

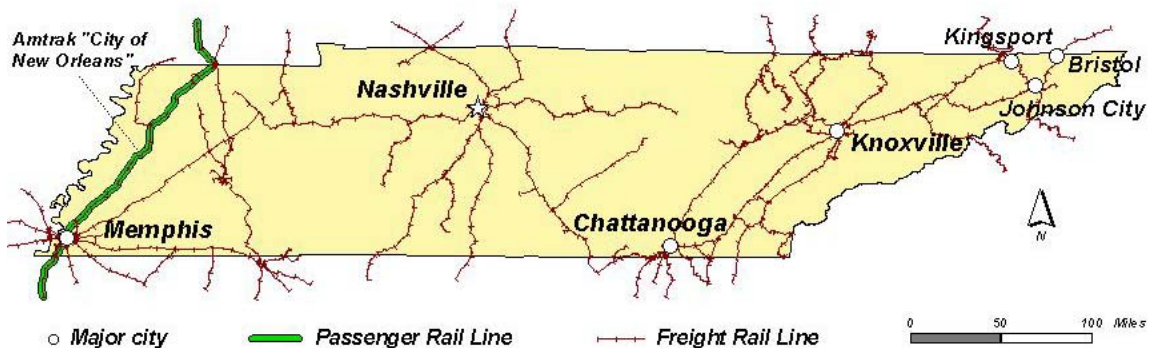
Task 4: Potential Intercity Passenger Rail Corridors

Introduction

This purpose of this task is to determine which rail corridors in the State of Tennessee are the most promising candidates for the implementation of new intercity passenger rail services. Planning level analyses are presented that demonstrate the feasibility of the preferred corridors on the bases of potential ridership, required capital improvements (which considers the existing condition of track and signal infrastructure), operating costs, and the availability of tracks and their capacity along the potential rail corridors.

Various developments and opportunities, both internal and external to the political environment of the State of Tennessee, have provided the impetus for this study. For years, passenger rail advocates have lobbied the State of Tennessee to play a greater role in the restoration of intercity passenger rail service. With over 3,000 miles of active rail lines, only a fraction (132 miles) of the rail network is used for passenger service. The sole passenger rail service in Tennessee is the Amtrak *City of New Orleans* route which serves the extreme western edge of Tennessee, as shown in Exhibit 1 below. Meanwhile, Interstate highways – which in most cases are paralleled by rail lines - are sustaining increases in traffic volumes and congestion. The escalating costs of construction and environmental mitigation pose significant obstacles to expanding highway capacity.

Exhibit 1. Operational freight and passenger railroad network of the State of Tennessee



Beyond Tennessee’s borders, various multi-state coalitions have formed to promote intercity passenger rail initiatives. The nine-state Midwest Regional Rail System, the four-state Southeast High Speed Rail coalition, and the five-state Gulf Coast Corridor initiative have cooperatively designated their respective high speed (110 or 125 mph maximum speed) rail corridors. It is important to note that the State of Tennessee, although almost completely surrounded by states interested in multi-state rail partnerships, is not a participant in any of these coalitions.

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These coalitions have pooled clout and resources in order to better position themselves for potential federal funding for the development of high speed intercity passenger rail corridors. At present, momentum is building in the Congress for an appropriation of more than ten billion dollars for funding various high speed rail projects across the nation. The realization that Tennessee could be left out of potential funds for intercity passenger rail development has prompted the attention of legislators at both the state and local level. To further leverage funding and influence, the State has expressed an interest in partnering with other states and joining coalitions.

The importance of Tennessee's railway lines to the national rail network, however, has not gone unnoticed nationally. Specifically, certain segments of the Tennessee rail network are critical to the proposed improvement of rail infrastructure in the I-81 corridor. A proposal to improve rail infrastructure along the I-81 corridor from Harrisburg, PA to Knoxville, TN has recently been completed by the Commonwealth of Virginia. This study found that a significant number of freight shipments could be diverted from the highway to the adjacent rail alignment if capacity and alignment enhancements are provided.

Another driving force for the re-examination of Tennessee's rail network is a congressionally mandated East-West Corridor Study. Congress provided funds for a study to examine the feasibility of rail enhancements to support freight movements and passenger rail service in the Memphis-to-Knoxville Corridor. A critical concern of the East-West Corridor Study is the feasibility of restoring a missing rail segment which comprises a significant portion of the route between Nashville and Knoxville.

For the purposes of the passenger rail analysis of the Knoxville-to-Memphis Corridor, the State proposed to examine two potential rail service scenarios; the critical difference between these scenarios is their speed characteristics. The first scenario considers 79-mile per hour intercity passenger rail service that is comparable to most of the existing intercity services offered by Amtrak. The second scenario is high speed (110 mph) rail, which is being considered for two reasons. First, higher average train speeds between destinations can more aggressively compete with the automobile mode and thus induce greater ridership and higher cost recovery. Secondly, high speed rail is currently at the forefront of the discussion on intercity passenger rail service; states with proposals for high speed rail service would be well positioned to receive federal funds that are currently being considered by the Congress.

The difference in the impacts of the conventional (79 mph) and high speed (110 mph) service are considerable, affecting every aspect of rail operation, construction, maintenance, and the regulatory environment. As a result, the 110-mile per hour scenario has been dropped from further consideration, at least in the near term, because of exorbitant infrastructure costs and physical and institutional constraints. The challenge is that the existing track configuration and its surrounding terrain in much of Tennessee are not conducive to high speed rail which requires comparatively long and straight stretches

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of track. In addition, the Class I railroads are opposed to the mixing of high speed passenger trains with slower moving freight trains on the same track. Presently, much of the freight rail network in Tennessee is single track. A separate track on an existing right-of-way, costing approximately \$1 million per mile to install, would be required to permit high speed passenger trains to utilize existing railroad rights-of-way. (Thus, on average, the costs of double tracking a 200-mile corridor could reach \$200 million, site contingencies not included.) Even if a second track was installed, track geometries – particularly in mountainous areas – may not be conducive to high speeds. It is also considered premature to propose the implementation of a statewide high speed passenger rail system where there is no established ridership base for even the lower speed (79 mile per hour) conventional rail service. However, one corridor in particular, the Louisville-to-Chattanooga Corridor (especially the segment north of Nashville), may be favorable to higher speed service and is worthy of designation as an official High Speed Rail Corridor. The Louisville-to-Chattanooga Corridor, if designated, would be established as an extension of the Midwest High Speed Rail Corridor providing through service to Chicago.



New Trainsets can present a futuristic image of train travel. These Talgos used in the “Cascades Corridor” have helped to attract new riders.

This study estimates the costs, both capital and operating, of implementing conventional passenger rail in the most promising Tennessee corridors. These costs will be compared with the expected benefits from new passenger rail services. Considered here, specifically, are the potential mobility, economic, and environmental benefits that could be realized by the provision of a reliable, alternative mode for intercity travel.

The investigations presented in this study are performed under the review of the Rail System Plan Advisory Committee (RSPAC). The consideration of this committee’s views and input has been critical in providing direction for this study.

Goals of Intercity Passenger Rail Development

The goals of intercity passenger rail development in Tennessee are typical of the objectives of other passenger rail initiatives throughout the nation and are stated below:

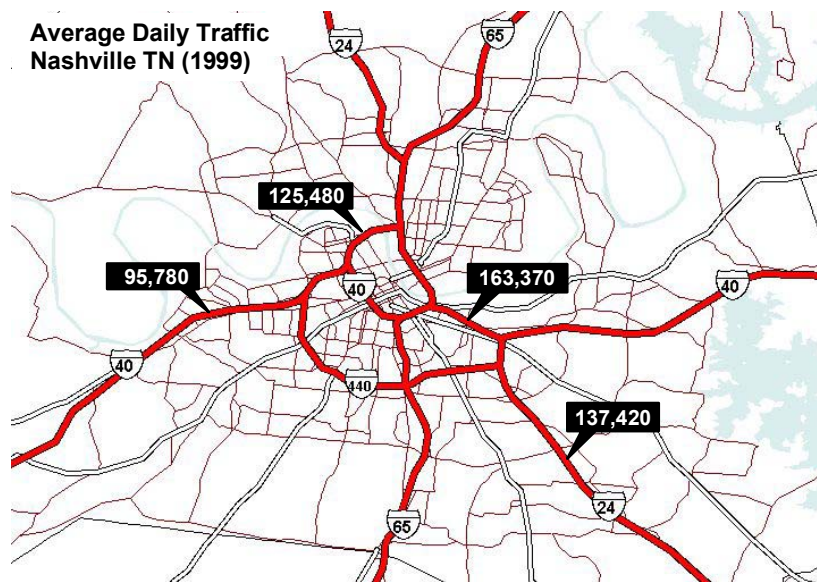
❑ **Add capacity to the existing transportation system.**

The use of freight railroad tracks and rights-of-way for intercity passenger rail service can provide additional capacity to the entire transportation network. The population of Tennessee has increased 16.7 percent over the last decade, and the State's population is expected to continue growing over this current decade. A vital question for the State is how to accommodate the inevitable population growth and its increasing travel needs. For a variety of reasons, it would be to the State's advantage to make use of existing railroad tracks and rights-of-way to serve the growing travel demand.

❑ **Reduce need to expand existing highway facilities.**

Increasing traffic volumes on Tennessee's major highways translates into more severe and frequent traffic congestion. (Exhibit 2 depicts locations of high average daily traffic on Interstates in the Nashville area.) Heavier traffic strains the State's road maintenance budget as roads deteriorate faster under greater use. Over time, the public demand for congestion relief places pressure on the State to expand highway facilities.

Exhibit 2. High Average Daily Traffic on Interstates in Nashville area. Investing in other forms of transportation can provide an alternative to increasingly crowded freeways.



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However, the costs of building a new freeway lane are high, typically averaging about \$8 million per mile. By comparison, the installation of new railroad track averages only \$1 million per mile.

Although rail transportation currently accounts for a relatively small proportion of passenger trips nationwide, it can relieve the need to expand peak roadway capacity. (However, passenger rail service cannot be expected to entirely eliminate traffic congestion in the near term.) The congestion mitigation effects of rail transportation are especially beneficial in instances where new rail infrastructure investments, intended for both freight and passenger use, provide the opportunity to divert highway truck traffic to freight rail.

□ **Improve Air Quality and the Environment.**

Despite improvements in automotive technology, air pollution from increasing vehicular traffic remains a major urban concern. The provision of alternative, less-polluting travel modes can stem the increase in vehicular emissions as these alternative modes carry more passengers for a given unit of fuel. Using railroads for freight and passenger transport also reduces the need to build new highways, thereby precluding the environmental impacts associated with new highway construction.

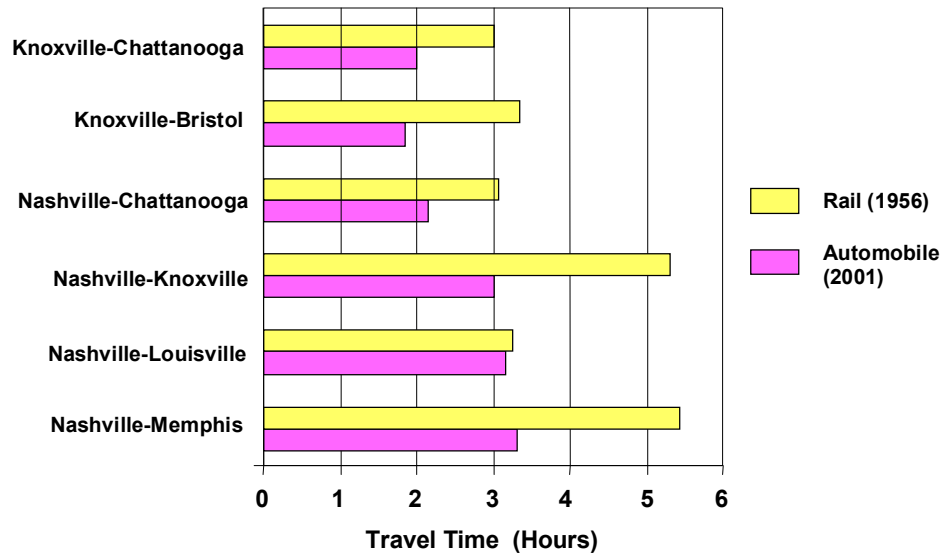
□ **Provide an alternative means of transportation.**

There are segments of the population that, because of age, income, or personal mobility do not have access to automobile transportation; many cannot drive or prefer not to drive. Within the next decade a large number of Americans, i.e., the baby boom generation, will be added to the already significant population of seniors. As a group, seniors are typically more dependent on public forms of transportation than their younger counterparts. College students and other young adults, although eligible to drive, may not have the financial resources to own an automobile and would benefit from enhanced public transportation. Unfortunately, there are also households that cannot afford to own an automobile. It is desirable from a societal perspective to provide these public transportation-dependent groups with an alternative means of travel between cities.

In general, though, most households have the wherewithal to own and operate an automobile. But as the percentage and volume of truck traffic increases on our interstate highways, many individuals, especially families, are growing ever more concerned with their personal safety when sharing the highways with heavy trucks. There are also individuals who consider rail travel to offer a more environmentally sensitive transportation mode than either automobile or air travel. In addition, compared with air travel, rail travel offers greater freedom of movement for long distance travelers by providing the opportunity to visit different attractions along the route. In general, intercity passenger rail provides a viable alternative to air travel for trips of less than 500 miles and automobile trips of more than 100 miles.

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Exhibit 3. Comparison of 1956 intercity passenger rail and 2001 automobile travel times.



Travel distances between Tennessee’s major cities and other cities in the region, including Washington, D.C. and Atlanta, fall approximately within this 500-mile range. In order for passenger rail to effectively compete with the automobile mode it should provide a comparable or reduced travel time. However, if other aggravating factors — such as cost, comfort, safety, parking — present significant obstacles, travelers may choose to leave their cars at home, even if rail travel time exceeds automobile trip time. Exhibit 3 compares the 1956 travel times for passenger rail – when the Tennessee passenger rail network was almost fully intact – with current automobile travel time between major cities, reflecting construction of the Interstate system and other highways in recent decades. Improvements in rail technology since the 1950s will offer reduced travel times between Tennessee’s major cities and enhanced ability to compete with the automobile for intercity travel.

❑ **Facilitate linkages with local public transportation systems.**

The quality of the travel experience at the beginning and end of the trip is an important consideration in the selection of travel mode. Intercity passenger rail systems around the world and in certain metropolitan areas of the United States include linkages to local transit systems, especially for access to bustling downtown business districts. While it is important to provide adequate station facilities and amenities at the start of the trip, such as adequate parking or comfortable waiting areas, it is equally important to provide intermodal transfer opportunities at the end of the trip. To this end, rail stations should facilitate passenger transfers to local transit systems, or at a minimum ensure the availability of taxi or rental car services.

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Beale St. in Memphis. Improved travel connections can help promote tourism.

□ Enhance economic development and tourism.

Improved travel connections and additional transportation modes can increase the attractiveness of tourism destinations. If courteous service in clean and comfortable trains is provided, rail travel can attract and cater to the discretionary, recreational travelers who are traveling to Tennessee's many popular tourist destinations.



Great Smoky Mountains National Park. A picture postcard and perfect perspective. Again, improved intercity links can open new perspectives.

A train ride can add significantly to the overall travel and vacation experience, one which is free from travel delays at major airports or the stressful and tiring experience of driving long distances while on vacation. In addition, the establishment of a train station can induce greater commercial activity around the station area, providing the opportunity for businesses to offer services and amenities to meet travelers' needs.

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□ **Minimize impacts to freight operations.**

The shared usage of tracks may present operational issues for the freight railroads. On some routes, the freight railroads have capacity to accommodate passenger service, while other routes may already be operating at capacity. In the latter instance, capital improvements may be required to permit the joint operation of passenger and freight trains over existing railroad lines. These improvements may entail the installation of new tracks (i.e., double tracking the alignments), adding new passing sidings and signal systems, and providing new support facilities as required.

□ **Partner with neighbor states to advance regional passenger rail projects.**

Most of the states surrounding Tennessee have already entered into multi-state coalitions to improve their likelihood of receiving federal funding for new intercity passenger rail service. Partnering with the state of Kentucky, for example, could yield tangible benefits for the inauguration of service to Louisville (and other points north), while an appropriate relationship with the Commonwealth of Virginia could establish access to Tennessee destinations from the substantial ridership base of the Northeast Corridor (i.e., Washington to Boston.)

In addition, a study of the feasibility of Maglev and various high speed rail technologies in the Atlanta-to-Chattanooga corridor has recently been completed. The *Atlanta-Chattanooga Maglev Deployment Study*, funded by the Federal Railroad Administration, established the viability of high speed ground transportation in the Atlanta-to-Chattanooga corridor and selected the most favorable technology (i.e., Maglev) and alignment for its implementation. Conceptually, a Maglev line connecting Atlanta to Chattanooga dovetails well with this study's examination of intercity rail service in the Louisville-to-Chattanooga Corridor. A convenient transfer between Maglev and intercity passenger rail at Chattanooga could ultimately provide connecting service to Chicago from Atlanta via other major cities such as Nashville and Louisville.

□ **Reduce societal costs.**

The terms “gridlock” and “road rage” have unfortunately become a part of our society's vocabulary, and traveling by automobile is becoming more time consuming particularly for onerous daily commuting. The time lost to automobile travel delays reduces labor productivity and energy efficiency while continued highway expansion induces additional costs and impacts. Highway construction inevitably costs millions of dollars per mile, may permanently displace residences and businesses, and can cause significant environmental impacts. Railroad expansion, on the other hand, typically imposes less costs and environmental impacts since it usually takes place within existing rights-of-way, thus obviating the need for major land acquisitions.

In addition, highways contribute to automobile dependency, induce greater urban sprawl and loss of open space, and generate air pollution, all of which affect quality

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of life in both urban and suburban areas. Better coordination of transportation systems and the steady expansion of public transportation may reduce daily dependence on the automobile and promote transit-oriented commercial and residential development.

□ **Establish corridors to carry the greatest number of riders at an affordable cost.**

The potential rail corridors must attract enough riders to justify any new service. In addition, the potential services must generate sufficient revenue to ensure an adequate cost recovery ratio, i.e., operating revenues to operating expenses. It should be recognized that some level of operating subsidy is almost always required for intercity passenger rail service.

□ **Provide adequate service to intermediate stations along the corridors.**

Intermediate stations along the potential passenger rail corridors are important in the selection of preferred corridors. For instance, smaller cities along the route can generate significant ridership. Residents of small towns and intermediate-sized cities (with approximately 25,000 persons) are usually deprived of a range of travel options. For example, because of their limited size, these areas do not support major airports. For lack of other travel options, these smaller, intermediate stations can supply passenger rail corridors with a significant percentage of their ridership.

In addition, the community leaders of these smaller towns and cities along any given corridor will be crucial in building support for the proposed rail service. However, there is a practical limit to the number of intermediate stations that can be served. In order to provide competitive travel times between major city pairs, it will be necessary to balance the number of intermediate stops with overall corridor travel times and sufficient ridership.

Background

Existing Tennessee Rail Network and Intercity Passenger Service

Over the past century, many of Tennessee's historic passenger trains that linked major cities in the Volunteer State slowly disappeared from the landscape. However, most cities in Tennessee, especially the major metropolitan areas, are still linked by operational freight rail lines. The only major exception is the severed linkage between Nashville and Knoxville that currently prevents a direct rail connection between these two metropolitan areas. (Although an indirect rail route between Nashville and Knoxville is currently operational via Chattanooga.) Of the approximate 216 miles of original track, about 185 miles are still in place between Nashville and Knoxville. Roughly 31 miles of track between Monterey and Crab Orchard, a section which once crossed the Cumberland

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Plateau, was removed in the 1960s following the bankruptcy of the Tennessee Central Railroad. Two potential alignments that could replace this missing section over the Cumberland Plateau have been examined as part of the Tennessee Rail System Plan.

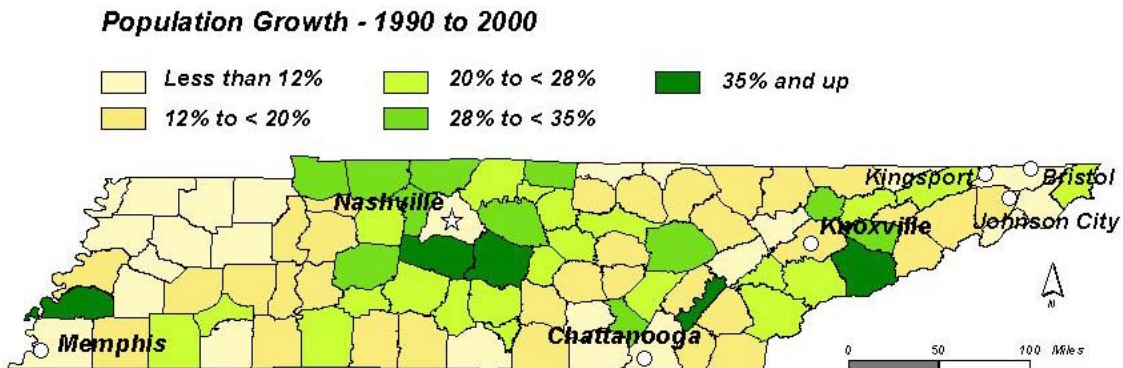
Currently, there are five Class I railroads and seventeen short lines, or Class 3 railroads, operating in Tennessee.

Economic Growth, Population Increases and Travel Demand

The 2000 US Census reported that Tennessee had 5,689,283 residents. According to the 2000 Census, Tennessee ranks 17th in population among the 50 states. About two-thirds of the state's people live in metropolitan areas (or Metropolitan Statistical Areas) which are, in order of population, Nashville; Memphis; Knoxville; Johnson City-Kingsport-Bristol; Chattanooga; and Clarksville-Hopkinsville, on the border Kentucky. Memphis is the state's largest city, followed by Nashville, Knoxville, and Chattanooga. Each of these cities has over 100,000 people. The fifth largest city is Clarksville with about 75,000 people. Ten other cities in the state have populations of 25,000 or more.

The population of Tennessee grew by 16.7 percent over the last decade, since the 1990 US Census, for a total increase of 812,098 persons. Tennessee is now the ninth fastest-growing state in the nation, and counties in east and central Tennessee are among the fastest growing counties in the United States. Exhibit 4 below depicts the growth sustained by Tennessee counties between 1990 and 2000 (US Census data). During this time period, traffic congestion worsened measurably. If the current rate of population growth continues, by 2010 the state could be home to an additional 950,000 persons resulting in an additional 2.89 million daily trips statewide. (This estimate assumes an average household size of 2.63 persons and an average of eight daily trips per household.)

Exhibit 4. Population growth of Tennessee counties from Year 1990 to 2000 (US Census).



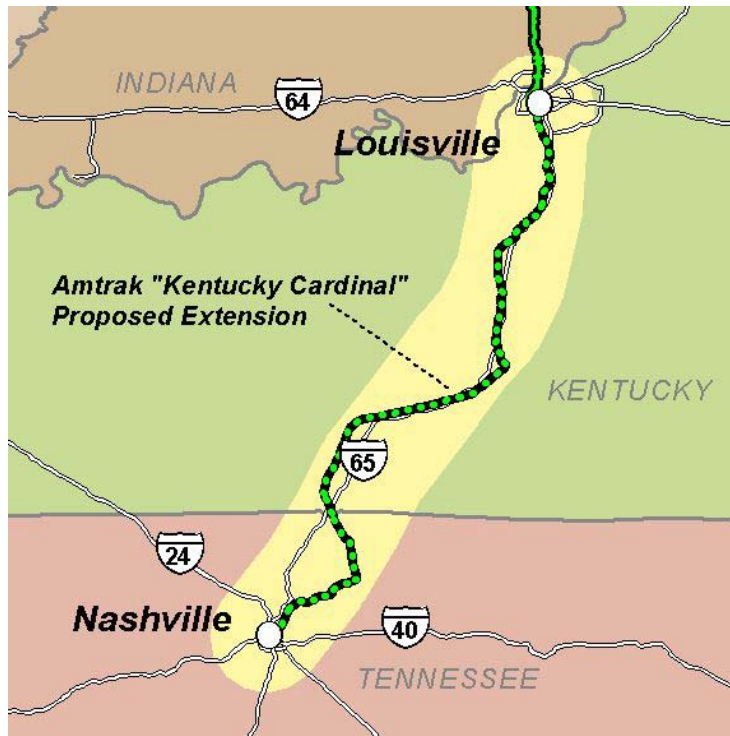
Other Opportunities and Initiatives

Several rail initiatives in Tennessee and surrounding states are highly supportive of intercity passenger rail in the State. There are also a number of promising rail projects proposed beyond the Tennessee border that would facilitate access to the national passenger rail network and its host cities.

Proposed Extension of the Amtrak *Kentucky Cardinal*

Amtrak is currently investigating the potential extension of its *Kentucky Cardinal* from Louisville to Nashville. Amtrak will determine whether the route extension (shown in Exhibit 5 below) will generate sufficient ridership to cover an acceptable portion of operating costs. If justifiable on a ridership/cost basis, the extension of the *Kentucky Cardinal* to Nashville will provide Tennessee with its second connection – the first being the *City of New Orleans* route which serves Memphis – to the Midwest passenger rail network and the busy Chicago hub. In support of this initiative, an Amtrak inspection train ran between Louisville and Nashville in late December 2001; the non-stop running time was 3.5 hours. Intercity bus travel time between Louisville and Nashville with stops is approximately 4 hours.

Exhibit 5. Proposed Extension of Amtrak “Kentucky Cardinal” from Louisville to Nashville.



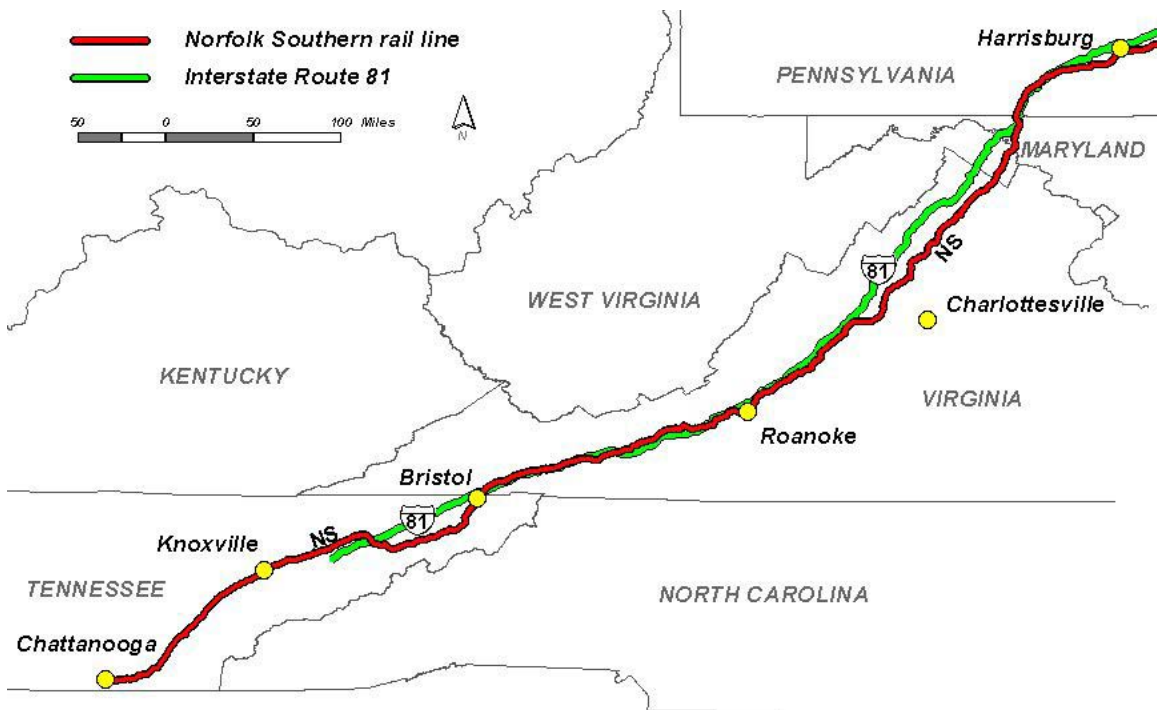
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I-81 Corridor

The Department of Transportation for the Commonwealth of Virginia plans to spend \$3.5 billion over the next 20 years widening Interstate 81, the state's longest highway at 323 miles from Winchester through Roanoke and on to Bristol. However, Norfolk Southern Railroad has presented an alternative proposal to the Commonwealth. Rather than spend billions of dollars to widen truck-saturated I-81, Norfolk Southern is seeking \$900 million in state funding to improve their rail alignment which runs parallel to I-81 from Harrisburg, PA to Knoxville, TN. (See Exhibit 6 below.) With capacity-enhancing track and signal improvements, Norfolk Southern claims they could lure freight currently shipped along I-81 to its rail line, in effect removing a significant percentage of trucks annually from the highway. (The Virginia Department of Transportation estimates that 40 percent of the vehicles that use I-81 today are trucks.)

A recently completed study that investigated the feasibility of this proposal found that, with capacity enhancements and other improvements, approximately 1,000 truckloads of freight could be diverted daily from I-81 to the parallel Norfolk Southern rail line. These improvements offer the potential to drastically improve passenger rail travel in Virginia while offering the opportunity to extend passenger rail service from Roanoke to Bristol, and then on to Knoxville.

Exhibit 6. Interstate 81 Corridor with freight rail alignment parallel to interstate highway.



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The line also offers the potential for eventually extending service to Nashville or Chattanooga, or both. The Norfolk Southern line would also serve a popular travel corridor and connect Tennessee with the Northeast Corridor, Amtrak's largest ridership base serving the major metropolitan areas of Washington, Baltimore, Philadelphia, New York, and Boston.

Trans-Dominion Express

Passenger rail service to Bristol from the east may be implemented soon thanks to the efforts of the Commonwealth of Virginia. The Trans-Dominion Express, a passenger rail initiative of the Commonwealth of Virginia, would provide through services to Washington, D.C. from Richmond and Bristol via Lynchburg. At this point in time, the initiative is seeking state and federal funds for infrastructure upgrades and rolling stock acquisition to implement the proposed services.

Nashville Commuter Rail System.

Nashville is currently planning a commuter rail system which could be implemented over time. The five corridors that are planned to link to downtown Nashville are as follows:

- Northeast: Briley Parkway-Hendersonville-Gallatin
- East: Hermitage-Mt. Juliet-Lebanon
- Southeast: Hickory Hollow-LaVergne-Smyrna-Murfreesboro
- South: Brentwood-Cool Springs-Franklin
- West: Belle Meade-Bellevue-Kingston Springs

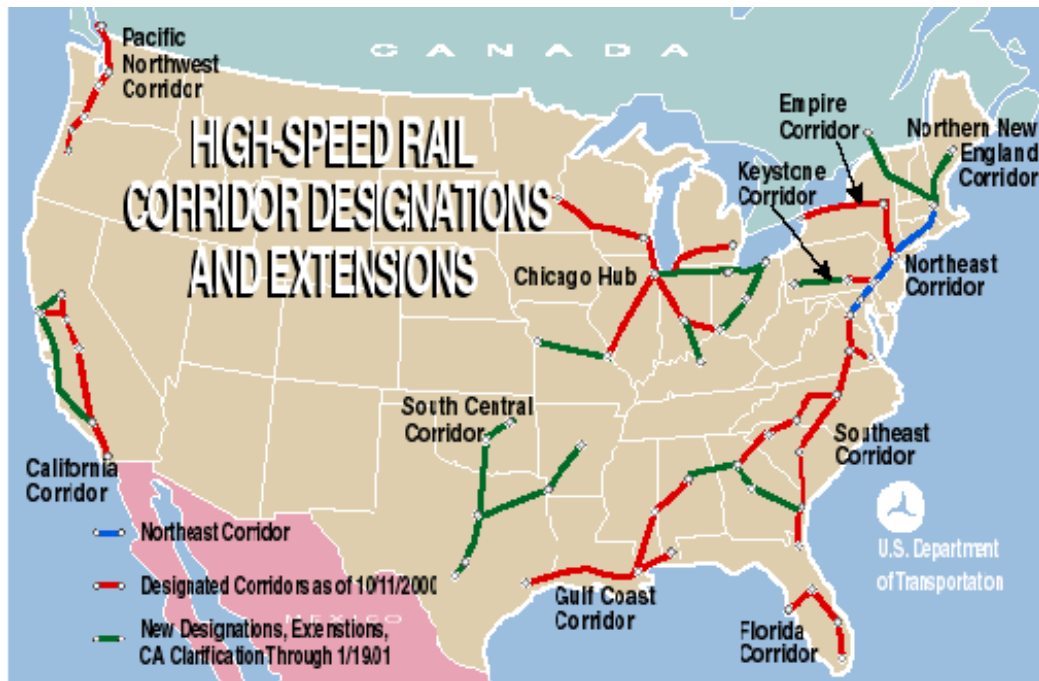
The 32-mile East Corridor between Wilson and Davidson counties, comprising a portion of the proposed East-West Corridor, is planned to be the first line developed. Intercity rail services can piggyback on the infrastructure improvements (e.g., track and signal enhancements and station facilities) for the East Corridor commuter rail line.

High Speed Rail Initiatives in the Region

A number of existing and proposed passenger rail corridors around the nation have been officially designated by the Federal Railroad Administration as "High Speed Rail Corridors." (See Exhibit 7 below.) This designation allows a state to receive federal funds for highway-railroad grade separation projects which promote higher train speeds and improve safety. Official High Speed Corridor designation is also considered an important prerequisite for additional federal funding, pending the passage of a multi-billion dollar high speed rail appropriation presently before the US Congress.

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Exhibit 7. FRA-designated High Speed Rail Corridors and Extensions in the United States¹.



¹ Does not include new corridors designated since February, 2001.

High speed rail corridor planning to date has focused primarily on upgrading existing lines to increase the maximum operating speed of 79 mph (typical of conventional intercity passenger rail trains) to 90 or 110 mph. (The desired outcome is to increase average train speeds, in turn reducing running time between stations.) The “upgrade” approach is being employed, for example, by the officially designated Chicago Hub and Southeast Corridors. An alternate high speed rail planning approach provides for new rail alignments that are exclusively devoted to passenger trains that can sustain speeds of 150 to 200 mph, comparable to true high speed rail systems operating in Europe and Japan. For example, the Florida Corridor utilizes the “new alignment” approach to connect Tampa and Orlando (primarily via Interstate 4) while the State of California has developed a business plan to implement a 200 to 300 mph service on new right-of-way.

The majority of designated high speed rail corridors cross one or more state boundaries, necessitating interstate coordination (or partnership) during the planning and implementation phases. In fact, most of the states surrounding Tennessee are participants in various high speed rail coalitions. These coalitions have been established to promote high speed rail service within their respective regions and are now well positioned to take advantage of the proposed appropriation currently under consideration by Congress. The Commonwealth of Virginia, for example, has teamed with North Carolina, South Carolina, Georgia, and Florida to promote the Southeast High Speed Rail Corridor.

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Amtrak's Acela Express, operating between Boston, New York, and Washington, D.C., provides this country's fastest rail service.

The nine-state Midwest Regional Rail Initiative (for the Chicago Hub Corridor) has already attained high speed designation of an extensive network of existing passenger rail routes; the last segment to be designated connects Indianapolis with Louisville for which major track and signal upgrades are planned to the existing Class 2 trackage. There is also a South Central High Speed Rail Corridor which includes Tennessee's neighbor to the west - Arkansas - and a Gulf Coast Corridor which includes Mississippi and Alabama, both of which border Tennessee. The affiliations of neighbor states of Tennessee are depicted in Exhibit 8 below. It is important to note that the States of Tennessee, Kentucky, and West Virginia are currently not party to any of these regional coalitions.

Exhibit 8. Regional High Speed Rail partnerships of states in the vicinity of Tennessee.



Challenges

Railroad Capacity and Negotiations

The existing capacity of freight rail lines often poses a significant impediment to the initiation of a new passenger rail service. Amtrak, for example, can operate on any freight railroad, however it must negotiate terms with the host railroads. These negotiations which establish the conditions of the lease can take months, or even years. On some routes, railroads may be very resistant to joint operation with passenger service, especially where there is little spare track capacity. In these situations, the passenger rail service sponsor must often agree to make capacity enhancements (i.e., track and signal upgrades) which could range from safety improvements to the double tracking of an alignment, an expensive undertaking.

The freight rail network serving Nashville is an excellent example of the challenges to a new passenger service. Nashville is an important rail hub for the region; at least one hundred trains per day are handled through the main lines and yard facilities in Nashville where extensive swapping of blocks (multi-car segments of freight trains) is accomplished. All of the main lines, which are currently owned by CSX and feed this hub, are single track and already have capacity constraints. Adding new passenger service may require double tracking of the freight rail alignments or the installation of extensive segments of passing sidings to permit the joint operation of freight and passenger trains.

Capital Costs of Improvements for Passenger Service

A requirement for double tracking an alignment or installing long stretches of passing sidings can cost anywhere from \$500,000 to \$8 million per mile, but average about \$1 million a mile. Since the State of Tennessee has had limited experience in passenger rail initiatives, there may be institutional barriers to funding new intercity rail services. In fact, the overwhelming majority of the State's transportation budget is spent on roads. Of TDOT's \$1.4 billion budget, only \$44 million is dedicated to public transit—about 3 percent. Seventeen million dollars come from the federal government and \$27 million from the state gas tax and other road-user revenue sources. All but \$14 million of the money is allocated to fund the State's 12 city bus systems.

Convenience of Automobile

The choice of transportation mode is governed primarily by cost and convenience. However, it is difficult to compete with the convenience of an automobile that allows one to travel relatively quickly between any city, day or night, via the Interstate highway system when traffic is not congested. While passenger rail has inherent advantages (such

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as safety and reliability), it is important that the rail travel mode provides a competitive travel time to the automobile. A successful passenger rail service would have to optimize ridership by weighing travel time against the number of station stops along the route.

Ticket prices are also another important determinant of success as the public perceives auto travel to be relatively inexpensive. Rail sponsors must strive for a balance between keeping prices low enough to attract customers and generating enough revenue to cover most of the operating costs. (Supplemental sources of revenue could come from advertising, concessions, mail/freight services, and state and local funding programs.) In addition, it is desirable that a transit system or other provision for local transportation is available at the end of the rail trip. Linking intercity rail stations with other transportation services can be challenging given the reduced emphasis on transit in certain cities.

Methodology for Passenger Rail Corridor Selection

The selection of the most promising passenger rail corridors follows a simple, two-step process. The first step entails the identification of a Long List, or “first cut”, of potential passenger rail corridors from the entire Tennessee rail network and portions of the national, or interstate, rail network. A Short List of corridors is then screened from the Long List to produce a set of corridors that justifies more detailed planning analyses.

Long List Selection Methodology

The Long List of potential corridors is determined through an examination of the statewide Tennessee rail network and the major cities that the rail network serves. The comprehensive, well-distributed Tennessee rail network offers the potential to serve several pairs of major cities both inside the state and beyond its borders. To merit inclusion in the Long List, it is reasonable to require that a potential passenger rail corridor meet all three of the following criteria:

1. Connect at least two major city pairs, preferably US Census-designated Metropolitan Areas.
2. Utilize existing railroad rights-of-way (over most of the distance in the corridor) between city pairs.
3. Follow (in an approximate parallel alignment) a major intercity highway route in Tennessee.

The first criterion, requiring the connection of at least two major city pairs, is fundamental to establishing a viable passenger rail service. While boardings at intermediate stops along a rail corridor are an important contribution to ridership

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(especially since fewer transportation alternatives exist outside major metropolitan areas), the most significant component of corridor ridership is generated by the major city pairs. The selection of appropriate city pairs is also key to public perception of the route, that is, in its provision of another effective means of accessing key destinations in the state.

The second criterion recognizes the expense associated with the implementation of new transportation infrastructure. Given the high costs of land, especially in urbanized areas, the acquisition of right-of-way for a new potential passenger rail corridor can be a significant financial impediment. In addition, the construction of a new right-of-way usually imposes significant impacts on communities and the natural environment. Thus, it is a crucial that the potential passenger rail corridor be established within an existing railroad right-of-way. This criterion permits discontinuities in a potential rail corridor that may be remedied by relatively minor capital investments or the restoration of missing rail segments that are currently under consideration for replacement through a capital improvements program.

The third and final criterion requires that the potential passenger rail corridor basically follow a major intercity highway route in Tennessee. There is a dual purpose for establishing this requirement. First, a stated objective of the passenger rail corridor initiative is to divert trips, otherwise made by the private automobile on major highways, to the passenger rail mode. The establishment of a passenger rail corridor that is roughly parallel to a highway facility offers an alternative means of accessing key destinations along the highway. Since the advent of the Interstate highway system, most new developments have been located along highway facilities.

A second reason for applying this third criterion is to maximize passenger rail benefits to Tennessee residents. The third criterion requires that a potential rail corridor, by following a major Tennessee highway, would by definition serve important destinations inside the State of Tennessee. However, there may be an existing rail corridor that connects a major city pair in Tennessee but runs through another state for most of its alignment. For example, the application of this criterion excludes the Memphis-to-Chattanooga corridor which, although directly connects two Metropolitan Statistical Areas (MSAs) in Tennessee by an existing rail line, runs primarily through the States of Mississippi and Alabama. Thus, this criterion ensures that a potential public transportation investment maximizes the benefits to communities within the State of Tennessee. (Recognizing the benefit to providing connectivity with the regional passenger rail network, this criterion is not applicable to city pairs where one of the major cities lies outside Tennessee.)

The corridors that meet the above criteria, and therefore merit inclusion in the Long List of corridors, are described in the following pages.

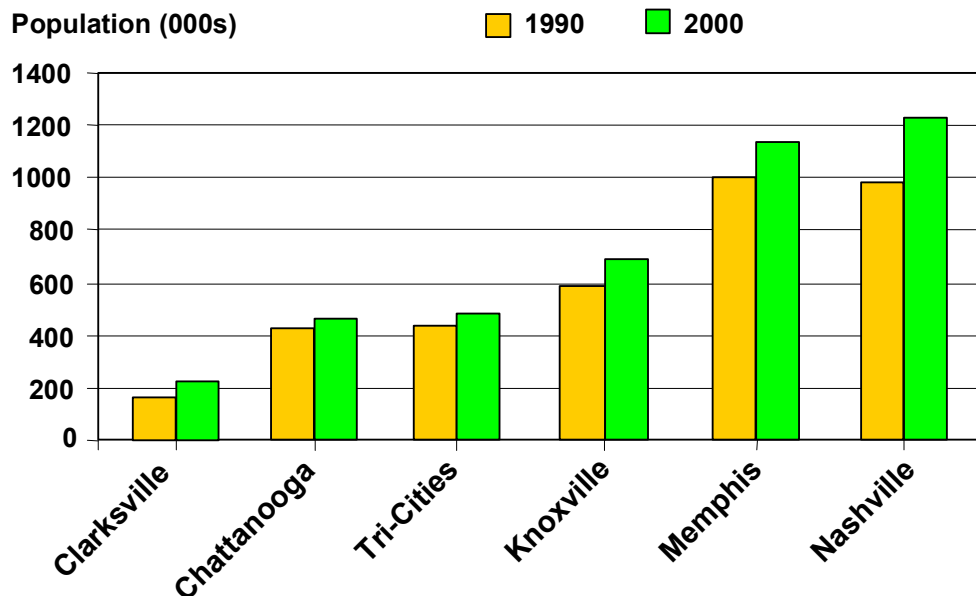
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Long List of Corridors

In order to establish a Long List of potential passenger rail corridors, it is first necessary to identify viable city pairs and the railroad rights-of-way that connect them. To this end, MSAs in Tennessee and major cities in surrounding states were mapped and overlaid onto existing railroad rights-of-way. The initial focus of this procedure was to ensure that existing railroad rights-of-way are available for connecting all of the MSAs inside the State of Tennessee. According to the latest US Census, the six largest MSAs in the State of Tennessee are, in order of decreasing size, Nashville, Memphis, Knoxville, the Tri-Cities area, Chattanooga, and Clarksville. (Bristol Tennessee-Virginia is a twin city located directly on the Tennessee-Virginia state line. Bristol is part of the metropolitan statistical area of Bristol, Johnson City and Kingsport, commonly called the Tri-Cities.) The population of these MSAs for Years 1990 and 2000 are provided in Exhibit 9 below.

The Memphis and Nashville MSAs, with more than 1 million residents each, are the most significant population centers in the State of Tennessee. It is important to note that Nashville displaced Memphis as the most populous MSA since the 1990 Census. Knoxville, with approximately 700,000 residents, maintains a definitive ranking as the third largest MSA, while the Tri-Cities area and Chattanooga MSAs (with approximately 500,000 residents each) are closely matched for the fourth and fifth population rank. The Clarksville MSA is about half the size of the Tri-Cities and Chattanooga MSAs; the remaining MSAs in the State of Tennessee are small by comparison with the MSAs described above, but fortunately are located along railroad corridors that connect specific pairs of these six largest MSAs.

Exhibit 9. Population Growth in the six largest MSAs of Tennessee from Year 1990 to 2000.



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The major city pairs (or MSA pairs) that can be connected by existing railroad rights-of-way to form corridors within the State of Tennessee are as follows:

- Memphis-to-Nashville
- Nashville-to-Chattanooga
- Nashville-to-Knoxville (with restored Cumberland Plateau segment)
- Nashville-to-Clarksville
- Knoxville-to-Tri-Cities, and
- Chattanooga-to-Knoxville.

These intrastate Tennessee corridors, in fulfillment of the three Long List requirements above, connect two MSAs, utilize existing railroad rights-of-way, and closely parallel existing highway alignments. Exhibit 10 below provides a geographic depiction of these corridors.

Exhibit 10. Long List of potential intercity passenger rail corridors for Tennessee region.



Major cities in surrounding states can also be paired with MSAs in Tennessee to establish viable passenger rail corridors. The largest cities in the surrounding region that are

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directly accessible to Tennessee by rail are Louisville, Birmingham, Atlanta, Charlotte, and Roanoke. Separate planning and implementation efforts (discussed in an earlier section) are underway to either initiate or enhance passenger rail service to most of these cities. These ongoing regional passenger rail projects could greatly enhance the viability of passenger rail corridors in the State of Tennessee by providing connectivity with the regional passenger rail network. Key regional connections provide access to the busy Chicago Hub and the highly successful Northeast Corridor (Washington-New York-Boston).

Interstate passenger rail corridors that may be established by linking MSAs in Tennessee with major cities outside Tennessee are as follows:

- Nashville-to-Louisville, KY
- Nashville-to-Birmingham, AL
- Chattanooga-to-Atlanta, GA
- Bristol-to-Charlotte, NC and
- Bristol-to-Roanoke, VA

The Long List, consisting of both intrastate and interstate passenger rail corridors and which satisfies all of the requirements for inclusion by the aforementioned criteria, are depicted in Exhibit 10 above.

Short List Screening Criteria

Each of the passenger rail corridors in the Long List undoubtedly offers some measure of public benefit. These potential public benefits, however, vary according to geography, population, socioeconomic factors and other characteristics. In addition, the corridors also differ widely in their expected ease of implementation, financial requirements, and degree of public support. Recognizing these variations and the fact that all of the corridors in the Long List are not likely to be implemented simultaneously, an appropriate screening methodology can narrow the Long List to a Short List of intercity passenger rail corridors. The most promising intercity passenger rail corridors, formed from the Short List, will then be subject to detailed planning analyses to estimate potential ridership, required capital investments, operating & maintenance costs, and public benefit. Four screening criteria, all of which must be fulfilled to justify inclusion into the Short List, are defined below:

1. The corridor should be actively used by a freight rail carrier and/or be identified for capital improvements funding,
2. The corridor should allow connectivity to other existing or potential passenger rail corridors at both termini, i.e., no stub ends.

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3. The potential passenger rail corridor should not induce adverse institutional impacts or encounter significant obstacles to implementation.
4. Where an interstate corridor is proposed, it should be an original initiative, i.e., not already included in a prior or ongoing study or implementation effort.

Note: A potential corridor will not be advanced into the Short List when one of the above criteria is not satisfied.

The criteria are further described below to provide the rationale behind their use in this screening process.

An important financial aspect of passenger rail implementation is considered in the first criterion. The presence of an active freight operator on a potential passenger rail corridor ensures that trackage is already in place and maintained in an operable condition. The use of railroad right-of-way that already incorporates tracks, bridges, and other infrastructure greatly reduces the capital investment required for the initiation of passenger rail service. (The use of existing freight tracks for passenger service, of course, depends on the provision of trackage rights by the freight railroad.)

The second screening criterion recognizes the importance of corridor connectivity, both within the State of Tennessee and with the national passenger rail network. By providing access to the national rail network, especially to Chicago and the Northeast, the market areas for potential Tennessee passenger rail corridors are greatly expanded. Ensuring connectivity at both ends of the corridor provides greater opportunity for transfers to and from other corridors and promotes the potential development of a seamless statewide and national passenger rail network.

The third criterion excludes corridors that may induce significant operational impacts to freight rail operators or entail rigorous coordination with another state to implement passenger rail service. For example, freight railroads may permit passenger trains to operate over their rail lines for a trackage fee. However, because of potential capacity constraints and other operational issues, the freight operator may not wish to host a proposed passenger rail operation. On the other hand, trackage rights may be granted, but only on the condition that expensive upgrades to the rail infrastructure be performed (or paid for) by the passenger rail sponsor. To warrant incorporation into the Short List, the third criterion requires that a passenger rail corridor acquire trackage rights without incurring exorbitant infrastructure costs.

The third criterion also excludes corridors whose implementation would require extensive political and interagency coordination with another state. This criterion applies especially where the proposed corridor provides limited value to the State of Tennessee (i.e., traverses areas of relatively low population in Tennessee).

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To avoid redundancy, the fourth screening criterion requires that this study focus only on interstate passenger rail corridors that are not currently the subject of investigation by another state or coalition of states. In certain instances, the proposal of a passenger rail corridor may indeed conflict with existing studies or plans for a specific corridor. However, it should be noted that this study can build upon the rail planning initiatives of other entities (e.g., Virginia’s TransDominion Express and the Atlanta-Chattanooga Maglev study) by proposing connections to Tennessee rail corridors. For example, projected ridership on Tennessee passenger rail corridors will be enhanced by assuming these aforementioned potential connections with proposed corridors in other states.

Short List of Passenger Rail Corridors

The Long List of potential passenger rail corridors was screened according to the four Short List criteria defined above. A summary table of the screening results, indicating “Pass” (✓) or “Fail” (X) ratings for criteria and the determination of corridors that advance to the Short List, is provided in Exhibit 11 below.

Exhibit 11. Screening Matrix of Short List Criteria and Corridors Advanced to Short List.

Corridor	Active Freight Line	National & Regional Connectivity	No Adverse Institutional Impacts	Conflicts with Other Initiatives	Advance to Short List
Memphis-Nashville ¹	✓	✓	✓	N/A	Yes
Nashville-Knoxville ²	✓	✓	✓	N/A	Yes
Nashville-Clarksville	X	X	✓	N/A	No
Nashville-Chattanooga	✓	✓	✓	N/A	Yes
Nashville-Birmingham	✓	✓	X	✓	No
Chattanooga-Knoxville	✓	✓	✓	N/A	Yes
Chattanooga-Atlanta	✓	✓	X	X	No
Knoxville-Bristol (TriCities)	✓	✓	✓	N/A	Yes
Nashville-Louisville	✓	✓	✓	✓	Yes
Bristol-Charlotte	✓	✓	X	✓	No
Bristol-Roanoke	✓	✓	✓	X	No

Legend: ✓ - Corridor meets criterion X – Corridor fails criterion N/A – Criterion not applicable

¹ Assumes construction of the McKenzie Bypass (provides direct route from Atwood to Huntingdon).

² Assumes restoration of track over the Cumberland Plateau.

According to the summary in Exhibit 11, six corridors advance to the Short List for detailed planning analyses. A discussion of the rationale for these determinations, i.e., how criteria are met, is provided below. It is important to note that the failure of a corridor to advance to the Short List does not preclude the corridor from ever supporting passenger rail service in the future. The purpose of this effort is to identify the specific

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corridors that, under current conditions, offer the highest public benefit to the State of Tennessee and the greatest ease of implementation.

The following corridors, depicted in Exhibit 12 below, are advanced to the Short List:

Memphis-to-Nashville Corridor. The rail line that directly connects Memphis to Nashville is an active freight line owned by CSX Transportation (CSX). According to a representative of CSX, ten to twelve trains per day (a relatively low number) utilize the 237-mile long rail line. According to recent rail traffic measurements, the rail line segments from Memphis to McKenzie and McKenzie to Nashville are classified as light density to medium density mainlines, respectively. Thus, the implementation of a passenger rail service on this route is not expected to significantly impact freight operations. Connectivity to other corridors is provided at Nashville for potential service to Louisville, Knoxville, and Chattanooga. A connection to the current Amtrak *City of New Orleans* train would be available at Memphis. It is also important to note that this corridor connects the two largest population centers in Tennessee. Thus, this corridor advances to the Short List.

Exhibit 12. Short List of potential intercity passenger rail corridors for Tennessee region.



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Nashville-to-Chattanooga Corridor. The CSX rail line from Nashville to Chattanooga sustains a relatively high level of freight traffic (30 to 35 trains per day). The initiation of passenger rail service over this line may pose potential operational challenges for CSX. However, a moderate level of infrastructure improvements (e.g., adding new passing sidings or lengthening existing sidings) can mitigate these operational impacts. The Nashville terminus of this route can provide through service to Louisville and Chicago, while, at Chattanooga, connecting services may eventually be established to Atlanta or Knoxville. Thus, this corridor is a worthy addition to the Short List.

Nashville-to-Knoxville Corridor. A significant portion of the trackage along this corridor (111 of the total 211 miles) is owned by Nashville and Eastern Railroad (NERR). NERR typically operates only one train per day over this line, offering ample capacity for frequent passenger rail service over their trackage from Nashville to Monterey. However, because the NERR is rated Class 2 (i.e., 30 MPH maximum speed for passenger trains) throughout and has no signal system in place, track and signal enhancements will be required to accommodate higher speed passenger trains.

From Monterey to Crab Orchard, a 31-mile segment of track was removed decades ago and is still missing from the Nashville-to-Knoxville Corridor. However, a major focus of this study is to restore this missing segment and improve track on other segments; these enhancements are known as the East-West Connector. According to the criteria defined above, the potential for significant investments in the restoration of this segment allows this corridor to be included in the Short List. (It is important to note that these investments can only be justified if freight movements are the primary purpose for the rail infrastructure enhancements.) The remainder of the corridor is comprised of three active segments, the 15.2-mile trackage from Crab Orchard to Rockwood owned by Franklin Industries, the 23.2-mile Norfolk Southern (NS) segment from Rockwood to Oliver Springs, and the 35.6-mile NS tracks from Oliver Springs to Knoxville. The last segment was selected over a parallel CSX route because of capacity constraints (See Task 10, Advance Planning Report, Project 1, Scenario B of the Tennessee Rail System Plan).

Despite the significant investments required to prepare this corridor for passenger rail service, the Nashville-to-Knoxville corridor is critical to the success of a statewide passenger rail network. The endpoints of this corridor, Nashville and Knoxville, permit potential connections to other potential passenger rail services. At Nashville, connecting service may be established to Louisville or Chattanooga while a connecting rail service may eventually be available for service to Chattanooga from Knoxville. Given the potential for new infrastructure investments, the existence of trackage over a majority of the corridor, and its importance to the statewide rail network, this corridor is included in the Short List.

Knoxville-to-Bristol (Tri-Cities) Corridor. NS owns the active freight rail lines that connect Knoxville to the Tri-Cities area. From Knoxville, the line proceeds east to Bulls Gap, a small town approximately 12 miles east of Morristown. At Bulls Gap, the line

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branches into two alignments (one to the north and the other to the south), both of which serve the City of Bristol. The more northerly of the two lines provides access to the City of Kingsport, but follows a winding and circuitous route to Johnson City, the larger of the two cities. The southerly route, on the other hand, provides more direct access to the City of Bristol and thus is chosen as the preferred passenger rail alignment for this corridor. (Bristol, Tennessee and Bristol, Virginia are twin, but independent cities. However, for the purposes of this study, the twin cities are treated as one destination.)

The rail line that connects Knoxville to Bristol is well maintained by NS. However, because of the mountainous terrain in this part of the state, the alignment's geometry typically limits the maximum train speed to 40 MPH. The average passenger train speed may be substantially improved (i.e., an approximate 8 percent running time reduction) through the use of tilting trainsets, a technology that is significantly more sophisticated than conventional, non-tilting trains. (Rolling stock options are discussed in a later section of this task.)

The Knoxville-to-Bristol corridor is also an essential link, or sub-corridor, of the proposed I-81 Corridor which may eventually offer service from Bristol to Chattanooga. This corridor also offers the opportunity to connect with the proposed Trans-Dominion Express, a passenger rail initiative of the Commonwealth of Virginia that would provide through services to Washington, D.C. from Richmond and Bristol via Lynchburg. The availability of existing rail infrastructure, the opportunity to connect with the proposed Trans-Dominion Express, and its significance to the I-81 Corridor advances the Knoxville-to-Bristol Corridor to the Short List.

Chattanooga-to-Knoxville Corridor. The most direct connection between Knoxville and Chattanooga is provided by an active NS rail line that closely parallels Interstate 75. (Two other rail lines, one owned by CSX and another by NS, also provide this connection but are less direct and serve fewer population centers.) This Corridor provides the opportunity for connections to Bristol and Nashville at Knoxville, and to Atlanta at Chattanooga. Although this corridor satisfies all of the Short List criteria, it serves the weakest of the potential city pairs in Tennessee in terms of population. (The Chattanooga and Knoxville MSAs are ranked third and fifth according to the US Census for Year 2000.) However, the strength of this corridor is its potential connection to other proposed passenger rail corridors, i.e., Bristol-to-Washington, D.C. and Chattanooga-to-Atlanta, both of which are under study by Virginia and Georgia, respectively. Thus, this corridor deserves inclusion in the Short List.

Nashville-to-Louisville Corridor. CSX owns the 187-mile active rail line that connects Louisville to the busy Nashville freight hub. A favorable alignment and well-maintained tracks permitted the non-stop *Southwind* to complete the Louisville-Nashville segment in just over three hours during the 1950s. Excellent alignment and track conditions are available today as CSX operates 30 to 35 freight trains daily (a moderate-to-high level of traffic) over this line. Thus, there is available infrastructure to restore passenger service.

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The mixing of freight trains with faster moving passenger trains, however, will likely require some track and signal improvements that are discussed in a later section.

Despite its current fiscal crisis, Amtrak continues to investigate new passenger rail markets. For example, the *Kentucky Cardinal* was recently extended into Louisville proper. (The *Kentucky Cardinal* formerly terminated in Jeffersonville just over the Indiana-Kentucky border, though the stop was officially designated Jeffersonville-Louisville.) Also, in December 2001 Amtrak operated an inspection train between Louisville and Nashville; this non-stop excursion was completed in only 3.5 hours. Amtrak is currently preparing a ridership estimate and cost-benefit analysis on the restoration of service from Louisville to Nashville. Finally, the Indianapolis-to-Louisville segment of the *Kentucky Cardinal*, a Class 2 line (maximum 30 MPH), would be significantly upgraded as an extension of the Chicago Hub high speed rail corridor. (The proposed travel time enhancement for this segment is assumed in the interstate ridership model for the Louisville-to-Nashville corridor presented in the next section.)

The objectives of this study do not conflict with the Amtrak initiative or with any official planning effort underway in the State of Kentucky (though this study is unaware of any specific Kentucky-led passenger rail initiative in this corridor). The proposed restoration of passenger rail service from Louisville to Nashville has achieved enough momentum, thanks to strong state and local support, that it removes the initial institutional challenges to interstate cooperation. Thus, the Nashville-to-Louisville corridor is not precluded from the Short List on the basis of institutional impediments or conflicts with other initiatives. Instead, this study builds upon the efforts of Amtrak and passenger rail advocates toward the implementation of service (or extension of the *Kentucky Cardinal*) to Nashville.

The following corridors fail to meet either one or more of the screening criteria, for reasons described below, and thus do not advance to the Short List:

Nashville-to-Clarksville Corridor. There are two alignments that may potentially be utilized to connect Nashville to Clarksville. The first alignment is approximately 67 miles long and follows 48 miles of CSX trackage from Nashville through the towns of Goodlettsville and Springfield; the latter 19-mile section completes the approach to Clarksville via the RJ Corman Memphis Line (RJCM). A less circuitous second alignment, only 51 miles, from Nashville to Clarksville is available along the former Nashville and Ashland City Railroad (NACR); however only 18.5 miles of track are in place. Although the right-of-way is still intact, the lack of existing trackage excludes this second alignment from the Short List.

Despite the availability of active freight track along the first alignment, this corridor does not provide through connectivity to other major cities at the Clarksville end of the corridor. (The third Short List criterion requires that connectivity be provided at both ends of the corridor.) However, either of the Nashville-to-Clarksville alignments offers the potential to serve as future spokes of a Nashville-based commuter rail system.

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Nashville-to-Birmingham Corridor. This corridor is excluded from the Short List of corridors since its implementation would require extensive interagency coordination with the State of Alabama. Although passenger rail advocates within the State of Alabama have identified this corridor as an important component of the national passenger rail network, there have been no recent state or Amtrak-sponsored efforts to establish passenger rail service between Nashville and Birmingham.

If implemented, the Nashville-to-Birmingham Corridor is expected to provide minimal potential benefit to the State of Tennessee. Since it traverses a less populated area of the State, it would attract significantly lower ridership compared to other interstate corridors.

Chattanooga-to-Atlanta Corridor. A recently completed FRA study selected Maglev technology as the preferred transportation mode for high speed ground transportation in the Atlanta-to-Chattanooga Corridor. (Maglev is an advanced transportation technology that uses electromagnetic forces to both levitate and propel a trainset along a guideway.) It would therefore be inappropriate for the State of Tennessee to propose another technology, i.e., conventional passenger rail trains, while Maglev is still considered the preferred alternative by state and federal agencies.

This corridor therefore fails the fourth criterion which precludes the consideration of a corridor that is already subject to study or implementation efforts by another state, especially where the study objectives are not consistent.

The potential connection of Tennessee rail corridors to Atlanta is dependent, in part, on the Chattanooga-Atlanta Maglev initiative. Since Atlanta is the most populated metropolitan area in the Southeast, passenger rail connections to Atlanta have the potential to significantly increase ridership within the State of Tennessee. However, the implementation of a Maglev system is a long-range effort (even if it is funded). Thus, the potential ridership impacts of the Maglev initiative are too speculative at this time to incorporate in the ridership model presented in the following section.

If the Maglev system between Chattanooga and Atlanta is not implemented, a conventional passenger rail service may alternatively be proposed. However, it is important to note that the line between Chattanooga and Atlanta is a heavily used intermodal freight corridor. CSX has already expressed reluctance to provide trackage rights to a passenger rail service over their single-track line. The installation of separate passenger tracks, a considerable infrastructure investment, would likely be required to initiate a new passenger rail service over this CSX line. Institutional obstacles imposed by CSX or the requirement for costly rail infrastructure (i.e., a new track) would thus exclude this corridor from the Short List.

Bristol-to-Roanoke Corridor. This corridor, a segment of the proposed Trans-Dominion Express, has already been the focus of a planning study by the Commonwealth of Virginia. The Trans-Dominion Express, which would provide service to Washington,

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D.C. from Richmond and Bristol via Lynchburg, is poised for implementation upon the funding of \$100 million for track and signal upgrades, station improvements, and rolling stock acquisition. It would therefore be redundant for the State of Tennessee to propose this corridor for its Short List of passenger rail corridors. However, the interstate ridership projections for the Chattanooga-to-Bristol and Knoxville-to-Bristol corridors will include the significant contribution of connections to the Trans-Dominion Express.

Bristol-to-Charlotte Corridor. This corridor has been excluded from the Short List for failing to meet the requirements of the third criterion, i.e., lack of institutional obstacles. Despite its zeal for developing new passenger rail services (such as the state-sponsored *Piedmont* service), the State of North Carolina has expressed no interest in establishing passenger rail service over the Bristol-to-Charlotte corridor which is located in the northwest portion of the state. In fact, their focus is instead on implementing a new service in southeastern North Carolina.

Perhaps the lack of interest in the northwest region of North Carolina stems from the realization that the corridor spans areas of relatively low population density. It is also important to note that this corridor – only 40 miles of which traverse the State of Tennessee – provides only minimal benefit to residents of Tennessee. In addition, for Tennesseans seeking efficient connections to the national passenger rail network, the Bristol-to-Roanoke corridor provides a more direct connection to the Trans-Dominion Express and Amtrak’s Northeast Corridor than the Bristol-to-Charlotte Corridor.

This section has described the screening methodology, with defined selection criteria, to determine both the Long List and Short List of study alternatives. The following sections will provide the results of planning analyses of the most promising corridors in order to estimate ridership, capital and operating and maintenance costs, and public benefit.

Estimated Ridership for Most Promising Corridors

A new intercity passenger rail service can only be instituted if there is demonstrable demand to financially support system operation and to justify the infrastructure and rolling stock investments that will certainly be required. It is therefore critical to develop sound ridership projections as these estimates will affect project viability.

Methodology for Comparable Corridors Model

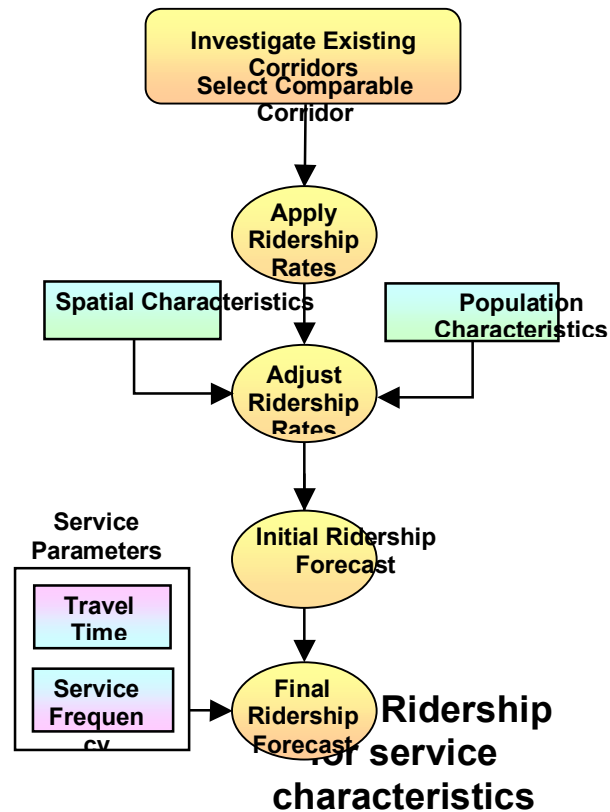
In this approach, the proposed passenger rail corridors in Tennessee are compared with appropriate existing intercity passenger rail corridors. Potential ridership is projected by applying the passenger rail market characteristics of the comparable corridor to the study corridors, in this case, the Short-Listed corridors. The choice of comparable corridors is

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based on population, land use, and socioeconomic characteristics as well as transportation facilities of the metropolitan areas served by existing passenger rail services.

This Comparable Corridors Model approach is predicated on the observation that North American cities share much in common in terms of development patterns and socioeconomic characteristics. These shared attributes in urban form, economic systems, and social structure translate into similarities in travel demand and mode choice. While the common functional characteristics (i.e., their role as centers of finance, commerce, and governance) of North American cities are obvious, there may be subtle local and/or regional differences in population density, land use, employment base, transit use, and tourism. These differences, especially the socioeconomic factors, affect travel behavior and thus must be considered when selecting comparable corridors.

Exhibit 13. Model development process for the Comparable Corridors Ridership Forecast.



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The ridership rates of a comparable corridor are applied on a pro rata basis to the study corridor, i.e., per thousand persons, to estimate the Initial Ridership Forecast in each the Short-Listed corridors. The Comparable Corridors Model accounts for variations in local conditions, such as differences in average speed (travel time) and frequency through an application of empirically-derived adjustment factors (mathematically termed as coefficients). Demand elasticities are calculated through an analysis of existing intercity passenger rail corridors and/or studies to determine the value of the adjustment factors. The adjustment factors are then applied to the Initial Ridership Forecast to calculate the Final Ridership Forecast. A flow chart is presented in Exhibit 13 above that describes the Comparable Corridors Model development procedure.

The most important step in the development of the Comparable Corridors Model, and upon which the validity of the model relies, is the identification of passenger rail corridors that share similar socioeconomic, spatial, and market characteristics with the Short-Listed Tennessee corridors.

The following guidelines are established to identify comparable corridors:

- The major cities of the comparable corridors should be alike in scale and regional significance to the city pairs of the most promising Tennessee corridors.
- The corridors to be compared shall be roughly similar in spatial and geographic characteristics, for example, overall length, population densities, and topography.
- The rail service along the comparable corridor should provide a direct connection between the city pairs (i.e., requires no connection to another service or mode).

In accordance with the criteria established above, this study reviewed existing intercity passenger rail routes throughout the United States to identify comparable corridors. The review list of potential corridors was comprised of all routes within Amtrak's six regions, i.e., the Northeast, Midwest, South, West, Northwest, and California.

A significant number of potential corridors are easily eliminated by the first criterion. Those routes which serve the largest metropolitan areas in the United States, such as New York, Chicago, and Los Angeles and their environs, are excluded from consideration because of their immense scale. These larger cities, because of their pre-eminent role in the national economy and strong downtown employment focus (and in some cases, extensive transit systems), are unique among metropolitan areas in the United States. In terms of population and economic considerations, these larger cities are not comparable with the smaller cities of Tennessee and its region. Thus, the rail routes that radiate directly from the Chicago Hub, serve the densely populated California coast, or traverse the Northeast Corridor (Boston-New York-Washington) are not viable corridors for ridership comparison.

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Additional corridors may be eliminated from consideration because of their spatial characteristics. For example, major cities in the Mountain States and the Southwest are separated by much greater distances than city pairs in Tennessee. The gross variation in distances between the major city pairs, and even intermediate cities, would require a ridership model adjustment that exceeds the reliability of the travel time correction factor. Furthermore, city pairs in the Southwest, Gulf Coast, Arkansas, and Mountain States are not stand alone corridors, but instead are route segments of long distance trains that provide limited service frequencies of three trains per week to one train per day. Thus, the Salt Lake City-to-Denver and San Antonio-to-Fort Worth city pairs and similar corridors are eliminated according to the second criterion established above. In addition, cities in the more northern Mountain states are among the least populated areas of the country and are clearly dissimilar to cities in Tennessee.

In addition, corridors that traverse coastal areas of the Gulf States, the eastern coast of Florida and New England are likely to be more heavily tourist-oriented than routes in Tennessee and/or their patronage may vary widely depending upon the season. Because of its more central location in the lower 48 states, the State of Tennessee is less likely to sustain large seasonal swings in tourism than New England and Florida. These differences in seasonal ridership are too variable to factor out in the Comparable Corridors ridership model.

After eliminating from consideration corridors in the West, Southwest, Gulf States, California, New England, the Chicago area, and the Northeast, only a handful of corridors remain for potential comparison. Not surprisingly, these remaining corridors, except for the Pacific Northwest Corridor, lie immediately to the east and west of the State of Tennessee and traverse the States of Missouri and North Carolina and the Commonwealth of Virginia. While the city pairs of Virginia and Tennessee are quite similar, the Virginia corridors connect to Washington causing their ridership to be too heavily focused toward the highly popular Northeast Corridor. A comparison with the Virginia corridors may produce disproportionately high ridership estimates for corridors in Tennessee. The Pacific Northwest Corridor provides an excellent example of a successful intercity passenger rail corridor. However, because of a consistent, multi-year infrastructure and rolling stock improvement program which has greatly enhanced capacity and running times, the Pacific Northwest Corridor passenger rail service is too highly developed for ridership comparison with the Short-Listed Tennessee corridors. In addition, the Pacific Northwest corridor is too far removed geographically from the Tennessee region to allow assumptions on land use, socioeconomic factors, and spatial characteristics.

The corridors in the two remaining states, Missouri and North Carolina, are the most comparable to the Tennessee passenger rail corridors. City size, land use patterns, socioeconomic characteristics, and the spatial relationships of cities along these corridors are sufficiently comparable to justify their use in the Tennessee Comparable Corridors Model. Even the service characteristics of the Amtrak routes along Missouri and North

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Carolina corridors are remarkably similar to this study's expectation for startup rail services in Tennessee. (The use of the North Carolina passenger rail system, in particular, as a prototype for the startup of new intercity passenger rail services in Tennessee will be presented in a later section.) Characteristics of the Missouri and North Carolina corridors which are relevant to the ridership model are described in greater detail below.

The Missouri Corridor: Kansas City to St. Louis

Spanning a distance of 285 miles across the east-west axis of the state, the Missouri Corridor connects two major metropolitan areas, St. Louis and Kansas City. (See map of Missouri corridor depicted in Exhibit 14 below.) These metropolitan areas are fairly comparable in scale to the major urban areas of Tennessee. Kansas City, at the western end of the corridor supports a population of approximately 1.8 million persons, roughly comparable to the 1.2 million and 1.1 million populations of Nashville and Memphis, respectively. The St. Louis metropolitan area, at 2.6 million residents, is significantly larger than any Tennessee city; however this difference can be factored out in the comparable corridor modeling process. In addition, the population density of counties along the Missouri Corridor is strikingly similar to densities for counties between the major city pairs of the potential Tennessee corridors.

Exhibit 14. Counties, cities, and railroad alignment of the "comparable" Missouri Corridor.



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Amtrak trains on the Missouri Corridor maintain an average speed of 50 mph, which is comparable to the expected average speeds (i.e., approximately 40 to 58 mph) on the potential Tennessee corridors. These differences in average speed and their effect on ridership are also factored out in the Comparable Corridors Model.

Finally, the service currently offered by Amtrak along the Missouri Corridor closely matches the type of service that would be appropriate for a new passenger rail startup in Tennessee. At present, two Amtrak routes, the *Ann Rutledge* and the *Mules*, serve the State of Missouri. Specifically, the Amtrak *Kansas City and St. Louis Mules* operate solely within the state of Missouri and provide a frequency of one train per day in each direction. But the service frequency between Kansas City and St. Louis is effectively two trains per day as the *Ann Rutledge*, an interstate route, operates once a day in each direction between Chicago and Kansas City.

The provision of intrastate and interstate rail service to Missouri offers improved service frequency within the state and higher ridership via access to Chicago, the largest city in the Midwest. The same service concept, i.e., one intrastate and interstate roundtrip each, is applied to the initiation of service in each of the most promising Tennessee corridors. The positive ridership effects of access to the national rail network cannot be underestimated. The Missouri component of the total *Ann Rutledge* ridership (e.g., 151,274 riders in Year 2000) was almost twice as large as the total ridership on the *Kansas City and St. Louis Mules* (e.g., 78,726 riders in Year 2000). Each of the Short-Listed Tennessee corridors provides potential interstate service to the Chicago hub or the Northeast Corridor (the latter of which provides access to major destinations such as Washington, Philadelphia, New York, and Boston).

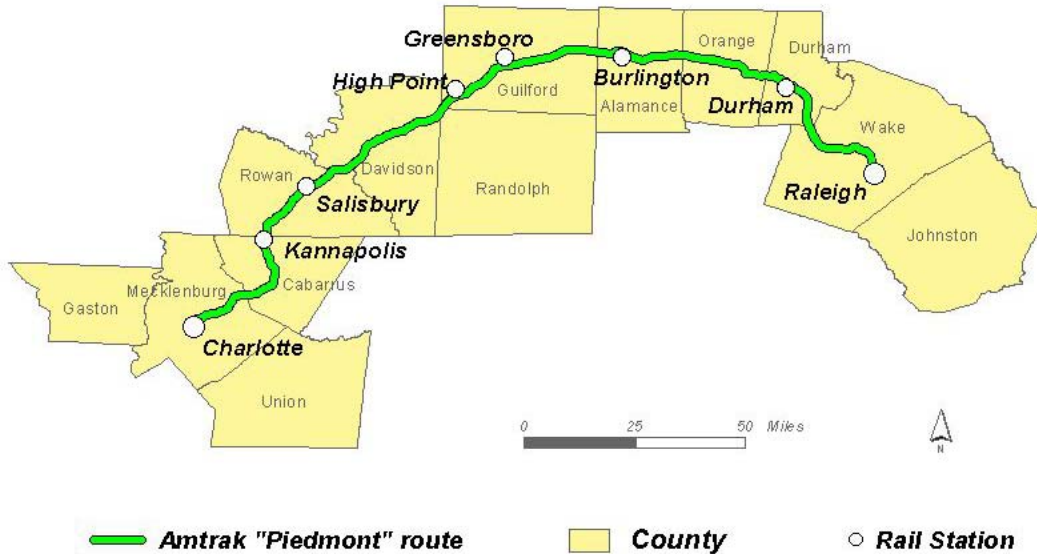
The North Carolina Corridor: Raleigh to Charlotte

The North Carolina Corridor, as shown in Exhibit 15 below, provides another set of useful data for the Comparable Corridors Model. The Raleigh and Charlotte areas, supporting an estimated 800,000 and 1,000,000 population, respectively, are comparable in size to the major metropolitan areas of Tennessee. The total population along the North Carolina corridor, about 3.2 million, is comparable to the average Tennessee corridor population, i.e., 2.6 million residents. The average population density of the counties between Raleigh and Charlotte, however, is somewhat higher than intermediate counties along the Short-Listed Tennessee corridors.

As described previously for the Missouri Corridor, the North Carolina Corridor offers both intrastate only and interstate rail services. The latter of the two is the Amtrak *Carolinian* route which provides once daily through service to New York from Charlotte in each direction. The Amtrak *Piedmont* route operates between Raleigh and Charlotte at a frequency of one train per day. Thus, the combined service provides two daily trains in each direction between Raleigh and Charlotte.

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Exhibit 15. Counties, cities and rail alignment of the “comparable” North Carolina Corridor.



The North Carolina Corridor, like the Missouri Corridor, provides access to major destinations in the national rail network, in this case the Northeast Corridor. With direct access to Washington, Philadelphia, New York, and Boston, the North Carolina Corridor sustains a relatively higher proportion of interstate ridership to total ridership as compared with the Missouri Corridor. For example, the North Carolina ridership component of the *Carolinian* (185,072 riders) is almost three and a half times as great as the ridership on the intrastate-only *Piedmont* route (53,272 riders) in Year 2000. These ridership comparisons reflect the enormous drawing power of the Northeast Corridor, which on a per capita basis, is significantly greater than the attractiveness of the Chicago Hub. The relative attractiveness of the Chicago Hub and the Northeast Corridor as rail travel destinations are factored into the ridership estimates presented below for the Short-Listed Tennessee corridors.

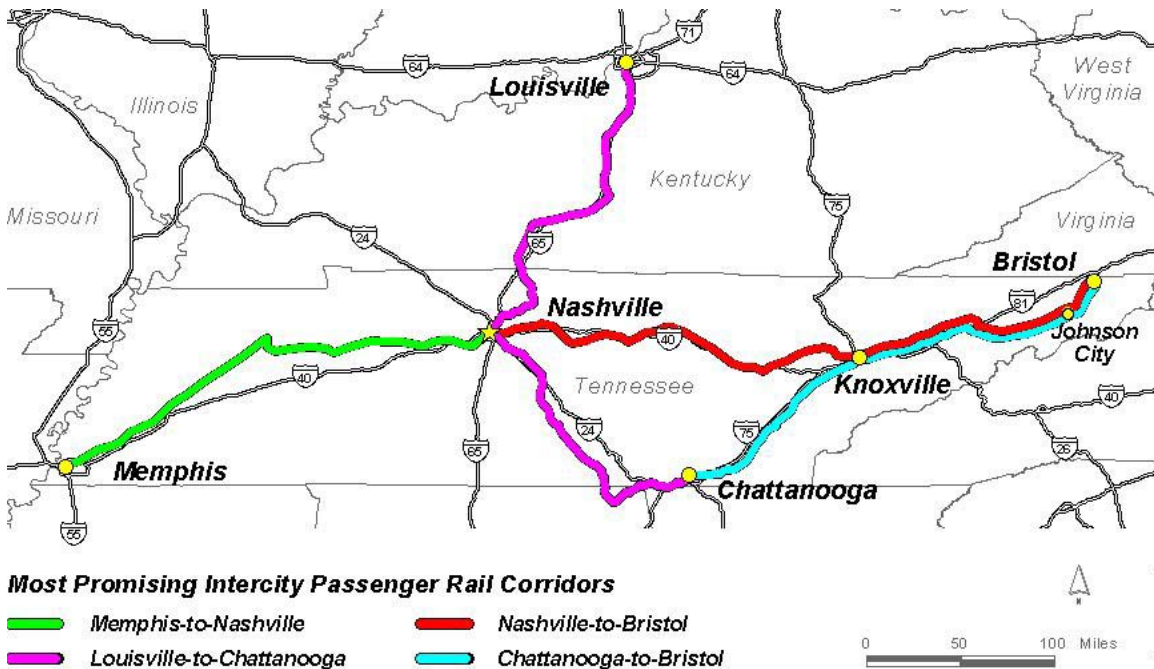
Annual Ridership Estimates

The corridors that comprise the Short List (depicted previously in Exhibit 12) were combined to establish potential, practicable routes for new passenger rail services. Except for the Memphis-to-Nashville Corridor, each of the corridors were coupled with an adjoining corridor to create a set of viable routes; these resulting four routes, as depicted

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in Exhibit 16 below, establish the most promising corridors for the implementation of new passenger rail service in the State of Tennessee.

Exhibit 16. Most promising intercity passenger rail corridors for the State of Tennessee.



As configured, the most promising intercity rail corridors are sufficiently similar both in overall length (See Exhibit 17 below) and market area to justify comparison on the bases of ridership, cost, and public benefit. The estimated ridership for each of the four most promising corridors will be modeled on the either the Missouri or North Carolina Corridors, depending upon the similarity of the market area of the Tennessee corridors with the comparable corridors.

The market area for a comparable corridor is comprised of the census-designated metropolitan statistical areas of its major city pair and the intermediate counties that are traversed by the route. For the purpose of consistency, the same method for establishing the passenger rail market in the comparable corridors was also used for the most promising corridors in the State of Tennessee.

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Exhibit 17. Overall route lengths of the most promising intercity passenger rail corridors.



Upon final determination of the most appropriate corridor for comparison with the study corridor, a preliminary ridership estimate can be prepared. The Initial, or unadjusted, Ridership Forecast is determined by applying the ridership rate (per thousand persons) to the population (in thousands) of the particular Tennessee corridor. For this purpose, intrastate and interstate ridership rates were developed for the Missouri and North Carolina corridors. It is interesting to note that the intrastate ridership rates for these two corridors are almost the same, 17.5 and 16.7 annual riders per thousand persons for Missouri and North Carolina, respectively. A deviation of only 0.8 riders per thousand persons verifies the expected similarity of intrastate rail travel in the Missouri and North Carolina corridors.

The attractiveness of passenger rail for interstate rail travel does, though, vary significantly between the two comparable corridors. A ridership rate of 33.6 annual riders per thousand persons is experienced in the Missouri corridor while the North Carolina corridor attracts almost 30% more, or 43.2 riders per thousand persons, to its interstate service. The difference in interstate ridership between the Missouri and North Carolina corridors is not unexpected, however, in recognition of the greater attractiveness of Northeast Corridor - Amtrak's most popular corridor - over the Midwest (Chicago Hub) Corridor. The Amtrak *Carolinian* route of the North Carolina Corridor provides direct

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access to major destinations on the Northeast Corridor including Washington, Baltimore, Philadelphia, and New York, while Chicago is the only major destination outside Missouri along the *Ann Rutledge* route.

The use of either the Missouri or North Carolina Corridor ridership rates is dependent on the degree of access of the study corridors to the Midwest and Northeast Corridors. As discussed above, the ridership rates, including both the intrastate and interstate components, are then applied to the four most promising corridors. At this point, ridership estimates are adjusted for differences in service frequency and average speed between the comparable and study corridors. However, in this instance, the service frequency of the comparable corridors and the most promising Tennessee corridors are equivalent. Specifically, the routes in the comparable and study corridors offer two trains per day in both directions, a total of four trains per route per day. Two trains serve destinations within the state only (i.e., intrastate), and the other two provide service to cities outside Tennessee (i.e., interstate). Thus, it is unnecessary to adjust for differences in the service frequency parameter.

The average speed of the comparable and most promising Tennessee corridors, however, do vary significantly. The average speed of a passenger train directly affects travel time which, in turn, impacts ridership. Following an inverse relationship, ridership tends to decrease with greater travel times and increase as travel time is reduced. The Comparable Corridors Model adjusts for the variation in average speed between the comparable and study corridors through an adjustment factor.

In the Comparable Corridors Model, ridership is increased or decreased, depending on the direction of the change, by 2.0 percent for every 1.0 mile-per-hour deviation in average speed between the study corridor and the comparable corridor. The value of the average speed adjustment factor was derived from the ridership model of the Cross-State Florida Rail Feasibility Study, an initiative that investigated the viability of various rail technologies for serving major destinations in central Florida. The application of the average speed factor to the Initial Ridership produces the Final Annual Ridership estimates which are provided in Exhibit 18 below. Exhibit 19 below provides a graphical comparison of annual ridership for each of the most promising Tennessee corridors.

Memphis-to-Nashville Corridor. The ridership estimate for this corridor is based on a comparison with the Missouri Corridor. The Missouri Corridor comprises the intrastate *St. Louis* and *Kansas City Mules* and the Chicago-oriented *Ann Rutledge*. For the purposes of this study, it is assumed that the Memphis-to-Nashville Corridor, like the Missouri Corridor, can provide access to the Chicago Hub via either Memphis or Nashville. Amtrak currently provides service from Memphis to Chicago on the *City of New Orleans* route, while Amtrak is currently considering extending the *Kentucky Cardinal* from Louisville to Nashville. Thus, the interstate ridership rate for the Memphis-to-Nashville Corridor is roughly comparable to that of the Missouri Corridor.

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Louisville-to-Chattanooga Corridor. The ridership estimate for this corridor is based on a comparison with the Missouri Corridor which connects Kansas City to St. Louis and which offers through routing to Chicago. Because the Louisville-to-Chattanooga Corridor would be oriented toward Chicago, and to which it would provide relatively direct access, its interstate ridership rates are assumed comparable to that for the Missouri Corridor. The intrastate ridership rates of the Louisville-to-Chattanooga Corridor are also based on the Missouri Corridor since the two corridors, as demonstrated earlier, share similar population densities and socioeconomic characteristics.

Given the favorable track alignment along this corridor, especially between Louisville and Nashville, rail travel time is expected to be strongly competitive with the automobile. In addition, the cities of Louisville and Nashville form the two strongest city pairs from all of the city pairs in the most promising corridors. As a result, the total expected ridership, 155,400 annual riders, is higher than that for any other Tennessee corridor. The total projected ridership (a few years after service has been established) comprises 53,200 annual riders for the intrastate service and 102,200 annual riders for the interstate service.

Nashville-to-Bristol Corridor. The ridership for the Nashville-to-Bristol Corridor is based on the North Carolina Corridor. Because of their mutual proximity, similar socioeconomic conditions, and access to the Northeast Corridor, the Nashville-to-Bristol Corridor and the North Carolina Corridor are considered comparable. The Nashville-to-Bristol Corridor assumes a connection with the planned Trans-Dominion Express which provides through routing to the Northeast from the twin cities of Bristol, Virginia and Tennessee. (It is also possible that, through mutual agreement between the State of Tennessee and the Commonwealth of Virginia, the Trans-Dominion Express could be extended to serve Knoxville directly.) A significant upgrade of the Nashville and Eastern Railroad track and the restoration of the missing track between Cookeville and Monterey are also assumed for this service.

The long and circuitous alignment of this corridor, especially between Knoxville and Bristol, complicates rail travel over this route through Tennessee. The relatively low average speeds along mountainous segments prolongs travel time, making the passenger rail mode less attractive than the automobile. However, its potential access to the Northeast Corridor and its proposed service to Tennessee's first, third, and fourth largest metropolitan areas, along with the scenic beauty of this route, have the potential to attract 134,700 annual riders. A particularly attractive destination in eastern Tennessee is the Great Smoky Mountains National Park, one the most visited National Parks in the country. The Nashville-to-Bristol Corridor can provide access to this major destination via motor coach connection at Knoxville. The intrastate and interstate services of this corridor are expected to reach 37,500 and 97,200 riders, respectively, within a few years after initiation of service.

Chattanooga-to-Bristol Corridor. Like the Nashville-to-Bristol Corridor, the Chattanooga-to-Bristol Corridor shares much in common with the North Carolina

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Corridor. These two eastern Tennessee corridors also share a common terminus, i.e., the City of Bristol. Thus, the ridership estimate for the Chattanooga-to-Bristol Corridor may be based on the North Carolina Corridor.

Providing rail service between Chattanooga and Bristol is expected to be relatively easy to implement, especially since the tracks are in good condition and the line has available capacity. However, because of the mountainous nature of the terrain, the journey between Chattanooga and Bristol would take approximately 6 hours. Unfortunately, the considerable travel time between Chattanooga and Bristol coupled with the relatively low population of this corridor induces a poor ridership expectation. The total expected annual ridership of only 88,200 (comprising 22,900 riders for the intrastate service and 59,300 for the interstate service) is the lowest for any of the Tennessee corridors under consideration in this study.

The limitations of any ridership model should always be considered. The ridership estimates of the Comparable Corridors Model are, of course, tied to the assumptions of corridor similarity, the future of existing intercity routes or Amtrak itself, and conditions extant during the Year 2000, for which time period the comparable corridors' ridership figures were collected. Since that time, the public perception of the airplane and airport safety has been significantly altered. Terrorist actions have caused a reduction in air travel and an increase in the use of intercity passenger rail services. These effects, which may continue indefinitely, complicate the estimation of ridership over the long term.

The uncertainty over Amtrak's future and the potential for modification or cancellation of service on certain Amtrak routes may limit the "shelf life" of the ridership estimates. Finally, with regard to the similarity of the comparable and study corridors, it is difficult to gauge the response of Tennessee residents to the initiation of a new rail service. Unlike the States of Missouri and North Carolina whose residents have enjoyed passenger rail service over the past two decades, the majority of Tennessee residents have not had access to passenger rail service since the 1950s. The key assumption is that Tennessee residents would patronize their proposed new passenger rail services to the same degree as their Missouri and North Carolina counterparts.

Capital Costs for Most Promising Corridors

The viability of the potential rail corridors will depend on the availability of capital funds needed to implement the new intercity passenger rail services. The capital costs model for the most promising Tennessee corridors provides feasibility-level estimates of required investments. Capital costs are those relating to the design, purchase, and installation of only those improvements that are required to accommodate passenger rail service. The costs of the East-West Connector, McKenzie Bypass, and other track improvements that are required to support freight rail are not included; passenger service is assumed feasible only if these improvements are implemented for the purpose of freight movement.

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Cost estimates are based on a review of data for existing railroad facilities (e.g., track charts and Federal Railroad Administration (FRA) databases), discussions with railroad representatives, costs of components in comparable systems, and information from previous or ongoing studies. These estimates are therefore consistent with the purpose of this effort, i.e., to examine the feasibility of implementing passenger rail service on the most promising Tennessee corridors.

It is important to note that field investigation of the entire passenger rail network is beyond the scope of this study. Thus, cost estimates incorporate a margin of error consistent with the limitations of available data. As a result, estimates may upon first review seem high, and indeed may be assumed to represent the upper range of infrastructure costs likely to be incurred. The estimates also reflect the degree of uncertainty in the outcome of trackage rights negotiations with the freight railroads. For example, the freight railroads may require additional infrastructure improvements beyond those that may appear necessary to accommodate passenger rail trains.

Key Assumptions

The capital cost model is based on several key assumptions that are consistent with the basic tenets of this study. The governing assumptions are as follows:

- 1) *Existing freight lines only are used to connect major city pairs and intermediate destinations.* The exception is where a significant investment in new rail infrastructure is already under consideration (e.g., the missing segment between Monterey and Crab Orchard on the Nashville-to-Knoxville Corridor).
- 2) *Passenger trains are limited to a maximum speed of 79 miles per hour.* A 110-mile per hour maximum speed scenario was considered for the most promising Tennessee corridors. However, the Class I railroads would not permit the mixing of high-speed passenger trains with slower moving freight trains on the same track. Based on discussions with railroad representatives, the railroads are not opposed to the use of their right-of-way by high-speed passenger trains, but require them to use a separate track. The construction costs of a separate track on any of the most promising corridors would be prohibitively expensive and would necessarily violate the first assumption stated above. It would also be difficult to justify an investment of hundreds of millions of dollars for high speed rail before the more conventional (i.e., 79 MPH maximum speed) passenger service was implemented and proven viable.
- 3) *New station facilities are required.* This assumes that previous stations, which may have been active decades ago, have either been dismantled or converted to new uses. It is possible that the original station buildings are still intact in many cities. For instance, the original station in Nashville is now used as a Wyndham Hotel. However, it may be possible to enter into a joint use arrangement with current owners.

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- 4) *Rolling stock.* Maintained either at a state-owned facility or by Amtrak. Rolling stock comprises locomotives, coaches, baggage cars, and food service/lounge cars.
- 5) *Inflation.* An annual rate of 4 percent is assumed for adjustments to current year.

Capital Cost Categories

The capital costs components are organized into four categories: 1) track, signal, and switch infrastructure, 2) rolling stock, 3) passenger stations, and 4) maintenance facilities as defined below. (A summary of capital costs by category is provided in Exhibit 20.)

Track, Signal, and Switch Infrastructure

Track, signal, and switch improvements are intended to increase the safety and efficiency of operating freight and passenger train traffic on the same tracks. In addition, the upgrade of the existing track, including super-elevation and minimal track straightening, are intended to improve ride quality and running time. The cost estimate for these improvements is based on comparable systems and the professional judgement of track engineers. Various contingencies, including the potential need for additional switches, interlocking modifications, and minor realignments, are assumed.

This estimate includes the construction of new sidings or the lengthening of existing sidings to allow “rolling meets”, that is, where freight and passenger trains pass each other on a single track line while both trains continue in motion. In this case, the freight train would enter the siding and allow the faster moving passenger train to proceed on the mainline track. Providing for rolling meets significantly increases capital costs, but ensures that auto-competitive rail travel times are established. This estimate provides for 5-mile passing sidings (where necessary), signals and switches, engineering, design, construction management, and contingencies. The possible relocation of existing track and utilities is an example of a contingency. However, the potential requirement for new bridges and property acquisition has not been included as it is assumed that the new sidings can be located within the existing right-of-way and utilize existing bridges. The estimate also provides a 30 percent cost reduction for the use of existing passing sidings. It also assumes no new grade separation projects will be constructed and existing crossing protection systems, with minor modifications as necessary, could be utilized.

Although not included in these estimates, safety enhancements may be considered as the project development process develops. These improvements may consist of elimination of highway-railway grade crossings through grade separation or closure. Technology upgrades and fencing may also be installed at selected grade crossings. All of these improvements would be made in accordance with FRA guidelines, and perhaps even with funding assistance from FRA safety programs.

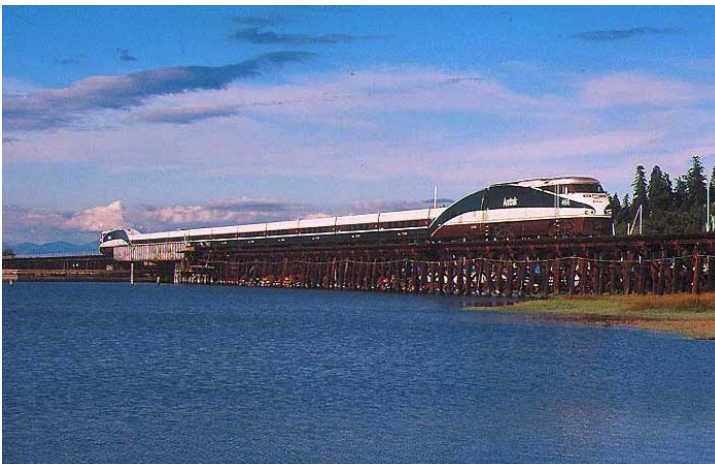
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The F59 locomotive is a workhorse used by several passenger rail operators nationally and in Canada.

Rolling Stock Acquisition

Capital costs consider two types of passenger trainsets: conventional and tilting trains. A conventional trainset would consist of one F59 locomotive, three “Amfleet” coaches, and one food service/lounge car. The tilting Talgo trainset (depicted below), currently in use in the Pacific Northwest, may also be used in any of the most promising Tennessee corridors.



Washington State purchased 3 sets of the sleek Talgo Trains for use in the “Cascades Corridor.”

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Because of their unique tilt apparatus, the Talgo trainset can travel more quickly through curves than conventional trainsets while providing enhanced ride quality. The use of the Talgo trainsets can reduce running times by as much as 8 percent, depending on the corridor. (Note: Running times for this study are based on the use of conventional equipment.) The cost of a Talgo trainset – manufactured in Spain – is approximately the same as that of a conventional trainset despite the increased sophistication of the Talgo technology. Four new trainsets are required for each corridor, plus one spare.

Passenger Stations

A governing assumption of the capital cost estimate is that new passenger facilities will be required at every station location. The major components of the station costs are 1) new station structures, equipment, and amenities, 2) property acquisition, and 3) potential construction or realignment of approach track. The first set of items includes passenger waiting areas, restrooms, boarding platforms and canopy, parking facilities, passenger drop-off and bus lanes, stairs and elevators, ticketing office, maintenance storeroom, and ticket vending machines. Two types of stations, large and small, are considered here.

Large stations are located in the more heavily urbanized urban areas of Nashville, Memphis, Knoxville, Chattanooga, and Bristol; smaller stations, requiring less space and amenities, and thus less capital investment, are located along the corridors between the major cities. (See Exhibits 21 and 22 in the following section for a list of stations and their locations.) The stations can share space with another use (e.g., convenience store, visitor's center, restaurant, police substation, or another service that the community requires), in turn, providing additional convenience and security to the traveler.



This new station in Bakersfield, CA was funded by the State of California.

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Maintenance Facility

In the short term, assuming the implementation of one new passenger rail service, Amtrak could provide maintenance for the required trainsets. Over time, as new routes and trainsets are added, the State may opt to build its own maintenance facility. This state maintenance facility could perform inspections, component changeout, and repairs such as wheel truing and air brake system replacement by state employees or by contracting out. Major repairs and overhauls, conducted once or twice over the lifespan of a rail vehicle, could be contracted out with a heavy maintenance facility (e.g., freight rail shop).

This maintenance facility could also provide for light maintenance including interior cleaning, servicing, and replacement of minor components. Light maintenance does not necessarily require a structure since cleaning and servicing may be performed in a storage yard or at either terminal point. One car wash facility, for exterior cleaning, would also be required.

The maintenance facility should be optimally located to reduce non-revenue train movements, or deadheading, of trains to distant maintenance facilities. It is preferable that the first maintenance facility be located as centrally as possible within Tennessee to ensure equal access to future additional routes of a more developed passenger rail system. The costs for the maintenance facility include engineering, property acquisition, and the construction of shops, storage yards, and a railcar wash facility.

Exhibit 20. Capital costs for most promising Tennessee intercity passenger rail corridors.

Capital Cost Components	Capital Costs for Most Promising Tennessee Corridors			
	Chattanooga-to-Louisville ²	Memphis-to-Nashville	Nashville-to-Bristol	Chattanooga-to-Bristol
Track and Signal Improvements ¹	\$25,575,000	\$7,500,000	\$10,500,000	\$17,500,000
Passing Sidings	\$49,000,000	\$21,000,000	\$35,000,000	\$35,000,000
Stations	\$11,250,000	\$6,750,000	\$11,750,000	\$10,750,000
Rolling Stock	\$48,500,000	\$48,500,000	\$48,500,000	\$48,500,000
Maintenance Facility	\$10,000,000	\$10,000,000	\$10,000,000	\$10,000,000
Total Capital Costs³	\$144,325,000	\$93,750,000	\$115,750,000	\$121,750,000

¹ Track and signal improvements do not include costs of the McKenzie Bypass, East-West Connector and other track enhancements that are assumed to be in place for freight rail prior to passenger service.

² Includes capital costs for Kentucky portion of Chattanooga-to-Louisville Corridor.

³ All costs are in Year 2002 dollars.

O&M Costs for Most Promising Corridors

It is fundamental to the determination of financial feasibility to estimate the proposed services' operating and maintenance (O&M) costs. A comparison of expected system revenue (discussed in the following section) and O&M costs provides decision-makers with an estimate of the required operating subsidies, if any. The O&M cost estimation approach for the most promising Tennessee corridors is intended to yield O&M cost estimates for planning level analyses. Estimates are developed at the unit service level to provide a consistent basis of cost comparison across the passenger rail corridors. This basis also supports the re-application of these costs to specific investment alternatives as investment options and their operating plans are refined and improved.

Operating and Maintenance Cost Model

The O&M costs model is based on a passenger rail operating plan that provides sufficient service levels for a start-up operation. The operating plan for each of the most promising corridors provides one intrastate service and one interstate service, operating daily in both directions, for a total of four trains per day. In time, as ridership increases, additional trains may be added thereby increasing service frequency. In the O&M costs model, costs are calculated for the entire intrastate service and for the portion of the interstate service that serves destinations inside Tennessee only. The O&M costs for services beyond Tennessee's borders are assumed to be borne by the service provider (e.g., Amtrak) and the host state. The exception in this case is the Louisville-to-Chattanooga Corridor where, for the purposes of this study, the O&M costs for the portion of the route in the State of Kentucky are included in both the interstate and intrastate O&M costs. The proper share of the O&M costs between Tennessee and Kentucky for the Louisville-to-Chattanooga Corridor has not been assumed or investigated, however, the costs derived here may be used as a starting point for negotiations on this issue.

The proposed intrastate and interstate services would be cost effective to operate and their financial performance would be expected to improve as the system matures. It must be pointed out that both the proposed initial service and the future service enhancements are all subject to the successful negotiation of trackage rights and a fee arrangement with the host railroads. Future service enhancements are also dependent on whether the freight railroad has adequate capacity to accommodate increased passenger rail service.

The O&M cost model for the most promising Tennessee corridors is based on the cost accounting system used by the Rail Division of the North Carolina Department of Transportation (NCDOT). NCDOT administers the passenger rail program for the state-sponsored Amtrak *Piedmont* and *Carolinian* routes, for which it assumes the operating and maintenance costs for services within the State of North Carolina. In addition, NCDOT owns the locomotives for the *Piedmont* service (coach and dining cars are

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privately owned and leased to the State) and performs regular maintenance at a state-owned facility.

The North Carolina O&M cost accounting system is applied to the most promising Tennessee corridors for the following reasons:

- 1) The North Carolina program provides considerable public benefit and thus serves as a model for the initiation of new passenger rail service in Tennessee.
- 2) One of the benefits of the North Carolina approach is that the state retains a greater degree of control over the provision of services and equipment maintenance for the *Piedmont* route. If the service provider (in this instance, Amtrak) can no longer maintain the operation (e.g., due to insolvency, labor disputes, or budget constraints), NCDOT has the ability to negotiate with another service provider or establish its own rail operations division. The independence of a state-owned fleet and stable source of state funding would better position the State for service alternatives in the event of an Amtrak reorganization.
- 3) The North Carolina Corridor was chosen as a comparable corridor for ridership modeling and offers almost identical service characteristics as that proposed for the most promising Tennessee corridors.
- 4) The application of a current cost accounting system, such as the NCDOT approach, provides a realistic assessment of O&M costs, especially as it represents the costs of using Amtrak, the likely service provider for the most promising Tennessee corridors.

O&M costs were developed for each of the alternatives by applying the required service units (e.g., trainset miles, crew hours) to unit costs (e.g., propulsion cost per mile, wage rates) from the NCDOT program. Most unit costs used in this model are derived from an average of the unit costs for the *Piedmont* and *Carolinian* services; the unit costs of the various cost components of these two services, however, vary only slightly. Service units are multiplied by unit costs to achieve the total cost for a specific cost component or, expressed mathematically:

$$\text{Cost} = \text{Service Units} \times \text{Dollars/Unit of Service.}$$

Operating and Maintenance Cost Components

This mathematical formula above is utilized to calculate the costs – which are in current year (2002) dollars – for all of the following O&M cost components:

Fuel Costs. It is assumed that the passenger rail propulsion units of the most promising Tennessee corridors will consist of diesel-fueled locomotives that are comparable to

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those in service on the *Piedmont* and *Carolinian* routes. The unit cost for fuel was calculated as \$1.42 per mile per trainset. Consistent with the trainsets of the North Carolina routes, one locomotive per trainset is also assumed for the proposed Tennessee routes. (Note: Unit fuel cost varies according to terrain and geometry of route alignment. For the purposes of this study, the North Carolina route alignments are assumed comparable to those of Tennessee.)

Food Service Crew and Supplies. The NCDOT Rail Division contracts with an outside supplier for food service supplies and café car attendants. The cost of food service for the *Piedmont* and *Carolinian* routes is assumed to be the cost of one café car attendant per train plus food supplies. A labor rate of \$18.08 per hour for a café car attendant was utilized in this calculation. It is assumed that the cost of food supplies, although negligible in this analysis, is easily recovered by sales.

Railroad Payments. The NCDOT purchases trackage rights from the owner of the freight rail line over which the *Piedmont* and *Carolinian* routes operate. In turn, the railroad owner applies the trackage fee toward the maintenance of track, signal systems, and right-of-way for joint use by both passenger and freight trains. Trackage rights agreements can vary widely, especially given the range of operating environments, service conditions, and railroad ownership. Thus, this study makes no assumptions on the specifics of trackage rights and fee agreements in Tennessee other than the following general premises: 1) the Tennessee passenger rail corridors would utilize only freight rail lines, 2) a favorable trackage fee, comparable to that for the North Carolina routes, can be arranged, and 3) spare capacity is available for passenger rail trains in each corridor. The latter premise is based on initial discussions with freight railroad representatives who have not established any outright objections, at least at the time of this study, to the use of their lines for passenger rail service. However, the successful negotiation of trackage rights will depend in part on the outcome of a rail capacity utilization study, requested by the freight railroad for each corridor and service plan, to determine the impacts to freight operations.

The average railroad fee of the *Piedmont* and *Carolinian* routes is \$3.06 per trainset mile. It is multiplied by the total trainset miles of the intrastate and interstate service within Tennessee to approximate the total trackage fees expected for a particular corridor.

Insurance. Insurance companies utilize complex, multivariable formulas to estimate risk and establish insurance premiums; such a calculation is beyond the scope of this effort. Thus, for the purposes of this study, it is assumed that the degree of risk for property damage and personal injury from the operation of the proposed Tennessee corridors would be comparable to that for the North Carolina routes. An insurance rate of \$1.46 per trainset mile is derived from the premium paid by NCDOT for insurance coverage of the *Piedmont* and *Carolinian* routes. This insurance rate is applied to the total trainset miles of a particular Tennessee corridor to estimate an annual insurance premium.

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Ticket Sales and Related Services. Unit costs were derived from the *Piedmont* and *Carolinian* routes for the following ticketing, sales, and promotional activities:

Commissions for Agents	\$0.54 per rider
Marketing and Sales	\$0.14 per rider
Reservations and Information	\$0.93 per rider

It is assumed that the passenger rail service provider for the most promising Tennessee corridors would be responsible for these activities. (Amtrak is in charge of ticketing and promotions for the example North Carolina routes presented here.)

Station Services. This O&M component comprises all costs required to maintain rail stations in a safe, clean, and efficient condition for use by rail passengers. Regular cleaning and as-needed repair of these public facilities is thus a mandatory requirement of station services. Daily cleaning, scheduled maintenance and on-call repair services are typically arranged by contract with a maintenance company. Concessions and retail activities are assumed to be furnished by the private sector.

The type and magnitude of station services vary primarily with the size of the station; station size is driven by the number of expected boardings and alightings which, in turn, determines the required level of staffing. For example, ticket agents are typically required at large stations while ticket vending machines (TVMs) are appropriate for small stations. Depending on station configuration, elevators and/or escalators may also be required.



Sounder-Auburn Station. New passenger stations should be both attractive and cost effective.

