesses are located.

Murfreesboro Road and Fesslers Lane

Murfreesboro Road and Fesslers Lane were mentioned as chokepoints by a logistics company. Murfreesboro Road was also identified as congested by Trimac Transport in Phase I of the study.

SR-840 from SR-452 to SR-265

Capacity modeling in Technical Memorandum #6 found that SR-840 roadway capacity between SR-452 and SR-265 is deficient. This corridor is used by an above average percentage of trucks, and a number of freight-intensive businesses are located along the segment, including distribution centers.

Beechcroft Road at CSX Crossing

Trains sometimes block this crossing for excessive amounts of time. Long-term, a $2.69 million project was added to the Nashville Area MPO 2030 LRTP to construct a bridge over the CSX tracks. However, this was not included among cost-feasible project in the 2035 Regional Transportation Plan (RTP). The Beechcroft Road project is tied to the fate of the nearby Saturn Plant in Spring Hill. Most of the blockages of Beechcroft Road resulted from trains that were sorting cars into and out of the Saturn Plant. This plant was recently idled, so trains should not be expected to block Beechcroft Roads as they had previously. However, statements by General Motors (GM) suggest that the plant could be reopened in the future. A simpler solution to the Beechcroft Road issue may be to change the rail operations at the GM plant, so that trains no longer need to block Beechcroft Road as they switch cars into and out of the plant.

As shown in **EXHIBIT 15,** potential relief strategies include a variety of initiatives, from operational improvements (low cost investments) to infrastructure projects (high cost investments) and legislative and policy based initiatives.

The specific roadway projects required to address stakeholder concerns were developed based upon technical analysis of data presented in previous technical memoranda including current and projected Levels of Service, Volume to Capacity ratios, and roadway segments with above average freight volumes. Field reconnaissance verified the condition of certain project locations and key intersections. Aerial photography was used to verify and supplement potential lane configuration issues. This analysis resulted in the projects listed in **EXHIBIT 16** below. The proposed projects are meant to address transportation related deficiencies in the Nashville region and are based on connectivity and congestion relief as well as cost and available funding, focusing on providing a balanced freight transportation system through the year 2035.

The initial list of road projects consist of major reconstruction and widening of existing routes and intersections, re-alignments, and new roads that provide connectivity and offer congestion relief to the existing network. Many of the issues were identified during the stakeholder interview process that included 19 personal interviews with stakeholders representing a cross-section of the regional economy. Issues facing drivers, distribution companies, and other local freight recipients and distributors revealed key freight routes, areas of congestion, and issues and opportunities needing to be addressed to improve freight transport in the Nashville region.

Once an initial list of issues and locations were identified, Geographic Information System (GIS) data and mapping was used to further analyze 2008 and 2035 Peak and Non-Peak volume to capacity (V/C) ratios at these locations. This analysis revealed many of the project locations had V/C ratios greater than .85, confirming existing and/or projected capacity and congestion issues. Specific roadway segments with V/C ratios greater than .85 *and* above average truck percentages in both 2008 and 2035 provided further evidence in support of the recommended road improvements.

Project recommendations also included all of the key intersections identified during the field observations of key intersections and facilities described in Technical Memorandum #3. Field reconnaissance efforts disclosed the current state of the recommended project location and either confirmed or disproved any potential issues and aided in refining the actual project recommendation.

Sometimes, actual travel to a proposed project location did not prove to be necessary or was at least aided by updated aerial photography when available. Again using GIS mapping, aerial photos were used to verify locations where lane configuration issues were identified. These images provide the number of lanes and physical markings of a road or intersection.

A thorough review and analysis of each of these components revealed issues – either current or projected within the Nashville Area MPO region that could potentially impact the transport of goods now and in the future. Existing studies, freight flows, the condition of key freight corridors, access to freight facilities, and on-ground conditions have all been evaluated to assess opportunities for improvement to the transportation system for the regional freight industry. The initial list of projects is recommended based on areas in need of improvement, deficient traffic conditions, or other inadequacies.

EXHIBIT 15 – POTENTIAL SOLUTIONS TO ROADWAY CAPACITY ISSUES

Problem/Issue Definition	Solutions: Low cost operational → High Cost Major Investment								
	Operational (Lower Cost)			Infrastructure (Higher Cost, Longer Timeframe)			Policy / Legislative		
	Lowest Cost		Highest Cost	Lowest Cost		Highest Cost	Lowest Cost		Highest Cost
Capacity constraints									
Examples:									
Lane drops (a lane-drop when a highway narrows from two lanes to one lane)	Re-stripping to add narrow lanes			Paved shoulder		Add lanes to provide route continuity			
Steep hills where heavy trucks must slow to climb and descend						Road realignment			
Absence of climbing lanes						Climbing lanes			
Curves with insufficient turning radii for trucks				Improve turning radii for trucks					
Bridges with gross vehicle weight limits that force trucks to make long detours	Bridge posting policy	Designate alternate truck routes		Improve alternate route to accommodate truck traffic	Bridge rehabilitation	Bridge replacement			
Tunnels or bridges with reduced overheard or side clearance	Bridge posting policy	Designate alternate truck routes		Improve alternate route to accommodate truck traffic	Bridge/Tunnel	Bridge/tunnel replacement			
Traffic volume exceeds road capacity	Reduce lane widths to add a travel lane; Traffic diversion information	Reversible lanes	ITS (Advanced Traffic Management System; Demand Management System)		Capacity expansion by adding new lanes	New construction on new alignment	Policy to provide more attractive alternatives to single occupant vehicles (e.g., more telecommuting)		Policy to provide more attractive alternatives to single occupant vehicle (e.g., better public transit, road pricing; manage toll lanes open to trucks)
Interchange constraints									
Examples:									

Problem/Issue Definition	Solutions: Low cost operational → High Cost Major Investment								
	Operational (Lower Cost)			Infrastructure (Higher Cost, Longer Timeframe)			Policy / Legislative		
	Lowest Cost		Highest Cost	Lowest Cost		Highest Cost	Lowest Cost		Highest Cost
Urban interchange connecting two interstate highways where the geometry of the interchange, traffic weaving and merging movements, and high volumes of traffic reduce throughput and create traffic queues on ramps and mainlines	Re-striping merge or diverge areas to better serve demand; Modify weaving by adding collector/ distributor or through lanes	Metering or closing entrance ramps	ITS (Advanced Traffic Management System)		Capacity expansion by adding new lanes	Road Bypasses, Overpasses, Connector road			
Intersection/Signal constraints									
Examples:									
Urban arterial operating at or near capacity with poorly timed signals	Better traffic signal timing on arterials	Improve arterials using access management principles	ITS (Arterial Management System)			Overpasses			

EXHIBIT 16: RECOMMENDATIONS TO ADDRESS IDENTIFIED ROADWAY ISSUES

Project	Issue	Recommendation	Termini
Long Term Roadway Projects			
Completion of the State Route 840 loop	Lack of northern loop around Nashville	Completion of SR 840 Loop North	Termini of SR 840 east and west of Nashville
Widen I-40 to six lanes between Nashville and Lebanon	Lane width	Widen to 6 lanes	Hardin Pike (US 70) to Charlotte Avenue
I-24 Alternative to Kentucky	Insufficient roadway Capacity	NA	NA
Short Term Roadway Projects			
Email construction information system	Insufficient knowledge of roadway congestion	N/A	N/A
Fesslers Lane / I-40 West on-ramp intersection	Interchange merging problems	Widen from 6 to 12 lanes and upgrade to full interchange with Fesslers Lane	East and West of Fesslers Lane (I-65 to I-24/I-40 junction)
Signage - Nissan Drive / Enon Springs Road intersection	Scuffing and/or tracing were observed on the northeast, northwest, and southeast corners of the intersection. There are no "Only" pavement markings or signs indicating exclusive right-turn "trap lanes" on westbound Enon Springs Road.	Improve Signage	Nissan Drive / Enon Springs Road intersection
Redesign Sidco Drive and Powell Avenue intersection	Scuffing was observed on the Powell Avenue curb radii. The entrance to a CSX rail yard is southeast of the intersection. Double yellow striping at the CSX entrance technically prohibits left-turn movements onto Sidco Drive. However, it is obvious by the worn pavement markings that drivers are violating this restriction.	Redesign Intersection	Sidco Drive and Powell Avenue intersection
Redesign Firestone Parkway / Bridgestone Boulevard and Parthenon Boulevard intersection	There are adequate lane widths at the intersection and scuffing/tracing was observed on the eastbound private driveway, northbound Old Hickory Boulevard, and along westbound Firestone Parkway turn radii.	Redesign Intersection	Firestone Parkway / Bridgestone Boulevard and Parthenon Boulevard intersection

Project	Issue	Recommendation	Termini
Redesign Butler Drive and US 231 intersection	Adequate lane widths are provided at this intersection and scuffing was observed on all intersection radii. The interchange at Exit 81 along I-24 is located just north of this intersection. Most of the large commercial vehicles travel north and south along US-231, but other large commercial vehicles turn from Warrior Drive and Butler Drive to access the I-24 interchange.	Redesign Intersection	Butler Drive and US 231 intersection
Redesign TN 109 and US 31 intersection	Curb scuffing was observed on both turn radii and the intersection.	Redesign Intersection	TN 109 and US 31 intersection
Redesign TN 109 and TN 52 intersection	Scuffing/tracing was observed on the southeast and southwest corners of the intersection.	Redesign Intersection	TN 109 and TN 52 intersection
Improve signage at Gap Boulevard and US 31 intersection	There are adequate lane widths at the intersection, but the lane widths are less than standard along US-31E. Scuffing/tracing was observed on the southwest bound US-31E turn radius. There are currently no pavement markings or signs indicating a right-turn lane on eastbound US-31E.	Improve Signage	Gap Boulevard and US 31 intersection
Old Hickory Blvd (TA Truck Stop) configuration review	Operations & maintenance issues	Add left turn lane to Firestone Parkway at Old Hickory Boulevard intersection	Firestone Parkway/Old Hickory Blvd intersection near (TA Truck Stop)
Ellington Parkway improvements	Insufficient roadway Capacity	Widen from 4 to 6 lanes. (Current conditions may change with recommendations made by the Northeast Corridor Mobility Study)	North First Street to Broadmoor Road
Expansion joint hazard, Hobson Pike at Priest Bridge	Expansion joint hazard	Fix expansion joint	Hobson Pike at Priest Bridge

Project	Issue	Recommendation	Termini
Elliston Place: Lack of parking causing trucks to double park	Lack of parking causing trucks to double park	Conduct a study to determine if alternate loading zone areas can be identified, coordinate with vendors, store owners and metro public works.	Elliston Place
Jefferson Pike at Murfreesboro Rd, La Vergne – Add signal	Signal needed	Add signal	Jefferson Pike at Murfreesboro Road (La Vergne)
Heil Quaker Rd, Bridgestone Pkwy & Old Hickory – Add signal	Signal needed	N/A	N/A
Harding near Sidco Truck Terminal – Add signal	Signal needed	Add signal	Harding Place near Sidco Truck Terminal
I-40 at White Bridge Road – Lane width	Lane width	Widen to 6 lanes	Hardin Pike (US 70) to Charlotte Avenue
Mason Road, La Vergne – Poor roadway condition and width	Poor roadway condition and width	Reconstruct 2 lane road	I-24 to Ingram Boulevard
8th Avenue Rail Bridge clearance	Rail Bridge clearance	Interim solution: Study to determine the feasibility and design parameters for the installation of a vehicle height detection system in advance of overpass in both directions to warn of clearance problems. Long-Term solution: determine feasibility of improving clearance height by lowering roadway section.	8th Avenue Rail Bridge
Tree branch and traffic light overhead clearances	Tree branches striking auto carriers	N/A	N/A
Signal timing project: 109 at Gallatin	Signal timing inconsistent with truck movements	Signal timing project	SR 109 at Gallatin Road
Briley Parkway resurfacing	Slick roadway surface	N/A	N/A

Project	Issue	Recommendation	Termini
Roadway Capacity Projects (Short or Long-Term)			
I-65 at I-24 merge	Interchange merging problems	Reconstruct interchange	South of Trinity Lane near Fern Avenue
I-65 Nashville to Spring Hill	Insufficient roadway capacity	Widen I-65 from 4 to 8 lanes	Saturn Parkway to Highway 96
I-65 at exit 65	Interchange merging problems	Reconstruct interchange	Highway 96/Murfreesboro Road
I-65 at I-440 merge	Insufficient roadway Capacity	Widen I-65 South from 6 to 8 lanes	Harding Place (SR-255) to I-40
I-65/I-40 merge	Interchange merging problems	Reconstruct interchange	I-65/I-40 merge east and west
I-24 toward La Vergne	Insufficient roadway Capacity	Widen I-24 from 8 to 10 lanes	Briley Parkway to Sam Ridley Parkway
I-24 at I-65 merge	Interchange merging problems	Widen I-65 from 6 to 10 lanes and I-24 from 4 to 6 lanes	North of Trinity Lane
I-24 at exit 56	Insufficient roadway capacity	Reconstruct Exit 56 interchange	Harding Place Exit
I-24 at exit 54	Insufficient roadway capacity	Reconstruct Exit 54 interchange	Briley Parkway Exit
I-24 and I-40 split, East and West	Interchange merging problems	Reconstruct interchange	Interchange
I-24 at SR 840	Lane Drop	Deleted - Lane drop does not exist	N/A
I-40 from Bellevue exit to I-440	Insufficient roadway capacity	Widen I-40 from 6 to 8 lanes	US 70 to I-440
I-40 from SR-265 to SR-840	Insufficient roadway capacity	Widen I-40 from 4 to 8 lanes	From SR 171 to SR 840
Murfreesboro Road	Insufficient roadway capacity	Widen Murfreesboro Road from 4 and 5 lanes to 7 lanes	Donelson Pike to Sam Ridley Parkway
Fesslers Lane at highway merges	Interchange merging problems	Widen from 6 to 12 lanes and upgrade to full interchange with Fesslers Lane	East and West of Fesslers Lane (I-65 to I-24/I-40 junction)
Fesslers Lane at bridges	Interchange merging problems	Widen from 6 to 12 lanes and upgrade to full interchange with Fesslers Lane	East and West of Fesslers Lane (I-65 to I-24/I-40 junction)
I-440	Insufficient roadway capacity	Widen from 6 to 8 lanes	I-40 West to I-24
SR-840 from SR-452 to SR-265	Insufficient roadway capacity	Widen from 4 to 6 lanes	SR-452 to SR-265

Project	Issue	Recommendation	Termini
Lebanon Road to Briley Parkway	Insufficient roadway capacity	Widen from 2 to 4 lanes	Park Glen Drive to Highway 109
Beechcroft Road (SR 247)	Intersection blocked by CSX trains	Construct bridge over CSX railway	Rail crossing

Preliminary Project Screening

Through data gathered for the technical memorandum, some projects have been identified as not warranting further analysis. Other projects require additional information to provide a quantitative assessment beyond what is available for this study. The projects will not lend themselves to a benefit/cost analysis in the next phase of the study, although they could be scored through qualitative criteria. Other projects are recommended for benefit/cost analysis. The recommended steps for evaluation of projects and policies are included in **EXHIBIT 17**. Those projects/policies that do not appear to warrant further study are indicated with "Drop." Those that cannot be quantified and would require additional study are indicated with "Further Study." Those that do lend themselves to benefit/cost analysis are indicated with "Benefit/Cost Analysis."

EXHIBIT 17: RECOMMENDED NEXT STEPS FOR PROJECT EVALUATION

Project/Policy	Recommended Action	Comments
Smyrna/Rutherford County Airport Economic Development	Further study	
Port-related Economic Development	Drop	Several specific maritime projects are proposed later in this study which should be investigated rather than a general economic development inquiry.
Regional freight / land use plan, addressing encroachment & conflict issues	Further study/ meetings	A series of recommendations are presented in this technical memorandum, the benefits of which are not quantifiable. But they merit further action.
Policy / legislation in support of transcontinental railroad mergers	Drop	It is uncertain that this project would benefit the region.
Truck right-lane policy review	Drop	It is doubtful that this change in policy would benefit the region.
Access management ordinance that addresses areas of concern regarding truck access to and from pickup and delivery locations, loading dock study / policy	Further study/ meetings	A series of recommendations are presented in this technical memorandum, the benefits of which are not quantifiable. But they merit further action.
Toll studies	Further study	The benefits of toll studies are not quantifiable unless a specific location is proposed at which time detailed study will be required to determine the feasibility of the specific project. TDOT has conducted several of these types of studies in recent history and continues to consider locations.
Dedicated truck lanes	Further study	The benefits of dedicated truck lanes are not quantifiable unless specific truck lanes are proposed.
Truck route study	Further study/ meetings	Suggest meeting between MPO and constituent jurisdictions to begin

Project/Policy	Recommended Action	Comments
		developing the next stages for a study.
Elliston Place – Lack of loading area causing trucks to double park	Further study	Unable to quantify without further information
South Royal Oaks Parkway truck restrictions	Further study	Further study to identify the impacts on local roads of through traffic
1801 West End Avenue	Further study/ meetings	Next action on this project will depend upon company located at 1801 West End Avenue.
Projects to be more "river friendly"	Drop	Not sure there is a project here. Subsequent stakeholder communication suggests that barge interests are being taken into account in Nashville riverfront development.
East/West line - cooperative use of infrastructure by the Class I roads thereafter might open a competitive rail corridor along I-40 and I-81.	Drop	This is at the discretion of the railroads and seems unlikely.
Reintroduction of sprint train service on the Atlanta-Nashville-Chicago line	Drop	This is at the discretion of CSX
New east/west (I-40) rail corridor	Subsequent study	A recent CBER study suggested a benefit/cost ratio less than one, but it could be beneficial if an analysis could look at not just truck diversion, but new trading opportunities as well.
Vine Hill bulk commodity terminal for rock, sand, stone/aggregate shipment	Drop	Not sure that there is a role for the public sector here.
Radnor Yard alternatives	Benefit/Cost Analysis	Improving capacity at Radnor Yard may provide the region with enhanced trading opportunities. However, this would depend upon cooperation by CSX.
Rail access to Hailey's Harbor Terminal	Benefit/ Cost Analysis	
Container on Barge Service	Further study	A quick analysis suggests that this service could benefit shippers, but a diversion analysis would be needed to quantify the benefits. A specific location would need to be identified to quantify costs.
Completion of the State Route 840 loop	Further study	Analysis of project benefits would require travel demand analysis of likely usage. The project has no momentum at this time and has been placed on indefinite hold by TDOT.
Widen I-40 to six lanes between Nashville and Lebanon	Drop	This project has been consolidated into I-40 from SR-265 to SR-840 as I-40 is already six lanes west of SR-265.
I-24 Alternative to Kentucky	Drop	Would require enormous expense and is not under consideration by other stakeholders.
Email construction information system	Further study	Unable to quantify benefits of construction information system

Project/Policy	Recommended Action	Comments
Fesslers Lane / I-40 West on-ramp intersection	Benefit/Cost Analysis	
Signage - Nissan Drive / Enon Springs Road intersection	Drop	Cannot justify benefits in travel time, vehicle operating costs, safety based upon signage.
Redesign Sidco Drive and Powell Avenue intersection	Benefit/Cost Analysis	
Redesign Firestone Parkway / Bridgestone Boulevard and Parthenon Boulevard intersection	Benefit/Cost Analysis	
Redesign Butler Drive and US 231 intersection	Benefit/Cost Analysis	
Redesign TN 109 and US 31 intersection	Benefit/Cost Analysis	
Redesign TN 109 and TN 52 intersection	Drop	Recent aerials reveal no issues with curb radius. Intersection has dedicated right turns at all approaches
Improve signage at Gap Boulevard and US 31 intersection	Drop	Cannot justify benefits in travel time, vehicle operating costs, safety based upon signage.
Old Hickory Blvd (TA Truck Stop) configuration review	Benefit/Cost Analysis	
Ellington Parkway improvements	Benefit/Cost Analysis	
Expansion joint hazard, Hobson Pike at Priest Bridge	Drop	This is an engineering/design issue with the roadway and a very isolated, specific issue that should have minimal impact on flow of freight. However, the concern should be passed on to TDOT.
Jefferson Pike at Murfreesboro Rd, La Vergne – Add signal	Benefit/Cost Analysis	
Heil Quaker Rd, Bridgestone Pkwy & Old Hickory – Add signal	Further study	No data is available to analyze traffic. Does not appear within MPO's travel demand network.
Harding near Sidco Truck Terminal – Add signal	Benefit/Cost Analysis	
I-40 at White Bridge Road – Lane width	Benefit/Cost Analysis	
Mason Road, La Vergne – Poor roadway condition and width	Further study	No data is available to analyze traffic. Does not appear within MPO's travel demand network.
8th Avenue Rail Bridge clearance	Benefit/Cost Analysis	
Tree branch and traffic light overhead clearances	Drop	There is no evidence that jurisdictions are failing to follow their own policies regarding roadway clearance.
Signal timing project: 109 at Gallatin	Drop	It appears that the signals are spaced so far apart that it would be nearly impossible to synchronize.
Briley Parkway resurfacing	Drop	There is no evidence that the surface of Briley Parkway is deficient.

Project/Policy	Recommended Action	Comments
I-65 at I-24 merge	Benefit/Cost Analysis	
I-65 Nashville to Spring Hill	Benefit/Cost Analysis	
I-65 at exit 65	Benefit/Cost Analysis	
I-65 at I-440 merge	Benefit/Cost Analysis	
I-65/I-40 merge	Benefit/Cost Analysis	
I-24 toward La Vergne	Benefit/Cost Analysis	
I-24 at I-65 merge	Benefit/Cost Analysis	
I-24 at exit 56	Benefit/Cost Analysis	
I-24 at exit 54	Benefit/Cost Analysis	
I-24 and I-40 split, East and West	Benefit/Cost Analysis	
I-24 at SR 840	Drop	Lane drop that stakeholder complained of does not exist
I-40 from Bellevue exit to I-440	Benefit/Cost Analysis	
I-40 from SR-265 to SR-840	Benefit/Cost Analysis	
Murfreesboro Road	Benefit/Cost Analysis	
Fesslers Lane at highway merges	Benefit/Cost Analysis	
Fesslers Lane at bridges	Benefit/Cost Analysis	
I-440	Benefit/Cost Analysis	
SR-840 from SR-452 to SR-265	Benefit/Cost Analysis	
Lebanon Road to Briley Parkway	Benefit/Cost Analysis	
Beechcroft Road (SR 247)	Benefit/Cost Analysis	

Next Step – Project Evaluation

The next technical memorandum of this study will evaluate and rank projects. Projects will be evaluated per the scoring criteria developed by the Nashville Freight Advisory Committee to evaluate potential freight projects. The criteria are as follows:

- Safety and Security (20 points)
- Environmental Impacts (10 points)
- Mobility (20 points)
- Cost Effectiveness (20 points)
- Technology (15 points)
- Support to Local, State, and Regional Plans (15 points)

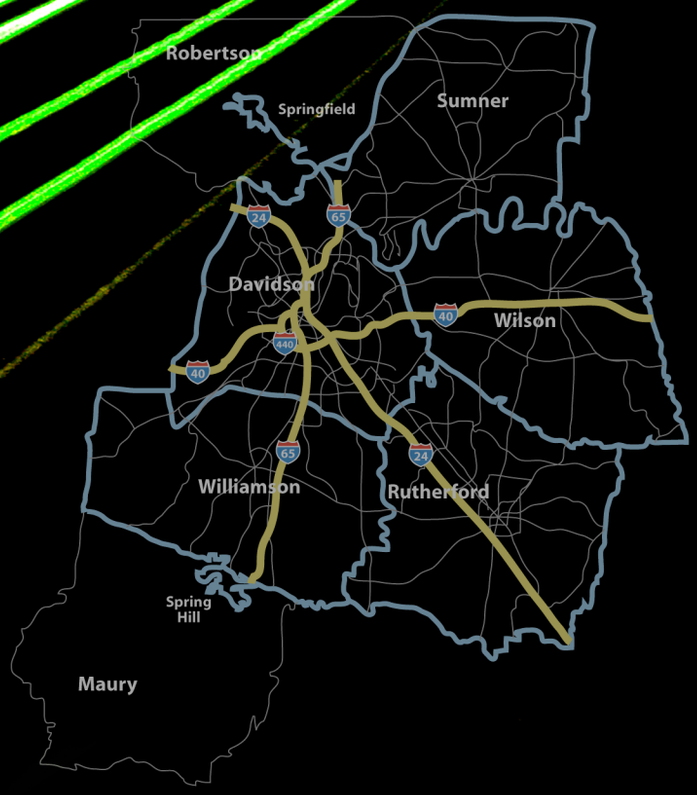
Evaluation of projects will be developed using the output of benefit/cost analyses, as well as a variety of other performance indicators to determine whether projects meet the criteria listed above. For example, the benefits of roadway project will be provided, which will indicate:

1. Travel time saving benefits
2. Vehicle operating cost saving benefits
3. Safety benefits

Other indicators will include considerations such as whether the project location is at an intermodal connector, whether the location is in a high freight zip code, whether the corridor is a high freight corridor. A variety of indicators will be combined to develop a scoring matrix that will evaluate and rank projects.

NASHVILLE REGIONAL FREIGHT & GOODS MOVEMENT STUDY

Technical Memo #8: Policy/Project Evaluation



March 2011

Submitted to: **Nashville Area Metropolitan Planning Organization**

Submitted by: **Wilbur Smith Associates**

NASHVILLE AREA
Metropolitan Planning Organization

NASHVILLE REGIONAL FREIGHT & GOODS MOVEMENT STUDY

PHASE II

TECHNICAL MEMO #8:
POLICY/PROJECT EVALUATION

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Introduction

The purpose of this technical memorandum is as follows:

1. Present the results of benefit/cost analyses performed for the Nashville Regional Freight and Goods Movement Study.
2. Discuss relative merits of projects that could not be assessed through benefit/cost analysis in order to prioritize for further study.
3. Present the framework for project evaluation, applicable to those projects for which a benefit/cost analysis was performed, including presentation of data that will be used to help evaluate project.
4. Evaluate and rank projects.

In Technical Memo #7, Policy and Project Recommendations, 64 potential freight projects or policies were presented based upon stakeholder input, empirical observations by study team members, traffic modeling of the region, and other studies that are relevant to the region's freight movement. These projects have been identified throughout the course of both Phase I and Phase II of the Nashville Regional Freight and Goods Movement Study. A preliminary screening was applied to the original 64 policies/projects to identify those which do not warrant further investigation. This process eliminated 17 of the original 64 projects or policies. The remaining 47 projects were then subdivided into those projects which can and those which cannot be analyzed through benefit/cost analysis. Those projects that can be assessed through benefit/cost analysis will be evaluated per the criteria developed by the Nashville Freight Advisory Committee (FAC). Those that were classified as "Further Study" will be prioritized, but this prioritization will be based upon a general discussion rather than a specific evaluation framework. Not enough information is available regarding these projects to provide an evaluation through the FAC framework. Projects to be addressed in this technical memorandum are listed in **EXHIBIT 1**.

EXHIBIT 1: PROJECTS/POLICIES SELECTED FOR FURTHER EVALUATION

Project/Policy	Recommended Action	Comments
Rail access to Hailey's Harbor Terminal	Benefit/ Cost Analysis	
Fesslers Lane / I-40 West on-ramp intersection	Benefit/Cost Analysis	
Redesign Sidco Drive and Powell Avenue intersection	Benefit/Cost Analysis	
Redesign Firestone Parkway / Bridgestone Boulevard and Parthenon Boulevard intersection	Benefit/Cost Analysis	
Redesign Butler Drive and US 231 intersection	Benefit/Cost Analysis	
Old Hickory Blvd (TA Truck Stop) configuration review	Benefit/Cost Analysis	

Project/Policy	Recommended Action	Comments
Ellington Parkway improvements	Benefit/Cost Analysis	
Jefferson Pike at Murfreesboro Rd, La Vergne – Add signal	Benefit/Cost Analysis	
Harding near Sidco Truck Terminal – Add signal	Benefit/Cost Analysis	
I-40 at White Bridge Road – Lane width	Benefit/Cost Analysis	
8th Avenue Rail Bridge clearance	Benefit/Cost Analysis	
I-65 at I-24 merge	Benefit/Cost Analysis	
I-65 Nashville to Spring Hill	Benefit/Cost Analysis	
I-65 at exit 65	Benefit/Cost Analysis	
I-65 at I-440 merge	Benefit/Cost Analysis	
I-65/I-40 merge	Benefit/Cost Analysis	
I-24 toward La Vergne	Benefit/Cost Analysis	
I-24 at I-65 merge	Benefit/Cost Analysis	
I-24 at exit 56	Benefit/Cost Analysis	
I-24 at exit 54	Benefit/Cost Analysis	
I-24 and I-40 split, East and West	Benefit/Cost Analysis	
I-40 from Bellevue exit to I-440	Benefit/Cost Analysis	
I-40 from SR-265 to SR-840	Benefit/Cost Analysis	
Murfreesboro Road	Benefit/Cost Analysis	
Fesslers Lane at highway merges	Benefit/Cost Analysis	
Fesslers Lane at bridges	Benefit/Cost Analysis	
I-440	Benefit/Cost Analysis	
SR-840 from SR-452 to SR-265	Benefit/Cost Analysis	
Lebanon Road to Briley Parkway	Benefit/Cost Analysis	
Beechcroft Road (SR 247)	Benefit/Cost Analysis	
Radnor Yard alternatives	Benefit/Cost Analysis	Improving capacity at Radnor Yard may provide the region with enhanced trading opportunities. However, this would depend upon cooperation by

Project/Policy	Recommended Action	Comments
		CSX.
New east/west (I-40) rail corridor	Further study	Benefit/Cost Analysis performed in three previous studies, but additional study is ongoing
Smyrna/Rutherford County Airport Economic Development	Further study	
Toll studies	Further study	The benefits of toll studies are not quantifiable unless a specific location is proposed at which time detailed study will be required to determine the feasibility of the specific project. TDOT has conducted several of these types of studies in recent history and continues to consider locations.
Dedicated truck lanes	Further study	The benefits of dedicated truck lanes are not quantifiable unless specific truck lanes are proposed.
Elliston Place – Lack of loading area causing trucks to double park	Further study	Unable to quantify without further information
South Royal Oaks Parkway truck restrictions	Further study	Further study to identify the impacts on local roads if trucks are permitted.
Container on Barge Service	Further study	A quick analysis suggests that this service could benefit shippers, but a diversion analysis would be needed to quantify the benefits. A specific location would need to be identified to quantify costs.
Completion of the State Route 840 loop	Further study	Analysis of project benefits would require travel demand analysis of likely usage. The project has no momentum at this time and has been placed on indefinite hold by TDOT.
Email construction information system	Further study	Unable to quantify benefits of construction information system
Heil Quaker Rd, Bridgestone Pkwy & Old Hickory – Add signal	Further study	No data is available to analyze traffic. Does not appear within MPO's travel demand network.
Mason Road, La Vergne – Poor roadway condition and width	Further study	No data is available to analyze traffic. Does not appear within MPO's travel demand network.
Regional freight / land use plan, addressing encroachment & conflict issues	Further study/ meetings	The benefits of these initiatives are not quantifiable but appear to merit further action.
Access management ordinance that addresses areas of concern regarding truck access to and from pickup and delivery locations, loading dock study / policy	Further study/ meetings	A series of recommendations are presented in this technical memorandum, the benefits of which are not quantifiable. But they appear to merit further action.
Truck route study	Further study/ meetings	Suggest meeting between MPO and constituent jurisdictions to begin developing the next stages for a study.

Project/Policy	Recommended Action	Comments
1801 West End Avenue	Further study/ meetings	Next action on this project will depend upon company located at 1801 West End Avenue.

Benefit/Cost Analysis

The first step of the benefit/cost analysis was to estimate the likely construction cost of the proposed improvement. Most of the projects analyzed were roadway improvement projects. The process of estimating construction costs of roadway projects is described below. Rail project construction costs will be discussed along with benefits later in this technical memo.

CONSTRUCTION COST ESTIMATES

An opinion of probable cost was prepared for each of the projects to assist in budgeting and project planning in the future. In cases where cost estimates were provided in the MPOs Long Range Transportation Plan, those costs were used. The opinion of probable cost for each recommended project was developed using TDOT's planning level cost estimating methodology. The TDOT planning level cost estimating methodology is based on recent project development in Tennessee and therefore reflects recent right of way acquisition, engineering, and construction costs. The methodology adds the cost of Right-of-Way (ROW) to the costs of engineering and construction. The TDOT cost estimating methodology assumes the base per mile ROW cost to be $930,000 and the base per mile construction cost to be $6,045,000 for state/federal routes and $4,533,750 for local roads. The cost of ROW is calculated by multiplying the ROW cost per mile, area factor, and distance of the recommended improvement. The construction cost is determined by multiplying the construction cost per mile, terrain factor, construction factor, and distance. The engineering cost is determined by taking 10% of the construction cost. This results in the formula below:

(ROW Cost per Mile x Area Factor x Distance) + (Construction Cost per Mile x Terrain Factor x Construction Factor x Distance) + (Construction Cost x 10%) = Opinion of Probable Cost

The area factor is based on the type of development currently in place within the area as well as whether the area is urban, suburban, or rural. For example, heavy commercial urbanized areas are much more expensive for right of way acquisitions than sparsely populated rural areas. The construction factor is based on the type of construction, such as the number of lanes that will need to be built or re-built, the type of roadway and whether or not the roadway is in an urbanized area. For example, Interstate construction within urbanized areas is much more expensive than construction of a two lane rural road. The terrain factor adjusts the costs of construction based on the topography of the location. For example, the factor is higher for rugged terrain, since it is more costly to build on steep topography. **Exhibit 2** presents the opinion of probable cost for each project along with the details of the various factors that resulted in the cost estimate. (Note: "N/A" indicates that the project cost estimate is derived from the MPO Long Range Transportation Plan or it is a project type that the criteria do not apply)

EXHIBIT 2: CONSTRUCTION COST ESTIMATES

Project	Recommendation	Termini	Project in MPO's LRTP	Area Factor	Terrain Factor	Const. Factor	Length (Miles)	ROW Cost	Const. Cost	PE Cost	Cost Estimate
Short Term Roadway Projects											
Redesign Sidco Drive and Powell Avenue intersection	Redesign Intersection	Sidco Drive and Powell Avenue intersection	No	N/A	1.00	1.00	0.1	N/A	$544,050	$54,405	$598,455
Redesign Firestone Parkway / Bridgestone Boulevard and Parthenon Boulevard intersection	Redesign Intersection	Firestone Parkway / Bridgestone Boulevard and Parthenon Boulevard intersection	No	1.75	1.00	1.00	0.2	$244,125	$680,063	$68,006	$992,194
Redesign Butler Drive and US 231 intersection	Redesign Intersection	Butler Drive and US 231 intersection	No	N/A	N/A	N/A	N/A	N/A	$70,000	$7,000	$77,000
Old Hickory Blvd (TA Truck Stop) configuration review	Add left turn lane to Firestone Parkway at Old Hickory Boulevard intersection	Firestone Parkway/Old Hickory Blvd intersection near (TA Truck Stop)	No	1.75	1.00	0.50	0.1	$97,650	$136,013	$13,601	$247,264
Ellington Parkway improvements	Widen from 4 to 6 lanes	North First Street to Broadmoor Road	X - 1023	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$9,000,000
Jefferson Pike at Murfreesboro Rd, La Vergne – Add signal	Add signal	Jefferson Pike at Murfreesboro Road (La Vergne)	No	N/A	N/A	N/A	N/A	N/A	$100,000	$10,000	$110,000
Harding near Sidco Truck Terminal – Add signal	Add signal	Harding Place near Sidco Truck Terminal	No	N/A	N/A	N/A	N/A	N/A	$100,000	$10,000	$110,000
Mason Road, La Vergne – Poor roadway condition and width	Reconstruct 2 lane road	I-24 to Ingram Boulevard	No	1.75	1.00	0.90	0.9	$1,464,750	$3,672,338	$367,234	$5,504,321
8th Avenue Rail Bridge clearance	Interim solution: Study to determine the feasibility and design parameters for the installation of a vehicle height detection system in advance of overpass in both directions to warn of clearance problems. Long-Term solution: etermine feasibility of improving clearance height by lowering roadway section.	8th Avenue Rail Bridge	No	N/A	1.10	1.50	0.1	N/A	$1,946,910	$194,691	$2,141,601
Roadway Capacity Projects (Short or Long-Term)											
I-65 at I-24 merge	Reconstruct interchange	South of Trinity Lane near Fern Avenue	No	N/A	N/A	N/A	N/A	N/A	$20,000,000	$2,000,000	$22,000,000
I-65 Nashville to Spring Hill	Widen I-65 from 4 to 8 lanes	Saturn Parkway to Highway 96	No								$91,098,605

Project	Recommendation	Termini	Project in MPO's LRTP	Area Factor	Terrain Factor	Const. Factor	Length (Miles)	ROW Cost	Const. Cost	PE Cost	Cost Estimate
I-65 at exit 65	Reconstruct interchange	Highway 96/Murfreesboro Road	No	N/A	N/A	N/A	N/A	N/A	$16,000,000	$1,600,000	$17,600,000
I-65 at I-440 merge	Widen I-65 South from 6 to 8 lanes	Harding Place (SR-255) to I-40	X - 1099	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$60,279,717
I-65/I-40 merge	Reconstruct interchange	I-65/I-40 merge east and west	No	N/A	N/A	N/A	N/A	N/A	$25,000,000	$2,500,000	$27,500,000
I-24 toward La Vergne	Widen I-24 from 8 to 10 lanes	Briley Parkway to Sam Ridley Parkway	No	1.75	1.10	0.70	12.6	$20,506,500	$58,648,590	$5,864,859	$85,019,949
I-24 at I-65 merge	Widen I-65 from 6 to 10 lanes and I-24 from 4 to 6 lanes	North of Trinity Lane	X - 1039 & 1089	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$33,000,000 (1039) $61,297,699 (1089)
I-24 at exit 56	Reconstruct Exit 56 interchange	Harding Place Exit	X - 1036	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$5,920,977
I-24 at exit 54	Reconstruct Exit 54 interchange	Briley Parkway Exit	No	N/A	N/A	N/A	N/A	N/A	$17,000,000	$1,700,000	$18,700,000
I-24 and I-40 split, East and West	Reconstruct interchange	Interchange	No	N/A	N/A	N/A	N/A	N/A	$23,500,000	$2,350,000	$25,850,000
I-40 from Bellevue exit to I-440	Widen I-40 from 6 to 8 lanes	US 70 to I-440	X - 1093	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$121,833,846
I-40 from SR-265 to SR-840	Widen I-40 from 4 to 8 lanes	From SR 171 to SR 840	X-7027	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$143,248,995
Murfreesboro Road	Widen Murfreesboro Road from 4 and 5 lanes to 7 lanes	Donelson Pike to Sam Ridley Parkway	No	1.75	1.10	0.95	11.2	$18,228,000	$70,750,680	$7,075,068	$96,053,748
Fesslers Lane / I-40 West on-ramp intersection	Widen from 6 to 12 lanes and upgrade to full interchange with Fesslers Lane	East and West of Fesslers Lane (I-65 to I-24/I-40 junction)	X - 73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$50,000,000
I-440	Widen from 6 to 8 lanes	I-40 West to I-24	No	3.25	1.00	1.05	7.7	$23,273,250	$48,873,825	$4,887,383	$77,034,458
SR-840 from SR-452 to SR-265	Widen from 4 to 6 lanes	SR-452 to SR-265	No	1.00	1.10	0.70	6.8	$6,324,000	$31,651,620	$3,165,162	$41,140,782
Lebanon Road to Briley Parkway	Widen from 2 to 4 lanes	Park Glen Drive to Highway 109	X - 7025	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$89,686,297
Beechcroft Road (SR 247)	Construct bridge over CSX railway	Rail crossing	X - 2003	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$2,690,000
Rail Projects											
Rail Access to Hailey's Harbor Terminal	Build 1,600 foot one-way spur	N&W line, Hailey's Harbor Terminal	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$470,000
Radnor Yard Alternatives	Help CSX to build a new combined intermodal ramp/ auto ramp near Smyrna		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$129,000,000

BENEFITS OF ROADWAY PROJECTS

The economic benefits and the benefit-cost ratio (BCR) of the candidate projects are estimated utilizing the theory and methods contained in the AASHTO Red Book[1] and its analysis tool. The two categories of benefits arising from the proposed projects include:

1. **Travel Efficiencies**, which are benefits accruing to highway users upon completion of the project, as measured in terms of travel-time, vehicle-operating cost and user-borne crash cost savings.

2. **Construction Impacts**, which is the impact on highway user costs due to project construction.

Travel Efficiency Gains

In estimating the travel efficiencies for highway users and the ensuing economic benefit implications thereof, the study utilizes the outputs of highway travel characteristics for the benchmark years 2008 (the base year) and 2035 (the horizon year) under the 'existing condition' generated by the regional travel demand model. Traffic volumes were provided by vehicle type (automobiles and trucks); trip purpose (work-related and non-work-related); daily peaks and off-peak; and total daily traffic.

Travel-Time Savings

Savings in travel time may result from highway improvements that allow users to travel at a higher speed, which, in turn, improve level of service (LOS) of the road network.

Travel-time savings are comprised of two separate components: resource cost and disutility cost. Resource, or opportunity, cost is equivalent to the value of time for the roadway network user, typically the value of the alternative activities that could potentially be conducted during the duration of the travel time. Disutility cost is associated with the additional stress exerted on the roadway network user because of road congestion. Generally, the opportunity cost is a function of the trip purpose, roadway network users' wage rate, and the magnitude of time saved. In this analysis, work and business-related trips are valued as a function of time savings and the prevailing wage rate in the Nashville Region while leisure-related trips are assumed to have zero economic value since leisure-related trips represent no out-of-pocket costs.

In forecasting the wage rates for private auto users and freight for the analysis periods, the 2009 data of hourly wage rates from the Nashville Region are used. By 2009, hourly wage rates for "all occupations" and "truck drivers" were $19.13[2] and $17.33[3,4], respectively. These wage

[1] American Association of State Highway and Transportation Officials (AASHTO). *User and Non-User Benefit Analysis for Highways*. September 2010.
[2] Bureau of Labor Statistics Data, online available at: http://www.bls.gov/oes/current/oes_34980.htm
[3] Bureau of Labor Statistics Data, online available at http://www.bls.gov/ro4/oestruckerstn.htm
[4] The labor cost for truck drivers is the average cost of Heavy and Tractor-Trailer Truck Drivers and Light or Delivery Services Truck Drivers.

rates are adjusted using the inflation rate provided by the Bureau of Labor Statistics (see **EXHIBIT 6**). Value of time per hour is listed in **EXHIBIT 3.**

EXHIBIT 3: VALUE OF TIME BY TRIP PURPOSE

Trip Type	Amount
Commuter trips	$18.62
Other purpose	$0.00
Trucks	$16.87

Vehicle-Operating Cost Savings

Savings in vehicle-operating costs (VOC) may result from improvements to the road pavement and operational and geometric improvements that resulted in changes in traffic speed, which, in turn, impose lower wear-and-tear and maintenance costs on highway users.

Generally, factors affecting VOC savings include vehicle type, vehicle speed, speed changes, roadway gradients and curvatures, and road surfaces. Operating costs include fuel and oil, maintenance and tires. In this analysis, the average gasoline and diesel prices in the State of Tennessee in the last five years are used in estimating VOC benefits resulting from the candidate projects in the Nashville Region.[5] The values represent $2.32 (in 2008 dollars) per gallon of gasoline and $2.52 (in 2008 dollars) per gallon of diesel. For the estimation of the oil, maintenance and tires expenditures, this analysis used the costs per mile provided by the AASHTO Red Book.

User-Borne Accident-Cost savings

Savings in user-borne crash costs may arise from highway improvements that reduce the probability or severity of death, injury and property damage from road users. Data provided by AASHTO (**EXHIBIT 4**) and the Tennessee Department of Safety (**EXHIBIT 5**) are used in the estimation of this category of highway user benefits

EXHIBIT 4: ESTIMATED ANNUAL TRAFFIC ACCIDENT COST (2000 DOLLARS)

Fatal Accidents	Injury (Non-Fatal Accidents)	Property Damage Only Accidents
$3,723,700	$108,600	$400

Source: American Association of State Highway and Transportation Officials (AASHTO). *User Benefits Analysis for Highways*. August 2003

[5] Energy information Administration, online available at http://www.eia.doe.gov/

EXHIBIT 5: ESTIMATED ANNUAL TRAFFIC CRASHES IN THE NASHVILLE REGION

County	Road Name	Five–Year Average (2003 – 2007)		
		Fatal Crashes	Injury (Non-Fatal Crashes	Property Damage Only Crashes
Davidson	I-24	7	375	854
Davidson	I-65	4	347	765
Williamson	I-65	2	110	234
Davidson	I-40	6	420	1,006
Davidson	I-440	2	99	247
Davidson	SR840	1	7.0	12
Sumner	SR109	2	63	137
Sumner	SR 52	1	25	52

Source: Tennessee Traffic Crashes on Interstate and State Routes (2003-2007), Tennessee Department of Safety.

User Disbenefits from Construction

Construction activities will potentially affect travel times, VOC, and highway safety during the project's construction time frames. These negative benefits may arise from construction zones, closed lanes and detours that affect travel speed, distance travel and road safety environment.

User disbenefits are estimated using the same methodology discussed and detailed in the travel efficiency gains section. Specific impacts on the individual user cost components due to construction periods included in this analysis are:

- Increased travel time due to reduced travel speed in construction zones
- Additional VOC due to changes in speed and decreased road capacity
- Potential costs associated with injury, property damage, and fatalities, both to car occupants and workers in the construction zones

Other Economic Parameters

Other economic parameters that were used in this assessment are shown in **EXHIBIT 6**. Twenty-four traffic parameters were used as input into the model. A sampling of data derived from traffic parameters is included in **EXHIBIT 7.**

EXHIBIT 6: OTHER ECONOMIC PARAMETERS

Item	Value	Source
Real discount rate	4%	*User Benefits Analysis for Highways*, AASHTO
Inflation rate	2.73%	Bureau of Labor Statistics, south region average inflation rate over 20 years (1990-2009)
Average Number of Occupants for each user class (commute and other trips)	1.35	Comsis Corporation (1993), Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience, USDOT and Institute of Transportation Engineers (www.ite.org); available at www.bts.gov/ntl/DOCS/474.html.
Average Number of Occupants for each user class (truck trips)	1	Comsis Corporation (1993), Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience, USDOT and Institute of Transportation Engineers (www.ite.org); available at www.bts.gov/ntl/DOCS/474.html.
Annual growth of value of time	2%	*User Benefits Analysis for Highways*, AASHTO
K factor that adjusts peak-hour volumes to daily volumes by user class	0.093	Highway Capacity Manual 2000
D factor that adjusts peak-hour volumes to daily volumes by user class	0.6	Highway Capacity Manual 2000
Weekday-to-Week factor that converts daily volumes to weekly volumes	7	*User Benefits Analysis for Highways*, AASHTO
Volume conversion factors	4.35	*User Benefits Analysis for Highways*, AASHTO
Seasonality factor	1	*User Benefits Analysis for Highways*, AASHTO

EXHIBIT 7: SAMPLE OF TRAFFIC PARAMETERS FROM DATA INPUTTED TO BENEFIT/COST MODEL

Project	Recommendation	Avg Segment Veh. Counts *	Max Segment VC Ratio	Percent Trucks
Redesign Sidco Drive and Powell Avenue Intersection	Redesign intersection	3,742	68%	5.6%
Redesign Firestone Parkway/Bridgestone Boulevard and Parthenon Boulevard Intersection	Redesign intersection	11,896	97%	7.8%
Redesign Butler Drive and US 231 Intersection	Redesign intersection	38,061	93%	4.5%
Redesign TN 109 and US 31	Redesign intersection	12,462	63%	7.9%
Old Hickory Blvd (TA Truck Stop) configuration review	Add left turn lane to Firestone Parkway at Old Hickory Boulevard intersection	9,402	61%	7.7%
Ellington Parkway improvements	Widen from 4 to 6 lanes	18,373	91%	4.7%
Jefferson Pike at Murfreesboro Rd, La Vergne - Add signal	Add signal	21,636	57%	4.1%
Harding near Sidco Truck Terminal - Add signal	Add signal	45,281	105%	4.9%
I-40 at White Bridge Road – Lane with	Widen to 6 lanes	39,197	61%	5.4%
8th Avenue Rail Bridge clearance	Increase clearance height by lowering roadway section	13,111	69%	3.7%
I-65 at I-24 merge	Reconstruct interchange	27,202	111%	5.8%
I-65 Nashville to Spring Hill	Widen I-65 from 4 to 8 lanes	40,610	82%	8.9%
I-65 at exit 65	Reconstruct interchange	11,921	88%	8.0%
I-65 at I-440 merge	Widen I-65 South from 6 to 8 lanes	13,484	60%	8.9%
I-65/I-40 merge	Redesign interchange	27,729	67%	7.9%
I-24 toward La Vergne	Widen I-24 from 8 to 10 lanes	51,275	84%	7.7%
I-24 at I-65 merge	Widen I-65 from 6 to 10 lanes and I-24 from 4 to 6 lanes	25,697	84%	8.3%

Project	Recommendation	Avg Segment Veh. Counts *	Max Segment VC Ratio	Percent Trucks
I-24 at exit 56	Widen I-24 from 8 to 10 lanes	57,983	71%	7.2%
I-24 at exit 54	Widen I-24 from 8 to 10 lanes	53,952	72%	7.1%
I-24 and I-40 split, East and West	Widen from 6 to 12 lanes and upgrade to full interchange with Fesslers Lane	26,935	60%	7.7%
I-40 from Bellevue exit to I-440	Widen I-40 from 6 to 8 lanes	45,687	79%	4.9%
I-40 from SR-265 to SR-840	Widen I-40 from 4 to 8 lanes	29,747	348%	8.1%
Murfreesboro Road	Widen Murfreesboro Road from 4 and 5 lanes to 7 lanes	15,145	112%	7.5%
Fesslers Lane/I-40 West on-ramp intersection	Widen I-40/I24 from 6 to 12 lanes and upgrade to full interchange with Fesslers Lane	76,269	92%	7.1%
I-440	Widen from 6 to 8 lanes	34,420	95%	6.5%
SR-840 from SR-452 to SR-265	Widen from 4 to 6 lanes	13,232	165%	10.4%
Lebanon Road to Briley Parkway	Widen from mostly 5 lanes to 7 lanes	19,278	63%	5.0%
Beechcroft Road (SR 247)	Construct bridge over CSX railway	4,963	34%	5.4%

* For interstates, Ellington Parkway, and SR-840, counts reflect one direction of traffic only. Overall movement on an area of roadway would be reflected by traffic in two directions.

EXHIBIT 8 Displays the results of the benefit/cost analysis of roadway projects.

EXHIBIT 8: RESULTS OF BENEFIT/COST ANALYSIS FOR ROADWAY PROJECTS

Project	Recommendation	Construction Cost (2009$)	Constr. Starts	Constr. Ends	User Value of Time Benefits	User Operating Cost Benefits	User Accident Reduction Benefits	User Disbenefits from Construction	Total Benefits	Benefit/Cost Ratio
Redesign Sidco Drive and Powell Avenue Intersection	Redesign intersection	$598,455	Jan, 2012	Dec, 2012	$648,748	$16,154	$2,554,048	-$2,256	$3,216,694	5.4
Redesign Firestone Parkway/Bridgestone Boulevard and Parthenon Boulevard Intersection	Redesign intersection	$992,194	Jan, 2012	Dec, 2012	$6,450,684	$116,883	$2,259,742	-$3,434	$8,823,875	8.9
Redesign Butler Drive and US 231 Intersection	Redesign intersection	$77,000	Jan, 2012	Dec, 2012	$1,262,457	$0	$4,626,277	-$28,432	$5,860,303	76.1
Redesign TN 109 and US 31	Redesign intersection	$1,894,875	Jan, 2012	Dec, 2012	$1,588,991	$70,908	$4,400,501	-$8,867	$6,051,533	3.2
Old Hickory Blvd (TA Truck Stop) configuration review	Add left turn lane to Firestone Parkway at Old Hickory Boulevard intersection	$247,264	Jan, 2012	Dec, 2012	$918,857	$0	$10,738,953	-$5,146	$11,652,664	65.2
Ellington Parkway improvements	Widen from 4 to 6 lanes	$9,000,000	Jan, 2012	Dec, 2013	$12,644,117	$1,079,737	$93,934,810	-$201,838	$107,456,825	17.1
Jefferson Pike at Murfreesboro Rd, La Vergne - Add signal	Add signal	$110,000	Jan, 2012	Dec, 2012	-$2,334,791	-$72,817	$9,677,292	-$24,577	$7,245,107	65.9
Harding near Sidco Truck Terminal - Add signal	Add signal	$110,000	Jan, 2012	Dec, 2012	-$5,087,123	-$323,990	$2,060,793	-$11,679	-$3,361,999	-42.3
I-40 at White Bridge Road – Lane width	Widen to 6 lanes	$3,200,000	Jan, 2012	Dec, 2012	$358,346	$0	$27,030,711	-$41,120	$27,347,937	8.5
8th Avenue Rail Bridge clearance	Increase clearance height by lowering roadway section	$2,141,601	Jan, 2012	Dec, 2012	-$349	$205,263	$513,956	-$974	$717,896	0.3
I-65 at I-24 merge	Reconstruct interchange	$22,000,000	Jan, 2015	Dec, 2015	$2,547,666	$231,416	$10,000,350	-$10,734	12,768,697	0.6
I-65 Nashville to Spring Hill	Widen I-65 from 4 to 8 lanes	$121,678,605	Jan, 2015	Dec, 2018	$7,225,259,277	$372,601,783	$324,700,240	-$5,489,109	$7,917,072,191	65.1

Project	Recommendation	Construction Cost (2009$)	Constr. Starts	Constr. Ends	User Value of Time Benefits	User Operating Cost Benefits	User Accident Reduction Benefits	User Disbenefits from Construction	Total Benefits	Benefit/Cost Ratio
I-65 at exit 65	Reconstruct interchange	$17,600,000	Jan, 2015	Dec, 2015	$14,143,985	$129,003	$13,720,338	-$7,399	$27,985,927	1.6
I-65 at I-440 merge	Widen I-65 South from 6 to 8 lanes	$60,279,717	Jan, 2015	Dec, 2015	$581,104	$42,617	$7,805,745	-$4,770	$8,424,696	0.1
I-65/I-40 merge	Redesign interchange	$27,500,000	Jan, 2015	Dec, 2015	$1,167,723	$79,057	$7,159,215	-$8,042	$8,397,953	0.3
I-24 toward La Vergne	Widen I-24 from 8 to 10 lanes	$85,019,949	Jan, 2015	Dec, 2015	$41,196,624	$1,396,763	$115,401,514	-$516,577	$157,478,325	1.85
I-24 at I-65 merge	Widen I-65 from 6 to 10 lanes and I-24 from 4 to 6 lanes	$94,297,977	Jan, 2015	Dec, 2015	$3,136,659	$165,988	$11,193,460	-$11,443	$14,484,665	0.2
I-24 at exit 56	Widen I-24 from 8 to 10 lanes	$5,920,977	Jan, 2015	Dec, 2015	$200,787	$40,270	$11,728,542	-$29,032	$11,940,568	2.0
I-24 at exit 54	Widen I-24 from 8 to 10 lanes	$18,700,000	Jan, 2015	Dec, 2015	$921,940	$99,076	$5,195,424	-$10,949	$6,205,491	0.3
I-24 and I-40 split, East and West	Reconstruct interchange	$25,850,000	Jan, 2015	Dec, 2015	$473,034	$46,026	$4,347,125	-$4,758	$4,861,427	0.2
I-40 from Bellevue exit to I-440	Widen I-40 from 6 to 8 lanes	$121,833,846	Jan, 2015	Dec, 2016	$19,102,883	$973,582	$129,275,310	-$538,053	$148,813,722	1.2
I-40 from SR-265 to SR-840	Widen I-40 from 4 to 8 lanes	$143,248,995	Jan, 2015	Dec, 2016	$85,758,126	$2,257,760	$61,715,718	-$495,685	$149,235,919	1.0
Murfreesboro Road	Widen Murfreesboro Road from 4 and 5 lanes to 7 lanes	$96,053,748	Jan, 2015	Dec, 2016	$137,414,656	$2,250,370	$102,339,699	-$531,410	$241,473,315	2.5
I-24/I-40, Fessler's lane exit	Widen from 6 to 12 lanes and upgrade to full interchange with Fesslers Lane	$50,000,000	Jan, 2015	Dec, 2016	$173,213,103	$9,502,526	$9,389,591	-$76,764	$192,028,455	6.5
SR-840 from SR-452 to SR-265	Widen from 4 to 6 lanes	$41,140,782	Jan, 2015	Dec, 2016	$24,213,156	$724,175	$3,607,564	-$147,039	$28,397,857	0.7
I-440	Widen from 6 to 8 lanes	$77,034,458	Jan, 2015	Dec, 2016	$147,586,735	$12,762,367	$168,171,929	-$538,106	$327,982,925	4.3

Project	Recommendation	Construction Cost (2009$)	Constr. Starts	Constr. Ends	User Value of Time Benefits	User Operating Cost Benefits	User Accident Reduction Benefits	User Disbenefits from Construction	Total Benefits	Benefit/Cost Ratio
Lebanon Road to Briley Parkway	Widen from mostly 5 lanes to 7 lanes	$89,686,297	Jan, 2015	Dec, 2015	$8,595,498	$430,430	$12,310,518	-$33,685	$21,302,761	0.2
Beechcroft Road (SR 247)	Construct bridge over CSX railway	$2,690,000	Jan, 2015	Dec, 2016	$663,958	$119,766	$154,170	$0	$974,856	0.4

BENEFIT/COST OF RAIL PROJECTS

Benefit/cost analyses of two rail-related projects are presented below. Wilbur Smith Associates recently developed a tool to assess the benefits of rail projects. This tool quantifies the following benefits associated with switching from truck to rail:

- Shipper savings, reflecting the difference between rail and truck operating cost per ton-mile
- Highway maintenance savings from removing trucks from highways
- Safety savings, since rail is a safer transportation mode than trucking,
- Environmental benefits associated with lower emissions by rail than trucking.

The tool was developed based upon guidance provided in the U.S. Department of Transportation's Notice of Funding Availability for TIGER (Transportation Investment Generating Economic Recovery) Discretionary Grants published on June 17, 2009 in the U.S. Federal Register Vol. 74, No. 115. Key parameters are identified in **EXHIBIT 9.**

EXHIBIT 9: KEY PARAMETERS TO WILBUR SMITH ASSOCIATES RAIL BENEFITS CALCULATOR

Item	Value	Source
Average Truck Payload Capacity in Tons	23.4	2002 U.S. Census Bureau *Vehicle Inventory and Use Survey* (VIUS)
Truck Highway Damage per Ton-Mile	$0.0056	FHWA *Highway Cost Allocation Study, 2000 Update*, indexed to current year
Short Line RR Operating Expense per Ton-Mile	$0.06	From American Short Line and Regional Railroad Association *Annual Data Profile*
Operating Expense per Ton-Mile for Intermodal Rail	$0.055	Carrier Financial Reports, STB Uniform Rail Cost System (URCS) model
Discount Rate	4%	*User Benefits Analysis for Highways*, AASHTO
Bulk Truck Operating Expense per Ton-Mile	$0.086	American Trucking Associations (ATA) *An Analysis of Operational Costs of Trucking*, adjusted to include admin exp. (based on *2003 Motor Carrier Annual Reports*, bulk carriers)
Intermodal Truck Operating Expense per Ton-Mile	$0.120	ATA Estimate with Administrative Costs, Adjusted by assumed 72% loaded rate from VIUS
Rail fuel consumption (Gallons per Ton-Mile)	0.00231	Association of American Railroads (AAR) *Railroad Facts*, 2008 Edition
Truck Fuel Consumption (Miles per Gallon)	5.1	FHWA *Highway Statistics, 2006*
Truck NO_X and PM Emissions per Mile	Varies by year	FHWA, *Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level*
CO_2 Tons per Gallon	0.011116	EPA, *Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel*
Rail NO_x and PM Emissions per Mile	Varies by year	EPA, *Emissions Factors for Locomotives*
Emissions Damage per Ton - NO_x	$4,000	National Highway Traffic Safety Administration (NHTSA), CAFE Standard *Final Regulator Impact Analysis* (FRIA)
Emissions Damage per Ton - PM	$168,000	NHTSA, CAFE Standard FRIA
Emissions Damange per Ton - CO_2	$33	NHTSA, CAFE Standard FRIA

Item	Value	Source
Combination Truck Fatalities per 100M VMT	2.5	FHWA, *Large Truck and Bus Crash Facts 2007*
Combination Truck Injuries per 100M VMT	38.1	FHWA, *Large Truck and Bus Crash Facts 2007*
Combination Truck Property Damage Only per 100M VMT	112.5	FHWA, *Large Truck and Bus Crash Facts 2007*
Cost per Fatality	$6,000,000	USDOT Guidance March 18, 2009
Cost per Injury	$93,000	USDOT Guidance March 18, 2009
Cost of Property Damage Only Hwy Accidents	$2,300	National Safety Council
Rail Accident Cost per Ton-Mile	$0.00243	Calculated using Federal Railroad Administration Accident Data, Accident costs from CAFE Standard FRIA

Rail Access to Hailey's Harbor Terminal

If a rail spur were built into the terminal from a nearby Nashville & Western (N&W) rail line, a preliminary estimate suggests that at least 1,600 feet of track would be needed for construction. At an estimated cost of $200 per foot plus a $150,000 turnout, the approximate total project cost would be $470,000. According to a representative from Hailey's Harbor, about 30,000 tons per year would enter and leave the terminal by rail if rail service were available. Most of this would be for local service. Significant state dollars have been spent to upgrade the N&W line, and the addition of this marine terminal to the shippers along the line could help to justify these expenditures.

Assuming 80 tons per car, an average length of haul of 30 miles, a traffic growth rate equal to the overall rail growth rate in the region, a calculation of benefits using the WSA benefit calculator tool suggests that the project would yield a benefit/cost ratio of 1.28.

User Benefits from Operation			Environmental Benefits	Total User Benefits
Shipper Cost Savings	Highway Maintenance Savings	Safety Benefits		
$354,573	$91,677	$58,611	$96,491	$601,352

Capital Costs	Net Benefits	Benefit-Cost Ratio
$470,000	$131,352	1.28

Radnor Yard Alternatives

As mentioned in Technical Memo #7, the CSX Radnor Yard is at capacity. It currently is the location of a major class I yard, an intermodal ramp, and an auto ramp. The Radnor Yard Alternatives would involve building a new combined facility either adjacent to or in close proximity to the Nissan automotive plant in Smyrna, TN. This evaluation focuses on one component of this project, the intermodal terminal. According to the 2002 Tennessee State Rail

Plan, the current intermodal ramp at Radnor Yard has a capacity to handle about 100,000 containers per year.[6] Data received from IHS Global Insight for this project suggests that Radnor Yard handled about 87,600 containers in 2007. Global Insight forecasts predicted a dramatic rise in the volume of containers into and out of the Nashville region, with an annual increase of about five percent to 2035. Due to the downturn in the economy, it is unlikely that container volumes have increased over the past several years. However, traffic would likely increase rapidly when the economy recovers. If the Global Insight predictions are verified, the intermodal ramp at the Radnor Yard will be at its 100,000 container capacity within a few years. According to the Global Insight database, over half of the intermodal traffic into and out of region is to and from Chicago, while most of the remainder is to/from Atlanta and Charleston, SC. In the future, traffic volumes between Nashville and Atlanta will increase, but Chicago will remain the most important origin/destination.

This benefit/cost analysis assumes that after the intermodal ramp at Radnor Yard reaches capacity, additional containers will need to be transported by truck rather than rail. Because container volumes are expected to reach about 300,000 by 2035, the new terminal would be assumed to have the capacity of 300,000. The cost of a terminal would depend upon numerous variables, but to simplify, a terminal would be assumed to have roughly the same cost as the planned Norfolk Southern terminal in Fayette County, TN, $129 million. The NS terminal when completed will have the capacity to handle 327,000 containers per year. It is assumed that the Nashville terminal would be built over a two year period. The results of the analysis suggest that the construction of a new terminal will generate significant benefits. The benefit/cost ratio is 2.8, so the project would generate benefits in excess of costs. This analysis includes only a component of the Radnor Yard Alternatives. Additional benefits would result in CSX's ability to expand the capacity of the classification yard at Radnor, as well as the ability to expand TDSI operations and the location in close proximity to the Nissan plant.

User Benefits from Operation			Environmental Benefits	Total User Benefits
Shipper Cost Savings	Highway Maintenance Savings	Safety Benefits		
$267,294,426	$24,945,412	$24,993,614	$50,119,471	$367,352,923

Capital Costs	Net Benefits	Benefit-Cost Ratio
$129,000,000	$238,352,923	2.8

[6] http://www.tdot.state.tn.us/publictrans/RailPlan/tasks/task02.pdf

Prioritization of Projects/Policies for Further Study

As shown in **EXHIBIT 1**, a number of projects were identified in Technical Memo #7 as warranting further investigation. However, insufficient information is available regarding these projects to evaluate them by the criteria established by the Nashville Freight Advisory Committee. But it would still be useful to prioritize these projects with available information, so that those projects that should be studied first would be identified. Several issues can help to shed light on which projects may merit attention first.

NATURE OF PROJECT IDENTIFICATION

Some projects were proposed based upon individual stakeholder feedback, whereas others were recurrent themes that appeared in Phase I and Phase II of this study and were identified by multiple stakeholders. The recurrent themes would tend to be higher priority, since feedback from multiple sources would suggest that they are more significant issues. **EXHIBIT 10** below categorizes projects as "Mentioned Once" or "Recurrent." In this case, "Mentioned Once" means that the issue/project was only identified by a single stakeholder. "Recurrent" refers to issues/projects that were identified by multiple, unrelated stakeholders or generally were raised multiple times throughout the course of the study.

EXHIBIT 10: NATURE OF PROJECT IDENTIFICATION

Project	Nature of Project Identification	Comments
New east/west (I-40) rail corridor	Recurrent	Already, three studies have addressed this issue, and it is continuing to be investigated.
Smyrna/Rutherford County Airport Economic Development	Mentioned Once	Economic development opportunities were discussed with the airport authority, but were not discussed with other stakeholders.
Toll studies	Recurrent	Two separate stakeholders recommended toll studies.
Dedicated truck lanes	Mentioned Once	Recommended by a single stakeholder
Elliston Place – Lack of loading area causing trucks to double park	Mentioned Once	Observed by team members in Phase I, but not mentioned by stakeholders
South Royal Oaks Parkway truck restrictions	Mentioned Once	Recommended by a single stakeholder
Container on Barge Service	Mentioned Once	A single stakeholder mentioned the idea of container-on-barge
Completion of the State Route 840 loop	Recurrent	The idea of completing the SR-840 loop has frequently been discussed in Nashville
Email construction information system	Mentioned Once	Mentioned by a single stakeholder
Heil Quaker Rd, Bridgestone Pkwy & Old Hickory – Add signal	Mentioned Once	Recommended by a single stakeholder
Mason Road, La Vergne – Poor roadway condition and width	Mentioned Once	Recommended by a single stakeholder

Project	Nature of Project Identification	Comments
Regional freight / land use plan, addressing encroachment & conflict issues	Recurrent	Several stakeholders mentioned land use conflicts. This was a major theme of both Phase I and Phase II of this study.
Access management ordinance that addresses areas of concern regarding truck access to and from pickup and delivery locations, loading dock study / policy	Recurrent	Several stakeholder mentioned truck access issues. This issue has appeared in both Phase I and Phase II of this study.
Truck route study	Mentioned Once	Truck route studies have been mentioned in both Phase I and Phase II of this study, but the issue was identified by the study team rather than through interviews with stakeholders.
1801 West End Avenue	Mentioned Once	Mentioned by a single stakeholder in Phase I of study

PROJECTS THAT ADDRESS SPECIFIC FAC CRITERIA

Some projects address specific subcriteria that were identified by the Nashville Freight Advisory Committee (FAC). For example, the FAC proposed that the technological aspects of projects be evaluated by the extent to which they promote Intelligent Transportation Systems (ITS). Some projects may promote specific goals. Maritime and rail projects also promote cleaner and safer transportation options, a consideration that should also be taken into account.

EXHIBIT 11: PROJECTS THAT FULFILL SPECIFIC SUBCRITERIA

Project	Subcriteria
Toll studies	Among the cost – effectiveness considerations proposed by the FAC was the potential for public-private partnerships (PPP). Toll studies can be consistent with PPP.
Elliston Place – Lack of loading area causing trucks to double park	One of the safety considerations put forward by the FAC was a project's ability to provide safe and secure parking for trucks. This project is consistent with this subcriterion.
Container on Barge Service	To the extent that this project would promote modal switch to maritime, it would support environmental and safety criteria established by the FAC. It would also be consistent with PPP under Cost Effectiveness because a private entity would likely participate in funding.

Project	Subcriteria
New east/west (I-40) rail corridor	To the extent that this project would promote modal switch to rail, it would support environmental and safety criteria established by the FAC. It would also be consistent with PPP under Cost Effectiveness because a private entity would likely participate in funding.
Email construction information system	The "Technology" criterion put forward by the FAC recommends usage of ITS. This project is consistent.
Regional freight / land use plan, addressing encroachment & conflict issues	Among the considerations put forward by the FAC under the "Environmental" criterion was to reduce noise and/or light pollution. Reducing land use conflicts would be consistent with this issue.
Access management ordinance that addresses areas of concern regarding truck access to and from pickup and delivery locations, loading dock study / policy	Among the safety considerations were to provide safe and secure parking for trucks. This policy area is consistent with this issue.
Truck route study	Among the considerations under the "Mobility" criterion established by the FAC were to remove trucks from congested urban areas. This project is consistent with this subcriterion.

In some cases it is impossible to identify the quantity of freight impacted by a given policy or project, but in others, this determination is possible. Those projects that impact more freight should be given a higher priority, per the "mobility" criteria established by the Nashville FAC. In cases where projects are relevant to rail or maritime, truck count equivalents are provided based upon tonnage handled.

EXHIBIT 12: TRUCK COUNTS OR TRUCK EQUIVALENTS IMPACTED BY SELECT PROJECTS

Project	Truck Counts	Comments
Smyrna/Rutherford County Airport Economic Development	Low	As pointed out in Technical Memo #4, air cargo is only about two to three percent of freight by volume for the region. It is somewhat higher by value, but this project would still be unlikely to impact a very large quantity of freight.
Elliston Place – Lack of loading area causing trucks to double park	468	From Nashville model
Container on Barge Service	6 to 11 (40 to 80 containers per week divided by seven	This service would likely begin with a single barge per week, similar to the Osprey Lines service between New

Project	Truck Counts	Comments
	days per week, rounded)	Orleans and Memphis. The barge would carry somewhere between 40 and 80 containers per week.
New east/west (I-40) rail corridor	109 (39,650 ÷ 365 days/year)	Per Younger Associates report
1801 West End Avenue	1,633	From Nashville model

PRIORITIZATION OF PROJECTS THAT REQUIRE FURTHER STUDY

Based upon the indicators listed above,
EXHIBIT 13 provides a rough prioritization of projects for further study. Each of the projects listed in
EXHIBIT 13 has merit, and even projects listed as having "Low" priority are worth further investigation. Although this ranking does not provide a full evaluation of projects it could be used as general guidance on which project to investigate first.

EXHIBIT 13: PRIORITIZATION OF PROJECTS THAT REQUIRE FURTHER STUDY

Project	Priority	Comments
Regional freight / land use plan, addressing encroachment & conflict issues	High	Recurrent theme in study, supports environmental criterion
Access management ordinance that addresses areas of concern regarding truck access to and from pickup and delivery locations, loading dock study / policy	High	Recurrent theme in study, supports safety criterion
Toll studies	High	Supports PPP, recommended by multiple stakeholders
New east/west (I-40) rail corridor	High	Supports safety, environmental, cost effectiveness criteria, recurrent issue
Elliston Place – Lack of loading area causing trucks to double park	Medium	Supports safety criterion
Container on Barge Service	Medium	Supports safety, environmental, cost effectiveness criteria
Email construction information system	Medium	Supports technology criterion
Truck route study	Medium	Supports mobility criterion
Completion of the State Route 840 loop	Medium	Recurrent issue
1801 West End Avenue	Low	
Smyrna/Rutherford County Airport Economic Development	Low	
Dedicated truck lanes	Low	
South Royal Oaks Parkway truck restrictions	Low	
Heil Quaker Rd, Bridgestone Pkwy & Old Hickory – Add signal	Low	
Mason Road, La Vergne – Poor	Low	

Project	Priority	Comments
roadway condition and width		

Project Evaluation

The Nashville Freight Advisory Committee (FAC) has developed a series of criteria by which to evaluate potential freight projects. The criteria are as follows:

- Safety and Security (20 points)
- Environmental Impacts (10 points)
- Mobility (20 points)
- Cost Effectiveness (20 points)
- Technology (15 points)
- Support to Local, State, and Regional Plans (15 points)

For each criterion, the FAC has proposed a series of indicators or subcriteria which could indicate whether a project meets a given criterion or not. For example, the subcriteria for Safety and Security include the following:

- Provides improvements at high crash locations (rate using TDOT high crash locations)
- Improves evacuation route that is also on a major truck route
- Reduces conflicts with commuter traffic
- Reduces number of at-grade rail crossings
- Provides safe and secure parking opportunities for commercial vehicle drivers

Each criterion must be translated into a workable framework for scoring projects, which involves asking a number of questions, including,

- For which subcriteria is data available? For example, evacuation route designations are proprietary and not publicly available. No data is available by which to evaluate project by this subcriterion.
- What is the weighting of the various subcriteria? Is it more important that a project reduce conflicts with commuter traffic, or that it provides improvements at high accident locations?
- Which subcriteria are relevant to the projects presented for evaluation? For example, none of the projects to which a benefit/cost analysis has been applied provide safe parking opportunities for commercial vehicle drivers.
- What are the most relevant statistics by which to evaluate criteria and subcriteria? For example, whether a project provides an improvement at a high crash location is indeed a relevant consideration. However, the rate of crashes is a key input into the safety benefits

calculation as part of the benefit/cost analysis. The quantified safety benefits may be a more telling consideration, which also includes crash rates for roadway locations.

SAFETY AND SECURITY

Project reduces traffic crashes and improves the safety and security of travelers.

Given the discussion above, it is recommended that projects be evaluated on Safety and Security through three parameters: 1) quantified crash reduction benefits, 2) reduction in commuter conflicts, and 3) reduction in at grade crossings. The quantified crash reduction benefits are weighted with a maximum of 10 points. The project with the highest crash reduction benefits would yield present value benefits of $325 million (I-65 Nashville to Spring Hill) for crash reduction, while the project with the lowest crash reduction benefits will yield only about $59,000 (Rail Access to Hailey's Harbor) in crash reduction benefits. It is proposed that each project receive a score of one point for providing positive safety benefits, and one point for each additional $30 million in safety benefits with a maximum score of 10 points. The scoring matrix is as follows:

User Accident Reduction Benefits	Score
< $0	0
$0 - $30 million	1
$30 million - $60 million	2
$60 million - $90 million	3
$90 million - $120 million	4
$120 million - $150 million	5
$150 million - $180 million	6
$180 million - $210 million	7
$210 million - $240 million	8
$240 million - $270 million	9
>$270 million	10

The reduction in commuter conflicts is identified by the percentage of traffic that is commuter and the identification of whether a project is on a Major Freight Corridor (as identified in Technical Memo #6). Conflicts with commuter traffic are high in those locations that are both Major Freight Corridor and have a high percentage of commuter traffic. Commuter traffic is assumed to be represented by passenger vehicles traveling during peak time periods. Of the projects studied, the median percentage of commuter traffic as a percentage of all traffic is 52. Projects that are both on a Major Freight Corridor and for which commuter traffic represents over 52 percent of all traffic at that location receive an extra five points. The projects that meet these criteria are identified in **EXHIBIT 14.**

The Beechcroft Road project receives an extra five points because it would remove a grade crossing. The Beechcroft Road project is the only grade separation project herein.

Scoring of projects for safety is provided in **EXHIBIT 15** below.

EXHIBIT 14: SAFETY STATISTICS BY ROADWAY PROJECT LOCATION

Project	Major Freight Corridor	Percentage Commuter Traffic	Major Freight and >52% Commuter
Short Term Roadway Projects			
Redesign Sidco Drive and Powell Avenue intersection	No	62%	No
Redesign Firestone Parkway / Bridgestone Boulevard and Parthenon Boulevard intersection	Yes	52%	No
Redesign Butler Drive and US 231 intersection	Yes	52%	No
Redesign TN 109 and US 31 intersection	Yes	55%	Yes
Redesign TN 109 and TN 52 intersection	Yes	53%	Yes
Old Hickory Blvd (TA Truck Stop) configuration review	Yes	52%	No
Ellington Parkway improvements	No	56%	No
Jefferson Pike at Murfreesboro Rd, La Vergne – Add signal	No	55%	No
Harding near Sidco Truck Terminal – Add signal	No	57%	No
I-40 at White Bridge Road – Lane width	Yes	52%	No
8th Avenue Rail Bridge clearance	No	62%	No
Roadway Capacity Projects (Short or Long-Term)			
I-65 at I-24 merge	Yes	47%	No
I-65 Nashville to Spring Hill	Yes	52%	No
I-65 at exit 65	Yes	53%	Yes
I-65 at I-440 merge	Yes	53%	Yes
I-65/I-40 merge	Yes	52%	No
I-24 toward La Vergne	Yes	54%	Yes
I-24 at I-65 merge	Yes	49%	No
I-24 at exit 56	Yes	54%	Yes
I-24 at exit 54	Yes	53%	Yes
I-24 and I-40 split, East and West	Yes	53%	Yes
I-40 from Bellevue exit to I-440	Yes	51%	No

Project	Major Freight Corridor	Percentage Commuter Traffic	Major Freight and >52% Commuter
I-40 from SR-265 to SR-840	Yes	50%	No
Murfreesboro Road	Yes	53%	Yes
Fesslers Lane/I-40 West on-ramp intersection	Yes	51%	No
I-440	Yes	52%	No
SR-840 from SR-452 to SR-265	Yes	50%	No
Lebanon Road to Briley Parkway	No	56%	No
Beechcroft Road (SR 247)	No	51%	No

EXHIBIT 15: SCORING OF PROJECTS FOR SAFETY

Project	Indicator			Score			
	User Accident Reduction Benefits	Major Freight and >52% Commuter	Eliminates a Grade Crossing	User Accident Reduction Benefits	Major Freight and >52% Commuter	Eliminates a Grade Crossing	Total Score
Redesign Sidco Drive and Powell Avenue Intersection	$2,554,048	No	No	1	0	0	1
Redesign Firestone Parkway/Bridgestone Boulevard and Parthenon Boulevard Intersection	$2,259,742	No	No	1	0	0	1
Redesign Butler Drive and US 231 Intersection	$4,626,277	No	No	1	0	0	1
Redesign TN 109 and US 31	$4,400,501	Yes	No	1	5	0	6
Old Hickory Blvd (TA Truck Stop) configuration review	$10,738,953	Yes	No	1	5	0	6
Ellington Parkway improvements	$93,934,810	No	No	4	0	0	4
Jefferson Pike at Murfreesboro Rd, La Vergne - Add signal	$9,677,292	No	No	1	0	0	1
Harding near Sidco Truck Terminal - Add signal	$2,060,793	No	No	1	0	0	1
I-40 at White Bridge Road – Lane width	$27,030,711	No	No	1	0	0	1
8th Avenue Rail Bridge clearance	$513,956	No	No	1	0	0	1
I-65 at I-24 merge	$10,000,350	No	No	1	0	0	1
I-65 Nashville to Spring Hill	$324,700,240	No	No	10	0	0	10
I-65 at exit 65	$13,720,338	Yes	No	1	5	0	6
I-65 at I-440 merge	$7,805,745	Yes	No	1	5	0	6
I-65/I-40 merge	$7,159,215	No	No	1	0	0	1
I-24 toward La Vergne	$115,401,514	Yes	No	4	5	0	9

Project	Indicator			Score			
	User Accident Reduction Benefits	Major Freight and >52% Commuter	Eliminates a Grade Crossing	User Accident Reduction Benefits	Major Freight and >52% Commuter	Eliminates a Grade Crossing	Total Score
I-24 at I-65 merge	$11,193,460	No	No	1	0	0	1
I-24 at exit 56	$11,728,542	Yes	No	1	5	0	6
I-24 at exit 54	$5,195,424	Yes	No	1	5	0	6
I-24 and I-40 split, East and West	$4,347,125	Yes	No	1	5	0	6
I-40 from Bellevue exit to I-440	$129,275,310	No	No	5	0	0	5
I-40 from SR-265 to SR-840	$61,715,718	No	No	3	0	0	3
Murfreesboro Road	$102,339,699	Yes	No	4	5	0	9
Fesslers Lane/I-40 West on-ramp intersection	$9,389,591	No	No	1	0	0	1
SR-840 from SR-452 to SR-265	$3,607,564	No	No	1	0	0	1
I-440	$168,171,929	No	No	6	0	0	6
Lebanon Road to Briley Parkway	$12,310,518	No	No	1	0	0	1
Beechcroft Road	$154,170	No	Yes	1	0	5	6
Rail Access to Hailey's Harbor Terminal	$58,611	N/A	No	1	0	0	1
Radnor Yard Alternatives	$24,993,614	N/A	No	1	0	0	1

ENVIRONMENTAL IMPACTS

Project minimizes negative environmental and/or social impacts.

The Nashville FAC proposed the following subcriteria to evaluate whether a project minimizes environmental or social impacts:

- Implements emissions reduction strategies
- Promotes energy conservation (e.g. truck stop electrification)
- Supports Environmental Justice initiatives for minority and low income populations
- Reduces noise and/or light pollution

The two rail projects would reduce emissions, in that freight would switch from truck to rail, and rail generates lower emissions. The energy and emissions impact of roadway projects is unclear. On the one hand, many of these projects would reduce congestion and therefore enable vehicles to operate at more fuel efficient speeds. On the other hand, reduced congestion could encourage more people to drive and locate farther from their employers.

It is recommended that the two rail projects receive 10 points for promoting usage of a more environmentally efficient mode.

MOBILITY

Project improves the movement of freight / system performance.

The Nashville FAC proposed the following criteria to asses project impacts on mobility:

- Volume of freight transported (rate using ADT, volume of trains, freight cars, tons (for freight movement, etc.)
- Improves level of service, reduces congestion, or increases the efficiency of freight service (rate using LOS (for highways) and the potential for higher speeds and greater capacity (for rail projects))
- Improves intermodal connectivity, provides multi-modal access (rate using number, quality, or importance of multiple modes; a higher score should be given for a greater number of connections or for quality or importance of connections)
- Regional scale and impact - Affects more than one community (projects that complete links between transportation facilities should score well)
- Incorporates truck-specific design elements
- Provides alternate routes for truck traffic (e.g. moving through trucks out of congested urban areas)
- Increases connectivity to industrial developments

Several of these considerations are included within the quantification of travel time savings and vehicle operation cost savings. As a project improves the level of service of a given roadway segment, it provides travel time savings and vehicle operating cost savings. Volumes of freight tend to be highest on roadways with overall high levels of traffic. Those areas that have the

highest vehicle counts yield the highest improvements in travel time savings and vehicle operating cost savings, all other factors being equal.

The scoring assigns projects a maximum of 10 points based upon the sum of travel time and vehicle operating cost savings. The project to widen I-65 between Nashville and Spring Hill has the highest travel time and user vehicle savings at over $7.5 billion, but this is an outlier.[7] The two roadway projects with the next highest travel time/vehicle operating benefits are the I-40/I-24/Fesslers Lane interchange improvements and the project to widen I-440, with about $183 and $160 million in travel time/vehicle operating cost benefits, respectively. Projects will be assigned points for each $15 million in travel time/vehicle operating cost benefit, with 0 - $15 million receiving one point. For rail projects, impacts on shipping costs and highway congestion/maintenance will form the basis of mobility benefits. The matrix of scores is as follows:

Travel Time + Veh. Op. Exp. Savings	Score
< $0	0
$0 - $15 million	1
$15 million - $30 million	2
$30 million - $45 million	3
$45 million - $60 million	4
$60 million - $75 million	5
$75 million - $90 million	6
$90 million - $105 million	7
$105 million - $120 million	8
$120 million - $135 million	9
>$135 million	10

Five points would be assigned based upon the percentage of trucks in a given corridor. For the project with the lowest percentage of trucks, commercial vehicles represent only 3.7 percent of total traffic counts (8th Ave. Rail Bridge Clearance) at that location, whereas trucks represent 10.4 percent of traffic at the location with the highest percentage of trucks (SR-840 from SR-452 to SR-265). Projects are assigned points based upon the following:

% Truck	Score
< 5%	0
5 - 6%	1
6 - 7%	2
7 - 8%	3
8 - 9%	4
>9%	5

[7] User benefits from operation are significantly high because highway users to benefit represent between 35,000 and 71,000 vehicles per day traveling in a 42-mile improved road segment.

The percentage of commercial vehicles for each roadway project location is displayed in **EXHIBIT 7**. Projects would also be assigned five points if they are applicable to an intermodal connector. The following projects are associated with intermodal connectors:

- The redesign of the Sidco Drive and Powell Avenue intersection helps to provide access to the CSX Radnor Yard.
- The project to add a signal on Harding Place near Sidco Truck Terminal also provides access to the CSX Radnor Yard.
- The project to add a signal at Jefferson Pike at Murfreesboro Rd helps to provide access to the Smyrna/Rutherford County Airport.
- The improvements to Murfreesboro Road provide access to the Nashville International Airport.

The rail projects will each be assigned five points for providing access to intermodal connections. **EXHIBIT 16** provides a summary of project scoring for mobility.

EXHIBIT 16: SCORING OF PROJECTS FOR MOBILITY

Project	Indicator			Score			
	Val of Time + Veh. Oper Benefits	% Trucks	Intermodal Connector	Val of Time + Veh. Oper Benefits	% Trucks	Intermodal Connector	Total
Redesign Sidco Drive and Powell Avenue Intersection	$664,902	5.60%	Yes	1	1	5	7
Redesign Firestone Parkway/Bridgestone Boulevard and Parthenon Boulevard Intersection	$6,567,567	7.80%	No	1	3	0	4
Redesign Butler Drive and US 231 Intersection	$1,262,457	4.50%	No	1	0	0	1
Redesign TN 109 and US 31	$1,659,899	7.90%	No	1	3	0	4
Old Hickory Blvd (TA Truck Stop) configuration review	$918,857	7.70%	No	1	3	0	4
Ellington Parkway improvements	$13,723,854	4.70%	No	1	0	0	1
Jefferson Pike at Murfreesboro Rd, La Vergne - Add signal	($2,407,608)	4.10%	Yes	0	0	5	5
Harding near Sidco Truck Terminal - Add signal	($5,411,113)	4.90%	Yes	0	0	5	5
I-40 at White Bridge Road – Lane width	$358,346	5.40%	No	1	1	0	2
8th Avenue Rail Bridge clearance	$0	3.70%	No	1	0	0	1
I-65 at I-24 merge	$2,779,082	5.80%	No	1	1	0	2

Project	Indicator			Score			
	Val of Time + Veh. Oper Benefits	% Trucks	Intermodal Connector	Val of Time + Veh. Oper Benefits	% Trucks	Intermodal Connector	Total
I-65 Nashville to Spring Hill	$7,597,861,060	8.90%	No	10	4	0	14
I-65 at exit 65	$14,272,988	8.00%	No	1	4	0	5
I-65 at I-440 merge	$623,721	8.90%	No	1	4	0	5
I-65/I-40 merge	$1,246,780	7.90%	No	1	3	0	4
I-24 toward La Vergne	$42,593,387	7.70%	No	3	3	0	6
I-24 at I-65 merge	$3,302,647	8.30%	No	1	4	0	5
I-24 at exit 56	$241,057	7.20%	No	1	3	0	4
I-24 at exit 54	$1,021,016	7.10%	No	1	3	0	4
I-24 and I-40 split, East and West	$519,060	7.70%	No	1	3	0	4
I-40 from Bellevue exit to I-440	$20,076,465	4.90%	No	2	0	0	2
I-40 from SR-265 to SR-840	$88,015,886	8.10%	No	6	4	0	10
Murfreesboro Road	$139,665,026	7.50%	Yes	10	3	5	18
Fesslers Lane/I-40 West on-ramp intersection	$182,715,629	7.10%	No	10	3	0	13
SR-840 from SR-452 to SR-265	$24,937,331	6.50%	No	2	2	0	4
I-440	$160,349,102	10.40%	No	10	5	0	15
Lebanon Road to Briley Parkway	$9,025,928	5.00%	No	1	1	0	2
Beechcroft Road	$783,724	5.40%	No	1	1	0	2
Rail Access to Hailey's Harbor Terminal	$446,250	NA	Yes	1	NA	5	6
Radnor Yard Alternatives	$292,239,838	NA	Yes	10	NA	5	15

COST EFFECTIVENESS

Amount of investment required / funding sources.

The Nashville FAC provided the following subcriteria by which to evaluate the cost effectiveness of projects.

- Provides the opportunity for Public Private Partnership (potential to leverage Federal transportation funds with other public or private investment)
- Capital cost in proportion to goods movement benefit (projects that are disproportionately expensive, save only a few minutes of travel time, or serve few people will tend to score low)
- Utilization and preservation of existing infrastructure, consideration of future maintenance, operating, and capital costs (New facilities would score low. High scores should be reserved for projects whose purpose is to restore facilities that are dilapidated or unused).

The primary indicator of cost effectiveness is the benefit/cost ratio. In addition, the two rail projects offer the opportunity for public/private partnership if the rail carriers or Hailey's Harbor help to pay for the project. It is therefore proposed that a maximum of 15 points be awarded on the basis of benefit/cost ratio. All projects with a benefit/cost ratio below one will be awarded zero points. Projects with a benefit cost ratio between one and five will be awarded 10 points. Projects with a benefit/cost ratio in excess of five will be awarded 15 points. The two rail projects will be awarded an additional five points due to the possibility of public/private partnership.

EXHIBIT 17: SCORING OF PROJECTS FOR COST EFFECTIVENESS

Project	Indicator		Cost Effectiveness		
	BC Ratio	PPP	BC Ratio	PPP	Total
Redesign Sidco Drive and Powell Avenue Intersection	5.4	No	15	0	15
Redesign Firestone Parkway/Bridgestone Boulevard and Parthenon Boulevard Intersection	8.9	No	15	0	15
Redesign Butler Drive and US 231 Intersection	76.1	No	15	0	15
Redesign TN 109 and US 31	3.2	No	10	0	10
Old Hickory Blvd (TA Truck Stop) configuration review	65.2	No	15	0	15
Ellington Parkway improvements	17.1	No	15	0	15
Jefferson Pike at Murfreesboro Rd, La Vergne - Add signal	65.9	No	15	0	15
Harding near Sidco Truck Terminal - Add signal	-42.3	No	0	0	0
I-40 at White Bridge Road – Lane width	8.5	No	15	0	15
8th Avenue Rail Bridge clearance	0.3	No	0	0	0
I-65 at I-24 merge	0.6	No	0	0	0
I-65 Nashville to Spring Hill	65.1	No	15	0	15
I-65 at exit 65	1.6	No	10	0	10
I-65 at I-440 merge	0.1	No	0	0	0
I-65/I-40 merge	0.3	No	0	0	0
I-24 toward La Vergne	1.85	No	10	0	10
I-24 at I-65 merge	0.2	No	0	0	0
I-24 at exit 56	2	No	10	0	10
I-24 at exit 54	0.3	No	0	0	0
I-24 and I-40 split, East and West	0.2	No	0	0	0
I-40 from Bellevue exit to I-440	1.2	No	10	0	10

Project	Indicator		Cost Effectiveness		
	BC Ratio	PPP	BC Ratio	PPP	Total
I-40 from SR-265 to SR-840	1	No	10	0	10
Murfreesboro Road	2.5	No	10	0	10
Fesslers Lane/I-40 West on-ramp intersection	6.5	No	15	0	15
SR-840 from SR-452 to SR-265	0.7	No	0	0	0
I-440	4.3	No	10	0	10
Lebanon Road to Briley Parkway	0.2	No	0	0	0
Beechcroft Road (SR 247)	0.4	Yes	0	0	0
Rail Access to Hailey's Harbor	1.3	Yes	10	5	15
Radnor Yard Alternatives	2.8	Yes	10	5	15

TECHNOLOGY

Project utilizes technological initiatives to improve freight transportation.

The Nashville FAC put forward the following subcriterion to evaluate whether projects utilize technological initiatives to improve freight transportation:

- ITS technology utilized to improve operations

Unfortunately, none of the projects that were assessed by benefit/cost analysis employ ITS technology. The technology criterion will not be used to assess projects, since it is not relevant to any of the projects to be assessed by the Nashville FAC criteria.

SUPPORT TO LOCAL, STATE, AND REGIONAL PLANS

Project supports area plans and addresses freight needs.

The Nashville FAC provided the following subcriteria to assess whether projects support area plans and addressed freight needs:

- Addresses freight needs (based on stakeholder input, existing transportation plans, data that identifies deficiencies such as truck model and Transearch data)
- Degree to which project is consistent with local comprehensive plans for freight movement and freight related facilities
- Implements goals and policies of the state and MPO long range transportation plan (All projects must be consistent with state and MPO transportation plans.)
- Public outreach that welcomes stakeholder input and garners public support

Each of the projects that are presented herein addresses freight needs and has been identified based on stakeholder input, existing transportation plans, or transportation data.

The goals enumerated in the MPO Long Range Plan are as follows:

Goal #1: Maintain and preserve the efficiency, safety and security of the region's existing transportation infrastructure
Goal #2: Manage congestion to keep people and goods moving
Goal #3: Encourage quality growth and sustainable land development practices
Goal #4: Protect the region's health and environment
Goal #5: Support the economic competitiveness of the Greater Nashville Area
Goal #6: Offer meaningful transportation choices to a diverse population including the aging.
Goal #7: Encourage regional coordination, cooperation, & decision-making
Goal #8: Practice thoughtful, transparent financial stewardship by ensuring that transportation improvements meet regional goals

The goals enumerated in the most recent Tennessee Long Range Transportation Plan are as follows:

- Maintain the efficiency, integrity, and effectiveness of the existing transportation system
- Provide the transportation resources and services necessary to optimize the movement of people and goods by providing greater access to transportation services and better connections between modes
- Make transportation investment to support economic growth, economic competitiveness, and tourism in Tennessee
- Provide a safe and secure transportation system for residents visitors and commerce
- Establish strong, ongoing collaborative partnerships with other state and federal agencies, city and county governments and regional organizations
- Protect, preserve, and enhance the social, historic and natural environments o the state
- Provide responsibility, accountability, and sustainability in the expenditure of transportation funds to produce tangible transportation benefits with minimal waste, and maximize the use of available transportation resources

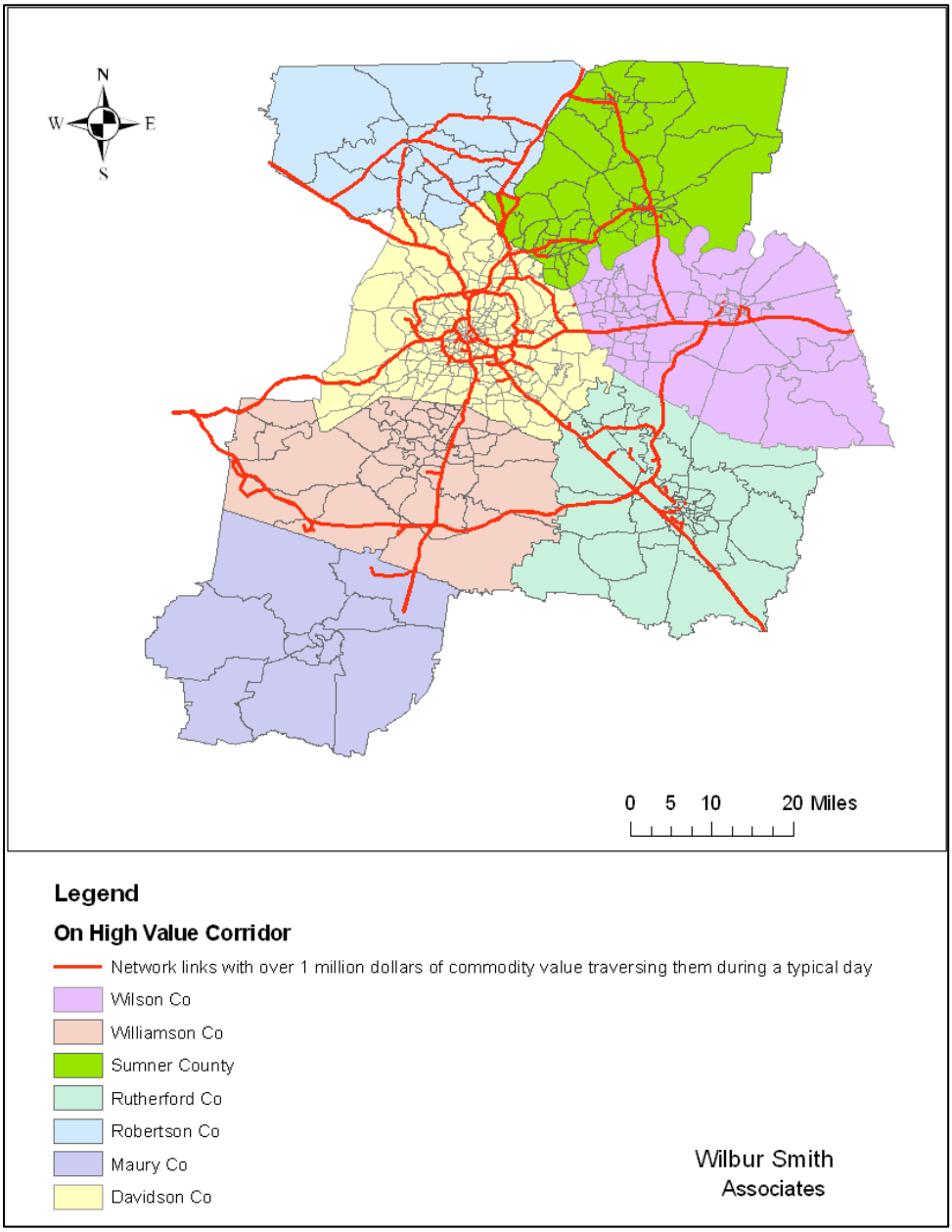
Most of these goals found in the MPO and statewide plans overlap with the criteria established by the Nashville FAC to assess freight projects. If a project scores high on the other FAC criteria, it will support area plans and address freight needs. Both statewide and MPO plans have established goals to improve the safety and environmental sustainability within their respective jurisdictions. Both state and local plans promise to promote cost-effective solutions and mobility, whether it be by connectivity or congestion management. Both plans promise to maintain existing infrastructure in a state of good repair.

Several themes are present in statewide and MPO plans that do not appear among the Nashville FAC criteria, including the promotion of economic development and sustainable land development practices. The criterion of sustainable land development would probably favor projects that are located in designated development corridors or locations that are already developed. Land use is an important issue within this study, but at this time, insufficient

guidance is available to evaluate whether freight projects promote or detract from sustainable land use.

Economic development is also an important consideration. Projects to which benefit/cost analysis has been applied would improve economic development in the region, primarily by improving the efficiency of freight networks. The Nashville MPO maintains a database of roadways that carry a high value of freight. These roadways are considered to have a sizeable impact on economic development since they facilitate a large volume of commerce. Projects are given an extra five points if they impact roadway segments that carry at least a million dollars of freight per day. **EXHIBIT 18** displays the high value corridors within Nashville.

EXHIBIT 18: HIGH VALUE CORRIDORS IN NASHVILLE REGION



Projects will also be given an additional five points if they appear on the Nashville MPO *2035 Regional Transportation Plan.* Because the "Support for State, Local, and Regional Plans" criterion overlaps with other criteria, it is proposed that the scoring of this criterion be reduced to a maximum of 10 points. **EXHIBIT 19** summarizes the scoring of projects per their consistency with other transportation plan.

EXHIBIT 19: SCORING OF CONSISTENCY WITH PLANS CRITERION

Project	Indicator		Score		
	In 2035 RTP?	On High Value Corridor?	2035 RTP	High Value Corridor	Total
Redesign Sidco Drive and Powell Avenue Intersection	No	No	0	0	0
Redesign Firestone Parkway/Bridgestone Boulevard and Parthenon Boulevard Intersection	No	Yes	0	5	5
Redesign Butler Drive and US 231 Intersection	No	No	0	0	0
Redesign TN 109 and US 31	No	No	0	0	0
Old Hickory Blvd (TA Truck Stop) configuration review	No	No	0	0	0
Ellington Parkway improvements	Yes	No	5	0	5
Jefferson Pike at Murfreesboro Rd, La Vergne - Add signal	No	No	0	0	0
Harding near Sidco Truck Terminal - Add signal	No	Yes	0	5	5
I-40 at White Bridge Road – Lane width	Yes	Yes	5	5	10
8th Avenue Rail Bridge clearance 2/	No	Yes	0	5	5
I-65 at I-24 merge	No	Yes	0	5	5
I-65 Nashville to Spring Hill	No	Yes	0	5	5
I-65 at exit 65	No	Yes	0	5	5
I-65 at I-440 merge	Yes	Yes	5	5	10
I-65/I-40 merge	No	Yes	0	5	5
I-24 toward La Vergne	No	Yes	0	5	5
I-24 at I-65 merge	Yes	Yes	5	5	10
I-24 at exit 56	Yes	Yes	5	5	10
I-24 at exit 54	No	Yes	0	5	5
I-24 and I-40 split, East and West	No	Yes	0	5	5
I-40 from Bellevue exit to I-440	Yes	Yes	5	5	10
I-40 from SR-265 to SR-840	Yes	Yes	5	5	10
Murfreesboro Road	No	Yes	0	5	5
Fesslers Lane/I-40 West on-ramp intersection	Yes	Yes	5	5	10
SR-840 from SR-452 to SR-265	No	Yes	0	5	5
I-440	No	Yes	0	5	5

Project	Indicator		Score		
	In 2035 RTP?	On High Value Corridor?	2035 RTP	High Value Corridor	Total
Lebanon Road to Briley Parkway	Yes	No	5	0	5
Beechcroft Road (SR 247)	No	Yes	0	0	0
Rail Access to Hailey's Harbor	No	No	0	0	0
Radnor Yard Alternatives 1/	No	Yes	0	5	5

1/ Data from IHS Global Insight suggests that Radnor Yard handles $12 million worth of intermodal freight per day.
2/ Rail line over 8th Avenue rail bridge carriers over $1 million worth of freight per day.

Results of Project Evaluation

EXHIBIT 20 provides a scoring of projects based upon the evaluation framework described above. **EXHIBIT 21** provides the same information sorted by project type and score.

EXHIBIT 20: SCORING OF PROJECTS

Project	Recommendation	Safety				Envir.	Mobility				Cost Effectiveness			Consistency with Plans			Total Proj. Score
		Acc. Red. Benefits	Comm. Conflict	Crossing	Total		Travel Time + VOC	% Trucks	Intermodal	Total	BC Ratio	PPP	Total	2035 RTP	High Value Corr.	Total	
Redesign Sidco Drive and Powell Avenue Intersection	Redesign intersection	1	0	0	**1**	**0**	1	1	5	**7**	15	0	**15**	0	0	**0**	**23**
Redesign Firestone Parkway/Bridgestone Boulevard and Parthenon Boulevard Intersection	Redesign intersection	1	0	0	**1**	**0**	1	3	0	**4**	15	0	**15**	0	5	**5**	**25**
Redesign Butler Drive and US 231 Intersection	Redesign intersection	1	0	0	**1**	**0**	1	0	0	**1**	15	0	**15**	0	0	**0**	**17**
Redesign TN 109 and US 31	Redesign intersection	1	5	0	**6**	**0**	1	3	0	**4**	10	0	**10**	0	0	**0**	**20**
Old Hickory Blvd (TA Truck Stop) configuration review	Add left turn lane to Firestone Parkway at Old Hickory Boulevard intersection	1	5	0	**6**	**0**	1	3	0	**4**	15	0	**15**	0	0	**0**	**25**
Ellington Parkway improvements	Widen from 4 to 6 lanes	4	0	0	**4**	**0**	1	0	0	**1**	15	0	**15**	5	0	**5**	**25**
Jefferson Pike at Murfreesboro Rd, La Vergne - Add signal	Add signal	1	0	0	**1**	**0**	0	0	5	**5**	15	0	**15**	0	0	**0**	**21**
Harding near Sidco Truck Terminal - Add signal	Add signal	1	0	0	**1**	**0**	0	0	5	**5**	0	0	**0**	0	5	**5**	**11**
I-40 at White Bridge Road – Lane width	Widen to 6 lanes	1	0	0	**1**	**0**	1	1	0	**2**	15	0	**15**	5	5	**10**	**28**
8th Avenue Rail Bridge clearance	Increase clearance height by lowering roadway section	1	0	0	**1**	**0**	1	0	0	**1**		0	**0**	0	5	**5**	**7**
I-65 at I-24 merge	Reconstruct interchange	1	0	0	**1**	**0**	1	1	0	**2**	0	0	**0**	0	5	**5**	**8**

Project	Recommendation	Safety				Envir.	Mobility				Cost Effectiveness			Consistency with Plans			Total Proj. Score
		Acc. Red. Benefits	Comm. Conflict	Crossing	Total		Travel Time + VOC	% Trucks	Intermodal	Total	BC Ratio	PPP	Total	2035 RTP	High Value Corr.	Total	
I-65 Nashville to Spring Hill	Widen I-65 from 4 to 8 lanes	10	0	0	**10**	**0**	10	4	0	**14**	15	0	**15**	0	5	**5**	**44**
I-65 at exit 65	Reconstruct interchange	1	5	0	**6**	**0**	1	4	0	**5**	10	0	**10**	0	5	**5**	**26**
I-65 at I-440 merge	Widen I-65 South from 6 to 8 lanes	1	5	0	**6**	**0**	1	4	0	**5**	0	0	**0**	5	5	**10**	**21**
I-65/I-40 merge	Redesign interchange	1	0	0	**1**	**0**	1	3	0	**4**	0	0	**0**	0	5	**5**	**10**
I-24 toward La Vergne	Widen I-24 from 8 to 10 lanes	4	5	0	**9**	**0**	3	3	0	**6**	10	0	**10**	0	5	**5**	**30**
I-24 at I-65 merge	Widen I-65 from 6 to 10 lanes and I-24 from 4 to 6 lanes	1	0	0	**1**	**0**	1	4	0	**5**	0	0	**0**	5	5	**10**	**16**
I-24 at exit 56	Widen I-24 from 8 to 10 lanes	1	5	0	**6**	**0**	1	3	0	**4**	10	0	**10**	5	5	**10**	**30**
I-24 at exit 54	Widen I-24 from 8 to 10 lanes	1	5	0	**6**	**0**	1	3	0	**4**	0	0	**0**	0	5	**5**	**15**
I-24 and I-40 split, East and West	Reconstruct interchange	1	5	0	**6**	**0**	1	3	0	**4**	0	0	**0**	0	5	**5**	**15**
I-40 from Bellevue exit to I-440	Widen I-40 from 6 to 8 lanes	5	0	0	**5**	**0**	2	0	0	**2**	10	0	**10**	5	5	**10**	**27**
I-40 from SR-265 to SR-840	Widen I-40 from 4 to 8 lanes	3	0	0	**3**	**0**	6	4	0	**10**	10	0	**10**	5	5	**10**	**33**
Murfreesboro Road	Widen Murfreesboro Road from 4 and 5 lanes to 7 lanes	4	5	0	**9**	**0**	10	3	5	**18**	10	0	**10**	0	5	**5**	**42**
I-24/I-40 Fessler's Lane Exit	Widen from 6 to 12 lanes and upgrade to full interchange with Fesslers Lane	1	0	0	**1**	**0**	10	3	0	**13**	15	0	**15**	5	5	**10**	**39**
SR-840 from SR-452 to SR-265	Widen from 4 to 6 lanes	1	0	0	**1**	**0**	2	2	0	**4**	0	0	**0**	0	5	**5**	**10**

Project	Recommendation	Safety				Envir.	Mobility				Cost Effectiveness			Consistency with Plans			Total Proj. Score
		Acc. Red. Benefits	Comm. Conflict	Crossing	Total		Travel Time + VOC	% Trucks	Intermodal	Total	BC Ratio	PPP	Total	2035 RTP	High Value Corr.	Total	
I-440	Widen from 6 to 8 lanes	6	0	0	**6**	**0**	10	5	0	**15**	10	0	**10**	0	5	**5**	**36**
Lebanon Road to Briley Parkway	Widen from mostly 5 lanes to 7 lanes	1	0	0	**1**	**0**	1	1	0	**2**	0	0	**0**	5	0	**5**	**8**
Beechcroft Road (SR 247)	Bridge over CSX line on Beechcroft Road	1	0	5	**6**	**0**	1	1	0	**2**	0	0	**0**	0	0	**0**	**8**
Rail Access to Hailey's Harbor	Build rail spur to Hailey's Harbor marine terminal	1	0	0	**1**	**5**	1	NA	5	**6**	10	5	**15**	0	0	**0**	**27**
Radnor Yard Alternatives	Assist CSX with moving TDSI, intermodal ramp from Radnor	1	0	0	**1**	**5**	10	NA	5	**15**	10	5	**15**	0	5	**5**	**41**

EXHIBIT 21: PROJECTS SORTED BY PROJECT TYPE AND SCORE

Project	Recommendation	Safety				Envir.	Mobility				Cost Effectiveness			Consistency with Plans			Total Proj. Score
		Acc. Red. Benefits	Comm. Conflict	Crossing	Total		Travel Time + VOC	% Trucks	Intermodal	Total	BC Ratio	PPP	Total	2035 RTP	High Value Corr.	Total	
Modify Local or Arterial Roadway Intersections																	
Redesign Firestone Parkway/Bridgestone Boulevard and Parthenon Boulevard Intersection	Redesign intersection	1	0	0	**1**	**0**	1	3	0	**4**	15	0	**15**	0	5	**5**	**25**
Old Hickory Blvd (TA Truck Stop) configuration review	Add left turn lane to Firestone Parkway at Old Hickory Boulevard intersection	1	5	0	**6**	**0**	1	3	0	**4**	15	0	**15**	0	0	**0**	**25**
Redesign Sidco Drive and Powell Avenue Intersection	Redesign intersection	1	0	0	**1**	**0**	1	1	5	**7**	15	0	**15**	0	0	**0**	**23**
Jefferson Pike at Murfreesboro Rd, La Vergne - Add signal	Add signal	1	0	0	**1**	**0**	0	0	5	**5**	15	0	**15**	0	0	**0**	**21**
Redesign TN 109 and US 31	Redesign intersection	1	5	0	**6**	**0**	1	3	0	**4**	10	0	**10**	0	0	**0**	**20**
Redesign Butler Drive and US 231 Intersection	Redesign intersection	1	0	0	**1**	**0**	1	0	0	**1**	15	0	**15**	0	0	**0**	**17**
Reconstruct Interstate Interchanges																	
I-65 at exit 65	Reconstruct interchange	1	5	0	**6**	**0**	1	4	0	**5**	10	0	**10**	0	5	**5**	**26**
I-24 and I-40 split, East and West	Reconstruct interchange	1	5	0	**6**	**0**	1	3	0	**4**	0	0	**0**	0	5	**5**	**15**
I-65/I-40 merge	Redesign interchange	1	0	0	**1**	**0**	1	3	0	**4**	0	0	**0**	0	5	**5**	**10**
I-65 at I-24 merge	Reconstruct interchange	1	0	0	**1**	**0**	1	1	0	**2**	0	0	**0**	0	5	**5**	**8**

Project	Recommendation	Safety				Envir.	Mobility				Cost Effectiveness			Consistency with Plans			Total Proj. Score
		Acc. Red. Benefits	Comm. Conflict	Crossing	Total		Travel Time + VOC	% Trucks	Intermodal	Total	BC Ratio	PPP	Total	2035 RTP	High Value Corr.	Total	
Widen Roadways																	
I-65 Nashville to Spring Hill	Widen I-65 from 4 to 8 lanes	10	0	0	**10**	**0**	10	4	0	**14**	15	0	**15**	0	5	**5**	**44**
Murfreesboro Road	Widen Murfreesboro Road from 4 and 5 lanes to 7 lanes	4	5	0	**9**	**0**	10	3	5	**18**	10	0	**10**	0	5	**5**	**42**
I-24/I-40 Fessler's Lane Exit	Widen from 6 to 12 lanes and upgrade to full interchange with Fesslers Lane	1	0	0	**1**	**0**	10	3	0	**13**	15	0	**15**	5	5	**10**	**39**
I-440	Widen from 6 to 8 lanes	6	0	0	**6**	**0**	10	5	0	**15**	10	0	**10**	0	5	**5**	**36**
I-40 from SR-265 to SR-840	Widen I-40 from 4 to 8 lanes	3	0	0	**3**	**0**	6	4	0	**10**	10	0	**10**	5	5	**10**	**33**
I-24 toward La Vergne	Widen I-24 from 8 to 10 lanes	4	5	0	**9**	**0**	3	3	0	**6**	10	0	**10**	0	5	**5**	**30**
I-24 at exit 56	Widen I-24 from 8 to 10 lanes	1	5	0	**6**	**0**	1	3	0	**4**	10	0	**10**	5	5	**10**	**30**
I-40 at White Bridge Road – Lane width	Widen to 6 lanes	1	0	0	**1**	**0**	1	1	0	**2**	15	0	**15**	5	5	**10**	**28**
I-40 from Bellevue exit to I-440	Widen I-40 from 6 to 8 lanes	5	0	0	**5**	**0**	2	0	0	**2**	10	0	**10**	5	5	**10**	**27**
Ellington Parkway improvements	Widen from 4 to 6 lanes	4	0	0	**4**	**0**	1	0	0	**1**	15	0	**15**	5	0	**5**	**25**
I-65 at I-440 merge	Widen I-65 South from 6 to 8 lanes	1	5	0	**6**	**0**	1	4	0	**5**	0	0	**0**	5	5	**10**	**21**
I-24 at I-65 merge	Widen I-65 from 6 to 10 lanes and I-24 from 4 to 6 lanes	1	0	0	**1**	**0**	1	4	0	**5**	0	0	**0**	5	5	**10**	**16**
I-24 at exit 54	Widen I-24 from 8 to 10 lanes	1	5	0	**6**	**0**	1	3	0	**4**	0	0	**0**	0	5	**5**	**15**

Project	Recommendation	Safety				Envir.	Mobility				Cost Effectiveness			Consistency with Plans			Total Proj. Score
		Acc. Red. Benefits	Comm. Conflict	Crossing	Total		Travel Time + VOC	% Trucks	Intermodal	Total	BC Ratio	PPP	Total	2035 RTP	High Value Corr.	Total	
SR-840 from SR-452 to SR-265	Widen from 4 to 6 lanes	1	0	0	**1**	**0**	2	2	0	**4**	0	0	**0**	0	5	**5**	**10**
Lebanon Road to Briley Parkway	Widen from mostly 5 lanes to 7 lanes	1	0	0	**1**	**0**	1	1	0	**2**	0	0	**0**	5	0	**5**	**8**
Other Projects																	
Radnor Yard Alternatives	Assist CSX with moving TDSI, intermodal ramp from Radnor	1	0	0	**1**	**5**	10	NA	5	**15**	10	5	**15**	0	5	**5**	**41**
Rail Access to Hailey's Harbor	Build rail spur to Hailey's Harbor marine terminal	1	0	0	**1**	**5**	1	NA	5	**6**	10	5	**15**	0	0	**0**	**27**
Harding near Sidco Truck Terminal - Add signal	Add signal	1	0	0	**1**	**0**	0	0	5	**5**	0	0	**0**	0	5	**5**	**11**
Beechcroft Road (SR 247)	Bridge over CSX line on Beechcroft Road	1	0	5	**6**	**0**	1	1	0	**2**	0	0	**0**	0	0	**0**	**8**
8th Avenue Rail Bridge clearance	Increase clearance height by lowering roadway section	1	0	0	**1**	**0**	1	0	0	**1**		0	**0**	0	5	**5**	**7**

Appendix A – Summary of Formulas Used to Calculate Roadway Benefits

The user benefits presented in this Technical Memo were calculated using the procedures and tool developed by the American Association of State Highway and Transportation Officials (AASHTO). The user manual for the tool, all reference information, and an explanation of the underlying logic are found in the *User Benefit Analysis for Highways* published in August 2003. This publication is often nicknamed, the "Red Book." This appendix provides a summary of equations and logic found in the Red Book. Three major sources of user benefits are recognized: travel time savings, operating cost savings, and accident cost savings.

Algebraically, the calculation of user benefits, *B*, for one period of a directly affected link is:

(A-1)

where:

user cost without the improvement
user cost with the improvement
trip volume without the improvement
trip volume with the improvement

An expansion of **Equation *A-1*** is:

(A-2)

where:

user benefit to vehicle or user class *c*, at travel hour *h*, on link *s*, in project year *t*
change in per-VMT user cost
change in per-VMT (or per-user) value of travel time
(without minus with)
change in per-VMT (or per-user) operating costs
(without minus with)
= change in per-VMT (or per-user) unreimbursed accident costs
(without minus with)
vehicles (or users) of class *c* in hour *h* without the improvement
vehicles (or users) of class *c* in hour *h* with the improvement

the segment or corridor length, in miles
vehicle or user class (passenger cars or trucks)
VMT = vehicle-mile traveled

The User Benefit Formula (**Equation *A-2***) is applicable to all user benefit calculations that involve changes in perceived user cost, and which play out over the length of a highway or corridor's various segments. It is general enough to be applied to analysis that is done by corridor, by road segment, by vehicle class, or by user class.

Calculating the Value of Time Savings

Changes in the value of time savings can arise either through a change in the amount of time spent traveling with the improvement, or through a change in the unit value applied to changes in travel time. In this analysis, changes in travel time arise through changes in speed.

The AASHTO *Highway Capacity Manual 2000* (HCM 2000) provides many tools and procedures to assist in the calculation of segment speeds. These procedures permit detailed consideration of segment features, including the effects of road geometry and weaving on the capacity and speed of a highway segment. Speed can be calculated for local streets and roads, highways, and freeways using the *HCM 2000*.

Exhibit A- 1 presents references to the relevant worksheets of *HCM 2000* that can be used to calculate segment speeds on various types of roadway segments.

Exhibit A- 1: Worksheets in *HCM 2000* for Calculating Speed on Roadway Segments of Various Types

Roadway Segment Type	*HCM 2000* Worksheets	Output of *HCM 2000* Worksheets
Urban Street	Urban Street Worksheet (Ch. 15)	S, segment speed
Two-Lane Highway	Directional Two-Lane Highway Segment Worksheet (Ch. 20)	S, segment speed
Multilane Highway	Multilane Highways Worksheet (Ch. 21)	S, segment speed
Freeway	Basic Freeway Segments Worksheet (Ch. 23)	S, segment speed

Once a change in speed is calculated from engineering information, the value of time savings resulting from these changes in speed can be calculated. It is assumed for the purpose of the basic analysis formulae that all vehicles on the segment are traveling at the same speed.

The value of the time savings that result from higher speeds will depend upon the unit value of time that users apply to the time savings, and the mix of those user types on the facility. A vehicle of class *c* with an associated value of time per person per hour of and a vehicle occupancy of will see a reduction in the value of the time spent traversing the segment, per mile, as in **Equation *A-3***.

(A-3)

where:

the value of travel time savings enjoyed by user class *c* (in cents per vehicle-mile)
the unit value of time for user class *c* (in dollars per hour)
the occupancy rate of vehicles of user class *c*
speeds without and with the improvement (in miles per hour)
vehicle or user class (passenger cars or trucks)

There is one , of course, for every vehicle class.

Calculating the Value of Operating Cost Savings

The impact of the project on the users' operating costs is the second element of user costs in the User Benefit Formula. Some operating costs are mileage (distance) related and therefore accrue to all the network segments. This is accommodated by aggregating user benefits across the various segments of the network with and without the project being built.

There are, however, certain costs that are hourly and thus depend upon speed along a given segment. In most cases, such changes in operating costs derive from changes in the density and "stop and go" nature of traffic, or changes in the road surface that result from the project. These changes in operating costs may change inconsistently with speed. For example, fuel consumption per mile improves up to certain speeds, and degrades thereafter. Speed changes also cause trucks carrying valuable cargo to experience different *inventory costs* than they otherwise would because goods in transit must be financed, may spoil, etc.

In general, therefore, there is no common function that captures all of these effects, but it is important to recognize the link between vehicle speed and vehicle operating costs. **Equation *A*-4** is a placeholder for the specific relationship between operating cost and speed.

(A-4)

where:

change in operating costs (in cents per vehicle mile)
a function relating changes in operating costs to changes in speed
vehicle or user class (passenger cars or trucks)

The term *operating cost* is used as a composite of the costs associated with owning and operating the vehicle over the road segments involved in the project analysis. Specifically, operating and ownership costs involve the following cost elements:

- *Vehicle Operating Costs*. These include fuel and oil, maintenance, and tires.

- *Ownership Costs*. These include insurance, license and registration fees and taxes, economic depreciation, and finance charges. In special cases, they also include the inventory cost of the cargo on the vehicle.

This analysis focuses on the vehicle operating costs to calculate the effect of an improvement project on user costs, the operating costs will need to be calculated both without and with the improvement. The difference between these two cost calculations is the change in operating costs that is attributable to the improvement.

In
Exhibit A- 2, the relationship between speed and fuel consumption is portrayed for both automobiles and trucks.

Exhibit A- 2: Fuel Consumption for Autos and Trucks, by Average Operating Speed

Speed	Gallons per Mile	
	Autos	Trucks
5 mph	0.117	0.503
10 mph	0.075	0.316
15 mph	0.061	0.254
20 mph	0.054	0.222
25 mph	0.050	0.204
30 mph	0.047	0.191
35 mph	0.045	0.182
40 mph	0.044	0.176
45 mph	0.042	0.170
50 mph	0.041	0.166
55 mph	0.041	0.163
60 mph	0.040	0.160
65 mph	0.093	0.158

Source: Inputs to SPASM Based on Cohn, Louis, Roger Wayson, and Roswell. 1992. "Environmental and Energy Considerations," in *Transportation Planning Handbook*. Institute of Transportation Engineers.

Exhibit A- 2 provides information that can be used to calculate the fuel component of operating costs as a function of speed. Recall from the improvement type chapters that operating costs can be calculated as a negative function of speed. With a change in speed resulting from an improvement, changes in fuel costs can be calculated with the following formula:

(A-5)

where:

change in fuel costs as a function of speed for vehicle class *c* (cents)
gallons per mile for vehicle class *c*, pre-improvement speed
gallons per mile for vehicle class *c*, post-improvement speed
fuel price per gallon for vehicle class *c* (cents)
vehicle or user class (passenger cars or trucks)

The factors shown in
Exhibit A- 2 for specific pre-improvement and post-improvement speeds combined with the price of fuel costs allows **Equation *A-5*** to be used to calculate speed related costs for each vehicle class.

Calculating the Value of Accident Cost Savings

The third category of user cost savings that contributes to user benefits is changes in accident costs. Because the analysis is only applies to user benefits, the only accident costs of interest are those that directly or indirectly impacting users.

Accident costs generally have four elemwents:

- Injury, morbidity, and mortality of the user
- Injury, morbidity, and mortality of those other than the user who must be compensated
- Damage to the property of the user
- Damage to the property of others

On the assumption that injury to the user and injury to other parties have like values, from the user's perspective, accident costs can be calculating using statistics on accident rates by incident type and the unit value of each type of incident. In general terms, therefore, the change in accident costs perceived by vehicle class *c* as a result of the

improvement depend on the expected change in each type of accident incident times the expected value of those incidents. The arithmetic of this perspective is as given in **Equation *A-6***.

(A-6)

where:

change in accident costs for vehicle class c (in cents per vehicle-mile)
perceived cost associated with each injury accident (in cents)
perceived cost associated with each fatal accident (in cents)
perceived cost associated with each property damage incident (in cents)
change in the number of injury accidents per vehicle-mile
change in the number of fatal accidents per vehicle-mile
change in the number of property damage incidents per vehicle-mile
vehicle class (passenger cars or trucks)