CORRADINO

Knoxville Area Transit (KAT)

Transit Development Plan

Corridor Analysis

Submitted to:

Knoxville-Knox County Metropolitan Planning Commission

Submitted by:

PB Americas, Inc.

Under contract to:

The Corradino Group, Inc.

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CORRADINO

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1. Introduction

This report analyzes various transit corridors throughout the Knoxville region to determine their potential for the development of high capacity transit services. The consultant team, in consultation with the Knoxville Knox County Metropolitan Planning Commission (MPC) and other local and regional officials, identified a number of corridors emanating from downtown Knoxville that warrant further study of their potential for various levels of transit enhancements. Enhancements could range from improved passenger amenities (such as upgraded bus stops and shelters), technological enhancements such as signal priority which would allow buses to go faster and stay on time, or physical improvements such as designated bus lanes. Designated bus lanes could be simply striped and signed to be fully grade-separated. Bus Rapid Transit (BRT) systems create a rail-like service using buses and roadway improvements. The implementation of streetcars or light rail transit would also be a possibility, provided that such improvements are warranted by transit demand. Nationally, transportation legislation is emphasizing high capacity transit corridors including BRT and Light Rail. It is important the Knoxville region and its leaders position themselves to be able to take advantages of future funding opportunities when they become available.

Consideration of local land use in the corridors is closely related to the potential for transit enhancements. The existing and future population, employment and development density of the corridors are important indicators of their potential for enhanced or upgraded transit service, including the potential future implementation of BRT or light rail services. In addition, the benefits of transit-oriented development (TOD) are an important component of support for higher capacity transit services. TOD, which includes higher density, mixed-use developments with specific transit-oriented elements, is an attractive and up-to-date form of development that adds a modern touch to traditional neighborhood planning. In addition to considering existing right-of-way conditions, transit services and ridership, the corridor analysis examines the local land use and potential for TOD in each corridor. Further analysis, including a feasibility study and potentially an alternatives analysis based on the FTA's New Starts criteria, is the next step in determining which corridors have the greatest potential for supporting higher capacity transit services in the future.

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2. Corridor Analysis

The purpose of this task is to identify transportation corridors in the Knoxville Area that are most suitable for the implementation of possible fixed-guideway, high capacity (rail or bus rapid transit) service and for transit oriented development (TOD) to support higher capacity transit service. A discussion of the typical components of TOD and different categories of higher capacity transit services provides a general idea of the some of the land use and transit options that might be realized in the Knoxville region with the potential implementation of transit enhancements. Eight corridors are identified and analyzed according to their existing right-of-way conditions, transit services, land use, and demographics, to determine the positive and negative attributes of each corridor with regards to their potential for supporting TOD and higher capacity transit services. Preliminary estimations of the operating and capital costs for implementing bus rapid transit (BRT), light rail transit (LRT), or commuter rail in each corridor are considered, followed by an initial discussion of the corridors with greatest potential to support transit enhancements in the future.

Transit Oriented Development

Transit oriented development (TOD) is mixed use, compact development that is meant to favor pedestrians and transit over automobile use. It includes a mix of housing, commercial office, retail, entertainment and even light industrial uses in a compact package that balances transit, auto, pedestrian and bicycle use (Figure 2-1).

Figure 2-1
Typical Components of TOD

Transit plays an important role in the types of development that can or will occur at existing and planned transit routes and stations. Transit-oriented development (TOD) is specifically designed to support both pedestrian and transit activities. Generally, it consists of moderate to highly compact development that is located within an easy walk of a major transit stop. It contains a mix of residential, employment and shopping opportunities designed primarily for use by pedestrians while still providing limited access by car. TOD is not just development located next to transit lines; it is development designed and constructed to facilitate and promote transit ridership through a number of specific design elements:

- **Compact:** Moderate to highly compact development is constructed to ensure that large numbers of people work, live and shop within a short walk of the transit line, and parking requirements are reduced or directed into multi-story parking structures.

- **Mixed-use:** Development includes a variety of land uses (i.e., residential, commercial, retail, etc.) within easy walking distance of the transit line and of each other.

- **Pedestrian-friendliness:** All elements of the development are designed to promote active living, walking and the use of transit. This also include things like the orientation of buildings, the placement of doors, the design of landscaping, sidewalks and crosswalks, and the positioning and size of parking facilities. Although the development of many cities and suburbs up to the 1940s was shaped, in part, by the existence of transit service, the term TOD is generally applied only to new development or redevelopment. With TOD, walking is considered the primary means of transportation. All of the retail shops, grocery stores, and homes are located so as to be within a very short walk of each other. The result increases transit ridership and reduces overall dependence on the automobile. This in turn improves air quality, saves tax dollars and improves the quality of life for everyone who uses the transportation system. A number of U.S. cities, most notably Portland, San Diego, San Jose, and the communities served by the Hudson-Bergen Waterfront Line in northern New Jersey, have been the sites of significant levels of TOD. As an example of a city closer to Knoxville, Atlanta's MARTA has also begun to support TOD around its stations. The types of public policies needed to encourage TOD include:

  - **Changes to planning and zoning ordinances** to allow mixed uses, compact development, smaller land setbacks and lower parking requirements that require pedestrian improvements with access for transit.

  - **Funding** for infrastructure improvements by local and state governments can be regulated to require transit oriented-development policies and improvements. Some local programs have provided direct subsidies, preferred financing or tax abatements for TOD. Federal transportation funding such as the Federal Transit Administration (FTA) Section 5309 New Starts program supports the planning, design and construction of major fixed-guideway transit projects with a requirement of transit-oriented improvements to support new transit stations and services.

  - **Joint development** of property owned by transit providers or governmental units to encourage location of development near transit stations, to help support that development, and take advantage of the opportunity to shape the land-use development.

  - **Direct development** of land around stations, by the transit provider or other governmental entity, has been employed in a few locations to provide an anchor around which other development can grow nearby.

High Capacity Transit Options

While there are many types of high capacity transit operating around the globe, ranging from personal rapid transit vehicles to high speed rail, not all transit types can be considered viable options for implementing higher capacity transit in Knoxville's corridors. The transit options with the greatest likelihood and potential to be implemented in the Knoxville region are considered here, including various levels of BRT, LRT, and commuter rail.

Bus Rapid Transit

Bus rapid transit (BRT) is a system of improvements to make bus service more attractive relative to auto travel. The primary goals of BRT are to reduce transit travel time and increase service reliability. This application concept is a flexible one that encompasses physical, technological, operational and marketing improvements in response to congestion, operational needs, opportunities and market demand.

The implementation of BRT service within a transportation corridor can be an evolutionary process in which transit amenities and infrastructure improvements are phased in over time as conditions and demand warrant them, and as funding becomes available. For example, an urban corridor supporting a high volume of bus service and ridership may designate the outside lanes as bus lanes during peak periods to increase travel speeds. In addition, station area enhancements and vehicle aesthetics can be implemented to identify a distinguishable transit mode. Later, as the corridor develops a traffic signal priority system and queue jumps at congested intersections can further improve bus throughput, resulting in additional ridership gains. As ridership increases, a full-time curb-separated right-of-way, and improved streetscape treatments could be put in place for the BRT system throughout a travel corridor.

BRT systems provide communities with an excellent opportunity to upgrade service to transit users and increase transit use. They also offer an opportunity to invest in streetscape and facility improvements that beautify and enhance the corridor. Developers and potential residential and commercial investors perceive these investments as a strong indication of the community's commitment to an area. This perception of commitment can promote redevelopment opportunities and improved development in the corridor.

BRT systems provide greater operational flexibility when compared to a system with a fixed alignment such as LRT and heavy rail. For example, BRT systems usually allow buses to leave their dedicated alignment at the beginning and end of the trip to serve as their own collector and distributor services, potentially offering more passengers a one-seat ride. This is accomplished by providing connections to major intersecting roads. This reduces the inconvenience associated with transfers from one mode or one vehicle to another. This feature is well suited to the residential end of the trip where densities are too low to provide transfer stations within convenient walking distance, as well as distribution systems to established employment centers such as central business districts, where the construction and operation of any form of fixed guideway transit may be difficult. Other bus routes operating partially over a common section can benefit from operation in the bus lanes over part of their trip.

BRT service is presented according to levels of service implementation (initial, intermediate and full) as defined by the Federal Transit Administration (FTA). Each level of BRT service includes various technological, operational, and structural elements according to the specific implementation level. Initial BRT is a basic set of amenities for BRT service. Intermediate provides a more comprehensive application of transit infrastructure and technology. Full BRT is a developed system that applies the transit elements of initial and intermediate BRT service. Each level of BRT service benefits from upgraded marketing and the installation of service enhancements to provide passenger safety, comfort, and convenience, which upgrades a system's image and increases customer attractiveness.

Initial BRT Service

Initial BRT service prescribes minimal improvements to existing bus services that includes an increase in service frequency, a decrease in transit travel time and the implementation of passenger amenities for the purposes of developing a distinct mode of transportation.

Initial BRT service is typically distinguishable from conventional bus service through vehicle aesthetic improvements and the installation of passenger station amenities. Vehicle improvements range from a color scheme different from existing conventional buses to purchasing new buses that are equipped to provide a more comfortable ride. Passenger stations are typically upgraded to include curbside concrete hard stands with covered seating areas, adequate lighting, highly visible signage and route information.

This type of BRT service shares a travel lane to operate in mixed traffic on urban or suburban streets with some level of preferential treatment. The type of preferential treatment for initial BRT service is achieved through a deployment of Intelligent Transportation Systems (ITS) technology such as signal prioritization. A signal prioritization system improves transit travel times by allowing buses to advance, prioritize, or pre-empt traffic lights when approaching a signalized intersection. The components of the system involve a bus-mounted transponder that utilizes an electronic signal to correspond with an intersections traffic signalization system. A signal priority system allows an approaching bus and traffic to pass through an intersection without being interrupted by a stop signal. This improvement minimizes transit travel delays, improves reliability and allows buses to maintain schedule adherence. The installation of an enhanced signalization network may even reduce the number of buses required to operate on a route to meet existing schedules, and thus reduce operating costs.

Intermediate BRT Service

Intermediate BRT service utilizes a designated right-of-way that applies various types of infrastructure and technology to reduce dwell time and accelerate transit travel time within a transportation corridor. Intermediate BRT may utilize either a designated lane during peak travel times, a fully dedicated lane or an HOV travel lane that may or may not be barrier separated from other vehicular traffic.

This type of BRT service includes an advanced upgrade of transit vehicles, bus stop amenities, and creation of bus "stations" at key locations in a corridor. Along a BRT service corridor various improvements are applied to speed up passenger boarding and reduce overall travel time. This is achieved using transit vehicles that are designed with low-floors and have multiple, wider doors for faster passenger boardings and alightings. Signage and information systems upgrades at bus stops typically utilize the deployment of ITS infrastructure such as passenger information systems to provide riders at bus stops with real-time route and schedule information. Improved fare collection systems are also implemented to include off-board fare collection and ticketing systems for this level of BRT. These types of service elements and information improvements increase passenger confidence in using the system, which results in increased transit ridership. Intermediate BRT service also involves measures to improve pedestrian conditions through streetscape and landscaping improvements that facilitate connections to properties and land uses adjacent to stops.

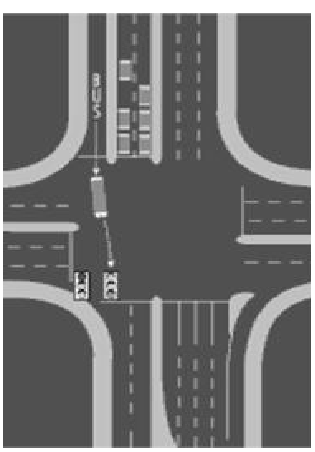
Non-Barrier Separated Bus Lane

A basic type of transit priority improvement is the designation of a specific bus lane for bus-only traffic. This type of bus lane designation restricts traffic from the use of that lane and is separated from traffic lanes only through pavement markings and signs. The restriction may be limited to the peak direction and to peak periods, or may be in both directions and at all times of day.

Figure 2-2
Silver Line, Boston

The most common type of bus lane is the curbside bus lane, in which the right (outer) lane in each direction is designated for bus-only use (Figure 2-2). Rarely, curbside bus lanes operate in the contra-flow direction. Curbside bus lanes allow ease of access to bus stops. Stopping buses do not block auto traffic, and auto traffic does not prevent buses from re-entering traffic after a stop. However, curbside bus lanes can rarely be barrier separated from traffic lanes because access to driveways and deliveries must be maintained along the urban and suburban street front. Usually, curbside bus lanes allow taxis, bicyclists, and right-turning traffic to use the designated bus lane, which can cause delays to bus traffic. In addition, auto breakdowns and illegal parking can block the bus lane, and violations of the bus lane are frequent, particularly under congested conditions. The Forbes-Fifth one way bus lanes between the Squirrel Hill area and downtown Pittsburgh, Penn., the downtown bus loop in Toledo, Ohio, and the Madison Avenue bus lanes in New York City, are examples of systems using curbside bus lanes in U.S. cities.

Figure 2-3
Queue Jumper
Lane Co., Ore.



Non-barrier separated BRT bus lanes have also been developed in several cities in the right (outer) lanes of expressways that are designated as HOV lanes which also serve car pooling auto drivers, in many cities. Use of HOV lanes and non-separated bus lanes can encounter violation by single-occupant drivers, breakdowns of autos and congestion from excessive numbers of high occupancy vehicles and buses. In addition, merging to and from median and inside-lane HOV facilities into the regular traffic stream can create delays for vehicles entering and exiting the expressway.

Another component of intermediate BRT is the installation of dedicated segments of right-of-way in urban and/or suburban settings that increase travel time and allow BRT to receive priority over auto traffic. These are installed as a non-barrier BRT bus lane. An example is a queue jumper which is installed at major intersections that allow buses to bypass congested traffic conditions (Figure 2-3). A queue jumper provides transit vehicles with a segment of exclusive right-of-way for a traffic signal that is programmed to turn green ahead of the other signals. This enables a bus to "jump" ahead of other traffic to provide transit vehicles with a speed and time advantage over the normal traffic flow. These bypass lanes can speed up bus service between 30 to 60 seconds at a typical signalized intersection. Bus stops at times are integrated into the design of queue jumps to create mini "stations" at major interchanges. This type of facility also helps to speed buses on expressways where full HOV or bus lanes have not been implemented. For example, queue jump lanes for buses (and HOVs) have been implemented in conjunction with ramp metering systems, allowing buses to bypass the ramp metering before cars may enter the entrance ramp. Queue jumps also have been installed at exit ramps. Many toll roads also have special bus lanes allowing them to bypass toll queues.

Typically, construction costs for this type of facility ranges from $200,000 to $500,000 per intersection. Queue jumpers are particularly applicable along major roadways where lower-passenger volumes, a lack of financial resources, or available right-of-way prevents the installation of a continuous exclusive right-of-way for bus. Queue jumpers have been implemented in Charlotte, N.C., Montgomery County, Md., and Santa Clara County, Calif.

Barrier Separated Bus Lane

Intermediate BRT also includes barrier separated or limited-access roadways for buses. An example is an at-grade separated median bus lane that operates in the center of arterial corridors, with two bus lanes or occasionally a single bi-directional lane. Median bus lanes do not potentially block curbside access or remove curbside parking and thus often are barrier separated from auto traffic, which makes them less subject to delays from drivers violating the bus lane restrictions, breakdowns or other mishaps. Median bus lanes, however, must accommodate bus stops or stations in each direction. Offsetting the stations can minimize the space they consume, but fitting the bus lanes, stations, and vehicle travel lanes into the roadway section can be challenging and costly, particularly because it often requires reconstruction of the entire roadway and/or adjacent sidewalks. In median bus lane applications, bus passengers must cross auto travel lanes to reach stations, requiring improvements to crosswalks and the implementation of fences and streetscape treatments to control pedestrian movements. Signage and signal systems must discourage motorists from accidentally entering the median bus lane during left turning movements from crossing streets.

Through-bus movements on the alignment may require a separate traffic signal phase to prevent left-turning motorists on the roadway adjacent to the alignment from crossing the path of oncoming buses. The Canal Street bus lane in New Orleans, the Market Street bus lane in San Francisco, the busway on Number 3 Road in Richmond, Va. (Figure 2-4), the Euclid Corridor project in Cleveland, Ohio, and the CATS busway in Independence Boulevard in Charlotte, N.C., are examples of BRT systems employing median bus lanes in arterial corridors.

Figure 2-4
Median Busway, Richmond, Va.

Intermediate bus service that operates on a separated individual right-of-way may employ bus technology that steers or guides buses over portions of their routes. This is

Figure 2-5
Guided Bus, Essen, Germany

accomplished by use of wayside-located guidance curbs or optical guidance systems that utilize a camera to follow painted tracks on the road. This technology relieves the driver of the responsibility of steering the bus when in the guideway. Optically-guided technologies also provide precise docking at stops or whenever a vehicle may need to negotiate tight rights-of-way. However, optically guided technologies can be affected by rain and are subject to tampering by vandals.

A primary benefit of this technology is it enables a bus to operate on a narrower guideway. On new installations, the required roadway width (approximately nine to ten feet) is also about 20 percent less than conventional bus lane requirements (approximately 11 to 12 feet), and no shoulders are required (Figure 2-5). Buses can leave the track at stations and/or at other locations and operate on streets as regular vehicles.

Fully Developed BRT

Fully developed BRT service consists of all the amenities and attributes of both initial and intermediate BRT. Full BRT service is defined as a fully separated bus facility, often running alongside or in the median of expressways, or in disused rail corridors. This type of BRT system allows unimpeded travel flow at the legal speed limit and, when combined with on-line stations and park-and-ride lots, can carry volumes and produce travel speeds comparable with light rail transit at a fraction of the initial capital cost.

Figure 2-6
Seattle Busway Tunnel

Full BRT may also include travel lanes typically built in a highway or roadway right-of-way, but are physically separated from the other traffic lanes and intersections and may have exclusive flyover access ramps. The Shirley Highway in Washington D.C., Seattle Bus Tunnel (Figure 2-6), the East and West Busways in Pittsburgh, several of the regional busways in Ottawa, and the priority lanes on major freeways in Houston, Texas, are examples of this type of BRT facility.

Buses using this type of BRT facility normally collect passengers on local streets or at park-and-ride facilities and then enter the exclusive busway and operate much like a rail vehicle on a fixed guideway system. Busways permit the location of stations along the busway at major community origins and destinations. However, compared to HOV lanes, which are generally considered highway facilities, busways are exclusively transit facilities and often must be financed exclusively using local, state and federal transit funding. On-line stations, particularly in the medians of expressways, may be less convenient for passengers. However, the characteristics of BRT allow passengers to board in their neighborhoods and alight near their destinations at off-line locations by buses that can then enter the bus lane for the express portion of the trip.

Light Rail Transit

LRT is a flexible transportation mode that can operate in a variety of physical settings. As the modern technological descendent of the streetcar, a distinctive feature of LRT is that vehicles draw power from an overhead wire. This is in contrast to heavy rail vehicles that usually are powered from a track-level third rail. This overhead power collection feature allows LRT systems to be integrated with other at-grade transportation modes and pedestrian areas. LRT (like streetcars) can operate in mixed traffic on tracks embedded at-grade with street and pedestrian crossings, or on a fully-segregated guideway.

Figures 2-7 and 2-8 illustrate LRT systems in operation in Portland and Cleveland.

Figure 2-7
Portland Streetcar LRT

Figure 2-8
Cleveland RTA LRT

The most recent light rail systems in the U.S. operate vehicles that are 90 to 95 feet long and up to nine feet six inches wide. Operator cabs at both ends of the vehicle (articulated and non-articulated) allow bi-directional operation. LRT systems can operate either as a single car or in multi-car trains. The capacity of a typical LRT vehicle ranges between 120 and 170 passengers. A three-unit train can carry up to 510 passengers, and the single direction, hourly capacity of a line can range up to 16,000 persons per hour per direction (pphpd).

The maximum operating speed of modern LRT systems generally ranges from 55 to 65 miles per hour, making it suitable for medium distance trips in suburbs or between central business districts. However, average operating speeds can be reduced to ten to 25 miles per hour if operating in mixed traffic with frequent stops.

Depending on the surrounding environment, LRT station design may incorporate high or low platforms. Generally, transit systems with on-street operations, where passengers can walk across tracks, use simple stations with low platforms, while systems with reserved right-of-way use high platforms.

Entry into light rail vehicles (LRVs) has traditionally been provided in one of two ways: step entry or level boarding. Low-floor LRVs provide level boarding and are becoming quite common and today operate in Portland, Ore., and Hudson-Bergen County, N.J. With the passage of the Americans with Disabilities Act of 1990 (ADA), all new rapid transit stations must provide access for the disabled to every car unit. This means that all LRT systems that opened after January 1993 must provide level boarding.

Diesel light rail vehicles such as the Siemens "RegioSprinter" operate like light rail vehicles but are self-powered and thus do not require overhead catenary power. This reduces the initial capital cost of developing a light rail line but eliminates some of the noise and pollution benefits of electric light rail. Diesel light rail vehicles have been used successfully in Europe and are being considered for implementation in Santa Cruz, Calif., Harrisburg, Penn., and some other cities.

Operating Characteristics for LRT

- Serves moderate to high passenger volume;
- Typically 3,600 to 22,000 per hour one-way;
- Low to medium speed – 30 to 65 mph (depending on degree of separation of right-of-way and distance between stops);
- May serve short to long distance trips;
- Stations spaced 0.5 to one mile apart;
- Normally uses overhead power collection;
- May operate in traffic, with cross-traffic, or on exclusive right-of-way;
- Can negotiate steep grades and small radius curves;
- Stations may be elaborate or simple. May use low platforms, high platforms, or both;
- Vehicles may operate alone or in trains of up to four vehicles;
- Numerous vehicle suppliers;
- Cannot operate jointly with freight trains or other railroad equipment;
- Moderate to high capital cost (more than commuter rail/less than heavy rail); and,
- Moderate O&M cost on a vehicle mile or passenger mile basis.

Commuter Rail

Commuter rail is generally applied to the longer distance regional rail trips. For conventional commuter rail operations, single or bi-level passenger cars are pushed or pulled by diesel or electrically-powered locomotives. Typically these systems are operated by railroads, under agreement with a transit agency, on their own tracks or through a leased track usage agreement. A major advantage of commuter rail is its ability to use existing freight trackage in joint use with freight trains or Amtrak service. Generally, commuter rail operates to provide peak period and peak direction service.

Due to federal regulations that require an automatic train control system for speeds in excess of 79 miles per hour, commuter rail generally operates at this maximum speed. Due to the slower acceleration and longer braking distances compared to the other rail technologies, commuter rail is best suited to longer distance trips. Commuter rail vehicles can use high or low platform boarding. Individual cars can carry up to 160 seated passengers with a nominal standing load capacity of 300 passengers. Trains with ten to 12 cars are not uncommon. Therefore, individual trains have a high capacity, but because headways are longer, the total line capacity is typically less than heavy rail (7,500 to 25,000 passengers per hour in a single direction).

Capital costs range from $7 million to $25 million per mile. The operating cost, primarily due to union labor costs, can be relatively high. Due to the high passenger capacity potential and the long distances traveled, the cost per passenger mile for commuter rail is in the middle range for rail transit alternatives.

Representative examples of U.S. commuter rail systems include:

- Cal Trans in San Francisco, Calif.;
- Tri-Rail, Florida;
- MARC in Baltimore, Md.; and,
- Metra in Chicago, Ill. (Figure 3-5).

Diesel-Electric and Electric Locomotives

Diesel-electric locomotives are the most common railroad locomotive in use in North America. They are used for both freight and passenger service. Traction power for these systems is either diesel or electric. Electric locomotives operate from electric power drawn from an overhead contact system. When a diesel locomotive is used, the locomotive is capable of pushing or pulling from one to eight cars (push-pull operation). Figure 2-9 depicts a locomotive-hauled commuter rail of double-decked passenger cars operating on Chicago's Metra system.

Figure 2-9
Chicago Metra Locomotive-Hauled Commuter Rail

Operating Characteristics for Commuter Rail (Traditional)

- Serves moderate to high passenger volume;
- Non-powered passenger cars pulled by locomotives or diesel multiple units (self-propelled);
- Can use existing tracks jointly with other railroad equipment;
- Serves long distance trips;
- Typically 8,000 to 25,000 per hour one-way;
- High speed – up to 79 mph (without cab signals);
- Stations spaced five to seven miles apart;
- Stations may be elaborate or simple, and use low platforms, high platforms or both;
- Can have long trains (usually four to 12 cars);

- Diesel locomotives have air and noise quality impacts, and are maintenance-intensive;
- Relatively low capital cost (when using existing tracks); and,
- Moderate to low O&M cost on a vehicle mile or on a passenger mile basis.

Multiple Unit Cars (Diesel and Electric)

Diesel and electric multiple unit cars are self-propelled commuter rail cars that do not require a locomotive to push or pull them. Multiple unit cars can operate as single cars or as trains of up to ten cars. These cars are typically 85 feet in length and provide seating for 60 to 100 passengers. They are capable of speeds from 80 to 120 miles per hour. Figure 2-10 depicts an electric multiple unit (EMU) commuter rail train operating on the New York Metro-North Commuter Rail system. Figure 2-11 illustrates the latest diesel multiple unit (DMU) prototype to meet the Federal Railroad Administration's approval. The South Florida Regional Transportation Authority (Tri-Rail) is using this prototype as part of a demonstration project.

Figure 2-10
New York Commuter Rail EMU

Figure 2-11
Diesel Multiple Unit

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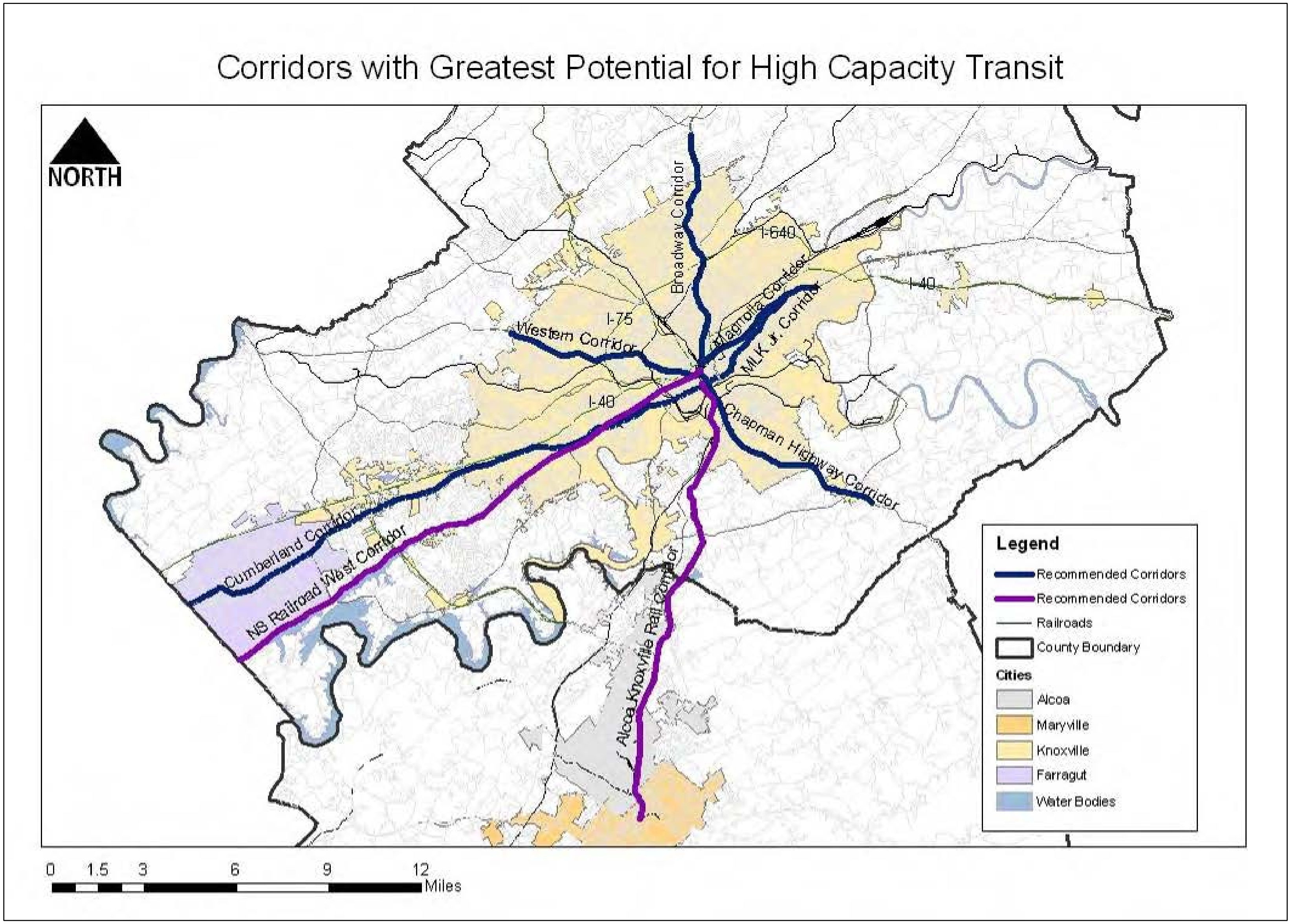
3. Potential Corridors

A series of factors were analyzed to determine the most likely corridors for TOD and supporting higher frequency transit. Factors included: existing transit service performance and characteristics; existing land use; population and employment density; ability to provide a connection between downtown and emerging areas such as South Waterfront, Cherokee Farms, and Cumberland Avenue; prevalence of sidewalks/trails; ridership on existing transit routes; and, general commuting patterns.

Based on the analysis, eight corridors were identified as having the greatest potential for increased transit and TOD. Figure 3-1 shows the locations of these corridors. The corridors are:

1. Cumberland Avenue Corridor;
2. Norfolk Southern Railroad West Corridor;
3. Western Avenue Corridor;
4. North Broadway Street Corridor;
5. Magnolia Avenue Corridor;
6. Martin Luther King, Jr. (MLK) Avenue Corridor;
7. Chapman Highway-James White Parkway; and,
8. Alcoa-Knoxville Rail Corridor.

Figure 3-1
High Potential Transit Corridors



Corridor 1: Cumberland Avenue/Kingston Pike Corridor

This corridor is an east-west route through the City of Knoxville. It is called Kingston Pike (U.S. 11/70) as it extends from the City of Farragut into Knoxville. In the downtown area, Kingston Pike becomes Cumberland Avenue, a center of commercial activity and major point of access for the students, faculty and visitors to the University of Tennessee (UT) (Figure 3-4).

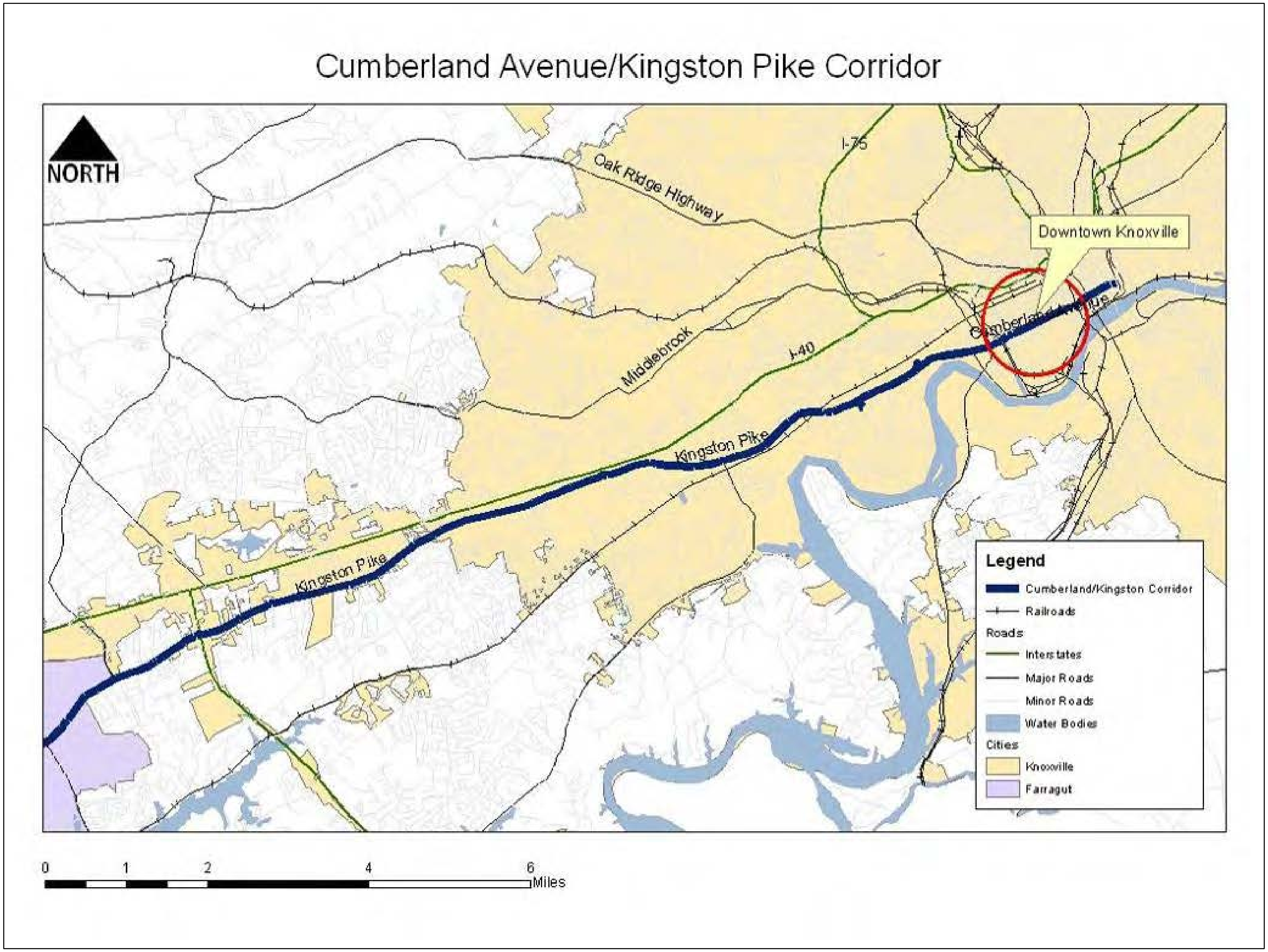
Transportation Network

Cumberland Avenue varies from four to five lanes through the downtown area. It is four lanes from Locust Street to 11th Street, then widens to five lanes through the UT Campus, constricts to four lanes at 13th, widens to five lanes at Circle Drive, then contracts to four lanes again near the pedestrian overpass (Figures 3-2 and 3-3). The lanes are fairly narrow, and right-of-way appears limited, with further constraints imposed by bridges and a pedestrian overpass. The City of Knoxville is currently finalizing a road diet study for the Cumberland Avenue corridor that would reduce the road from four lanes to three and widen the adjacent sidewalks.

Figure 3-2
Cumberland Avenue near 19th Street

Figure 3-3
Cumberland Avenue at 11th Street

Figure 3-4
Map of Cumberland Avenue/Kingston Pike Corridor



At Volunteer Boulevard, there is a bridge which constrains Cumberland Avenue to five narrow lanes. Near U.S. 129, there is a concrete divided section. As Cumberland Avenue becomes Kingston Pike, the number of lanes increases to six at Neyland Drive. Past this intersection, the road contracts again to four lanes. Kingston Pike continues to vary between a four- and five-lane section as it progresses west towards Farragut. The road typically widens to five lanes at signalized intersections, and constricts to four lanes between signals (Figures 3-5 and 3-6). The likely terminus for the Cumberland Avenue/Kingston Pike Corridor is West Town Mall, located at the intersection of Kingston Pike and Lyons View Pike.

Figure 3-5
Example of Kingston Pike Four-lane Section

Figure 3-6
Example of Kingston Pike Five-lane Section

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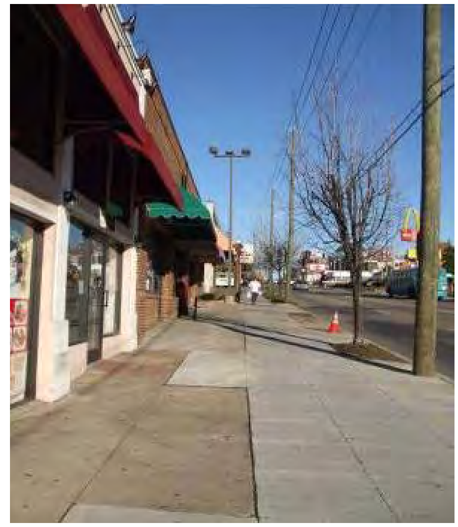
Figure 3-7
Sidewalks on Cumberland Avenue



The presence of sidewalks varies along Cumberland Avenue. In some locations they are approximately five to six feet wide with a two-foot landscape buffer between the sidewalk and street. In other locations, the width narrows to approximately three to four feet without a buffer. Utility poles are generally located in the landscape buffer (right-of-way) next to the street (Figure 3-7), constraining the ability to further widen the roadway to accommodate a BRT or light rail system or necessitating costly relocation of the utility poles (this is in addition to any potential relocation or changes to underground utilities, which were not reviewed in this study). There are numerous curb cuts and driveways which interrupt the consistent flow of the sidewalk. The City of Knoxville's road diet study is considering the possibility of reducing the number of lanes on Cumberland Avenue and widening the sidewalks, which would greatly improve the pedestrian experience on the street.

Sidewalks were observed to be well utilized by pedestrians in the area of the UT campus. This road also provides a pedestrian/vehicular connection to adjacent streets where student housing is located.

Transit Service

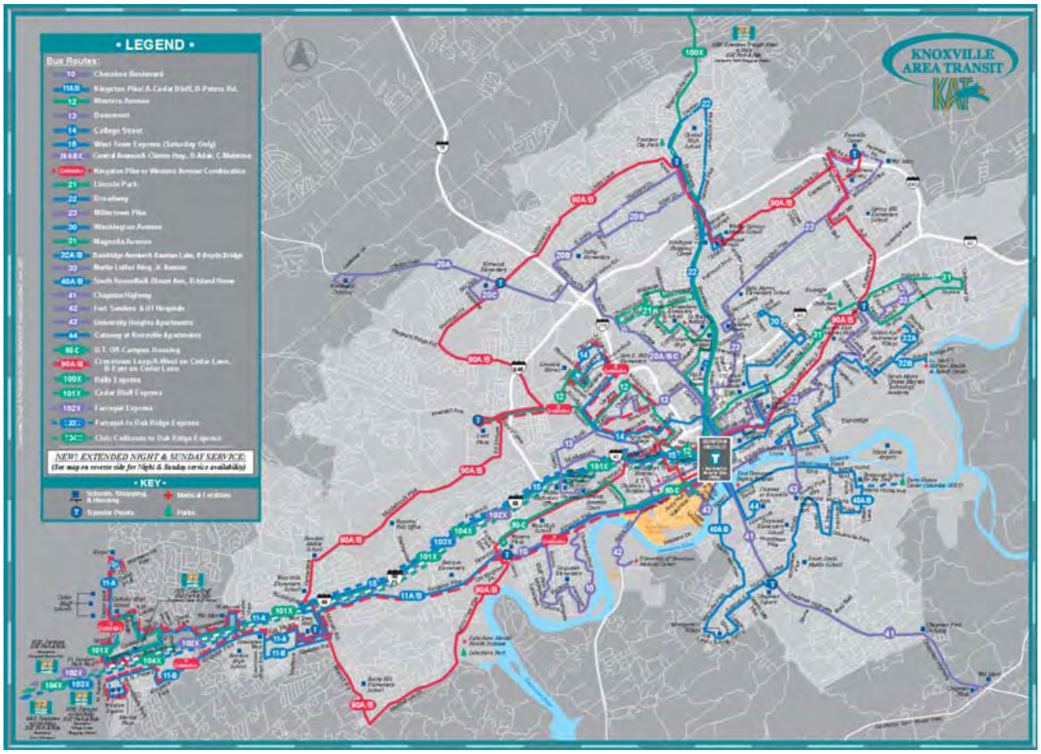
Knoxville Area Transit (KAT) routes are shown on Figure 3-8. KAT operates three routes that run along the Cumberland Avenue and Kingston Pike Corridor (see Table 3-1 below). Route 11 A/B – Kingston runs along the entire corridor, from downtown to just past the Knoxville city limits. Route 10 – Cherokee runs on Kingston Pike from Colony Road to downtown. Route 50C – The T-Off Campus Apartments runs on Cumberland Avenue, between Concord Road and Philip Fulmer Way. Bus shelters are found along the street.

Table 3-1
Transit Routes on Cumberland/Kingston Corridor

Route	Route Name	Segment of Cumberland/Kingston Traveled	2008 Annual Ridership	Revenue per Revenue Mile Rank
10	Cherokee	Colony to downtown	19,013	28
11 A/B	Kingston	City limits to downtown	216,617	15
50C*	The T-Off Campus Apartments	Cumberland Avenue between Concord and Phillip Fulmer Way	143,671	3
90 A/B	Crosstown	Crosses Kingston Pike at Morrell/Buckingham near West Town Mall	165,296	26

*Route may be eliminated

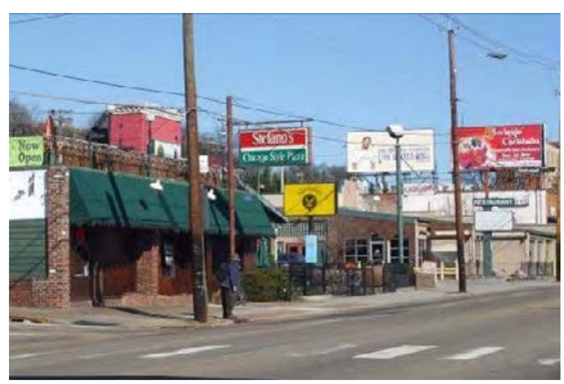
Figure 3-8
KAT Transit Routes



Land Use

There are many restaurants, banks, retail stores and convenience centers along Cumberland Avenue that cater to the university population. The buildings are relatively densely sited, but most are single stories until traveling west of the immediate UT area. The buildings in the UT area are well positioned near the street, with limited parking in the front of the buildings (Figure 3-9). Additional parking may be found in the back or on the surrounding streets. There is also a multi-story parking garage near the First Tennessee Bank and 11th Street. Student housing is located on adjacent streets, primarily in single family homes that have been converted to rental units (Figure 3-10). Apartments and dorms are located south of Cumberland Avenue.

Figure 3-9
Commercial Uses



Moving west of the downtown and University areas, the land uses on Kingston Pike differ in scale from those on Cumberland Avenue. There are segments of single family homes, churches and low intensity commercial uses in the area between Alcoa Highway and Lyons View Pike. West of this area, there is a stretch of medium density retail development, with some residential mixed in. After Bearden Road, the development becomes less dense, car dealerships are common, commercial shops are further back from the street and parking is located in front of the buildings.

Figure 3-10
UT Student Housing

In the Papermill Road area, still less than seven miles from downtown, the buildings appear to be aging. However, the businesses seem to be sustaining (as judged by the limited number of vacant units).

West Town Mall, near the edge of Knoxville, is a transfer point for the bus routes. This is a typical large indoor mall surrounded by retail outparcels, with some low to medium density housing and office uses in the surrounding area. The mall is a likely terminus for fixed-guideway rail or bus service in the corridor.

Population and Employment Density

The population density along the Cumberland Avenue/Kingston Pike Corridor varies from zero persons to more than 5,000 persons per square mile. The highest density areas are multi-story student housing developments in the UT area. Other pockets of dense population are found near Forest Heights and Tobler Road, just south of I-40; near Morrell Road; Gallaher Road; and, South Peter Street. In total, more than 53,000 people live within a ½ mile radius of the Cumberland Avenue/Kingston Pike Corridor. The average population density along the Cumberland/Kingston Corridor is 1,610 people per square mile. Figure 3-11 below details population density within ½ miles of the corridor.

Projected future population (2035) was also assessed for the corridor, based on the outputs of the Knoxville TPO's Travel Demand Model. The area south of UT Knoxville, across the river, shows the greatest percentage increase in population. Figure 3-12 displays the Traffic Analysis Zones along the corridor and the percentage of change in population projected.

There are more than 5,300 employment locations identified within ½ mile of this corridor, providing more than 78,000 jobs. The employers with the greatest number of employees in this area are Jewelry Television, Fort Sanders Regional Medical Center, Mercy Health Partners, Children's Hospital and the Tennessee Valley Authority. The average number of employees per square mile along the Cumberland Avenue/Kingston Pike Corridor is 2,300. Figure 3-13 shows the employment locations with the largest employee centers highlighted in light blue.

The Knoxville TPO's model projects that employment will grow by 25 to 50 percent or 50 to 100 percent for nearly all of the TAZs located along the Cumberland Avenue/Kingston Pike Corridor by

2035. The greatest employment growth is anticipated for the TAZ located between Gallaher and Morrell Roads, north of I-40 (Figure 3-14).

Household Income

The median household income in Knox County is approximately $42,000. The income levels along the Cumberland Avenue/Kingston Pike Corridor are on par with the median countywide income, with nearly all of the TAZs having a median income of $41,000 - $82,000 (Figure 3-15).

Potential for Higher Frequency Transit along Cumberland Avenue/Kingston Pike Corridor

Positive Attributes

- Higher density and mixed-uses in the Cumberland Avenue vicinity;
- Physical proximity to the University of Tennessee;
- Large employment centers concentrated in downtown area;
- Existing pedestrian traffic;
- Existing bus route;
- West Town Mall is a regional attraction;
- Right-of-way may be available along Kingston Pike, past the downtown area; and,
- Segments of Kingston Pike would benefit from redevelopment.

Areas that Need Improvement

- Right-of-way limitations under bridges; and,
- Lower density on Kingston Pike outside of downtown.

Figure 3-11
Cumberland Avenue Corridor
Population Density

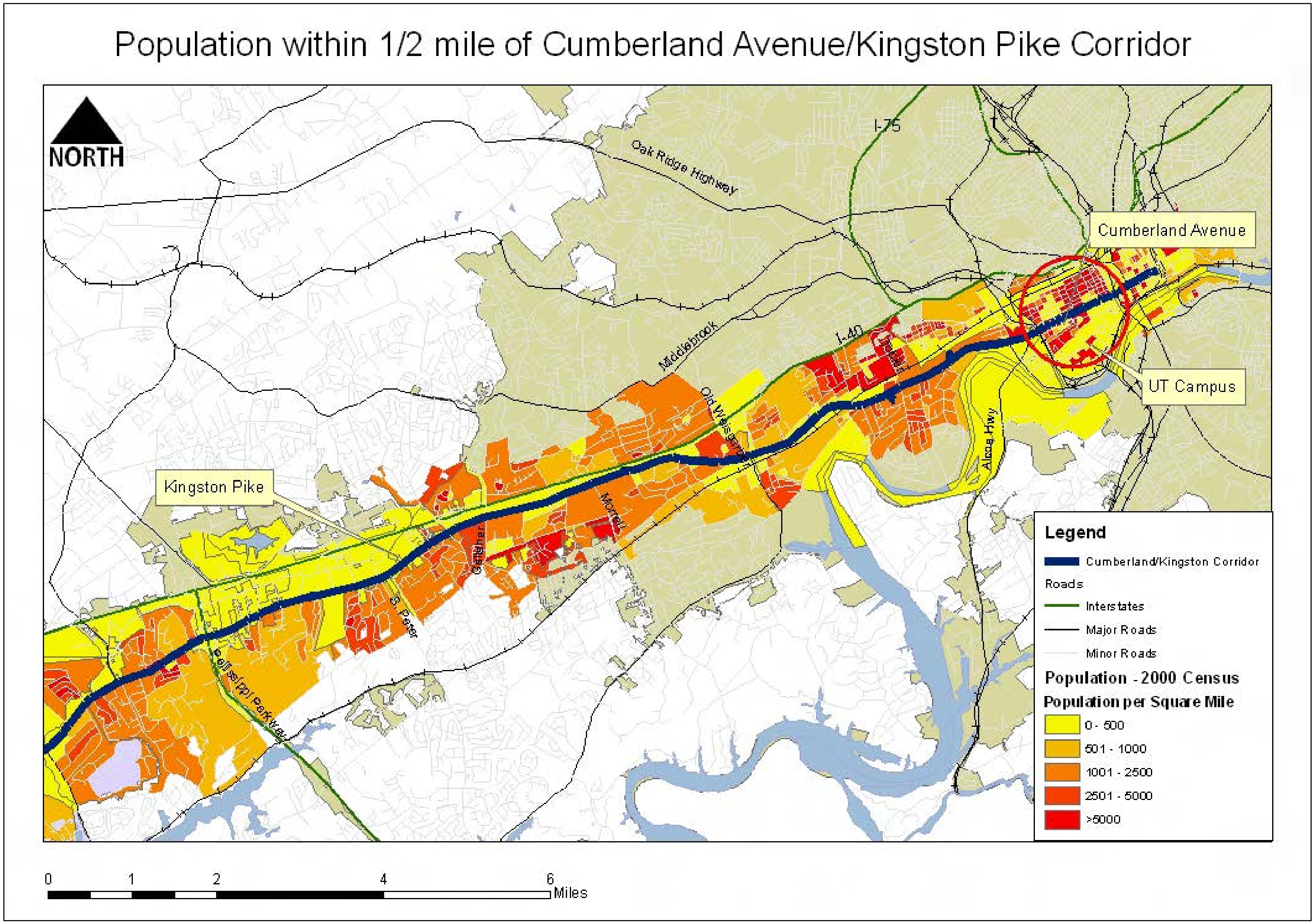


Figure 3-12
Cumberland Avenue Corridor
Population Change (2006 – 2035)

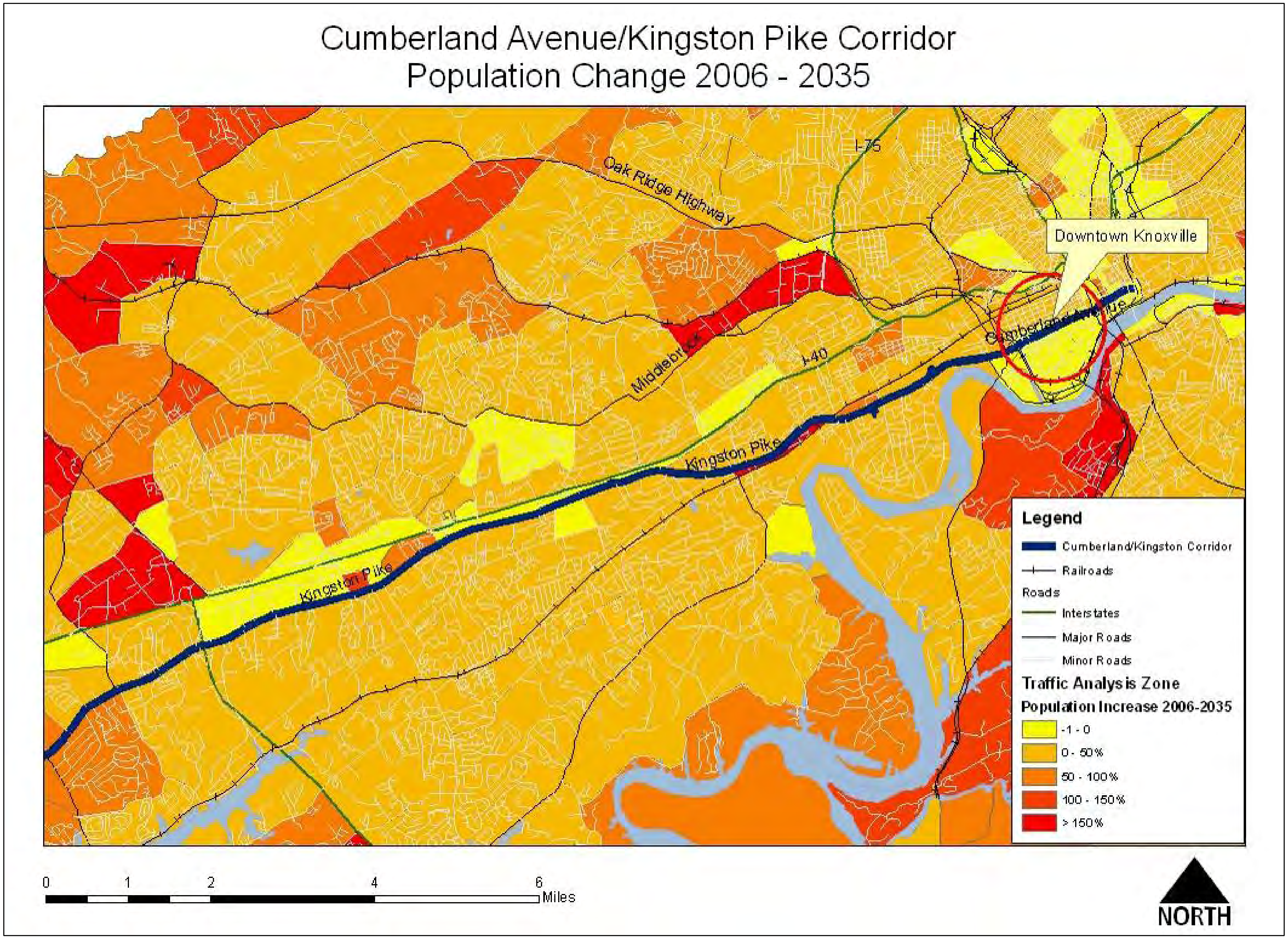


Figure 3-13
Cumberland Avenue Corridor
Employment Locations

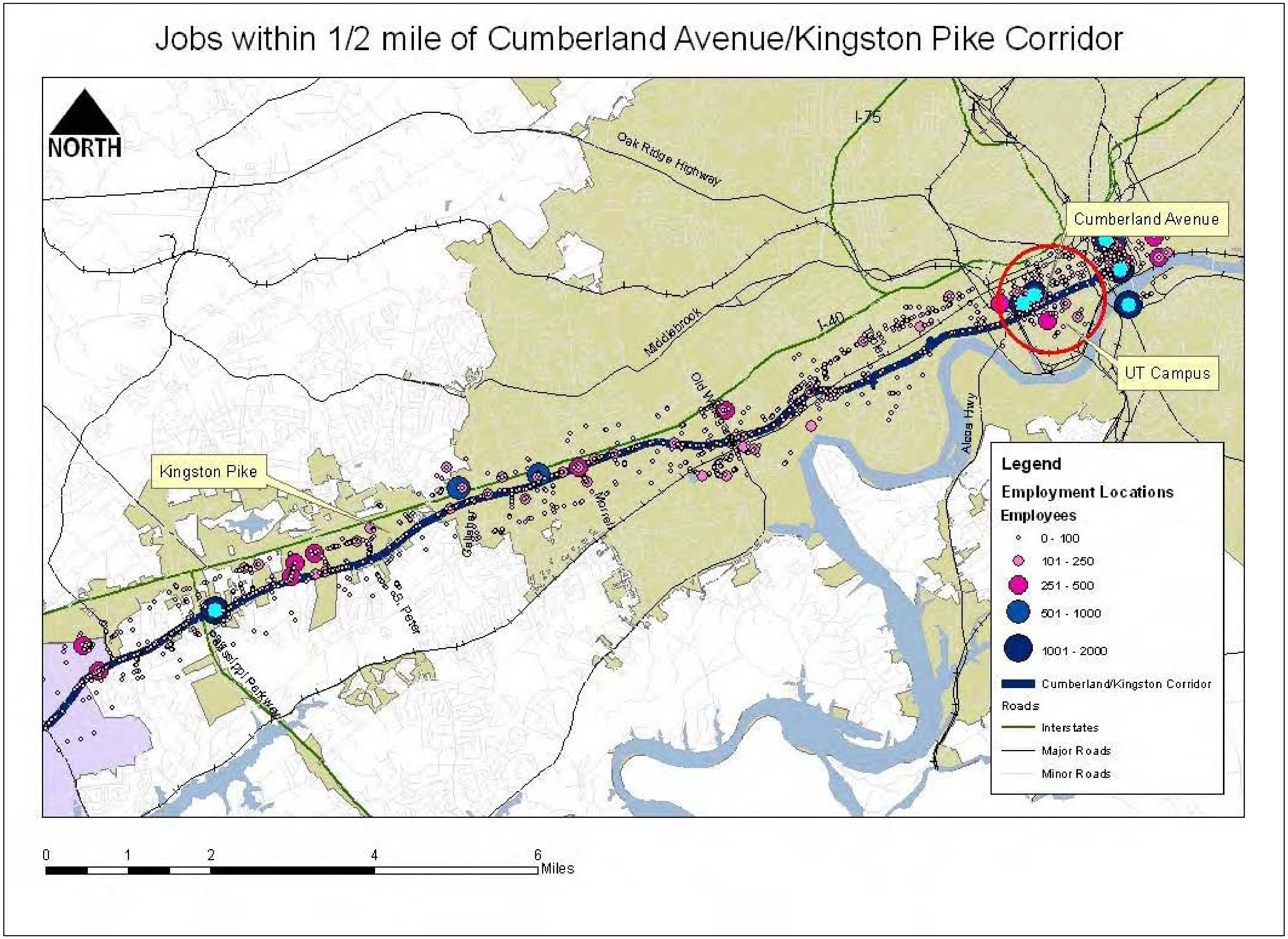


Figure 3-14
Cumberland Avenue Corridor
Employment Change (2006 - 2035)

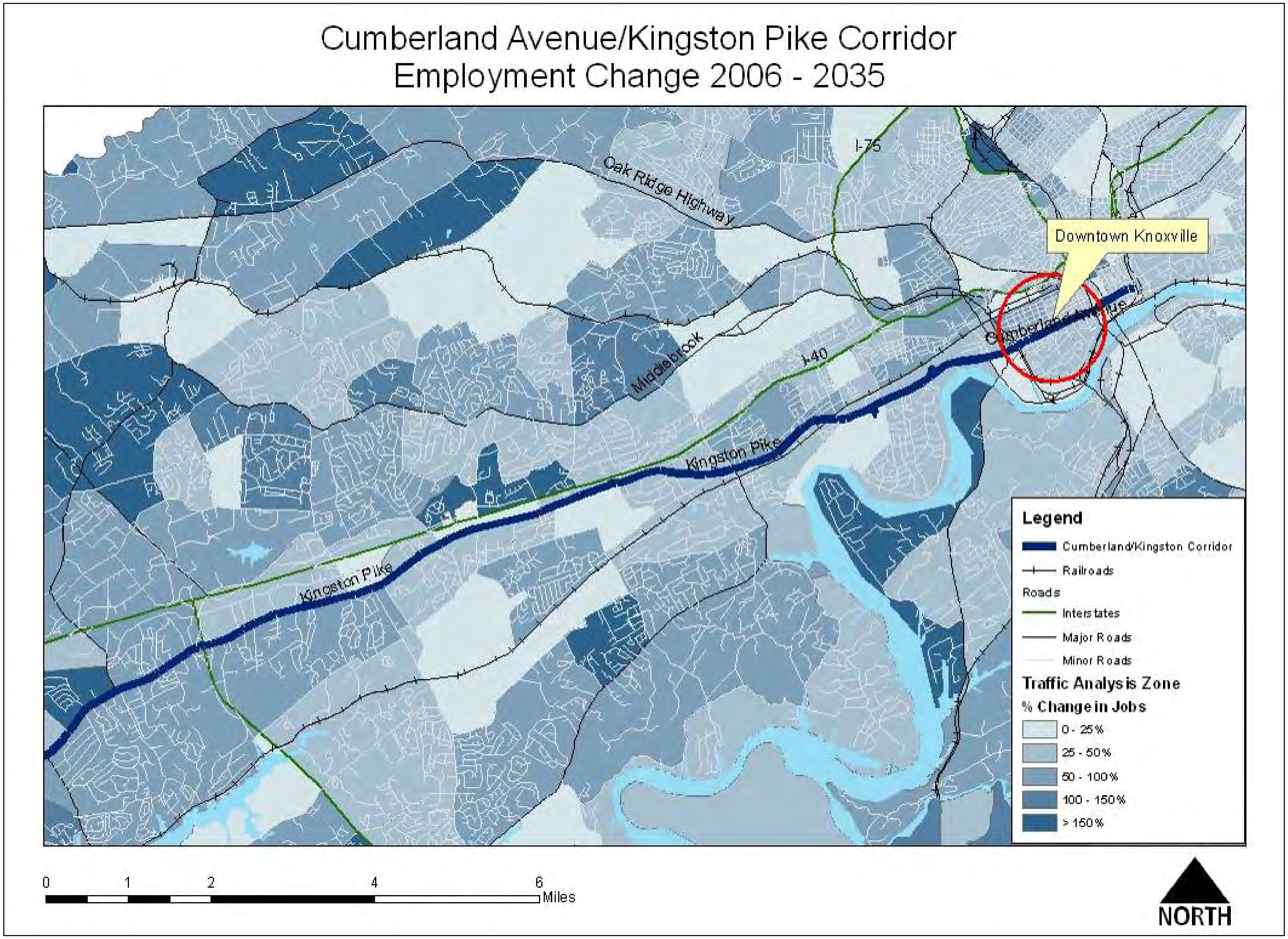
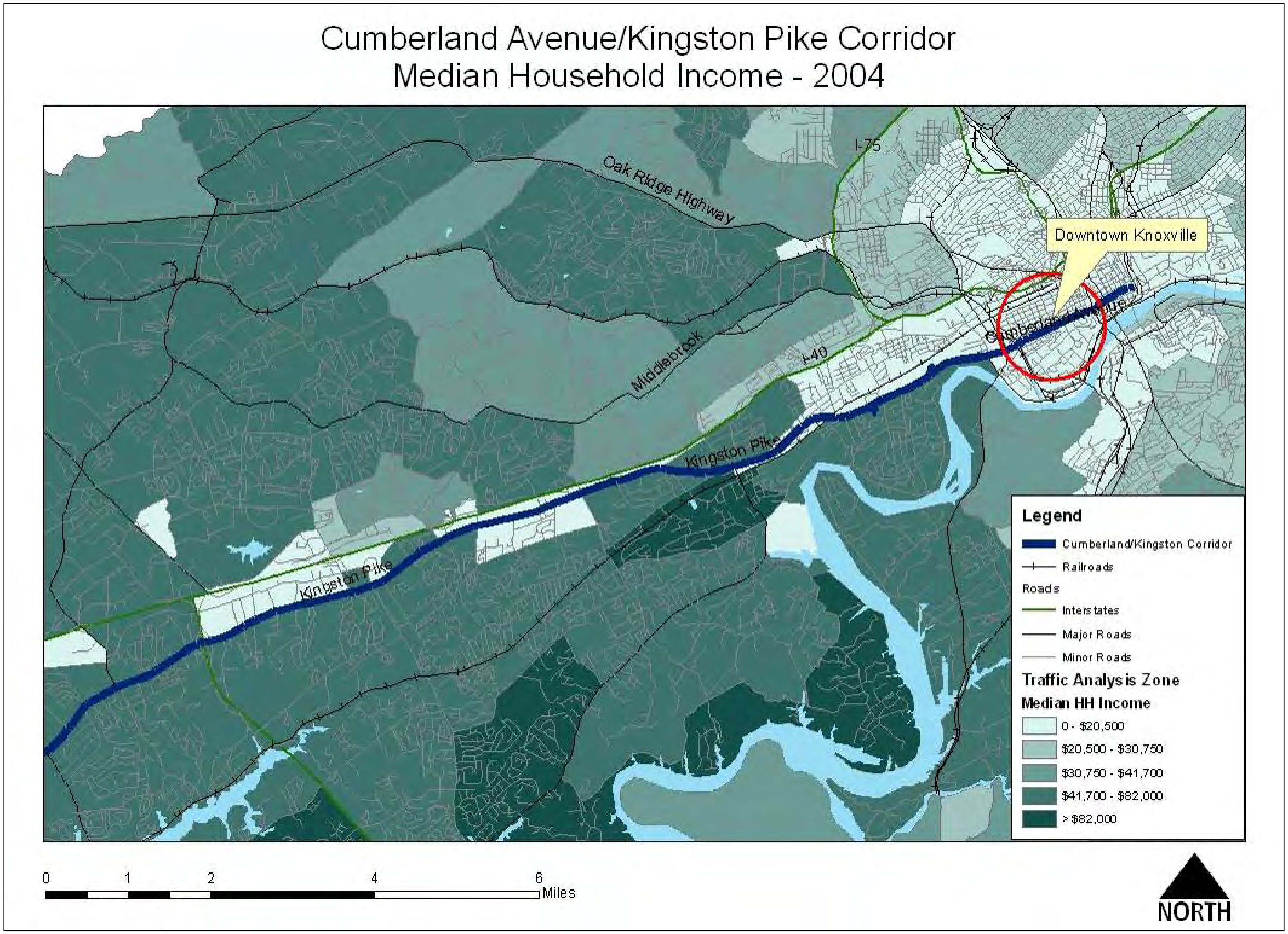


Figure 3-15
Cumberland Avenue Corridor
Median Household Income



Corridor 2: Norfolk Southern Railroad Corridor

This corridor is an east-west rail corridor extending through the City of Knoxville. The alignment operates in the rail yard located in a deep cut on the northern edge of downtown. The alignment roughly parallels Cumberland Avenue and Kingston Pike west of downtown, running north of Cumberland/Kingston (Figure 3-18).

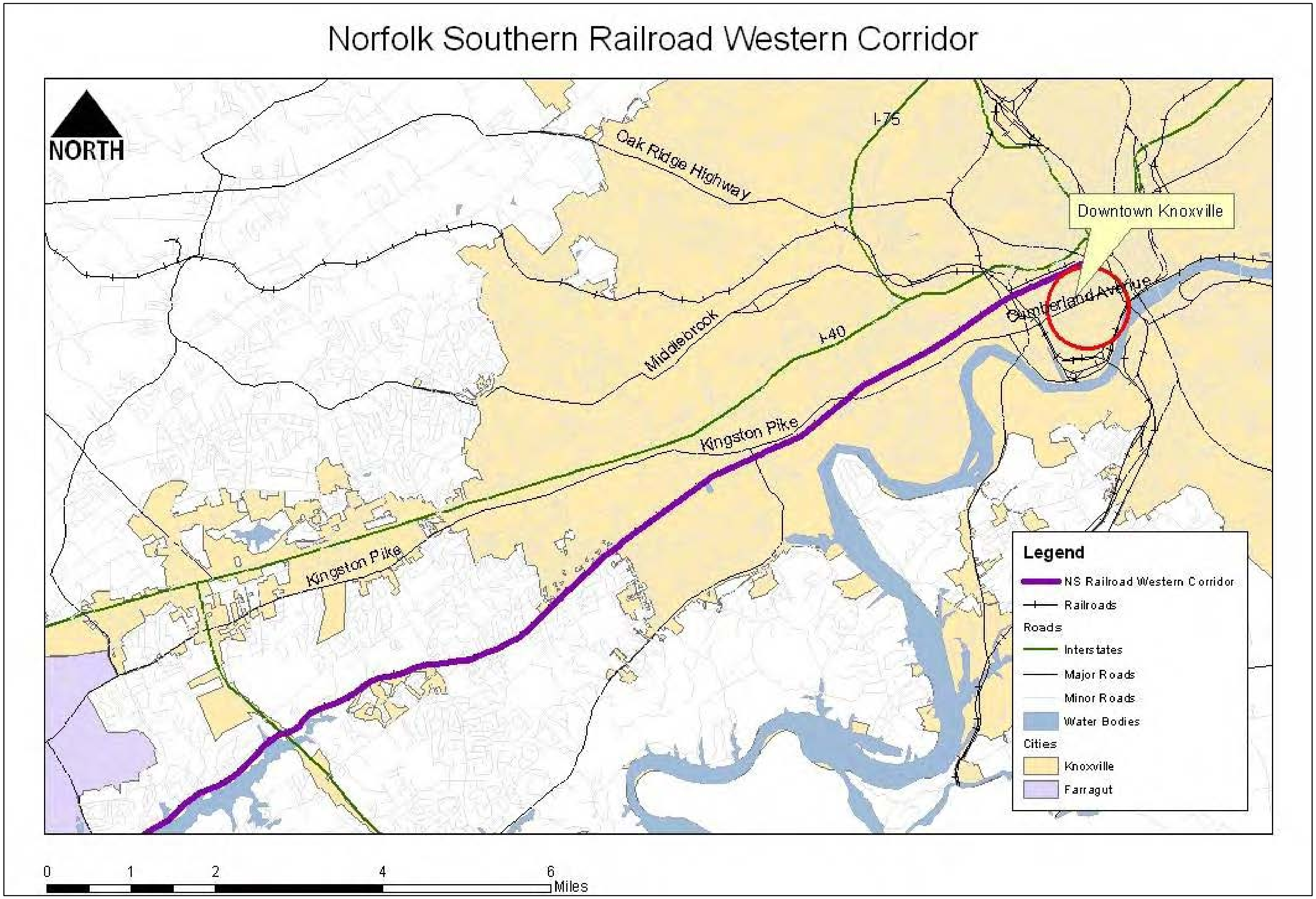
Transportation Network

The rail line begins near the old rail station north of downtown (Figure 3-16). This is in a deep cut below the grade of downtown, and passenger access would require a means for getting pedestrians down to track level, and most likely shuttles to bridge the distance to the heart of downtown. In the downtown area, the track begins in a rail yard with up to eight tracks. Connecting to a rail station in the World's Fair Park area would require a track connection to the rail line that runs north-and-south, which does not now connect to the Southern Railway line to allow the north-to-west or east-to south connection required (Figure 3-17).

Figure 3-16
Rail Station and Yard North of Downtown Knoxville

Figure 3-17
Area for Potential Connection to North South Track on Western Side of Downtown

Figure 3-18
Norfolk Southern Railroad Western Corridor

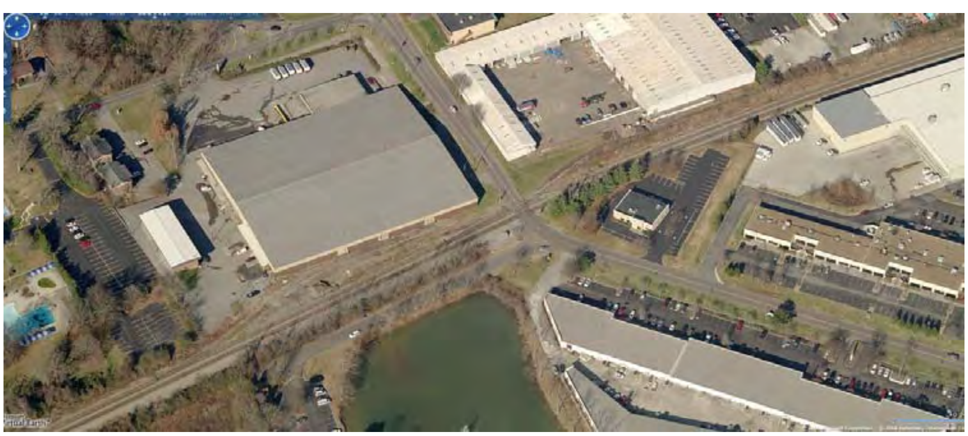


West of Broadway the rail line becomes a three track section. Near the end of 16th Street, the track narrows to two tracks, returning to a three track section west of 17th. Two of these tracks veer off to the south just east of Alcoa Highway (U.S. 129). Also east of Alcoa Highway is an at-grade crossing of the NS rail line with the CSX rail line. West of Alcoa Highway there is an at-grade road crossing at South Concord Street. For a short distance, the alignment contains a single track, widening to two tracks east of South Concord. The track narrows to a single track to cross a bridge at Third Creek (Figure 3-19). Just west of Third Creek, there is a grade crossing at Tobler Lane.

Figure 3-19
Bridge over Third Creek

The alignment continues west as a single track until it widens to two tracks in the area between Homberg Street and the Cherokee Country Club. A number of industrial sidings widen the alignment to three tracks between North Shore Drive SW and Baum Drive. There are a number of grade crossings in this area, including at Agnes Road, Gore Road, and Baum Drive/Royal Crown Drive (Figure 3-20). West of Baum, the rail alignment returns to a single track section through Morrell Drive.

Figure 3-20
Grade Crossing at Baum Drive/Royal Crown Drive



The proposed transit alignment would end just east of Morrell Road near the West Town Mall, the proposed terminus of the Cumberland/Kingston Pike Corridor (Figure 3-21).

Figure 3-21
Terminal Area at Morrell Road

The proposed rail line is generally separated from adjacent development, except in areas dominated by industrial land uses that are served by the rail line. In the railroad's interest for safety, the rail line rarely is served by or adjacent to pedestrian infrastructure such as sidewalks or walking paths.

Transit Service

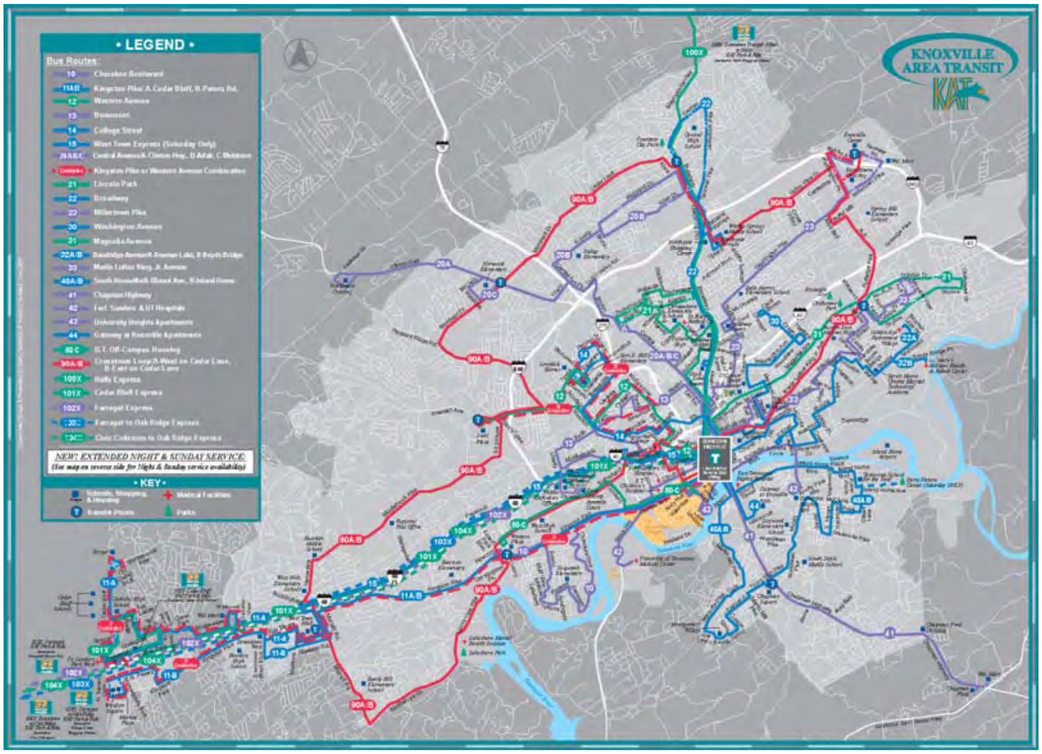
Knoxville Area Transit (KAT) routes are shown on Figure 3-22. The nearest existing parallel transit services in the corridor are the lines that operate on Cumberland Avenue and Kingston Pike corridors, which are discussed under Corridor 1, and are shown again as Table 3-2 below. In many areas, the rail alignment is not located within reasonable walking distance from the rail line or the line is isolated from transit by the relative lack of pedestrian infrastructure.

Table 3-2
Transit Routes near N-S Railroad Western Corridor

Route	Route Name	Segment of Cumberland/Kingston Traveled	2008 Annual Ridership	Revenue per Revenue Mile Rank
10	Cherokee	Colony to downtown	19,013	28
11 A/B	Kingston	City limits to downtown	216,617	15
50C*	The T-Off Campus Apartments	Cumberland Avenue between Concord and Phillip Fulmer Way	143,671	3
90 A/B	Crosstown	Crosses Kingston Pike at Morrell/Buckingham near West Town Mall	165,296	26

*Route may be eliminated

Figure 3-22
KAT Transit Routes



Land Use

The rail line runs along the north side of the downtown area and is at a lower grade than the level of the downtown area. Pedestrian connectivity to the rail line from downtown would be relatively difficult and a circulator bus would be required to make the connection from most of downtown. Moving west from downtown – in the area where Cumberland Avenue passes through the University of Tennessee and the higher-density commercial and residential area just west of the University, the adjacent land uses are primarily active industrial in nature between downtown and Third Creek.

West of Third Creek, the rail line runs alongside the Cherokee Country Club on the south side and through some residential and commercial areas near where the rail line crosses Kingston Pike. The rail line travels through a number of commercial and retail areas, but runs along the backside of the lower-density strip shopping retail.

West of North Shore Drive, the rail alignment passes through some low density, light industrial, warehouse and office uses south of Kingston Pike. West of Baum Drive/Royal Crown Drive to the proposed terminus at Morrell, the adjacent land use is mostly lower density residential.

Population and Employment Density

The population density along the Norfolk Southern Railroad Western Corridor varies from 0 persons to more than 5,000 persons per square mile. The highest density areas are multi-story student housing developments in the UT area. Other pockets of dense population are found near Forest Heights and Tobler Road, just south of I-40; near Morrell Road; Gallaher Road; and, South Peter Street. In total, nearly 48,000 people live within a ½ mile radius of the Norfolk Southern Railroad Western Corridor. The average population density along the Norfolk Southern Railroad Western Corridor is 1,404 people per square mile. Figure 3-23 below details population density within ½ mile of the corridor.

Based on the outputs of the Knoxville TPO's Travel Demand Model, projected future population for the year 2035 was also assessed for the corridor. The Norfolk Southern Railroad Western Corridor shows a consistent 50 to 100 percent projected growth in population in nearly all of the TAZs along the corridor. Figure 3-24 displays the Traffic Analysis Zones along the corridor and the percentage of change in population projected.

There are more than 2,500 employment locations identified within ½ mile of this corridor, providing more than 35,000 jobs. The employers with the greatest number of employees in this area are Fort Sanders Medical Center, Children's Hospital, Tennessee Valley Authority, and 21st Century Mortgage. The average number of employees per square mile along the Norfolk Southern Railroad Western Corridor is roughly 1,000. Figure 3-25 shows the employment locations, with the largest employee centers highlighted in light blue.

The Knoxville TPO's model projects that employment will grow by 25 to 50 percent for nearly all of the TAZs located along the Norfolk Southern Railroad Western Corridor by 2035. The greatest employment growth is anticipated for the TAZ located immediately west of Morrell Road and south of the rail corridor (Figure 3-26).

Household Income

The median household income in Knox County is approximately $42,000. The income levels along the Norfolk Southern Railroad Western Corridor are on par with the countywide median household income, with nearly all of the TAZs having a median household income of $41,000 - $82,000 (Figure 3-27).

Potential for Higher Frequency Transit along Norfolk Southern Railroad Western Corridor

Positive Attributes

- Physical proximity to the University of Tennessee;
- Large employment centers concentrated in downtown area; and,
- Some segments of this area would benefit from maximized development.

Areas that Need Improvement

- Likely downtown station location is at edge of downtown, would require circulator connections to achieve connectivity;
- Commuter rail is only option that could be considered without achieving temporal or physical separation with existing rail traffic;
- Single track sections of rail that would limit capacity;
- Right-of-way limitations under bridges;
- Low population density near rail corridor outside of downtown; and,
- Low employment density near rail corridor outside of downtown.

Figure 3-23
Norfolk Southern Railroad Western Corridor
Population Density

Population within 1/2 mile of Norfolk Southern Railroad Western Corridor

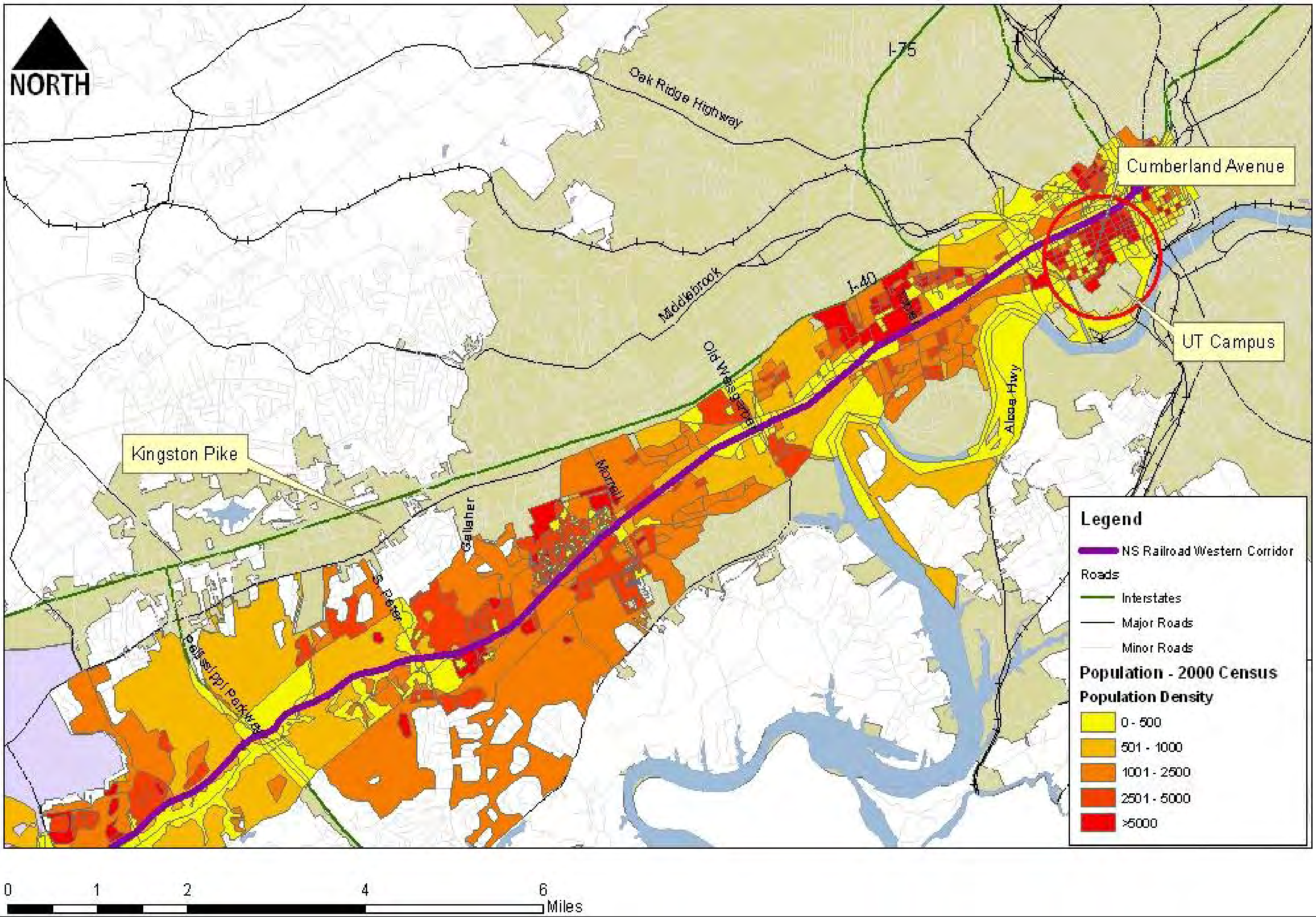


Figure 3-24
Norfolk Southern Railroad Western Corridor
Population Change (2006 – 2035)

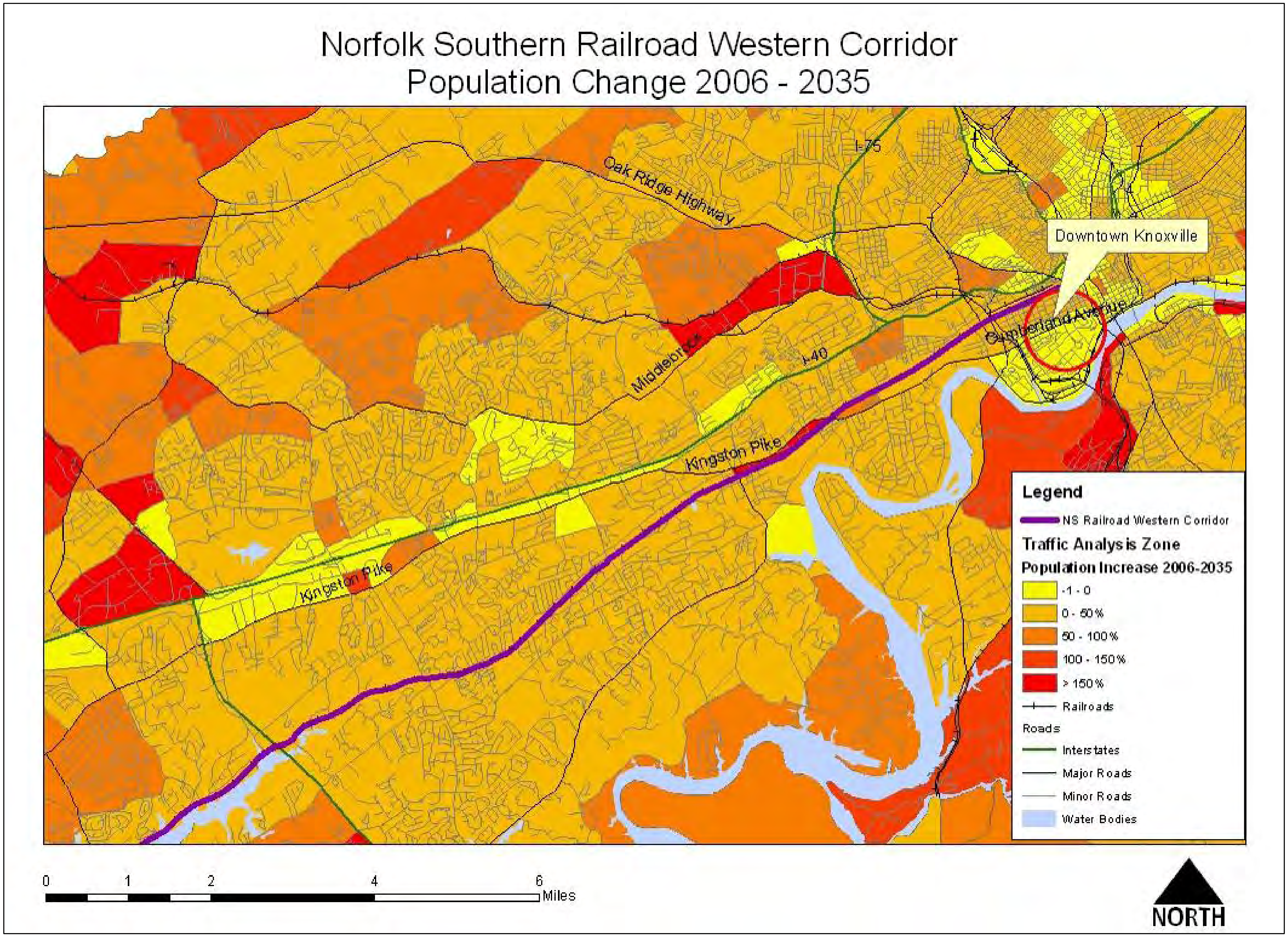


Figure 3-25
Norfolk Southern Railroad Western Corridor
Employment Locations

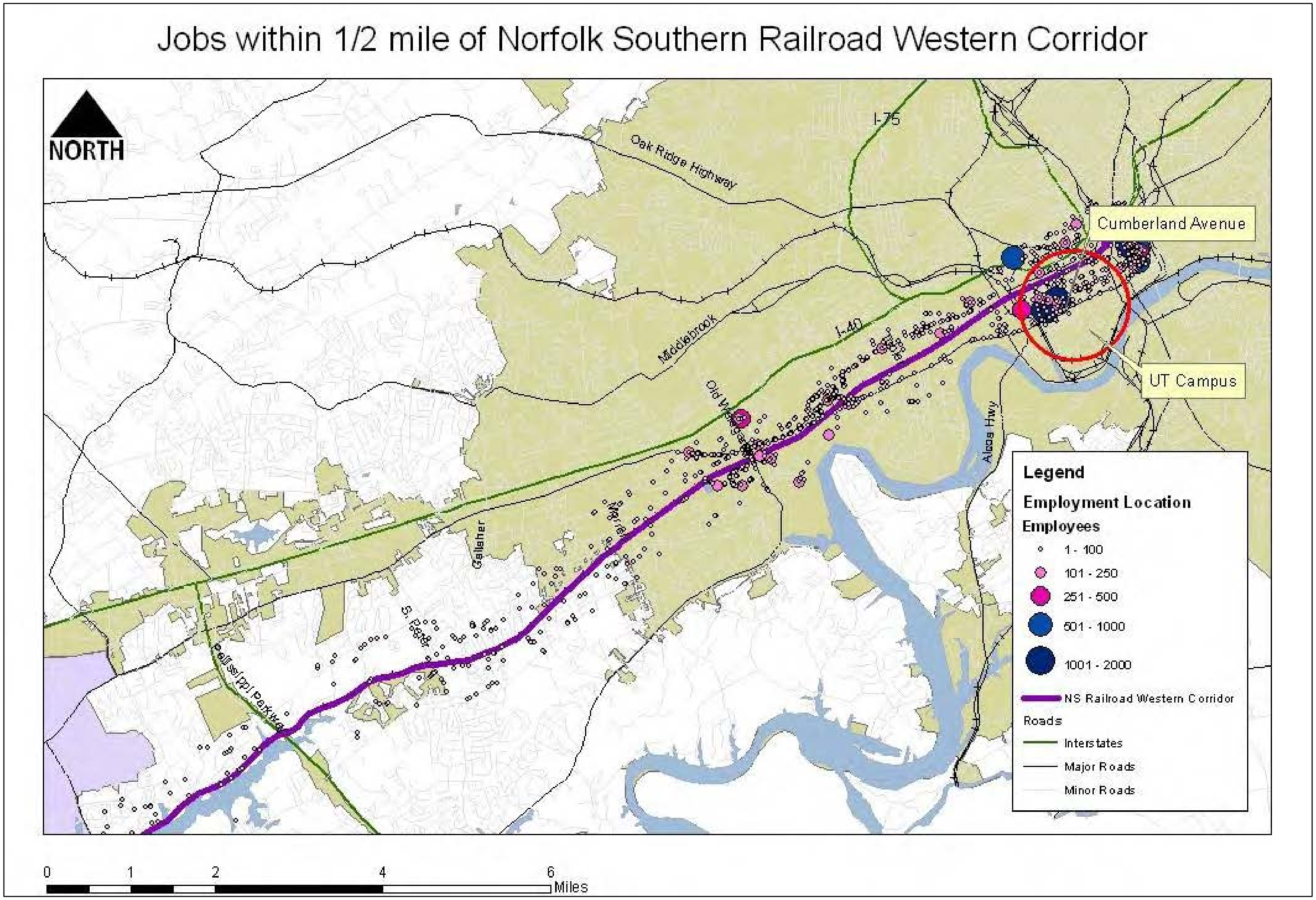


Figure 3-26
Norfolk Southern Railroad Western Corridor
Employment Change (2006 – 2035)

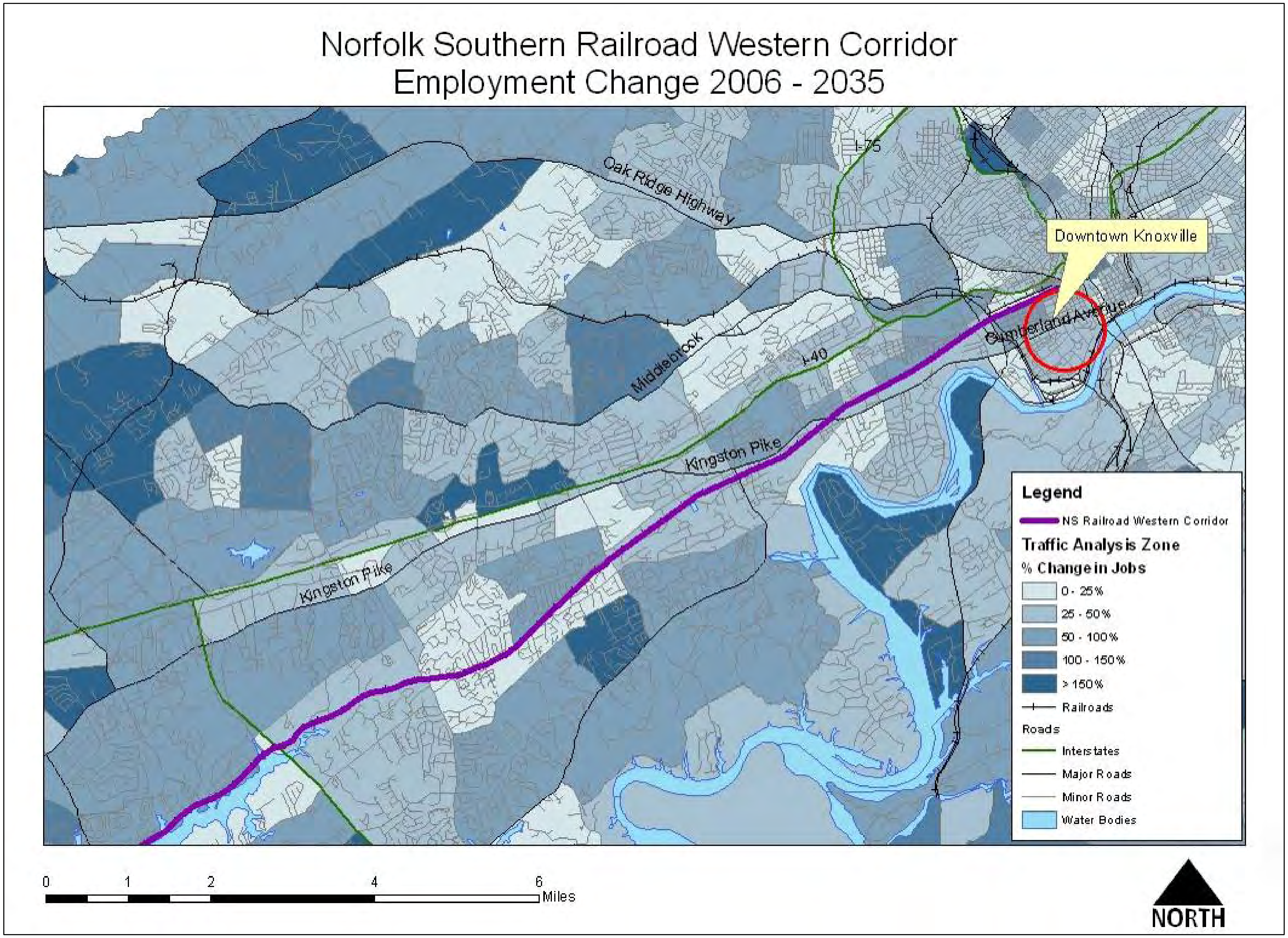
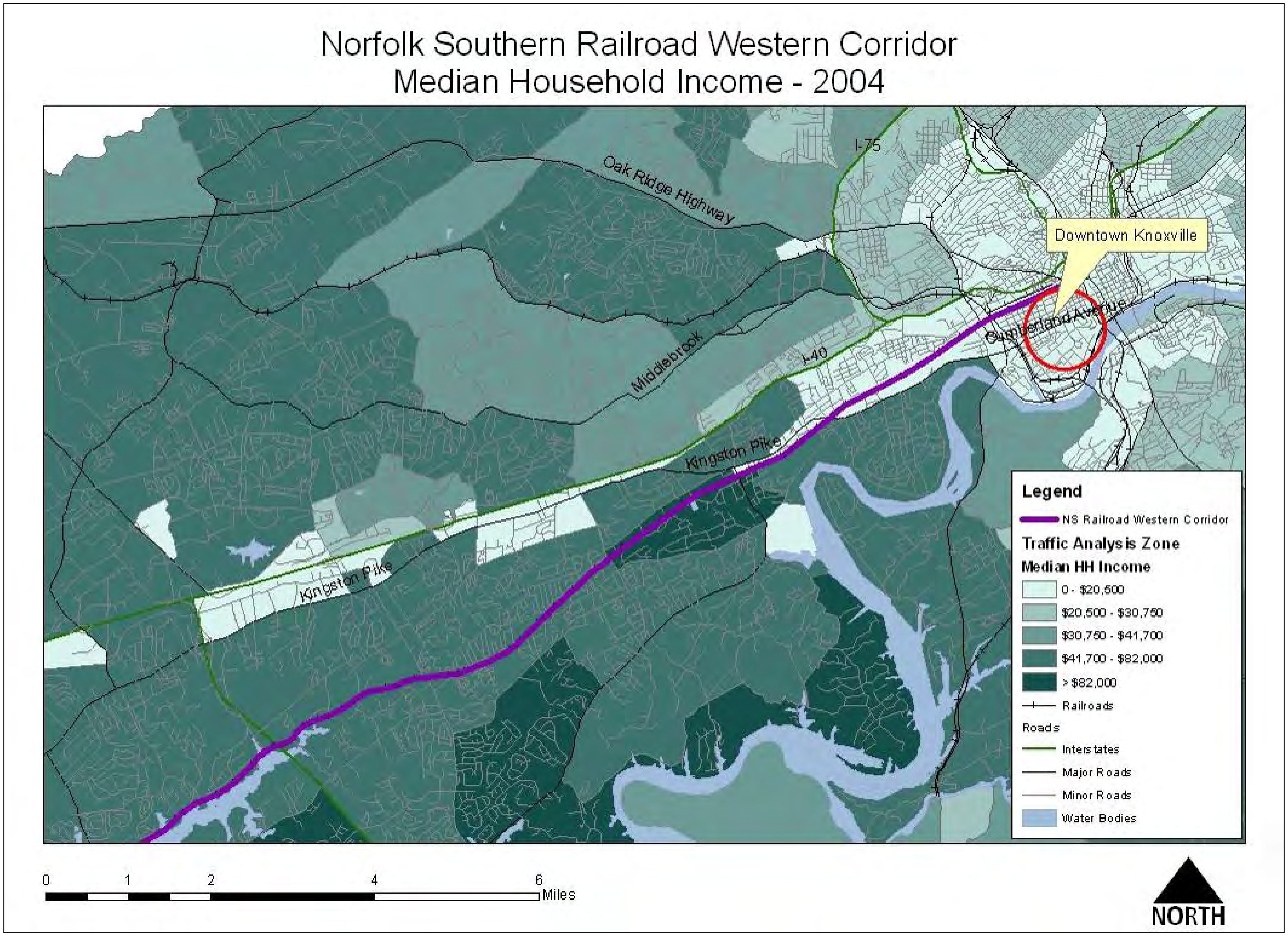


Figure 3-27
Norfolk Southern Railroad Western Corridor
Median Household Income



Corridor 3: Western Avenue Corridor

The Western Avenue Corridor (SR 62) is an east-west route through the City of Knoxville (Figure 3-29). It is called Oak Ridge Highway as it extends from the City of Oak Ridge in Anderson County into Knoxville. There is an interchange with Western Avenue and I-640 on the west side of town, and the road feeds directly into 11th Street in downtown Knoxville, providing access to the University of Tennessee along its eastern edge. Western Avenue ends at Henley Street, just east of 11th Street.

Transportation Network

Western Avenue is a limited access facility with a series of intersection bridges and ramps from Henley Street to Interstate 40 through the downtown area (Figure 3-28), which limits the ability to implement TOD in this area. The number of lanes varies from four to six through downtown Knoxville. It is six lanes from Henley Street to 11th Street, four lanes with slip lanes to I-40 and five lanes to College Street. From College Street to Middlebrook Pike, Western Avenue becomes a four-lane at-grade roadway, with left turn lanes at major intersections. From 21st Street North to Orange Avenue, there is a continuous center turn lane. Western Avenue continues as a four-lane to Keith Avenue. Between Schofield and Keith there is an at-grade railroad crossing, after which Western becomes a two-lane road until just before the intersection of Texas Avenue. Past Pleasant Ridge it is six lanes, with a center turn lane to Sanderson Road. From Sanderson to Hinton Road there are six lanes, with a median and turn lanes at major intersections. At Hinton Road, Western Avenue again becomes a two-lane cross-section, with shoulders and ditches to the Knoxville city limits (Figures 3-30 and Figure 3-31).

Figure 3-28
Western Avenue from Henley Street to I-40

Figure 3-29
Map of Western Avenue Corridor

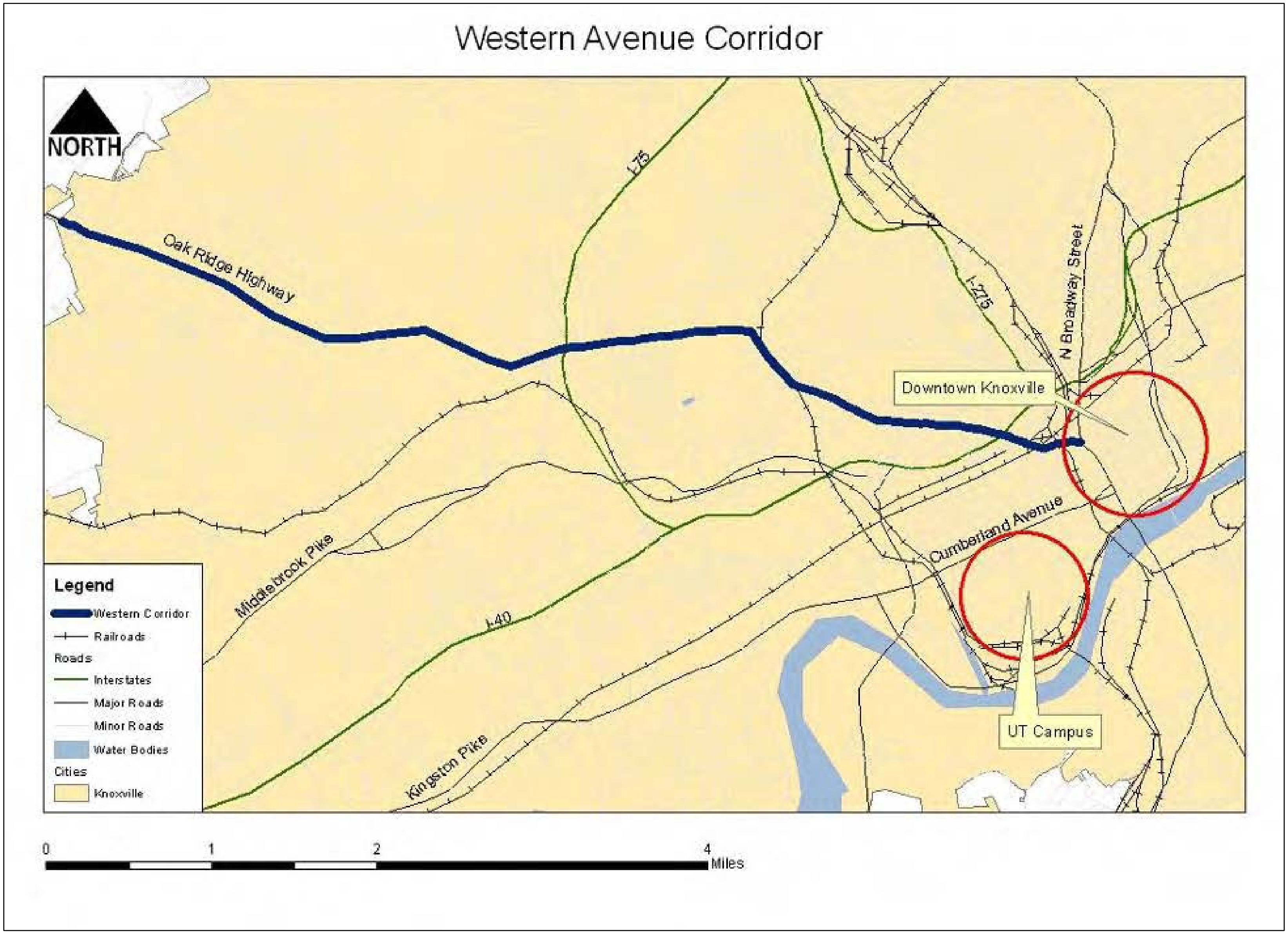


Figure 3-30
Western Avenue near Middlebrook Pike

Figure 3-31
Western Avenue Two-lane Section

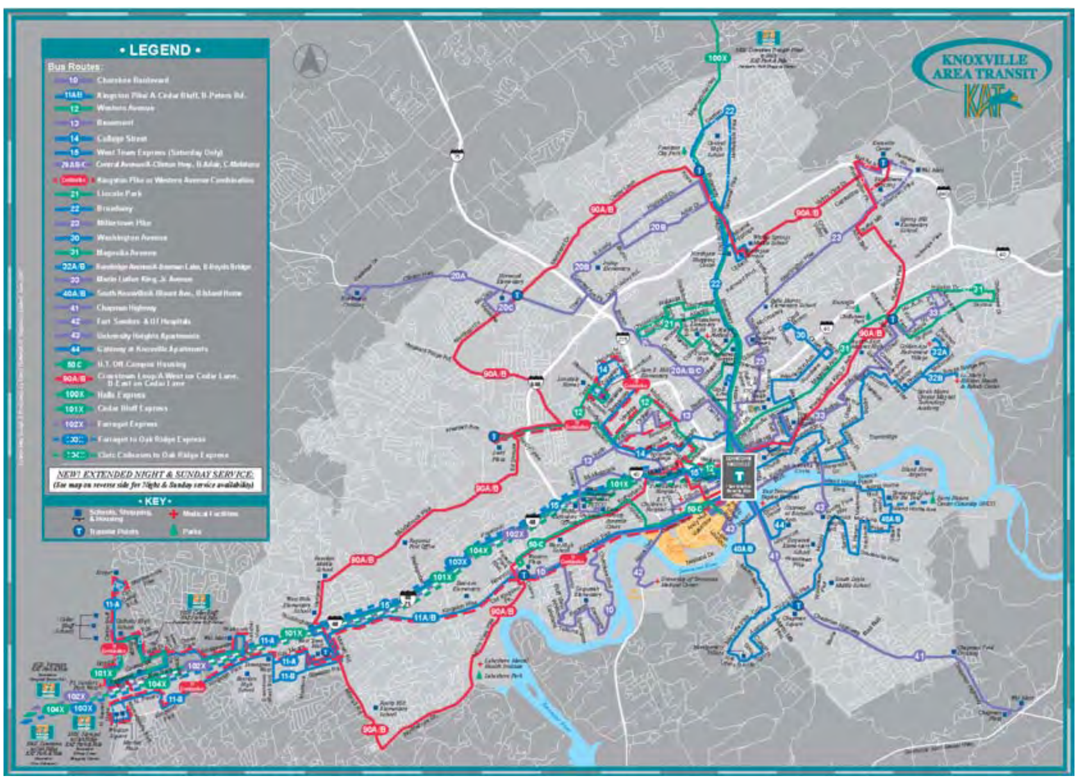
Transit Service

Knoxville Area Transit (KAT) routes are shown on Figure 3-32. KAT operates four routes that travel on Western Avenue for a portion of their route. Bus shelters are found along the street at stops with higher volumes of boardings. Detailed route information is below in Table 3-3.

Table 3-3
Transit Routes on Western Avenue Corridor

Route	Route Name	Segment of Western Avenue Traveled	2008 Annual Ridership	Revenue per Revenue Mile Rank
11 A	Kingston Pike	City limits to Morrell Road	216,617	15
15	West Town Non-Stop	Morrell Road to downtown	3,133	33
101x	Cedar Bluff Express	City limits to downtown	11,371	32
102x	Farragut Express	City limits to downtown	19,960	29

Figure 3-32
KAT Transit Routes



Land Use

Western Avenue through downtown Knoxville is surrounded by industrial uses and a few small commercial businesses. Past the University of Tennessee there is public housing, sections of which appear to be newly constructed. The buildings are constructed close to the street. New Gray Memorial Cemetery is located between Tennessee Avenue and Pleasant Ridge Drive. Between Sanderson Road and Hinton Road is a stretch of commercial strip centers and fast food restaurants. This section of the corridor is aging, in various stages of disrepair, and the land is underutilized.

After Western Avenue crosses Hinton Road, the land use becomes less dense and buildings are set further back from the street. A proposed fixed guideway transit system most likely would terminate in this area.

Population and Employment Density

The greatest population densities occur north of Western Avenue between I-275 and the railroad tracks near Schofield Street and north and south of Western Avenue from the railroad tracks to I-75 (Figure 3-33). With the exception of several parcels used for commercial purposes, the density within the I-75/I-275 loop is fairly contiguous. Other pockets of dense population are found from Windsor Park to the Knoxville City limits. In total, more than nearly 25,000 people live within a ½ mile radius of the Western Avenue Corridor. The average density along the corridor is 2,200 people per square mile.

Projected future population (2035) was also assessed for the corridor, based on the outputs of the Knoxville TPO's Travel Demand Model. The area near Windsor Park shows the greatest percentage increase in population. Figure 3-34 displays the Traffic Analysis Zones along the corridor and the percentage of change in population projected.

There are over 1,300 employment locations identified within ½ mile of this corridor, providing more than 24,000 jobs. The employers with the greatest number of employees in this area are: Tennessee Valley Authority, City of Knoxville and Knox County government offices, Knoxville News Sentinel, and 21st Century Mortgage. There are between 1,300 and 540 jobs at these six locations, located on the eastern side of Broadway in downtown Knoxville and near the rail line just west of the downtown. The average employment density for the corridor is approximately 2,100 employees per square mile. Figure 3-35 shows the employment locations, with the largest employment centers shown in dark blue.

Anticipated employment growth rates based on the TPO's 2035 model projections show a fairly consistent employment growth of 25 to 50 percent or 50 to 100 percent for nearly all of the TAZs along the Western Avenue Corridor (Figure 3-36).

Household Income

The median household income in Knox County is approximately $42,000. The median household income along the Western Avenue Corridor within the I-75 loop fall within two categories: $20,500 - $ 30,750 and $30,750 - $41,700, less than half and less than three-quarters of the median household income respectively. Past the I-75 loop and away from downtown Knoxville, the median household income increases to be on par with, and even surpassing, the countywide median household income (Figure 3-37).

Potential for Higher Frequency Transit along Western Avenue Corridor

Positive Attributes

- Dense population centers are fairly contiguous;
- Large employment centers concentrated in downtown area and near rail line;
- Public housing located along corridor;
- Existing bus route;
- Lack of pedestrian facilities; and,
- Large segments of Western Avenue would benefit from redevelopment.

Areas that Need Improvement

- Limited access roadway through downtown limit TOD opportunities;
- Right-of-way limitations under bridges and in other areas;
- Lower residential density after Hinton Road; and,
- Limited employment outside of downtown.

Figure 3-33
Western Avenue Corridor
Population Density

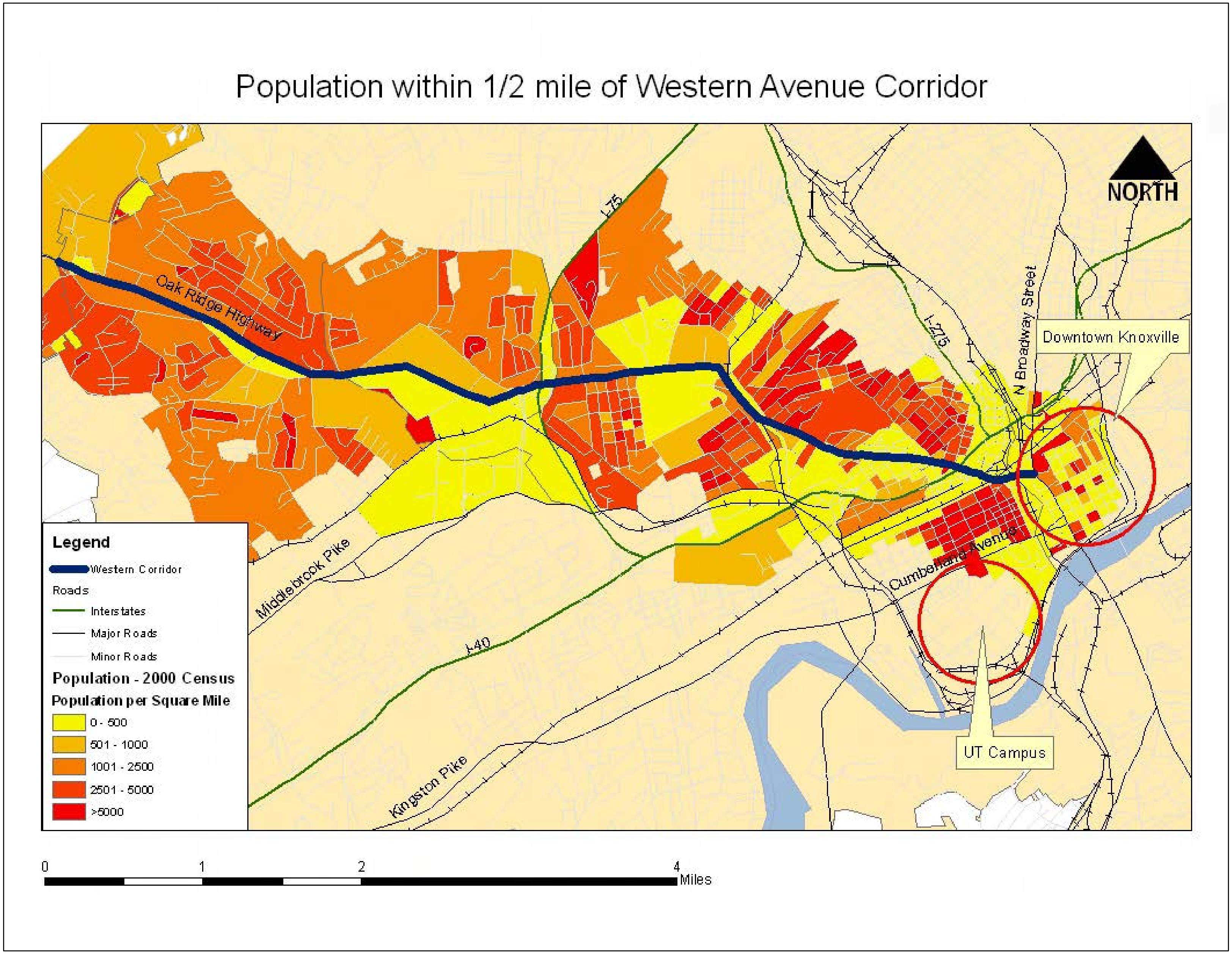


Figure 3-34
Western Avenue Corridor
Population Change (2006 – 2035)

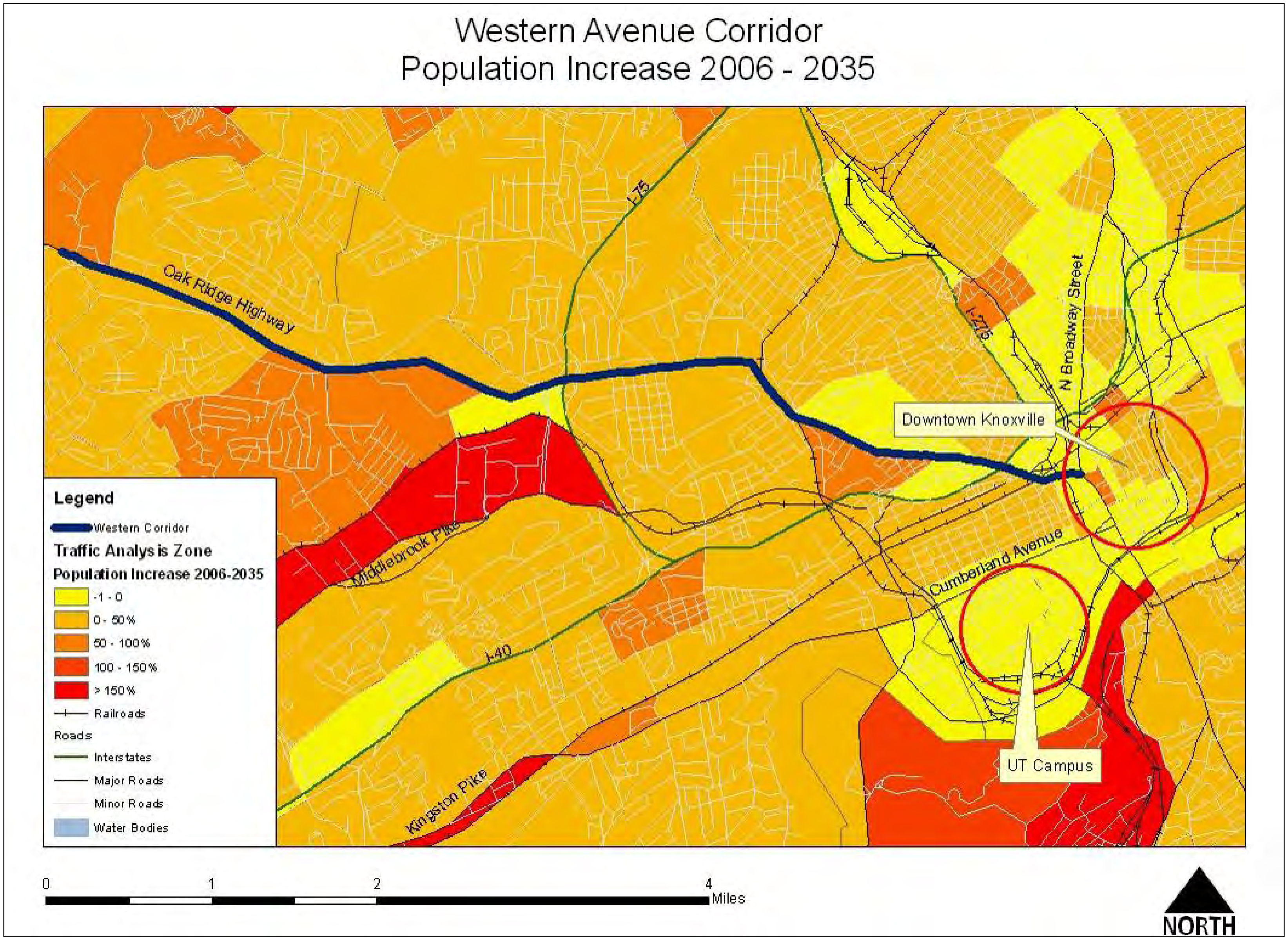


Figure 3-35
Western Avenue Corridor
Employment Locations

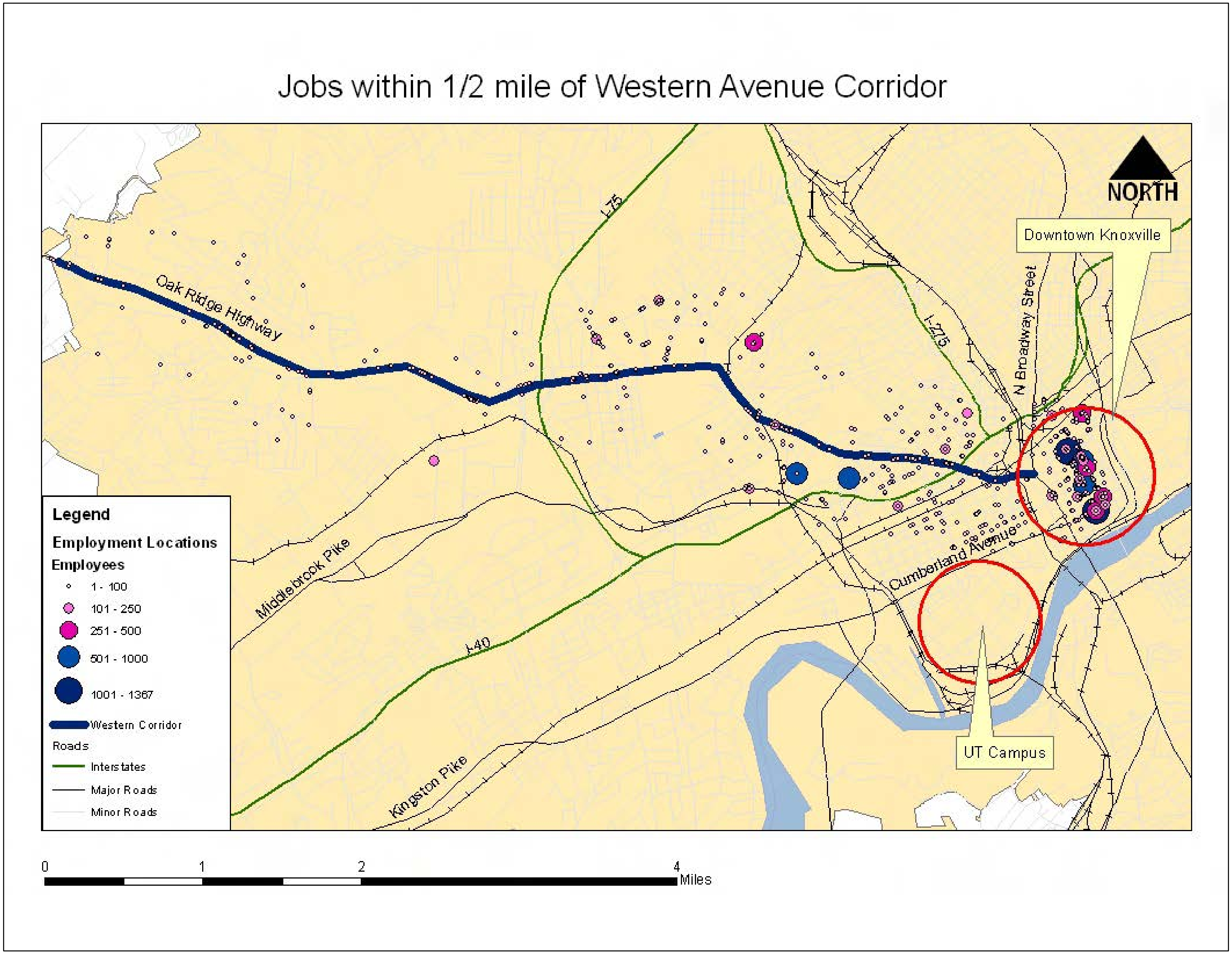


Figure 3-36
Western Avenue Corridor
Employment Change (2006 – 2035)

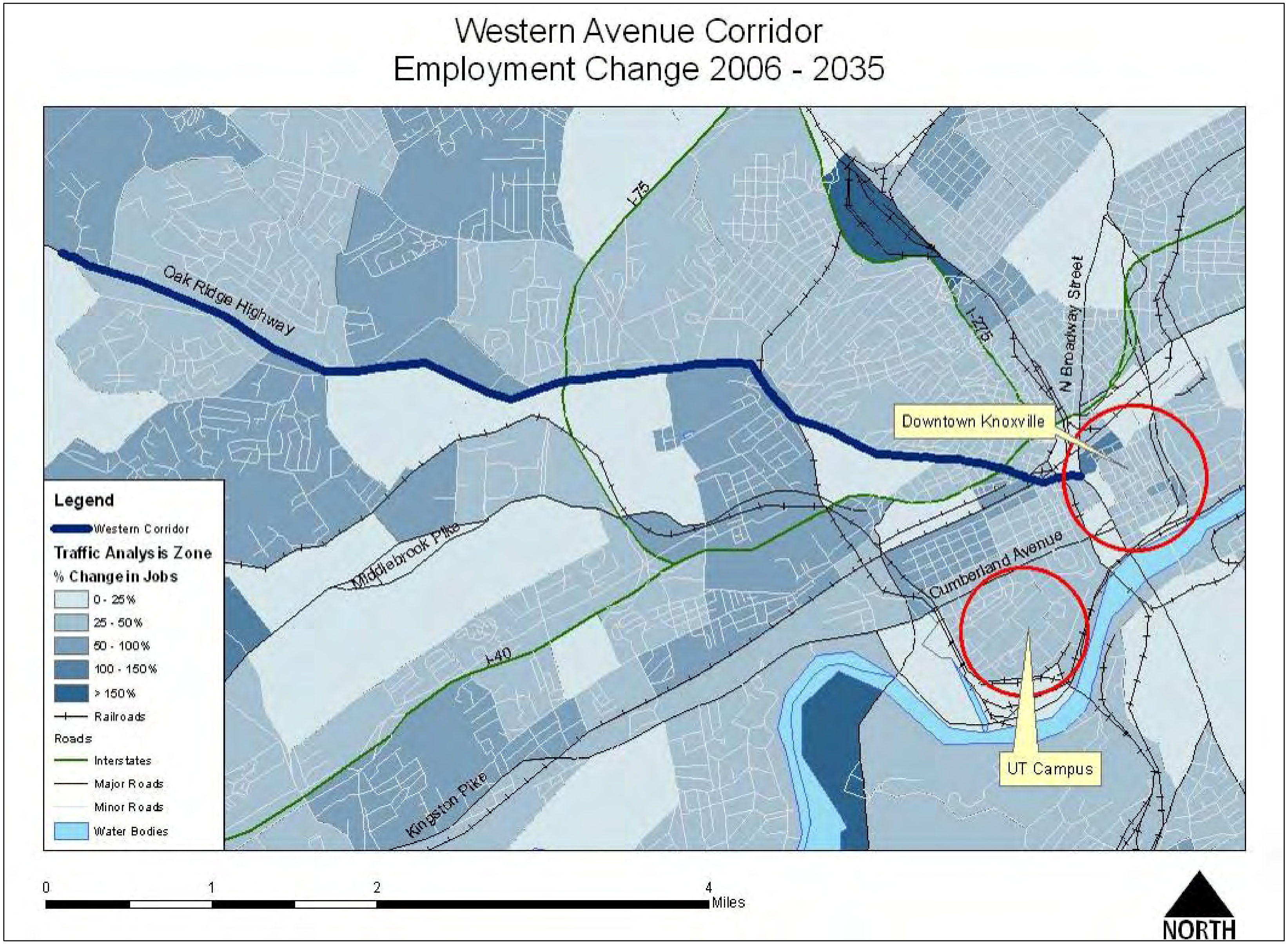
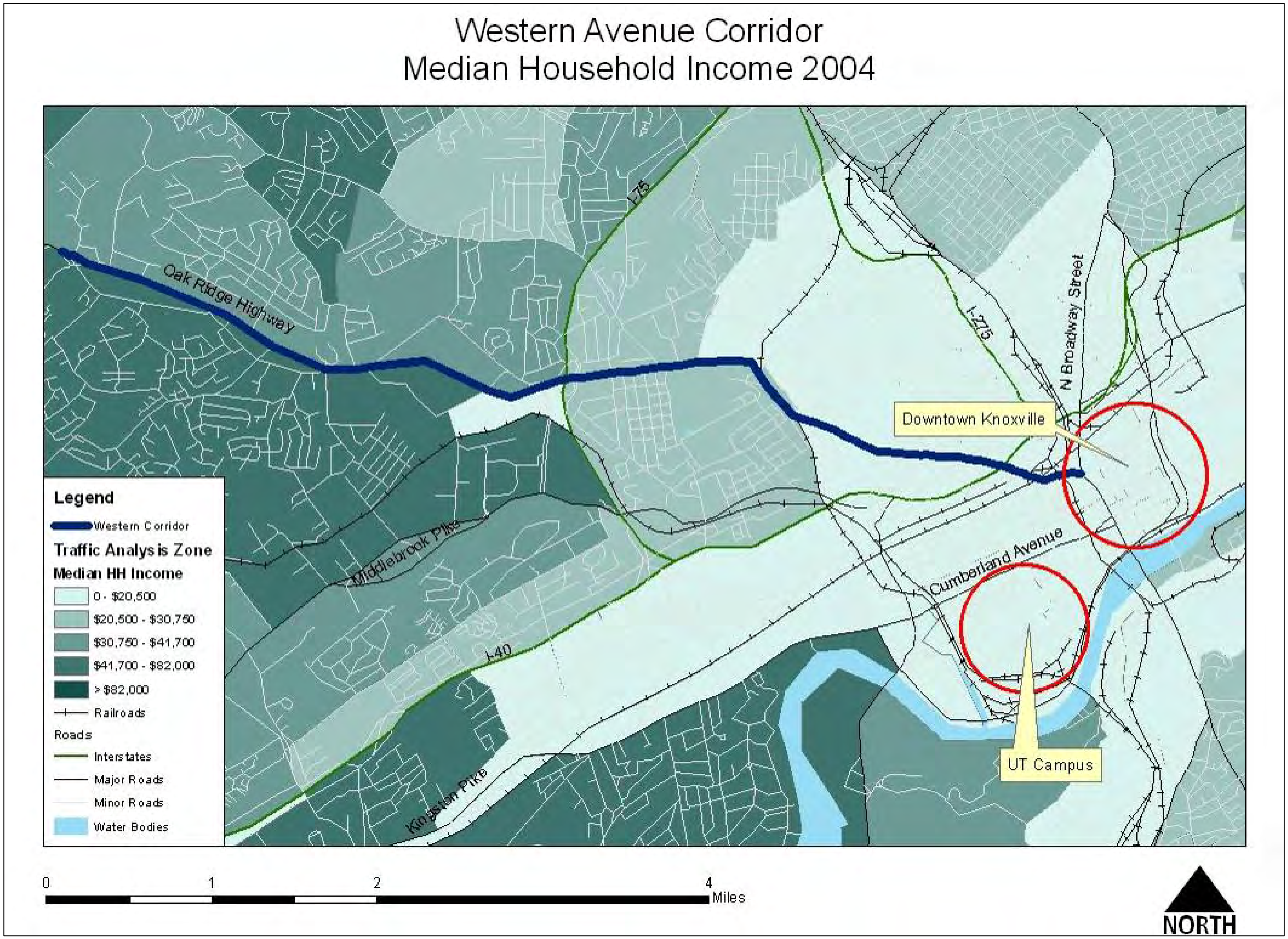


Figure 3-37
Western Avenue Corridor
Median Household Income



Corridor 4: North Broadway Street Corridor

The North Broadway Corridor (U.S. 441/SR 33) runs north – south from downtown Knoxville north to Maynardville (Figure 3-40). The corridor was analyzed from the intersection of Henley Street to the Knoxville city limits.

Transportation Network

The number of lanes on North Broadway varies from three to five along the length of the corridor. Through downtown there are five lanes at Summit Hill Drive and four lanes from Oak Avenue to North Central Avenue (Figure 3-38). There is a bridge that limits expansion of the road at Oak Avenue. There are three lanes from North Central Avenue to Grainger Street.

There are double left turn lanes at the Woodland Avenue intersection that provide additional turning capacity for Fulton High School (Figure 3-39). There is sufficient right-of-way in this area, through the intersection of Raleigh Avenue, to widen for transit if necessary.

Figure 3-38
North Broadway at North Central

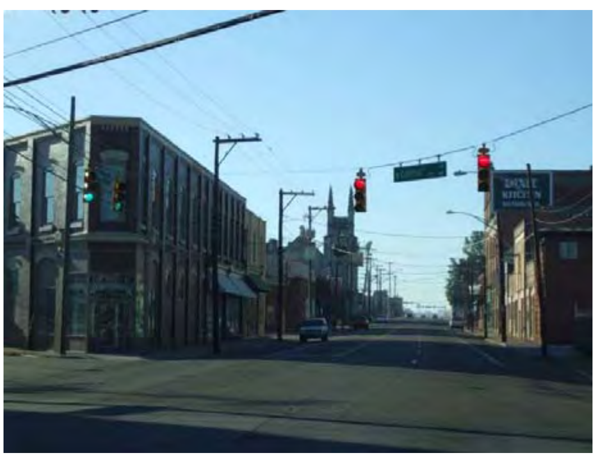
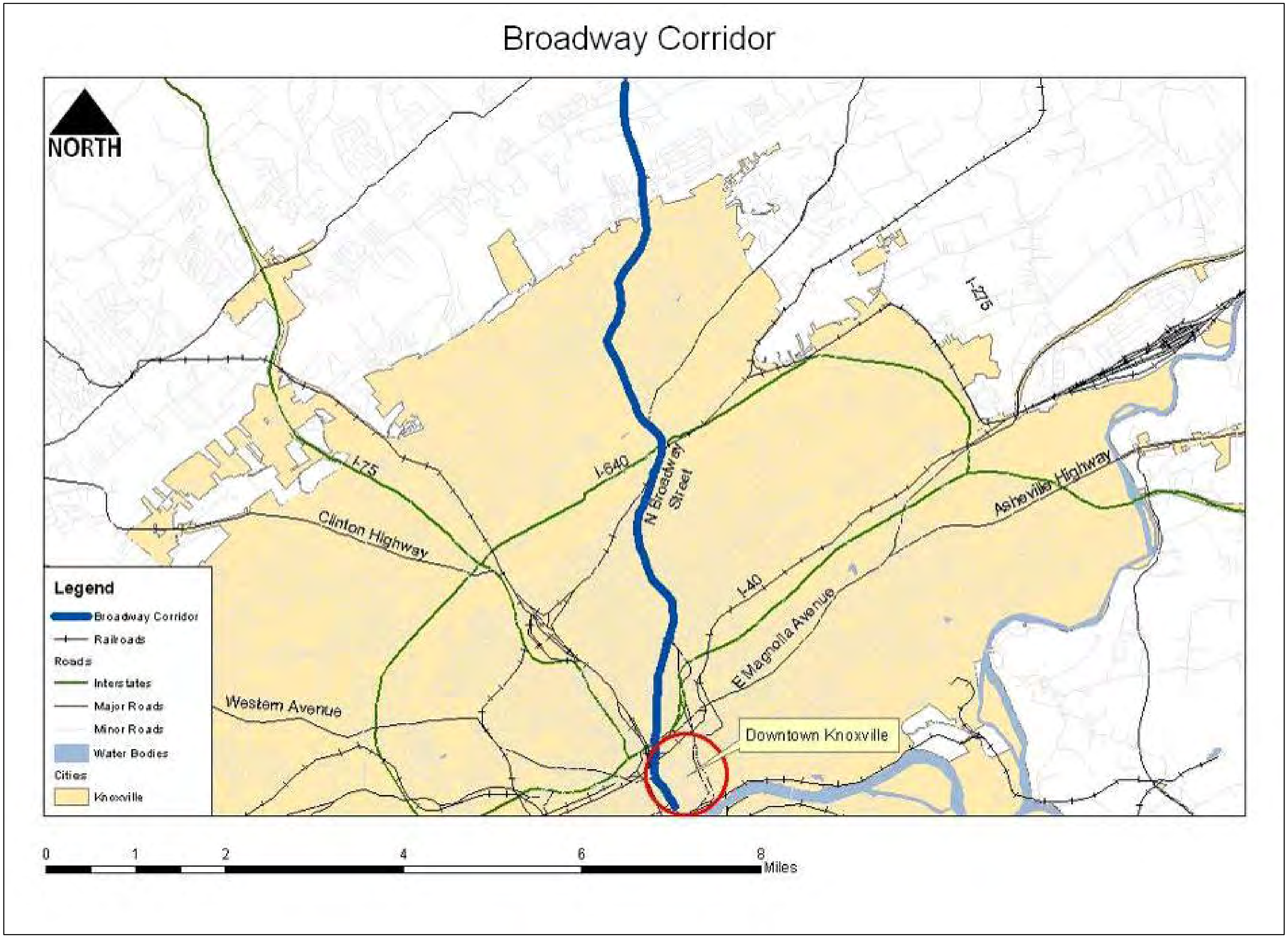


Figure 3-39
North Broadway at Coker/Woodland

Figure 3-40
Map of North Broadway Corridor



Broadway widens to five lanes from Grainger Street to Raleigh Avenue, where it is reduced to four lanes until Adair Drive. Just south of Adair, at Old Broadway, North Broadway is a four-lane section with a concrete median and an overpass for I-640. Between Adair Drive and the Halls Community there are five lanes with a grass median. This is a wide cross-section, with sufficient room for transit enhancements. The likely terminus for the corridor is at the Halls Shopping Center, a former KAT Park & Ride lot (Figure 3-41).

Figure 3-41
North Broadway at Halls Shopping Center Park & Ride Lot

Sidewalks exist along North Broadway in the downtown area and continue after I-40 through the intersections of Woodland Avenue near Fulton High School. There are gaps in the sidewalk network for the remainder of the corridor. They generally exist, though in varying widths and conditions, through the commercial areas in Fountain City. Utilities are located in the right-of-way and would need to be relocated if the road were improved for transit.

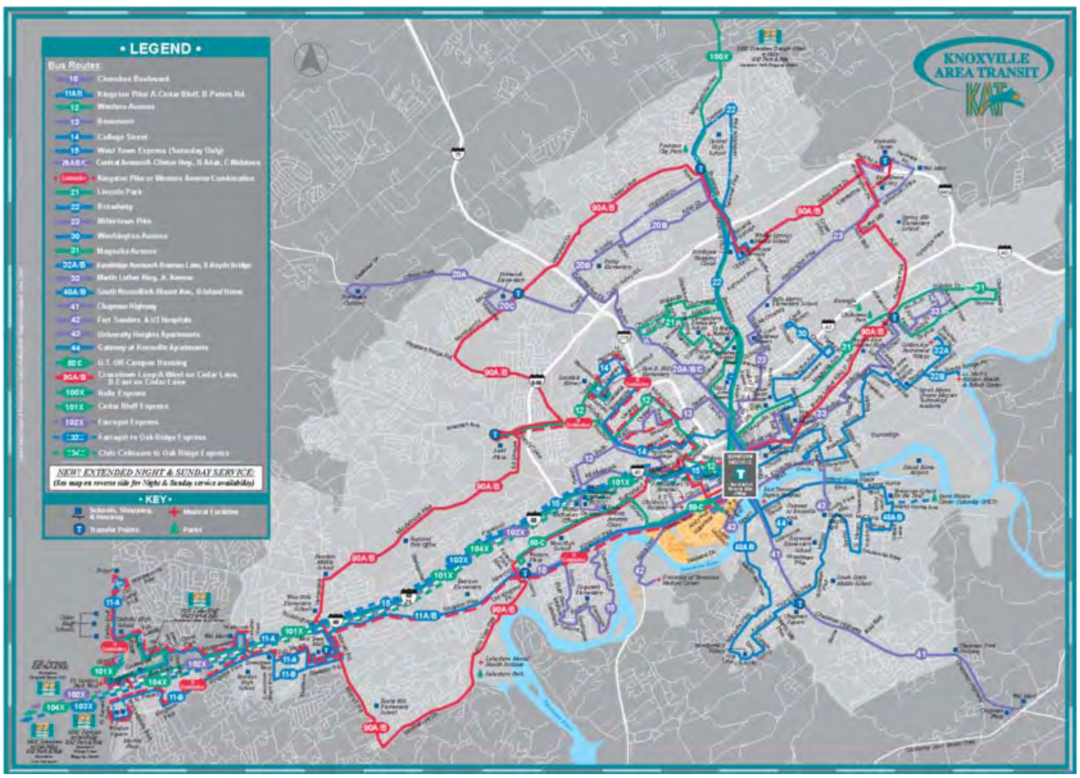
Transit Service

Knoxville Area Transit (KAT) routes are shown on Figure 3-42. KAT operates Route 22 (Table 3-4 below) from downtown north along Broadway and portions of Old Broadway, making a loop north of Central High School, inside the Knoxville City limits. Route 100X was an express route that ran express buses from downtown to Halls along North Broadway/Maynardville Highway. The route was eliminated in August 2009. The Halls Shopping Center, located near the intersection of Maynardville Highway and Cunningham Road, acted as a KAT Park-and-Ride while the express route was in operation. Signs for the routes, but no benches or shelters, are located along the North Broadway Corridor.

Table 3-4
Transit Routes along North Broadway Corridor

Route	Route Name	Segments of N. Broadway Traveled	2008 Annual Ridership	Revenue per Revenue Mile Rank
22	Broadway	Garden to downtown	172,591	9

Figure 3-42
KAT Transit Routes



Land Use

From the southernmost point of North Broadway through the general downtown area, the land uses are industrial, institutional (churches) and small scale commercial such as banks or small fast food restaurants. The Salvation Army and Rescue Mission are located near Oak Avenue and the buildings are close to the street. Several buildings are boarded up or in a state of disrepair (Figure 3-43). There is, however, some indication of infill development, with the St. John's Community Development underway.

Figure 3-43
Dilapidated Building on North Broadway near Rescue Mission

The Old Gray Cemetery is on the western side of North Broadway, just north of the I-40 overpass. The buildings in this area are older and in need of repair. Vacant buildings are interspersed along the corridor. This is an ideal area for redevelopment activities.

After Gill Street, the buildings appear to be newer and in better condition. There are large expanses of parking lots and underdeveloped lots. After Grainger Street, the development becomes less dense and the buildings are located further back from the street.

Near the intersection of Raleigh Avenue, there are marginal businesses such as small used car lots that could be redeveloped.

North Broadway between I-40 and I-640 has areas of dense, urban residential development to the east and west (Figure 3-44). Fulton High School and the Northgate Shopping Center are also located in this area.

Lynnhurst Cemetery is located just north of I-640, on the west side of North Broadway. Between Adair Drive and Hotel Road is still an urban environment, with buildings close to the street, a small commercial center and a park. North of Hotel, the topography becomes hillier, the density decreases, and the area becomes more rural in nature. The topography and development continues in this way to the northern Knoxville city limits (Figure 3-45).

Figure 3-44
North Broadway near Hotel Street

Figure 3-45
North Broadway near Northern City Limits

Population and Employment Density

The population density along the North Broadway Corridor is contiguous and consistently dense along the entire corridor (Figure 3-46). The greatest densities occur in the area of the University of Tennessee Campus. Other pockets of dense population are found within the loop created by I-40 and I-640. All total, more than 33,000 people live within a ½ mile radius of the North Broadway Corridor. The average density along the corridor is 1,830 persons per square mile.

Projected future population for 2035 was assessed for the corridor based on outputs from the Knoxville TPO's Travel Demand Model. This corridor shows moderate levels of population growth at best. The areas within the I-640 loop are either projected to lose population between 2006 and 2035, or experience an increase of 50 to 100 percent. Outside of the I-640 loop, population is projected to increase at the 50 to 100 percent level. Figure 3-47 displays the Traffic Analysis Zones along the corridor and the percentage of change in population projected.

There are over 2,500 employment locations identified within ½ mile of this corridor, providing more than 38,000 jobs. The employers with the largest number of employees in this area are: Mercy Health Partners, Tennessee Valley Authority, and the City of Knoxville and Knox County governments. There is an average of more than 2,100 employees per square mile. Figure 3-48 shows the employment locations, with the largest employment centers in dark blue.

The Knoxville TPO's model projects that employment will grow by 25 to 50 percent or 50 to 100 percent for nearly all of the TAZs located along the North Broadway Street Corridor by 2035. The greatest employment growth is anticipated for the TAZ located just north of I-640 and east of North Broadway (Figure 3-49).

Household Income

The median household income in Knox County is approximately $42,000. The income levels along the North Broadway Street Corridor are all less than the countywide income, with nearly all of the TAZs in the downtown are having a median household income of less than $21,000 ((Figure 3-50).

Potential for Higher Frequency Transit along North Broadway Corridor

Positive Attributes

- High residential density, especially from downtown to the I-640 overpass;
- Large employment centers concentrated in downtown area;
- Existing pedestrian traffic;
- High Transit Ridership on Route # 22;
- Right-of-way may be available along North Broadway, past the downtown area (near Woodland Avenue and Raleigh Avenue and towards northern city limits);
- Segments of North Broadway would benefit from redevelopment; and,
- Some land is underutilized along the northern portion of the corridor.

Areas that Need Improvement

- Right-of-way limitations in the downtown area;
- Limited destinations to the north; and,
- Economically depressed area.

Figure 3-46
North Broadway Corridor
Population Density

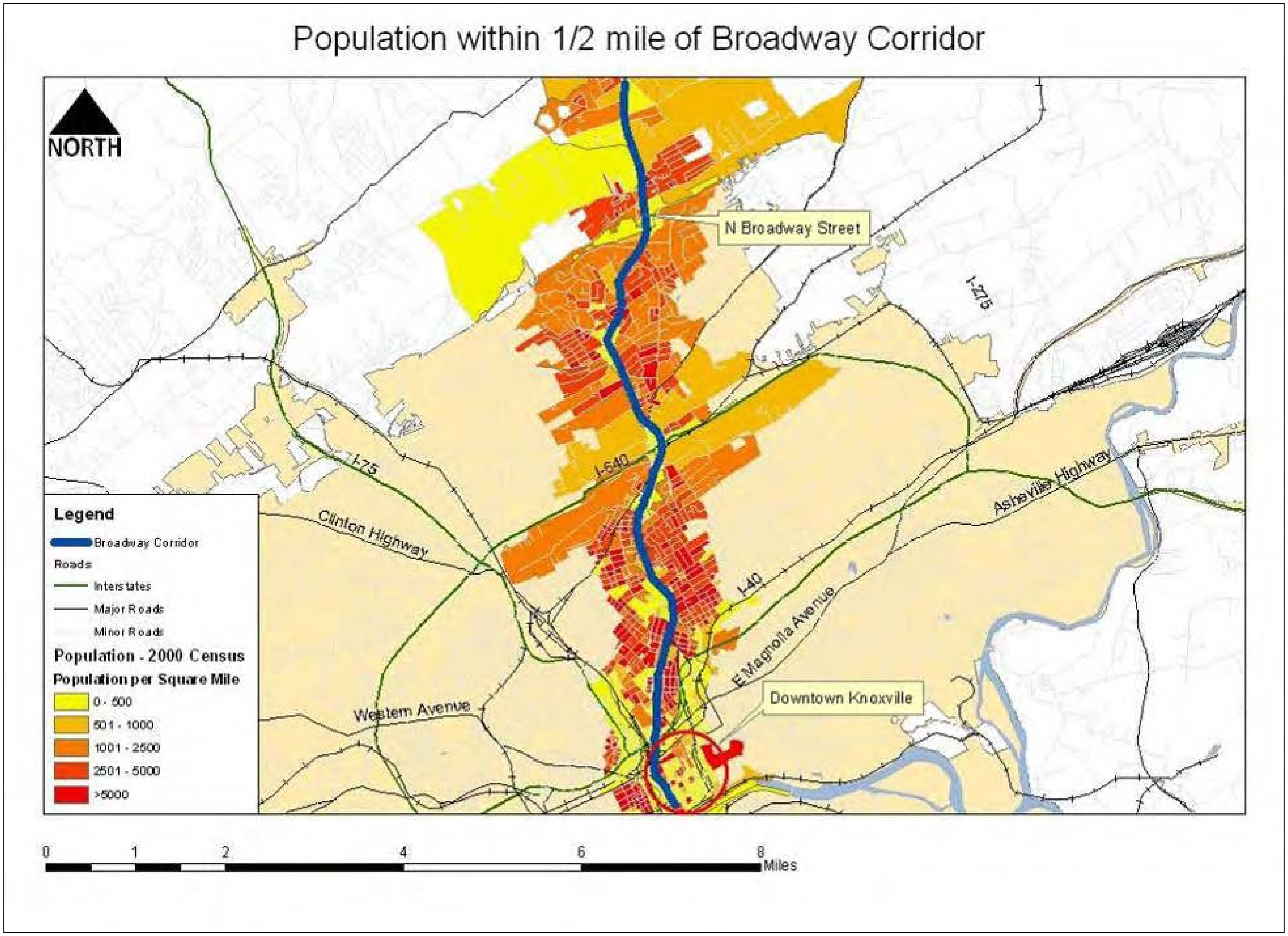


Figure 3-47
North Broadway Corridor
Population Change (2006 – 2035)

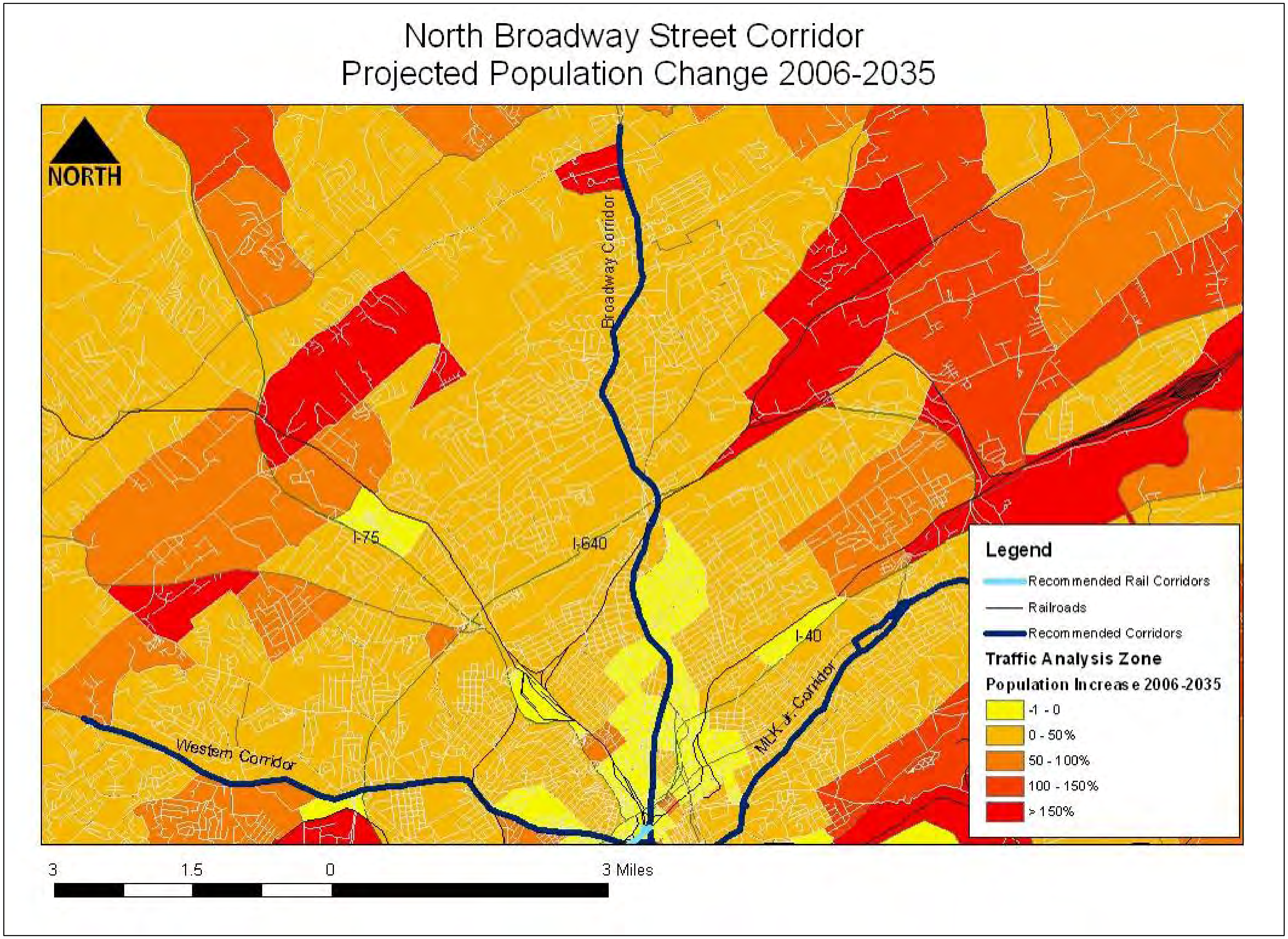


Figure 3-48
North Broadway Corridor
Employment Locations

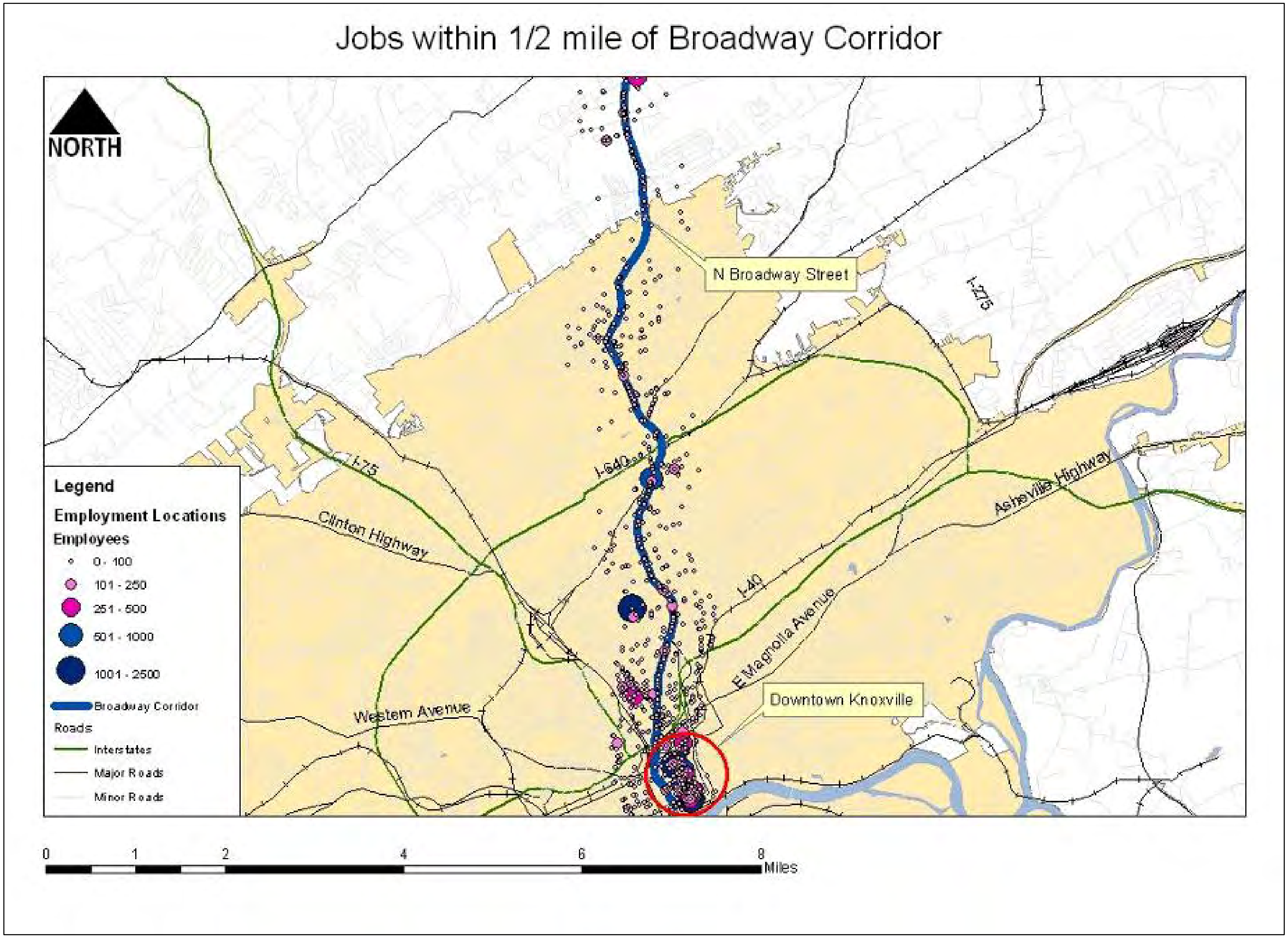


Figure 3-49
North Broadway Street Corridor
Employment Change (2006 – 2035)

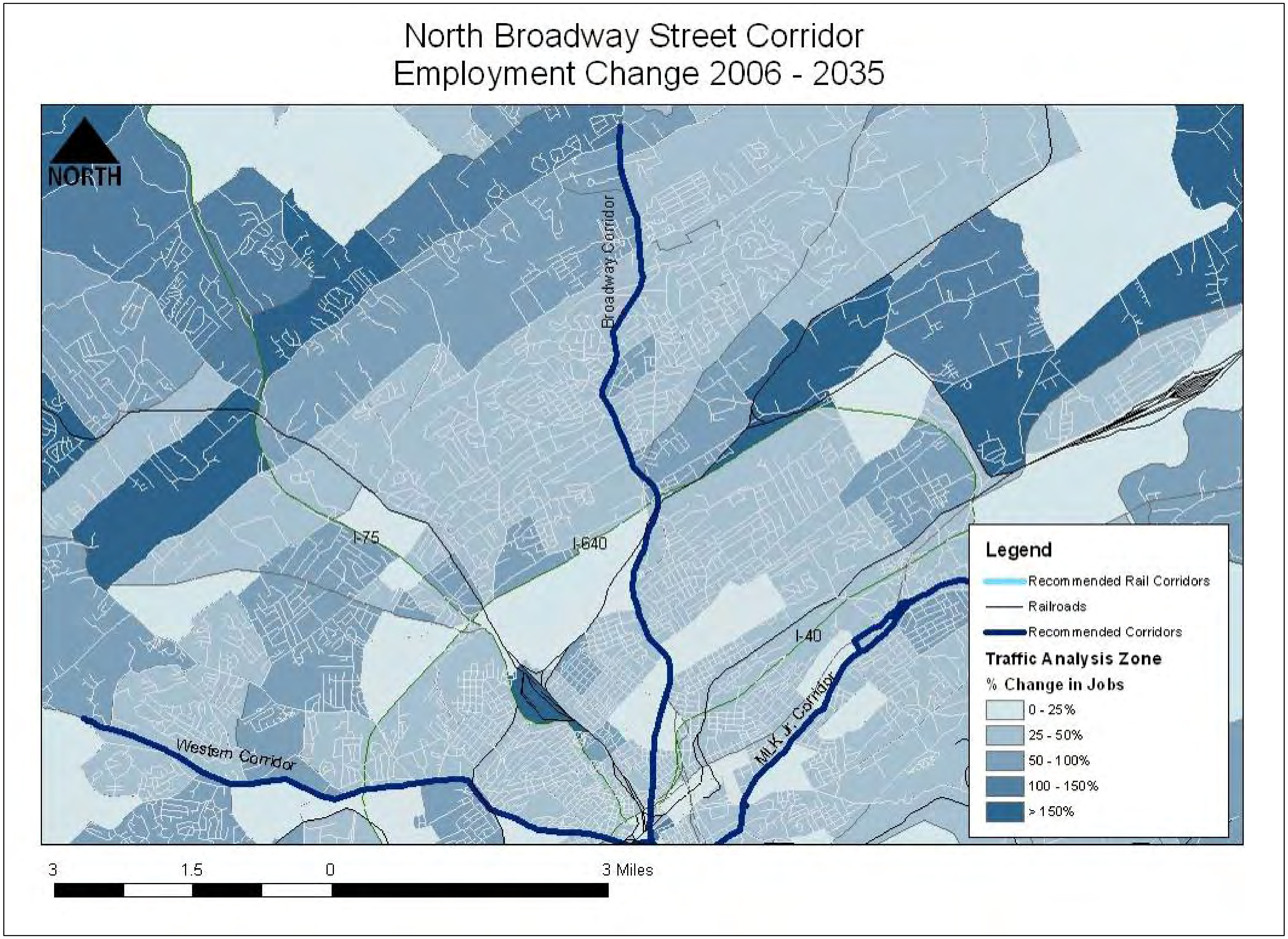
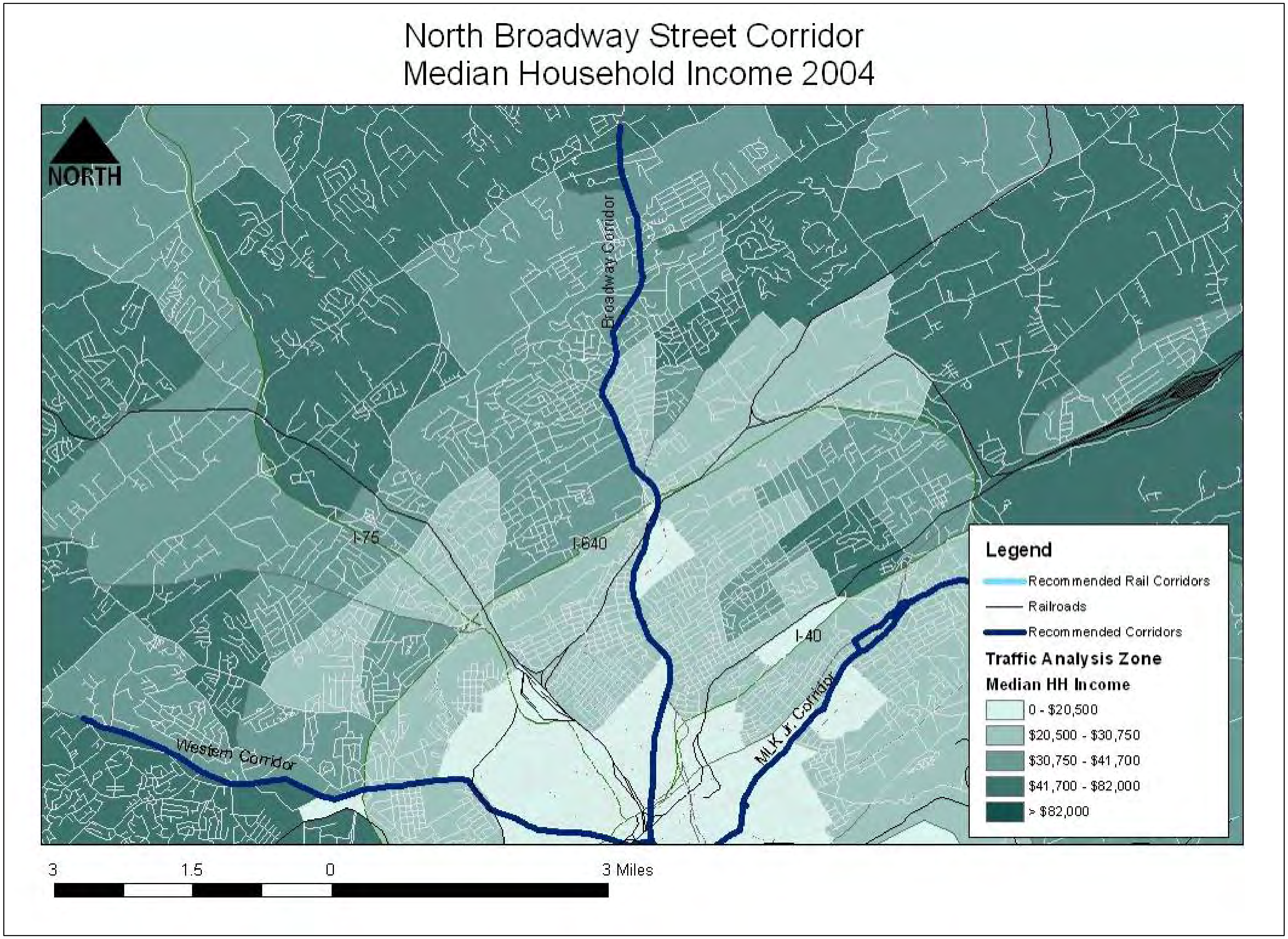


Figure 3-50
North Broadway Street Corridor
Median Household Income



Corridor 5: Magnolia Avenue Corridor

The Magnolia Avenue corridor runs northeast-southwest between downtown Knoxville and Jefferson County to the east (Figure 3-52). Magnolia Avenue (U.S. 70/11/25W, SR 1) is a major commercial arterial in the northeastern area of the city and extending into the rural area of the county. The alignment is relatively flat until the road reaches the border of Knoxville, at which point the topography becomes steep. The alignment would enter downtown from the north via Hall of Fame Drive, which would route the alignment through the new downtown transit center. From there, the route would serve downtown via Church Street.

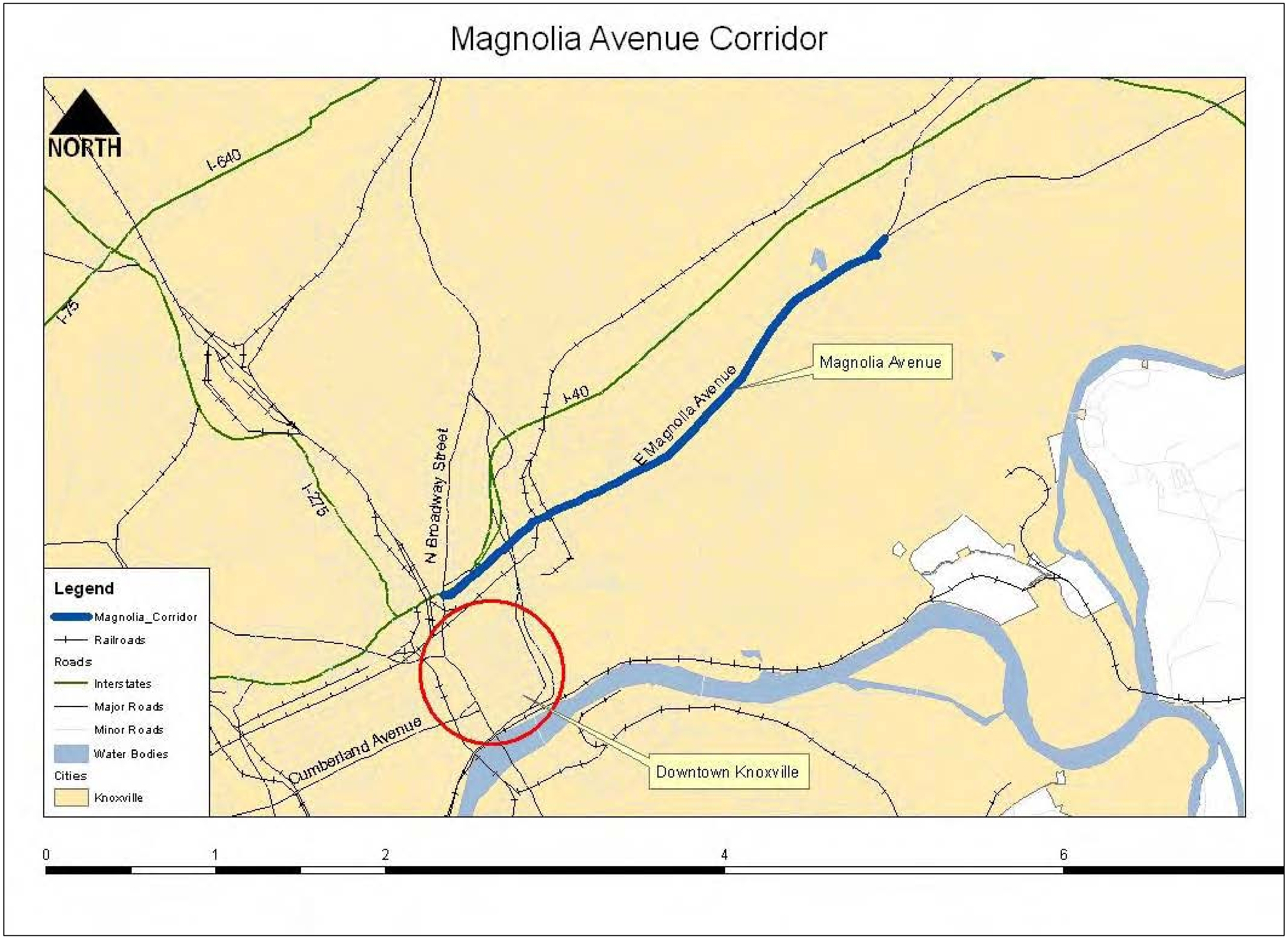
Transportation Network

Hall of Fame Drive intersects with Magnolia Avenue to the northeast of downtown Knoxville and will provide direct access to the new downtown transit center. Hall of Fame Drive has two lanes in each direction, with narrow lanes south of Summit Hill and wider, divided lanes north of Summit Hill. Magnolia Avenue is a five-lane road with a center turn lane from downtown Knoxville, northeast to North Beaman Street (Figure 3-51). This is a wide cross-section with potential for bus lanes near the Hall of Fame Drive and Gay Street. From North Beaman to Lakeside, Magnolia Avenue is a four-lane divided road, with a wide shoulder along the majority of the section. There is sufficient right-of-way in this area for transit enhancements

Figure 3-51
Magnolia Avenue Median Divided Section

On Magnolia Avenue, there are sidewalks along the five-lane section near Milligan Street, up through the intersection of Prosser Road and on through to Burns Road near the Kroger shopping center. From Prosser Road to Beaman Street, the shoulder is marked as a bike lane.

Figure 3-52
Map of Magnolia Avenue Corridor



CORRADINO

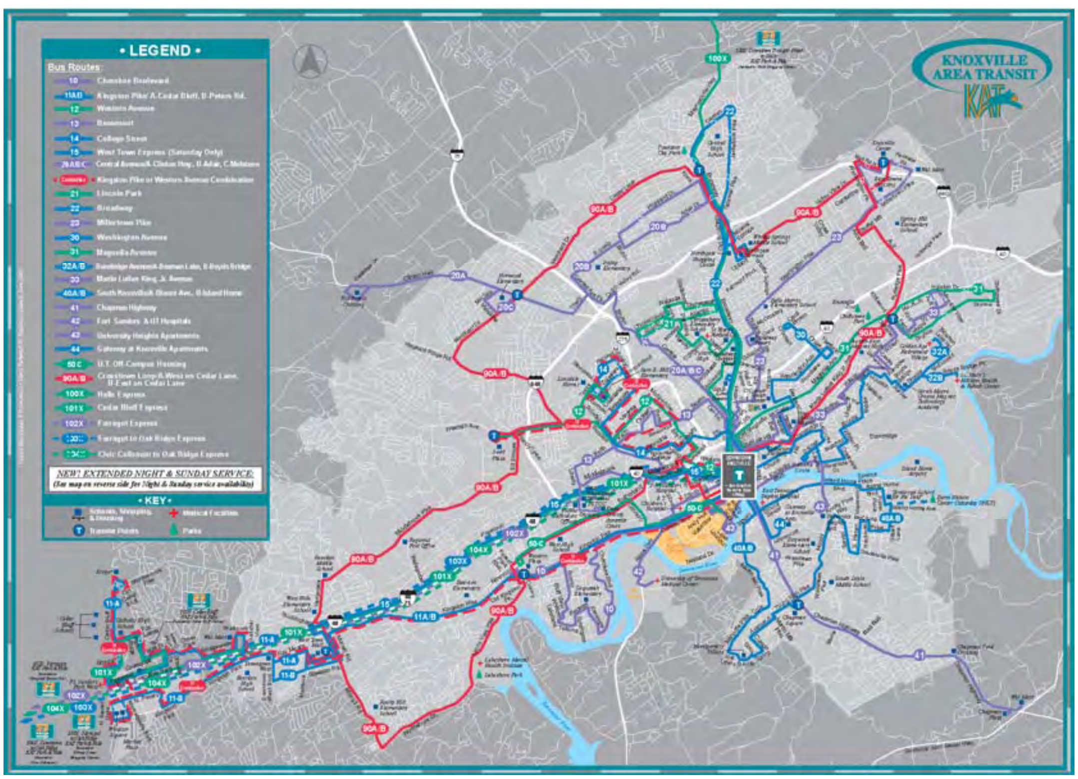
Transit Service

Knoxville Area Transit (KAT) routes are shown on Figure 3-53. KAT operates Route 31 along Magnolia Avenue. Route information is shown in Table 3-5.

Table 3-5
Transit Routes along Magnolia Avenue Corridor

Route	Route Name	Segments of Magnolia Avenue Traveled	2008 Annual Ridership	Revenue per Revenue Mile Rank
31	Magnolia	Holston Drive to downtown	194,166	8

Figure 3-53
KAT Transit Routes



Land Use

Along Magnolia Avenue near downtown there is light industrial development and older residential property (Figure 3-54). Moving towards Olive Street and Milligan Street, the uses become apartments, commercial shops/banks and fast food restaurants. There is high density housing located near Cherry Street. Strip commercial centers, including a Kroger supermarket, are set back further from the road near Burns Road.

Figure 3-54
Magnolia Avenue near Lakeside Drive

Population and Employment Density

The highest population density along the Magnolia Avenue Corridor occurs just east of James White Parkway, where public housing is located. Other pockets of dense residential areas are found near S. Olive Street and Hillside Avenue (apartments). In total, more than 14,000 people live within a ½ mile radius of the Magnolia Avenue Corridor (Figure 3-55). This is an average density of 2,670 people per square mile.

Projected future population for 2035 was assessed for the corridor based on outputs from the Knoxville TPO's Travel Demand Model. The corridor shows a projected population growth of zero to 50 percent for the 2006-2035 time period. Figure 3-56 displays the Traffic Analysis Zones along the corridor and the percentage of change in population projected.

There are over 1,000 employment locations identified within ½ mile of this corridor, providing more than 13,000 jobs. The employers with the greatest number of employees in this area are: Tennessee Valley Authority, John H. Daniel Custom Tailors, Regions Nationwide Bank and the

Home Federal Bank of Tennessee. The employment density is 2,400 jobs per square mile. Figure 2-68 shows the employment locations, with the largest employment centers in dark blue.

The Knoxville TPO's model projects that employment will grow by up to 50 percent for nearly all of the TAZs located along the Magnolia Avenue Corridor by 2035 (Figure 3-58).

Household Income

The median household income in Knox County is approximately $42,000. The income levels along the Magnolia Avenue Corridor are considerably lower than the countywide average. Closest to downtown Knoxville, the median household income is less than $21,000. Moving out of the downtown area, the incomes increase slightly, but are still only 50 to 75 percent of the countywide median household income (Figure 3-59).

Potential for Higher Frequency Transit along Magnolia Avenue Corridor

Positive Attributes

- Large employment centers concentrated in downtown area;
- Consistent residential densities;
- Good sidewalk system;
- High transit ridership on Route 31;
- Several schools along the corridor;
- Right-of-way may be available; and,
- Low income area.

Areas that Need Improvement

- Limited destinations outside of downtown employment center; and,
- Lower residential densities outside of the immediate downtown area.

Figure 3-55
Magnolia Avenue Corridor
Population Density

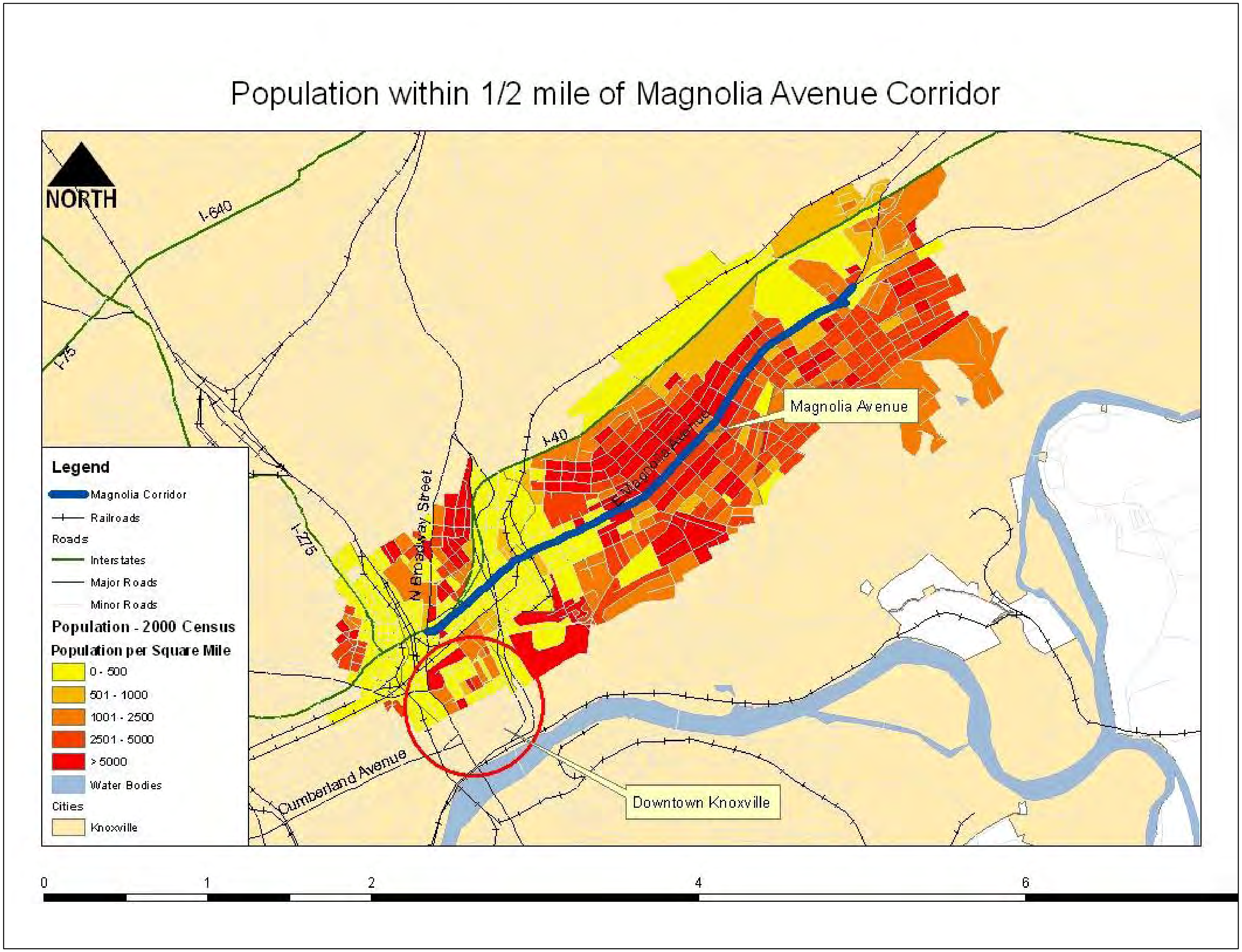


Figure 3-56
Magnolia Avenue Corridor
Population Change (2006 – 2035)

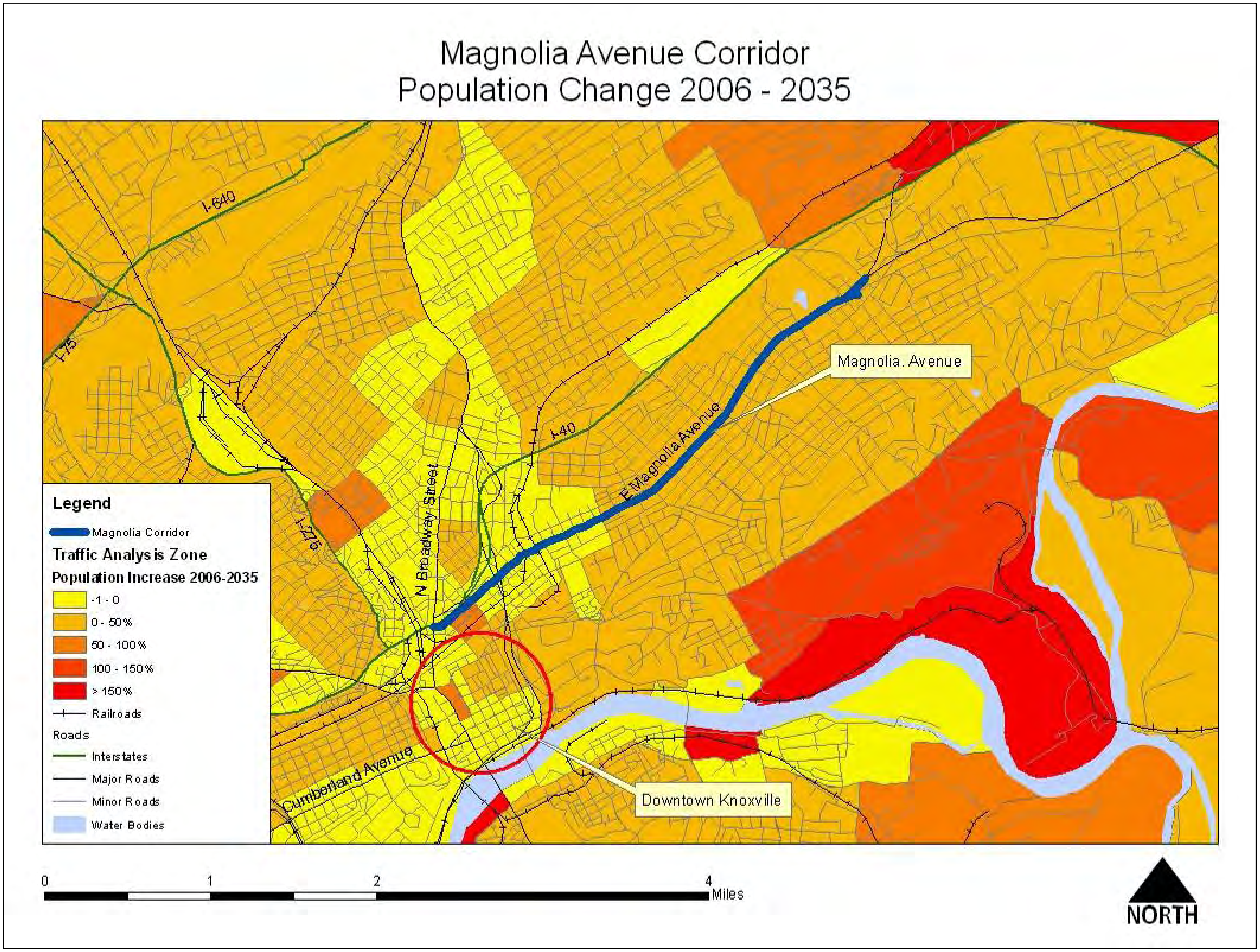


Figure 3-57
Magnolia Avenue Corridor
Employment Locations

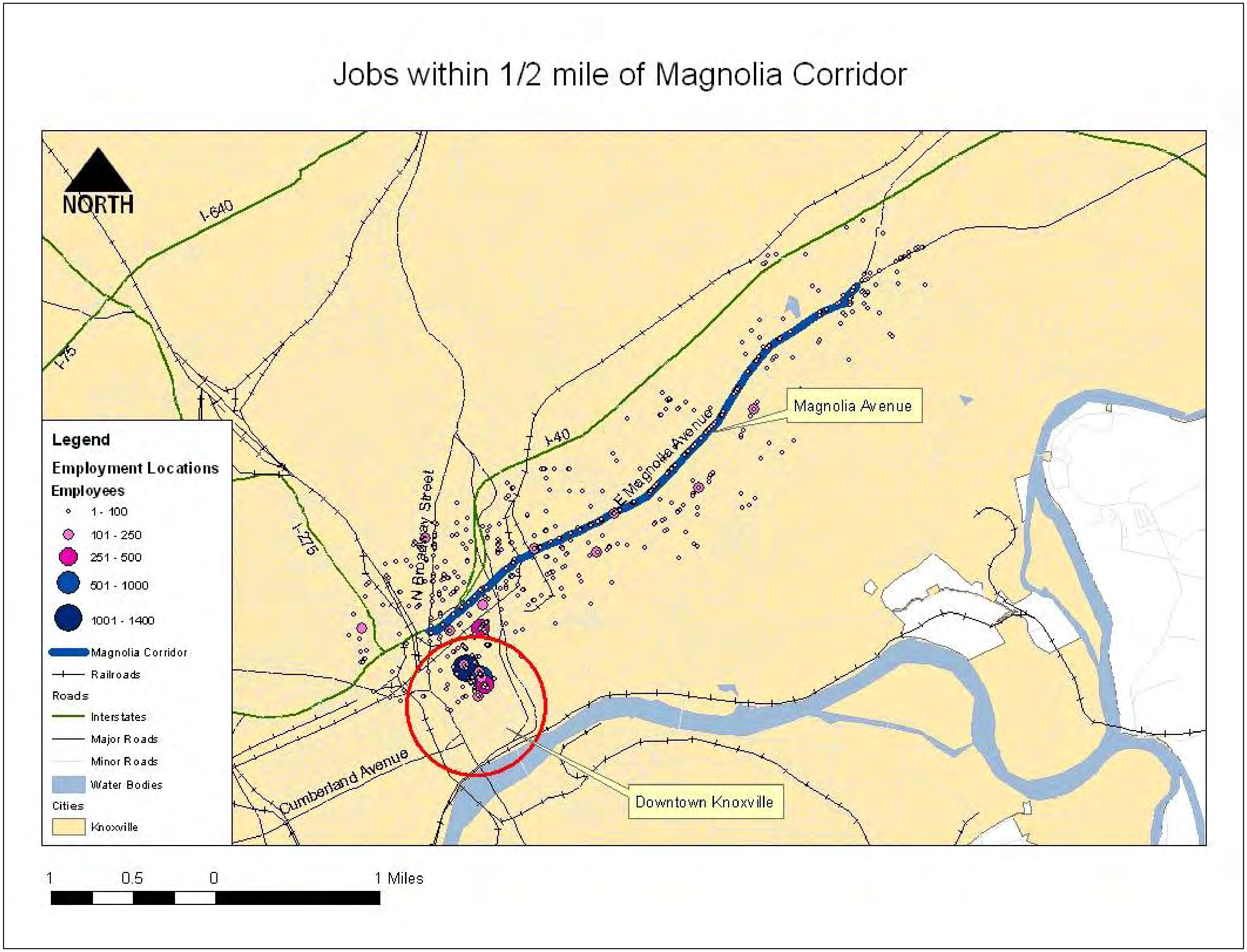


Figure 3-58
Magnolia Avenue Corridor
Employment Change (2006 – 2035)

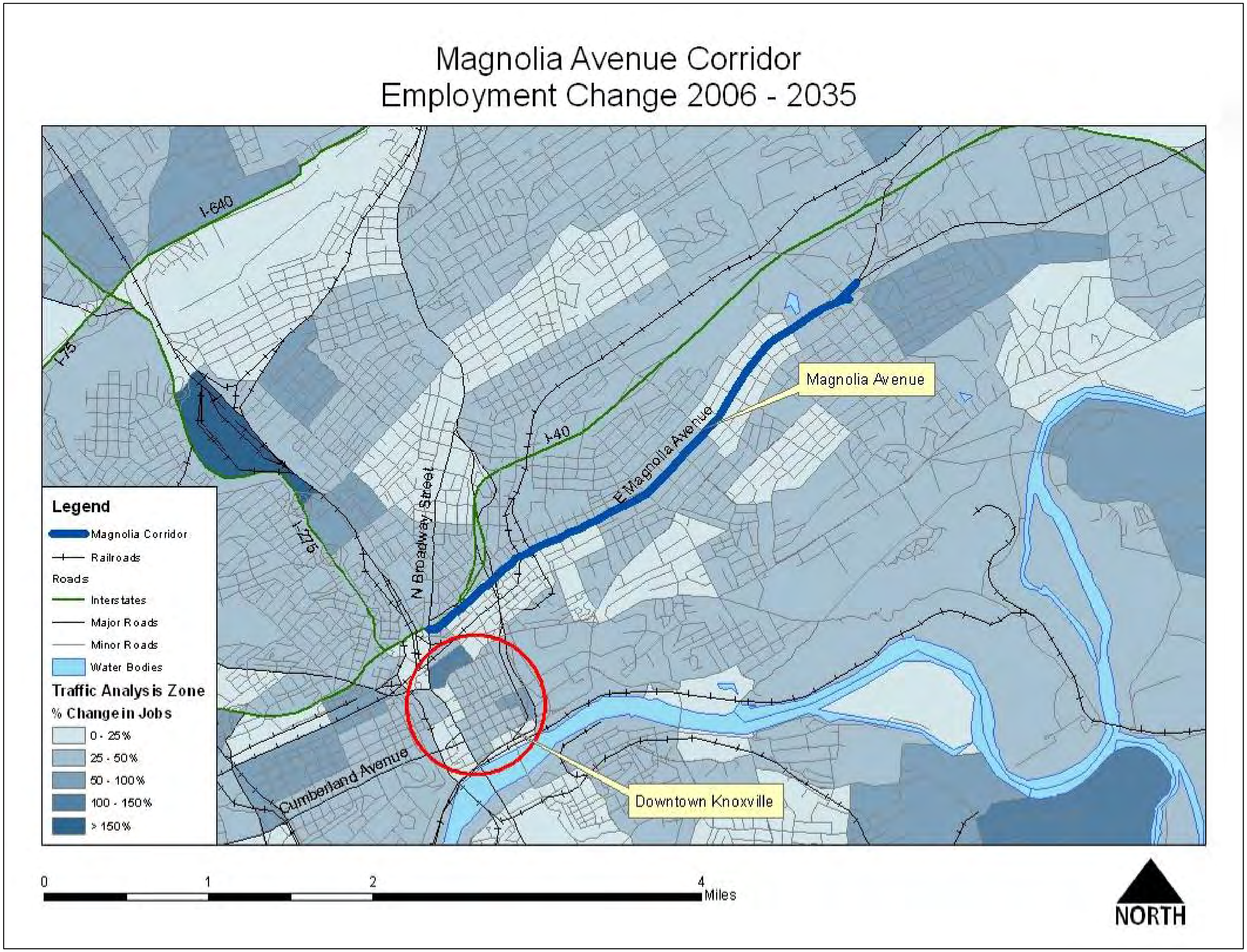
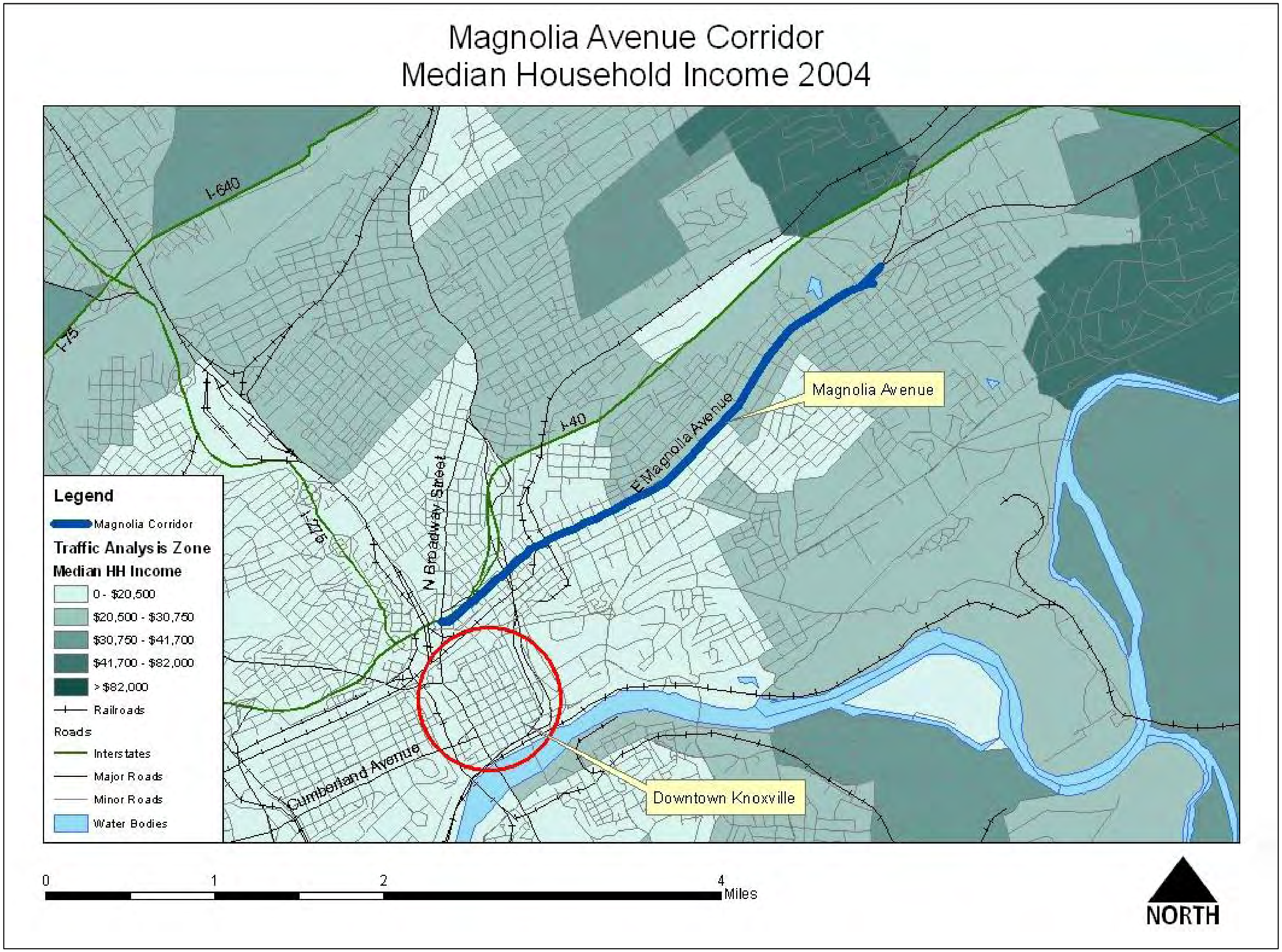


Figure 3-59
Magnolia Avenue Corridor
Median Household Income



Corridor 6: Martin Luther King Jr. Avenue Corridor

The Martin Luther King Jr. Avenue Corridor runs northeast-southwest between downtown Knoxville and Jefferson County to the east (Figure 3-61). MLK Jr. is a local road that ends at Magnolia Avenue (U.S. 70/11/25W) after Rutledge Pike (SR 1). The topography becomes steep east of Knoxville and there is minimal rural development going toward Jefferson County. This corridor connects with downtown at East Hill Street.

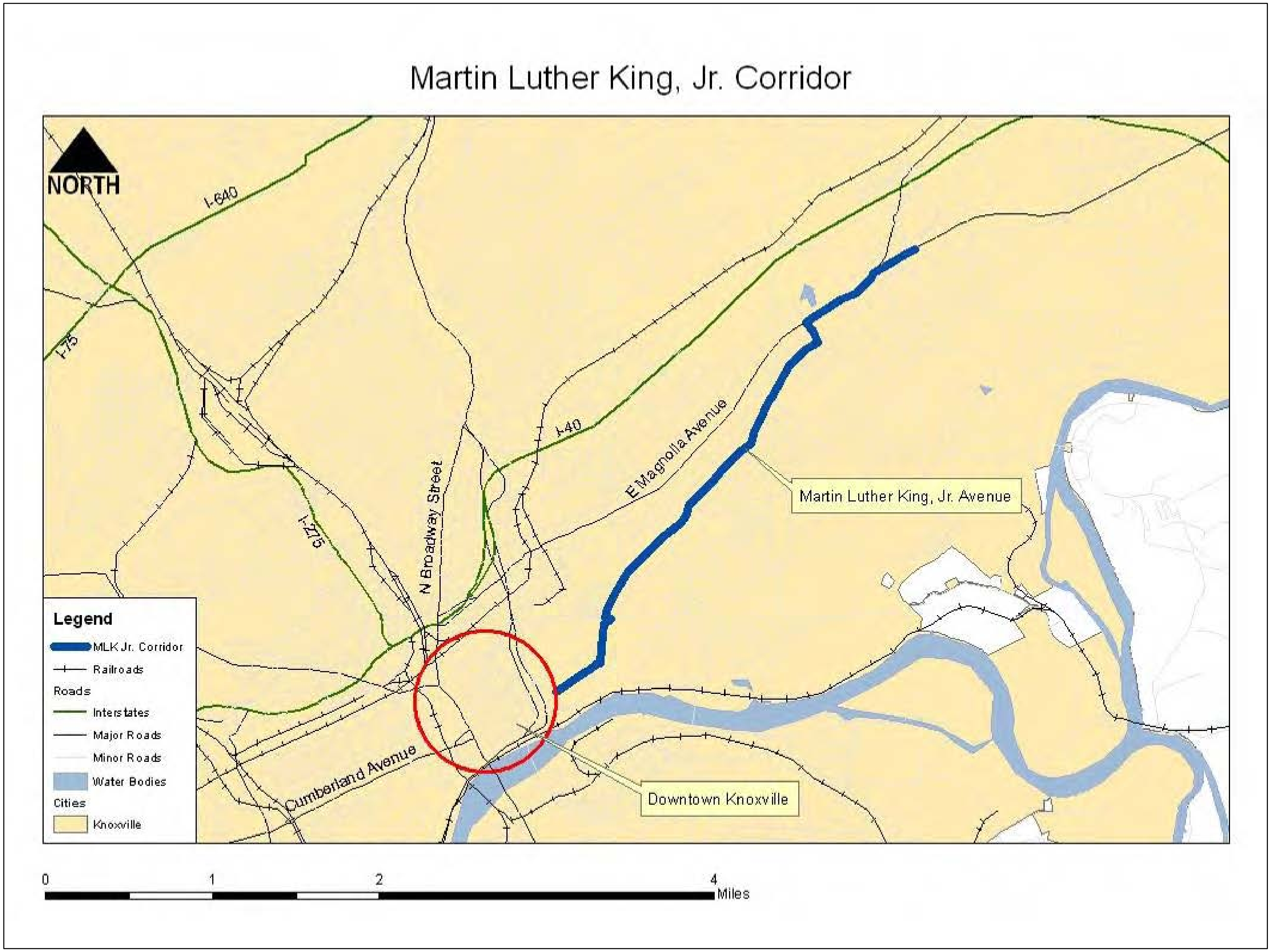
Transportation Network

MLK Jr. Avenue is three lanes from downtown to Olive Street. At Olive it becomes a two-lane road until it ends at Holston Drive. The buildings are fairly close to the road, but there is the possibility to widen in certain areas.

There are sidewalks beginning near Olive Street, through to South Cherry Street. After South Cherry, sidewalks exist, but are inconsistent, and are mostly on one side of the road. Beyond this area, sidewalks are found on MLK Jr. Avenue through to Holston Drive (Figure 3-60). Utility poles are typically located in the right-of-way between the sidewalk and the street.

Figure 3-60
MLK Jr. Avenue near Holston Drive

Figure 3-61
Map of MLK Jr. Avenue Corridor



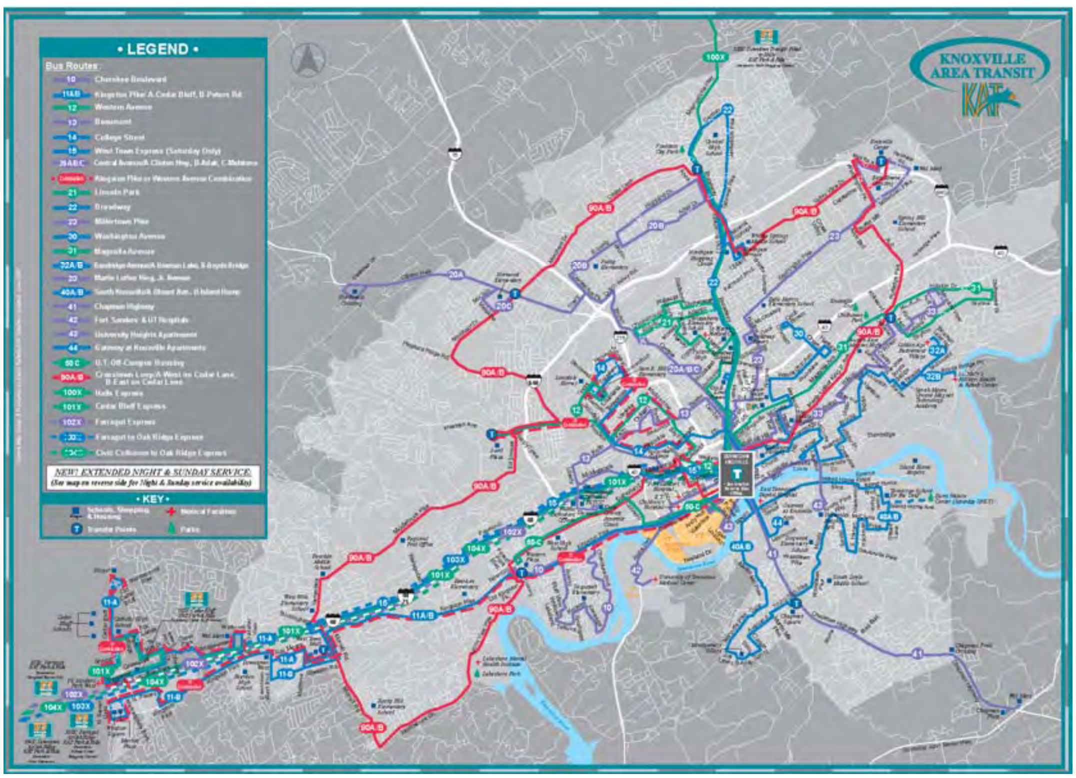
Transit Service

Knoxville Area Transit (KAT) routes are shown on Figure 3-62. KAT operates Route #90 A/B along MLK Jr. Avenue. Route information is shown in Table 3-6.

Table 3-6
Transit Routes along MLK Jr. Avenue Corridor

Route	Route Name	Segments of MLK Jr./Magnolia Avenue Traveled	2008 Annual Ridership	Revenue per Revenue Mile Rank
90 A/B	Crosstown	Rutledge Pike to downtown	165,296	26

Figure 3-62
KAT Transit Routes



Land Use

The land use on MLK Jr. Avenue closest to downtown is medium density; light industrial and residential, including public housing. Buildings are constructed close to the road. Morningside Park and Green Elementary are located just south of E. Summit Hill Drive (Figure 3-63 shows general area). Further northeast along MLK Jr. Avenue are small, early 20th century houses, interspersed with churches and some commercial uses (Figure 3-64). Several of the commercial buildings are boarded up and abandoned. Austin-East Magnet High School is located at South Cherry Street. Moving further along MLK Jr. towards Holston Drive are older, run-down homes built close to the street, with pockets of light industrial development.

Figure 3-63
MLK Jr. Ave. North of E. Summit Hill Dr.

Figure 3-64
Residential Land Use on MLK Jr. Avenue

Population and Employment Density

The highest population density along the MLK Jr. Avenue Corridor occurs just east of James White Parkway, where public housing is located. Other pockets of the densest residential areas are found near S. Olive Street and Hillside Avenue (apartments). In total, more than 15,000 people live within a ½ mile radius of the MLK Jr./Magnolia Avenue Corridor (Figure 3-65). This is an average density of 2,680 people per square mile.

Projected future population for 2035 was assessed for the corridor based on the outputs of the Knoxville TPO's Travel Demand Model. The corridor shows a consistent projected population increase of zero to 50 percent. Figure 3-66 displays the Traffic Analysis Zones along the corridor and the percentage of change in population projected.

There are over 1,100 employment locations identified within ½ mile of this corridor, providing nearly 18,500 jobs. The employers with the greatest number of employees in this area are: City of Knoxville and Knox County governments, 21st Century Mortgage, 21st Insurance and the Knoxville Police Department. The average employment density is 3,300 jobs per square mile. Figure 3-67 shows the employment locations, with the largest employment centers in dark blue.

The Knoxville TPO's model projects that employment will grow by up to 50 percent for nearly all of the TAZs located along the MLK Jr. Avenue Corridor by 2035 (Figure 3-68).

Household Income

The median household income in Knox County is approximately $42,000. The income levels along the MLK Jr. Avenue Corridor are considerably lower than the countywide average. Closest to downtown Knoxville, the median household income is less than $21,000. Moving out of the downtown area, the incomes increase slightly, but are still only 50 to 75 percent of the countywide median household income (Figure 3-69).

Potential for Higher Frequency Transit along MLK Jr. Corridor

Positive Attributes

- Large employment centers concentrated in downtown area;
- Consistent residential densities along MLK Jr. Avenue;
- Good sidewalk system;
- High transit ridership on Route # 90 A/B;
- Several schools along the corridor;
- Segments of MLK Jr. Avenue would benefit from redevelopment; and,
- Low income area.

Areas that Need Improvement

- Limited destinations outside of downtown employment center;
- Lower residential densities outside of the immediate downtown area; and,
- Limited right-of-way of much of MLK Jr. Avenue.

Figure 3-65
MLK Jr. Avenue Corridor
Population Density

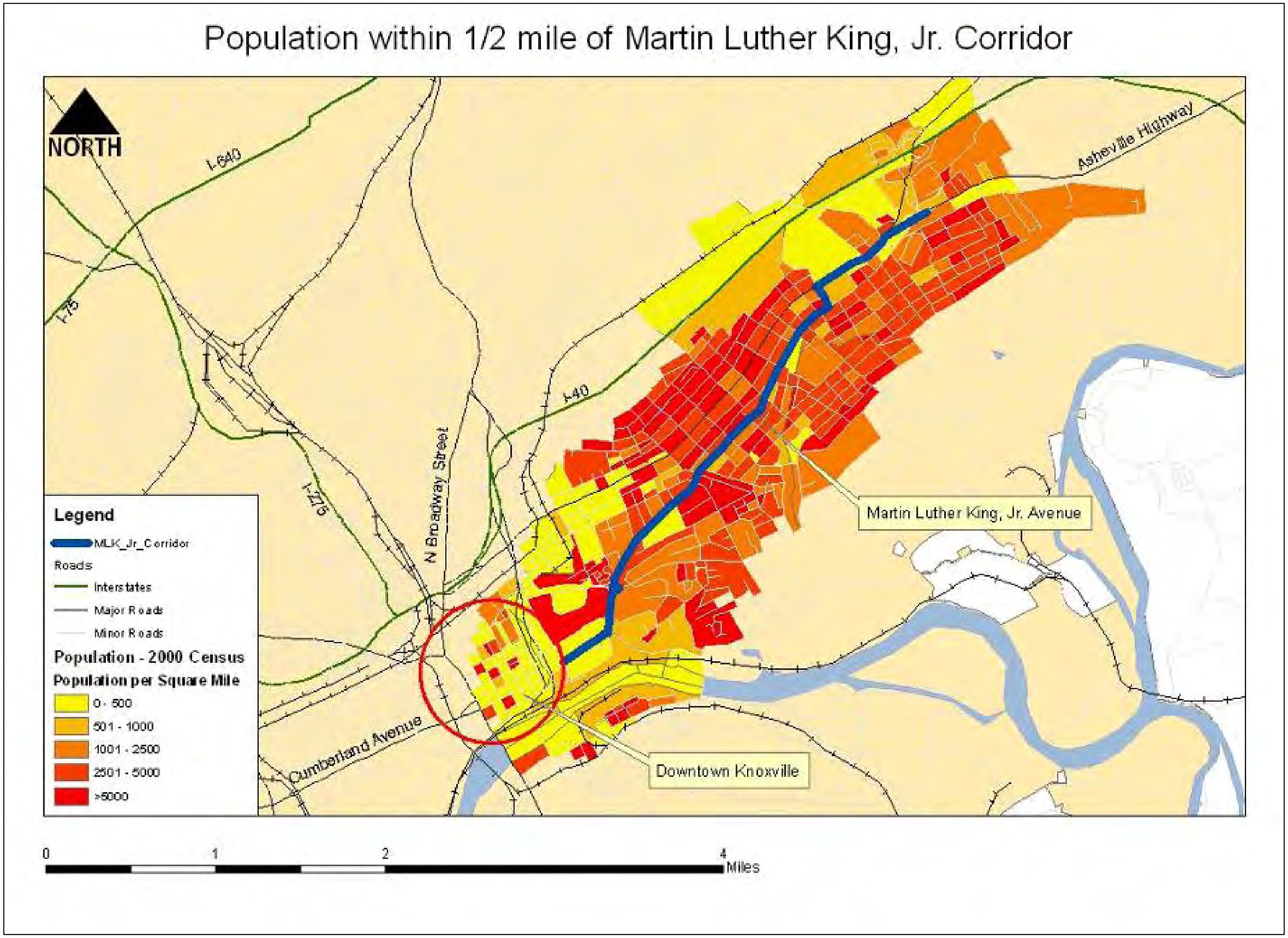


Figure 3-66
MLK Jr. Avenue Corridor
Population Change (2006 - 2035)

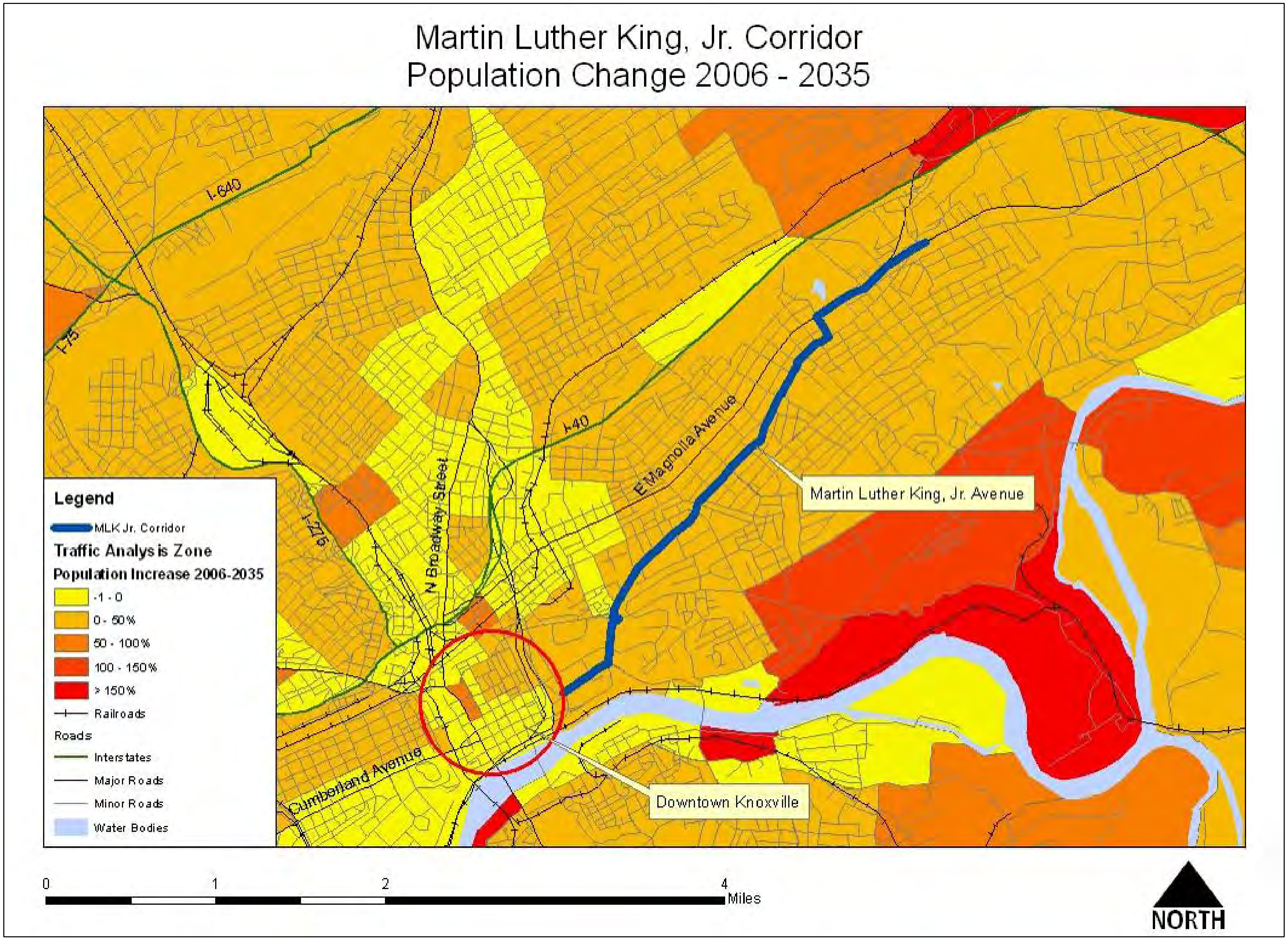


Figure 3-67
MLK Jr. Avenue Corridor
Employment Locations

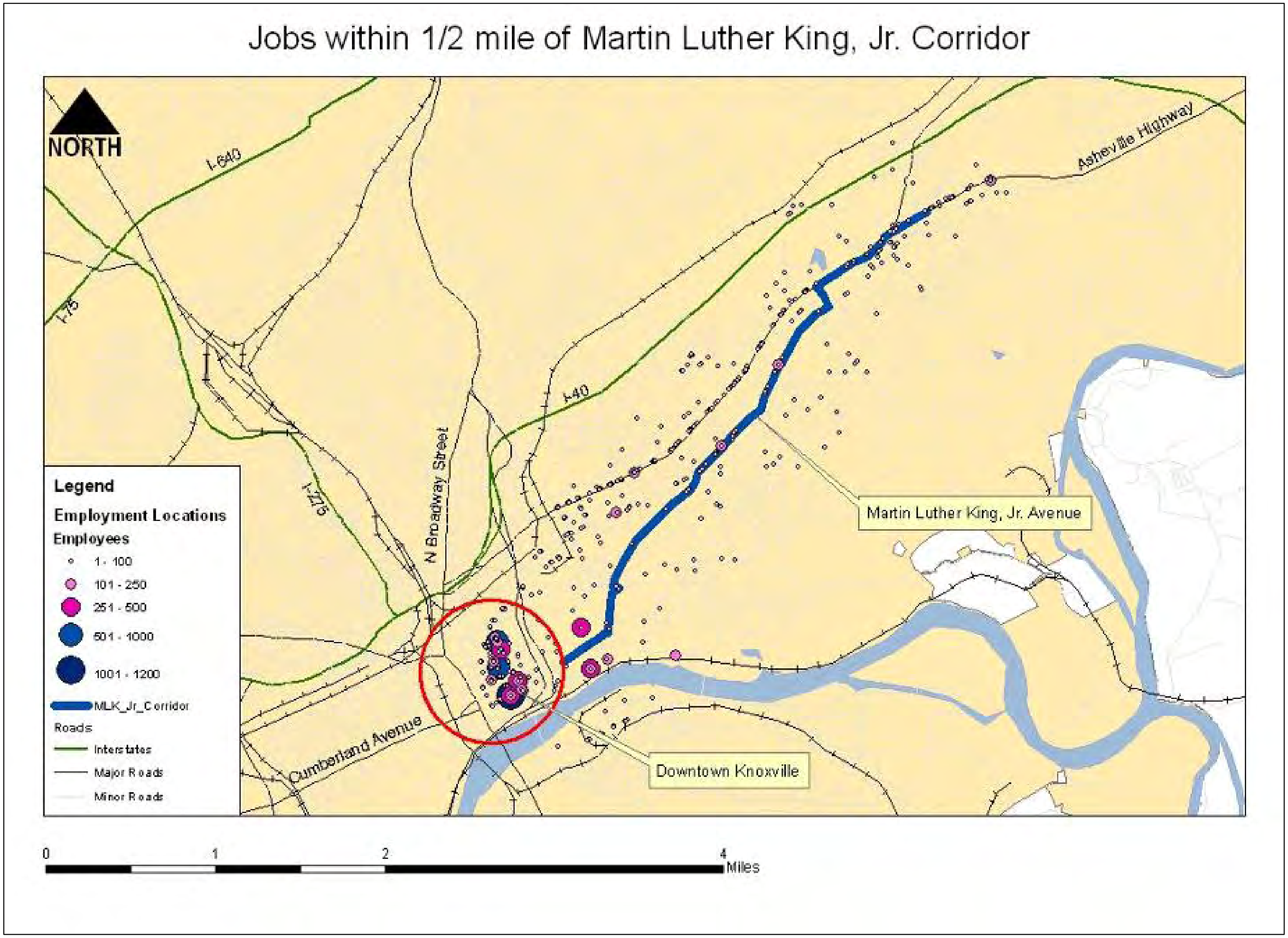


Figure 3-68
MLK Jr. Avenue Corridor
Employment Change (2006 – 2035)

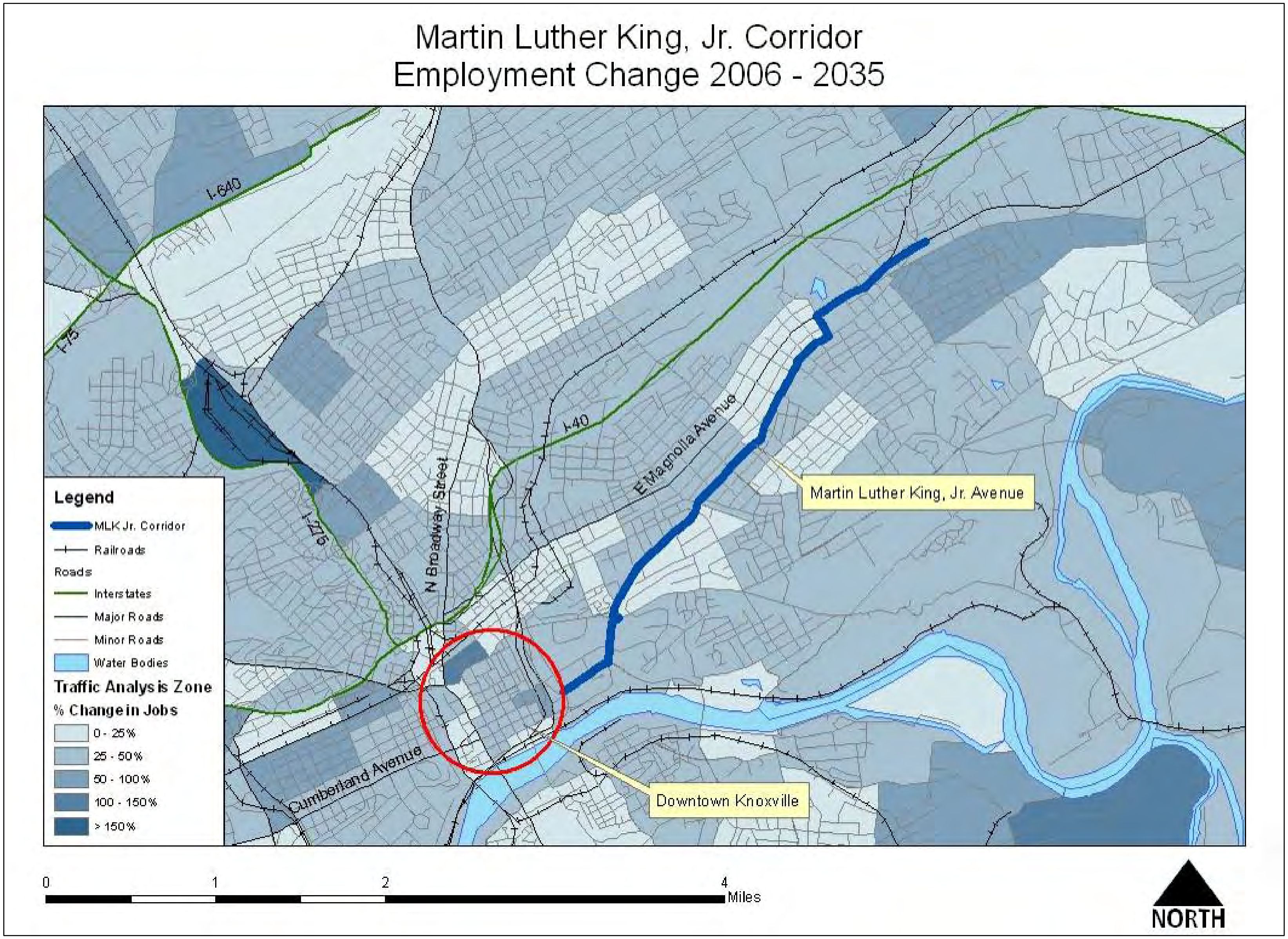
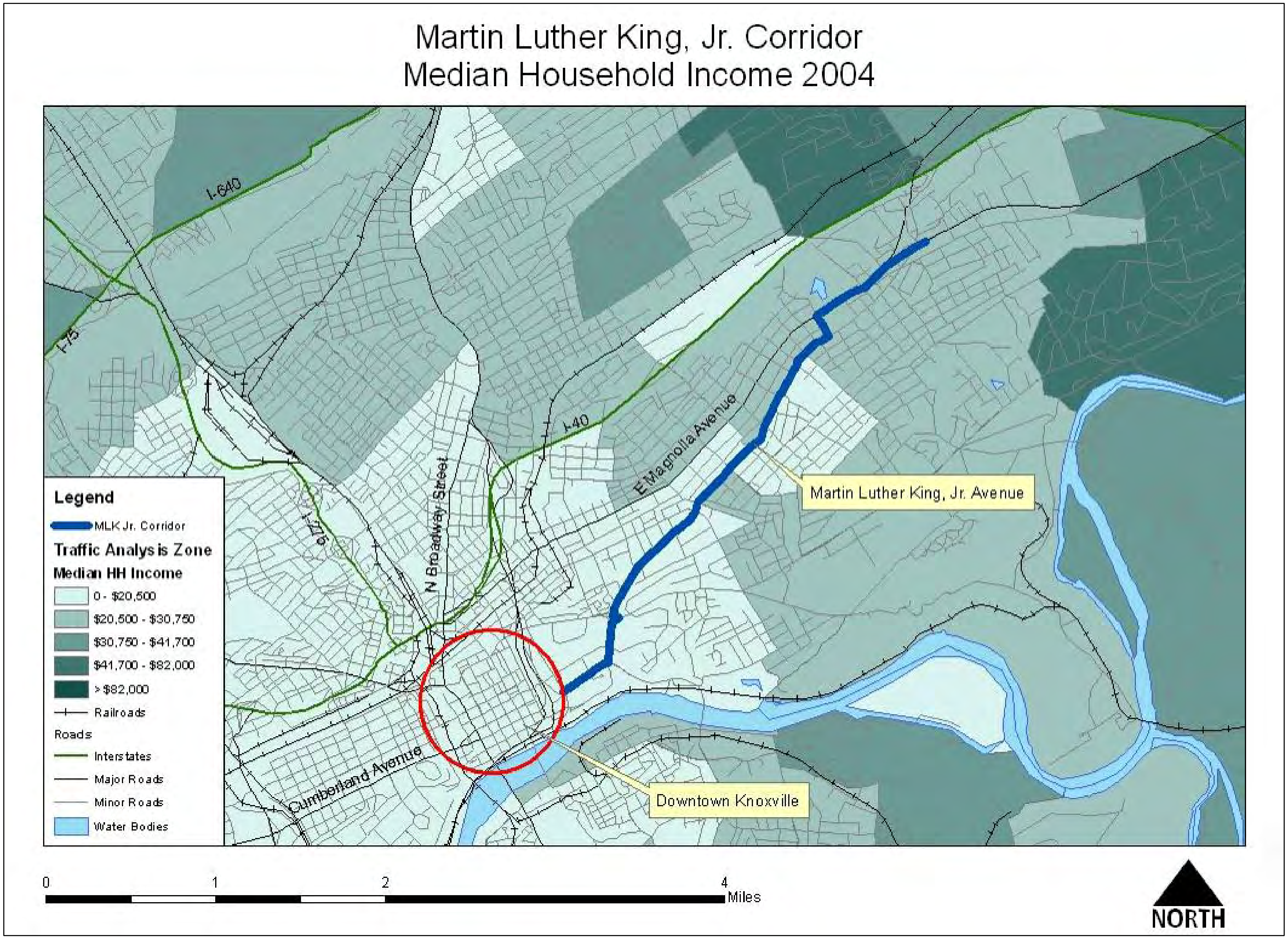


Figure 3-69
MLK Jr. Avenue Corridor
Median Household Income



Corridor 7: Chapman Highway/James White Parkway Corridor

Chapman Highway is a commercial arterial road extending south from downtown Knoxville (Figure 3-72).

Transportation Network

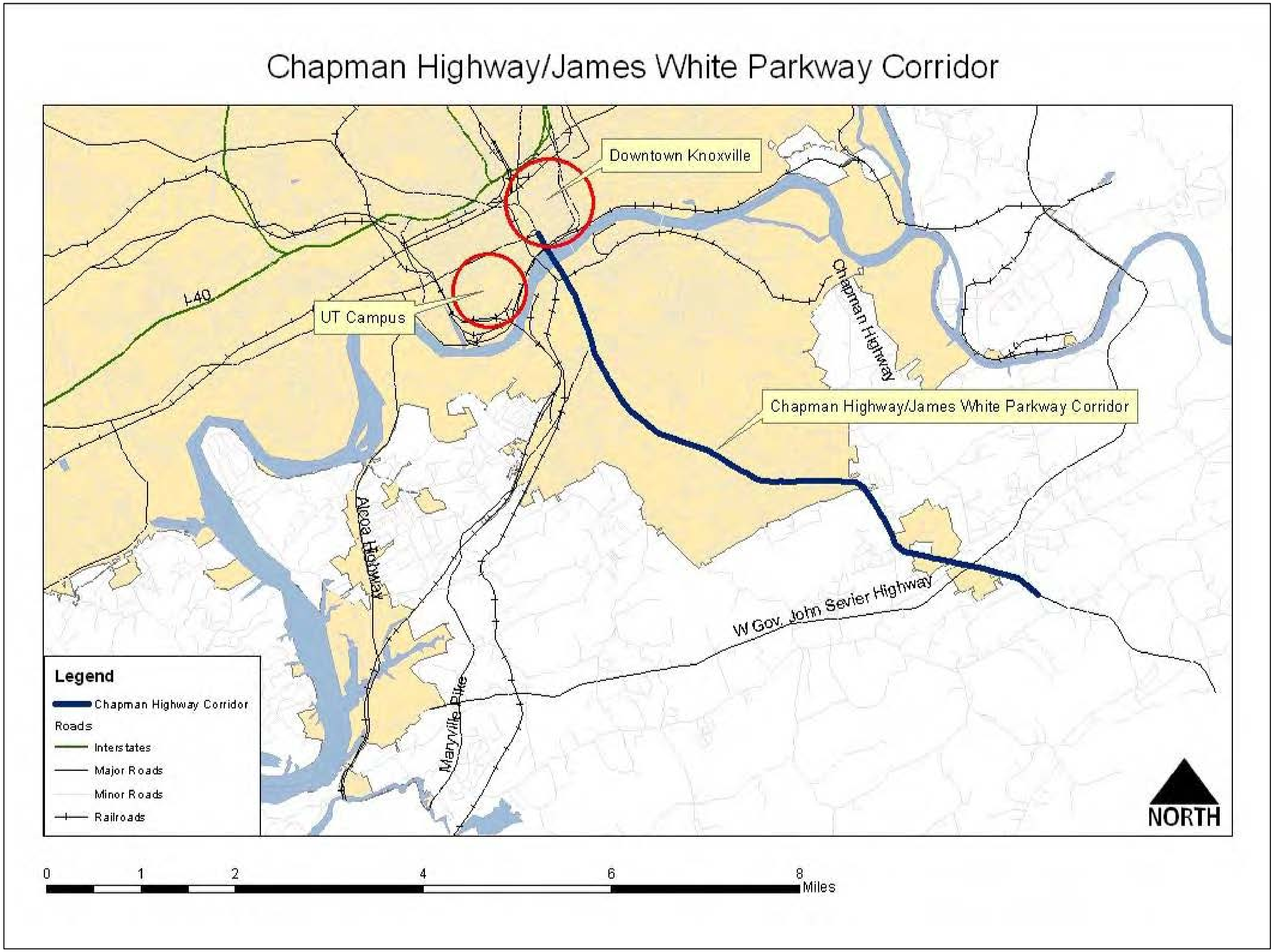
In downtown Knoxville, Henley Street is a divided roadway with six lanes in each direction south to Main Street. From Main Street south across the Henley Street Bridge to Fronda Lane (2.3 miles) the road operates as a five lane section (on the bridge the road operates as three southbound and one northbound.) See Figure 3-70 below. The center lane becomes a left turn lane south of the bridge.

Figure 3-70
Traffic on Henley Street Bridge

South of Fronda Lane, the road cross section is two lanes in each direction to Lake Forest Drive. From Fronda Lane south through the end of the corridor, there appears to be sufficient right of way to widen the roadway to accommodate additional transit capacity, except at bridge abutments and through the town of Seymour. From Lake Forest Drive the road widens to a five lane section to Anderson Drive through a low-density commercial and retail area (Figure 3-71). The roadway returns to a four lane cross section to Dick Ford Lane.

Figure 3-71
Commercial Area South of Lake Forest Drive

Figure 3-72
Chapman Highway/James White Parkway Corridor



From Dick Ford Lane to Sevier Highway, the road is a five lane section. Sevier Highway passes over Chapman Highway, with access to Chapman by a connector road (Figure 3-73). South of Sevier Highway the road contracts again to four lanes and remains in that configuration until it reaches Maples Road in the town of Seymour. The cross section is five lanes for about 3/4 of a mile through the town. The road narrows to a four lane section from Seymour to Maryville Highway.

Figure 3-73
Sevier Highway Passing over Chapman Highway

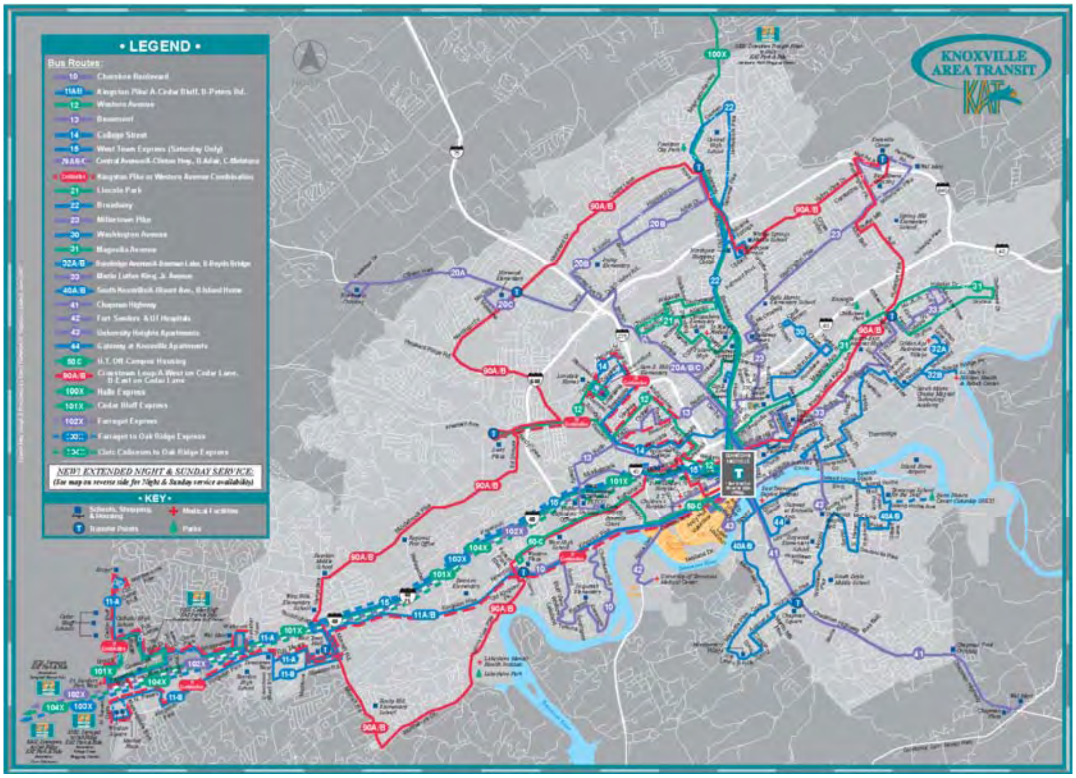
Transit Service

Knoxville Area Transit (KAT) routes are shown on Figure 3-71. KAT operates Route 41 along the Chapman Highway/James White Parkway Corridor. Route information is detailed in Table 3-7 below. Route 40 A/B also intersects with the Corridor in two locations, at Henley Street and Blount Avenue near downtown and where Chapman Highway crosses Young High Pike.

Table 3-7
Transit Routes along Chapman Highway/James White Parkway

Route	Route Name	Termini	2008 Annual Ridership	Revenue per Revenue Mile Rank
40 A/B	South Knox	Martin Mill Pike from Montgomery Village to downtown	78,971	20
41	Chapman Highway	WalMart near Gov. John Sevier Hwy to downtown	92,555	16

Figure 3-74
KAT Transit Routes



Land Use

The land use on the south bank of the river in the Chapman Highway/James White Parkway Corridor includes light industrial and institutional uses. The former Baptist Hospital, now a part of Mercy Health Partners, is located just to the east Chapman Highway on the southern bank. Most of the hospital has been closed and offers a prime opportunity for redevelopment as part of the city's 2007 South Knoxville Waterfront Development Plan. The plan calls for a mixture of new residential, commercial, and retail uses along the waterfront, in addition to improved recreational and public spaces. South of the waterfront development area, the corridor becomes a typical suburban commercial strip, with mid-to-lower density commercial and retail spaces. In much of this area, the development density falls off sharply beyond a few hundred feet of the roadway alignment. South of Fronda Lane, the development density falls off to lower density suburban and rural housing until reaching the town of Seymour. From Old Sevierville Pike south of Seymour, there is a node of medium density in the town of Seymour before gradually falling off to lower densities as the corridor runs south to Maryville Highway.

Population and Employment Density

The Chapman Highway/James White Parkway Corridor is densest near the urban core, but becomes progressively less dense heading towards Governor John Sevier Highway. The highest population density along this Corridor is near Blount Avenue and Maryville Pike. In total, more than 15,000 people live within a ½ mile radius of the Chapman Highway/James White Parkway Corridor (Figure 3-75). This is an average density of 1,000 people per square mile.

Future population growth, based on the TPO's model projections shows a fairly consistent increase of zero to 50 percent or 50 to 100 percent for nearly all of the TAZs along the Chapman Highway/James White Parkway Corridor. The greatest percentage increase is anticipated in the TAZ just north of Gov. John Sevier Highway, east of James White Parkway, at 100 to 150 percent (Figure 3-76).

There are over 1,300 employment locations identified within ½ mile of this corridor, providing nearly 22,000 jobs. The employers with the greatest number of employees in this area are: Tennessee Valley Authority, City of Knoxville and Knox County governments, and 21st Century Mortgage. The average employment density is 1,400 jobs per square mile. Figure 3-77 shows the employment locations, with the largest employee centers in dark blue.

The TPO's model projects a wide range of employment growth rates along the Chapman Highway/James White Parkway Corridor, ranging from zero to 50 percent in some TAZs to more than 150 percent in other TAZs. The greatest percentage increases are anticipated in the TAZs just south of Gov. John Sevier Highway (Figure 3-78).

Household Income

The median household income in Knox County is approximately $42,000. The income levels along the Chapman Highway/James White Parkway Corridor vary widely, with TAZs near downtown Knoxville showing median household incomes of less than $21,000 and those closest to Gov. John Sevier Highway showing median household incomes of more than $82,000 (Figure 3-79).

James White Parkway Option

James White Parkway is a controlled access highway built to interstate standards, running from I-40 south along the eastern side of downtown Knoxville, connecting to state route 132, before continuing south across the Tennessee River. The roadway extends south several miles as a controlled access highway, and continues south to Moody Avenue/Sevierville Pike where it terminates. From there, traffic can travel east or west along Sevierville Pike. In order to access Chapman Highway, travelers must travel east on Moody Avenue.

The advantage of James White Parkway alignment, as opposed to Chapman Highway, is the ability to connect directly to downtown Knoxville.

Figure 3-75
Chapman Highway/James White Parkway Corridor
Population Density

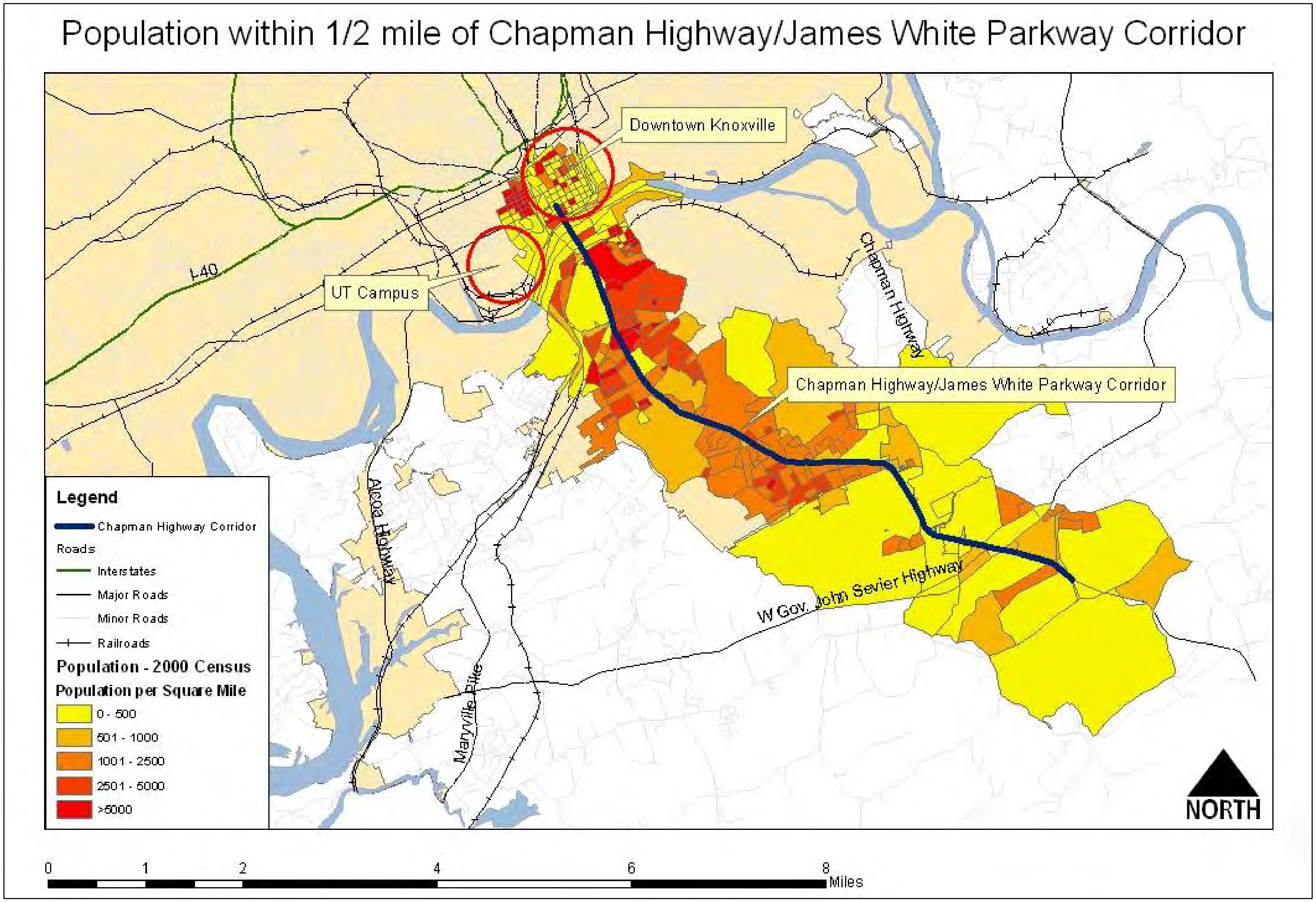


Figure 3-76
Chapman Highway/James White Parkway Corridor
Population Change (2006 – 2035)

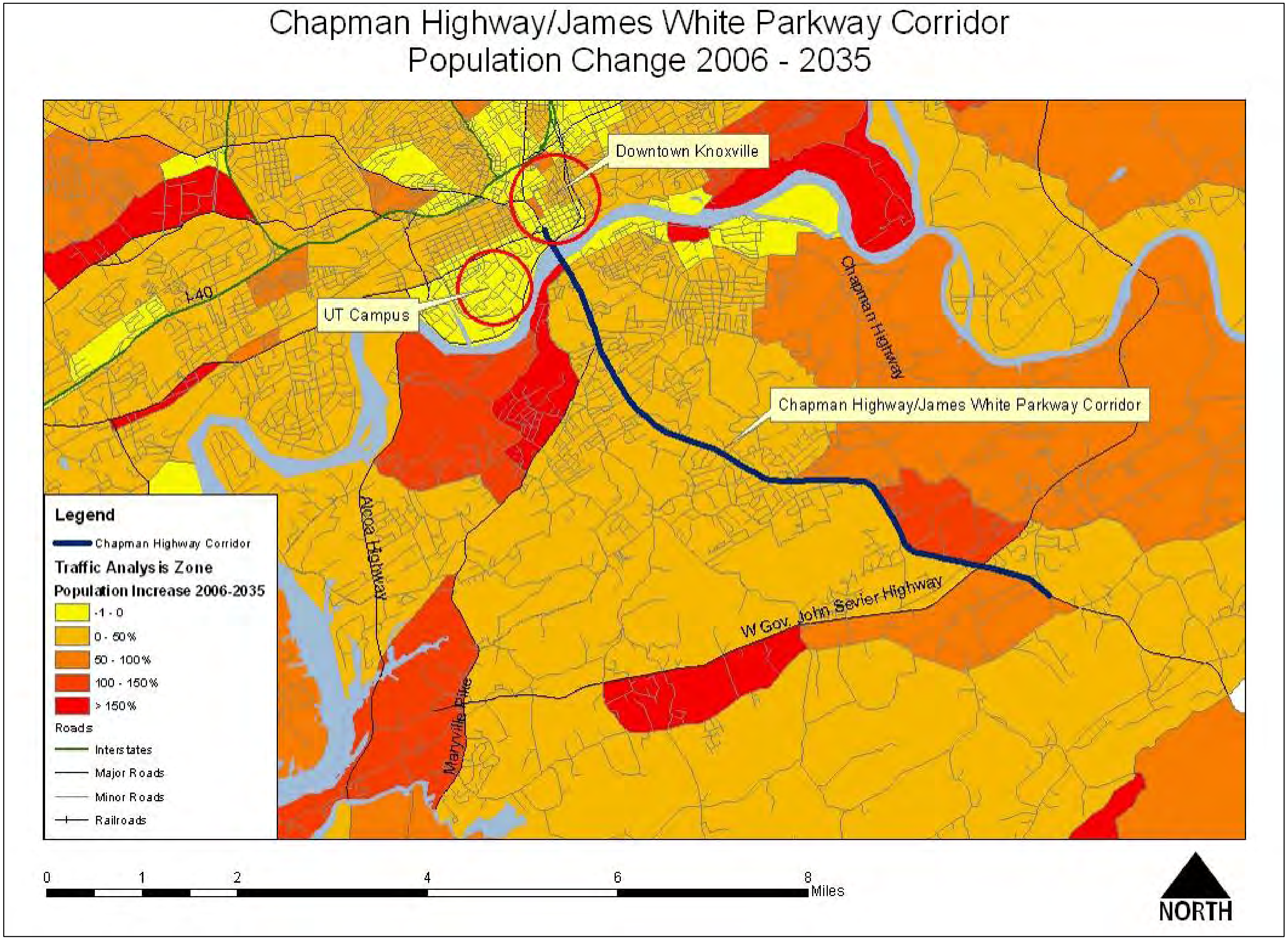


Figure 3-77
Chapman Highway/James White Parkway Corridor
Employment Locations

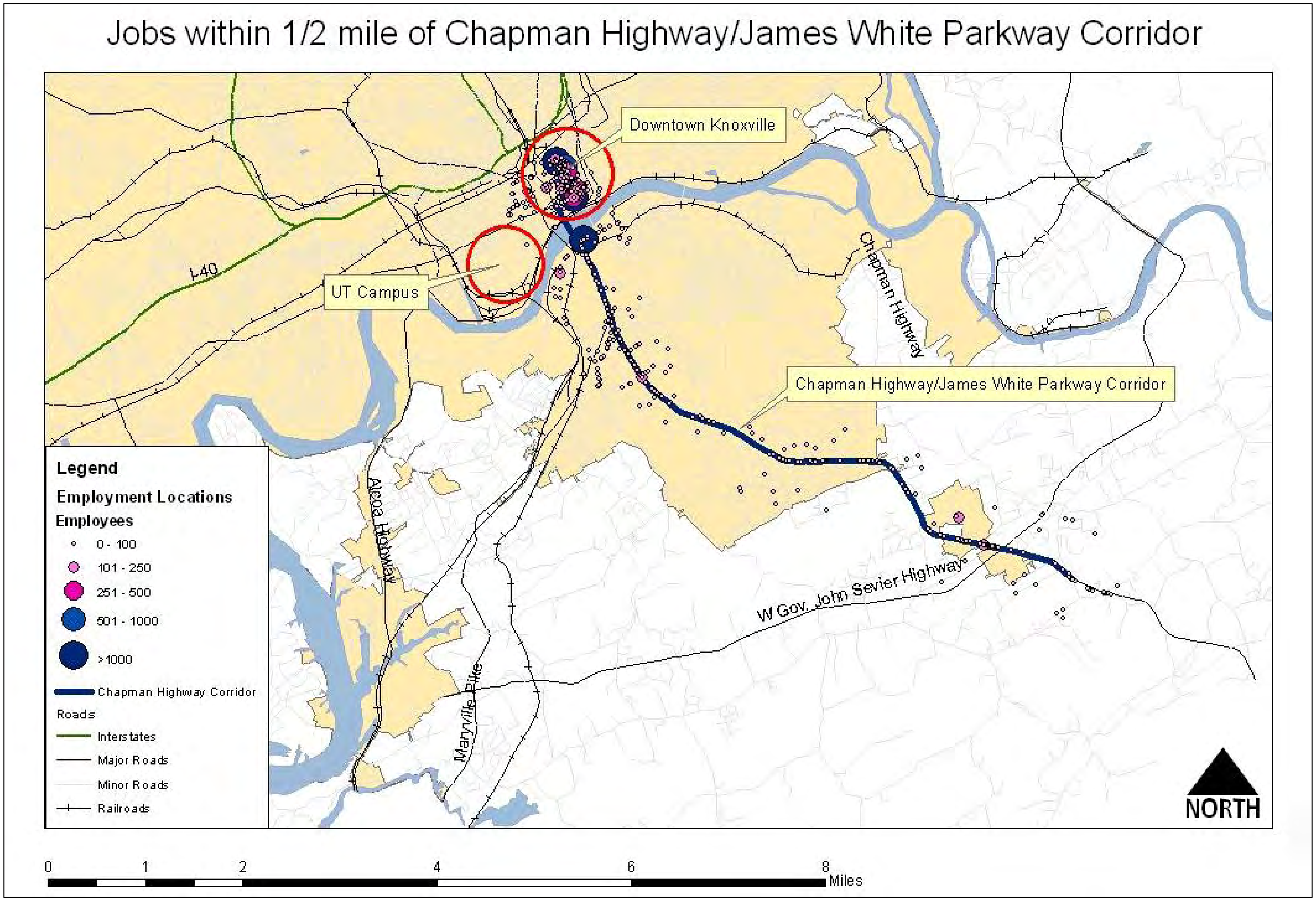


Figure 3-78
Chapman Highway/James White Parkway Corridor
Employment Change (2006 – 2035)

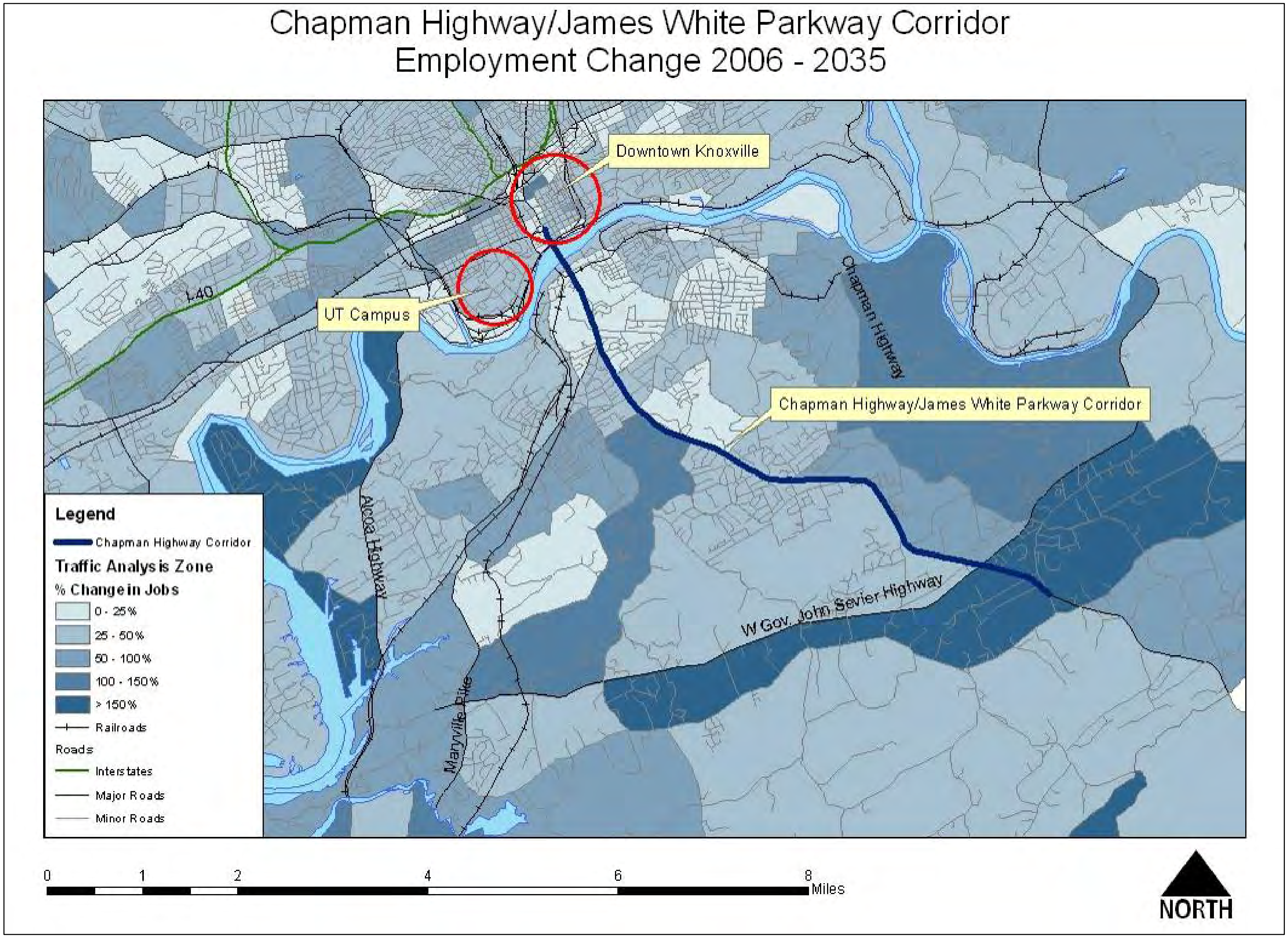
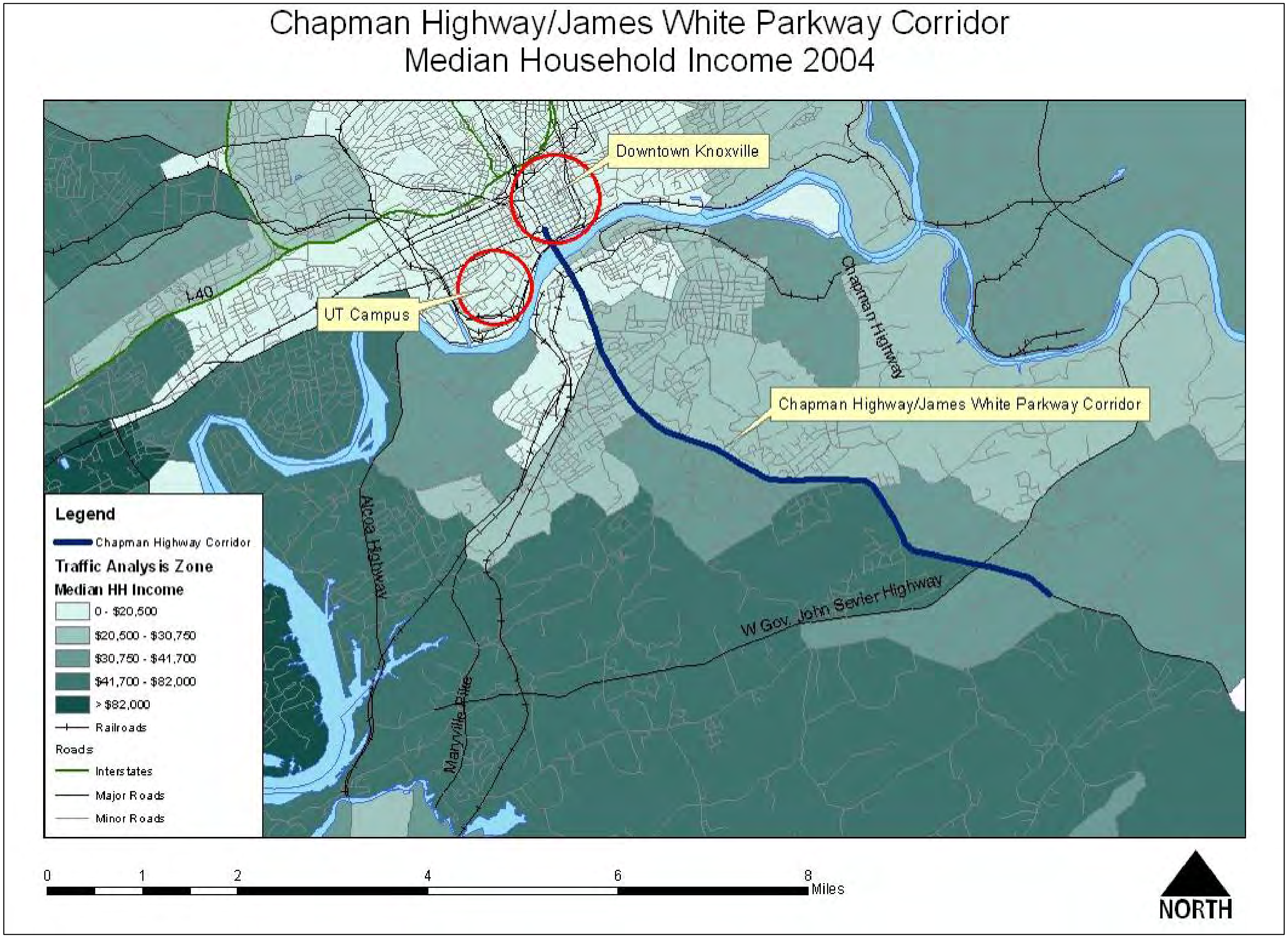


Figure 3-79
Chapman Highway/James White Parkway Corridor
Median Household Income



Potential for Higher Frequency Transit along Chapman Highway/James White Parkway Corridor

Positive Attributes

- High ridership on existing bus route;
- Existing commercial corridor;
- Potential for concentration of in-fill density along route; and,
- Few right-of-way restrictions closest to urban core.

Areas that Need Improvement

- Passes through some relatively low density, less developed area;
- Decreasing density farther away from downtown;
- Relatively low employment density adjacent to route;
- Possible right-of-way restrictions within Town of Seymour; and,
- James White Parkway option is lower density, less direct alignment.

Corridor 8: Alcoa – Knoxville Rail Corridor

Two rail corridors operate from the downtown area south to near the McGhee Tyson Airport and Alcoa (Figure 3-81). The CSX rail line passes along the southern side of the UT campus and along the northern bank of the Tennessee River, before crossing the river and continuing south to the airport and Alcoa, approximately paralleling the Alcoa Highway. The Norfolk Southern (NS) route passes through the western end of downtown Knoxville before taking a circuitous path that leads it to the area east of the airport and Alcoa.

Both rail lines pass through relatively low-density, residential areas between downtown Knoxville and the airport/Alcoa area. The analysis focused on the NS corridor because it has better connections with downtown Knoxville, and because it has been reported that NS may be considering abandonment of a portion of the line.

Transportation Network

The Norfolk Southern rail line is a single track nearest to downtown Knoxville, with little right-of-way to provide a double track in the future. The railroad tracks run behind Mary Vestal Park in south Knoxville. The alignment in this area has many curves, and is likely speed restricted.

There is an at-grade crossing at Candora Road, a two-lane road with no shoulder (Figure 3-80). At Caleb Road there is a two-lane bridge near an industrial area. There is another rail line overpass before Governor John Sevier Highway (SR 168) (Figure 3-82). Before Crescent Drive is a narrow bridge immediately before an at-grade rail crossing. The rail line is double tracked at Russell Road near the Alcoa Plant. Near the airport, the rail line passes approximately 1.5 miles to the east of Alcoa Highway. Any plans to provide rail service to the airport would require additional tracks (Figure 3-83).

Figure 3-80
Rail Crossing at Candora Road

Figure 3-81
Alcoa-Knoxville Rail Corridor

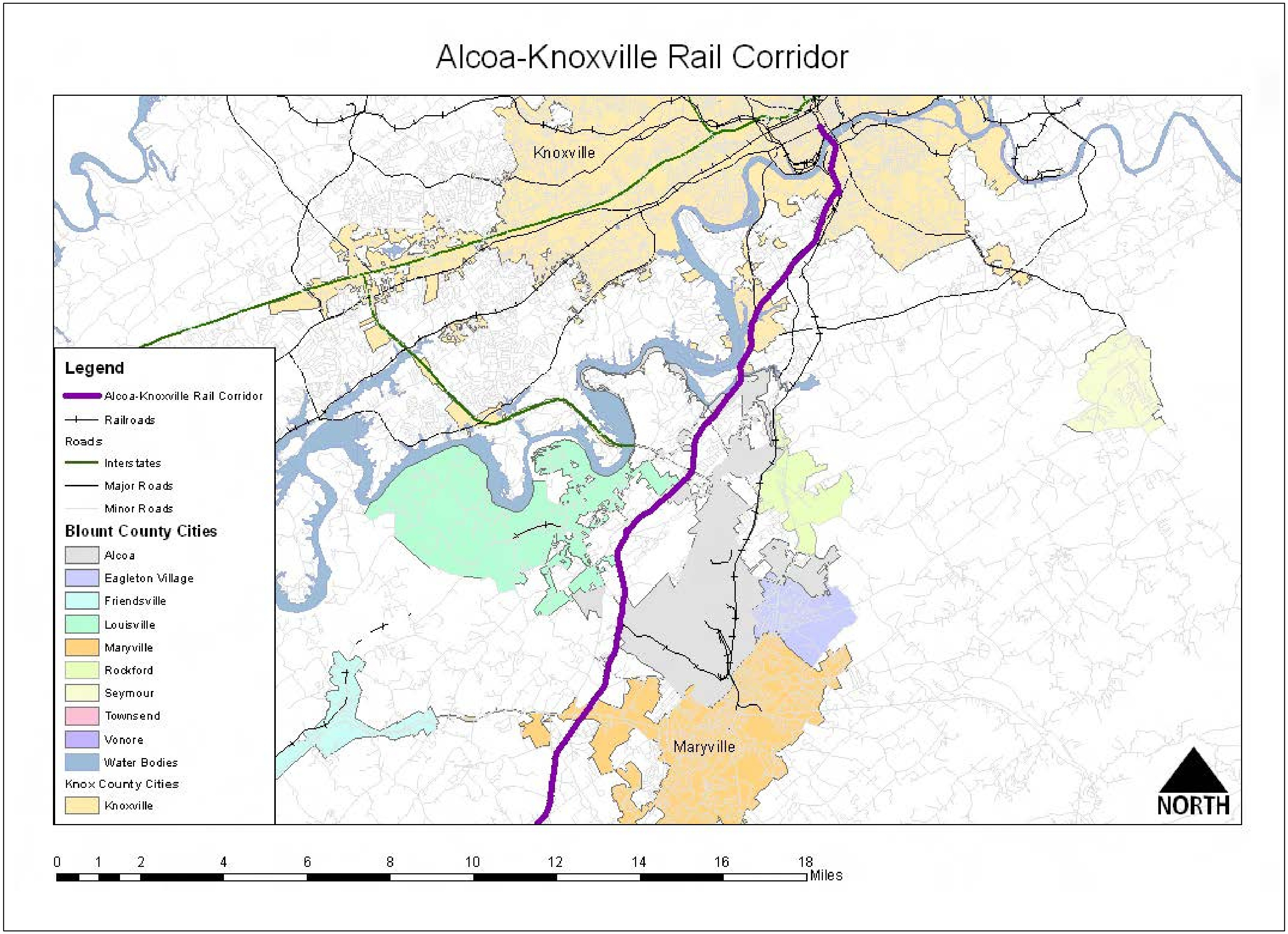


Figure 3-82
Overpass at SR 168

Figure 3-83
Double Tracks near Alcoa Plant

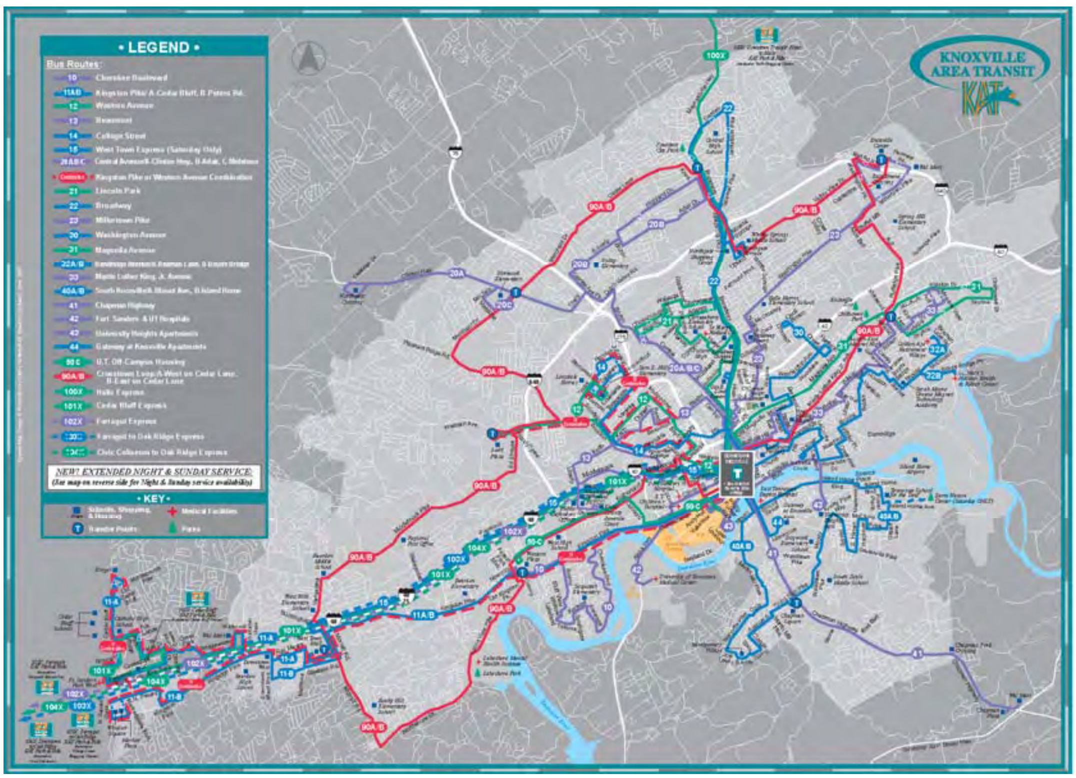
Transit Service

Knoxville Area Transit (KAT) routes are shown on Figure 3-84. KAT operates Route 40 A/B in the general vicinity of the Alcoa–Knoxville Rail Corridor. Route information is detailed in Table 3-8 below.

Table 3-8
Transit Routes along Alcoa-Knox Rail Corridor

Route	Route Name	Termini	2008 Annual Ridership	Revenue per Revenue Mile Rank
40 A/B	South Knox	Martin Mill Pike from Montgomery Village to downtown	78,971	20

Figure 3-84
KAT Transit Routes



Land Use

The land use in this corridor is predominantly rural, with farms, churches, a park, a school and a few small shops. (Figure 3-85). There is an industrial area located near Caleb Road. Near Government Farm Road is the trailhead for the greenway and a new, suburban-style residential development. In the area closest to the City of Alcoa, the land use is industrial with the Alcoa Plant and supporting uses (Figure 3-86). Under discussion is a major redevelopment plan for the existing Alcoa, Inc. property that was never developed. Some of the early concept plans envision a neo-traditional development, creating business and retail space and a mix of housing types. The rail line runs through the proposed development.

Figure 3-85
Single Track Rail Line near Church

Figure 3-86
Industrial Land Use near Alcoa Plant

Population and Employment Density

The population density along the Alcoa-Knoxville Rail Corridor is not continuous, but rather occurs in pockets. The greatest densities occur in the area of the University of Tennessee Campus and downtown Knoxville. Other pockets of dense population are found near Chapman Highway, north and south of the rail line. Further south along the rail line, the density is very low. More than 17,000 people live within a ½ mile radius of the Alcoa-Knoxville Rail Corridor (Figure 3-87). The average population density along this corridor is 1,275 people per square mile. It is worth noting that the corridor surrounding U.S. 129 (Alcoa Highway), to the west of the rail corridor, includes a commercial area and appears to have higher population and employment densities than either of the rail corridors.

Projected future population for 2035 was assessed for the corridor based on the outputs of the Knoxville TPO's Travel Demand Model. The changes in population vary along the corridor, although the average increase is 50 to 100 percent. The area south of UT Knoxville, across the river, shows the greatest percentage increase in population. Figure 3-88 displays the Traffic Analysis Zones along the corridor and the percentage of change in population projected.

There are more than 1,100 employment locations identified within ½ mile of this corridor, providing approximately 20,500 jobs. The employers with the greatest number of employees in this area are: the University of Tennessee, Tennessee Valley Authority, City of Knoxville and Knox County governments, and, 21st Century Mortgage. Figure 3-89 shows the employment locations, with the largest employee centers in dark blue.

The TPO's model projects a wide range of employment growth rates along the Alcoa-Knoxville Rail Corridor, ranging from zero to 50 percent in some TAZs to more than 150 percent in other TAZs. The greatest percentage increases are anticipated in the TAZs south of downtown Knoxville, towards the City of Maryville (Figure 3-90).

Household Income

The median household income in both Knox and Blount Counties is approximately $42,000. The median household income levels along the Alcoa-Knoxville Rail Corridor vary between $31,750 - $41,700 and $41,700 - $82,000 (Figure 3-91).

Potential for Higher Frequency Transit along Alcoa-Knoxville Rail Corridor

Positive Attributes

- Only potentially available rail corridor in the region serving a significant radial route;
- NS has discussed possible abandonment of a portion of the alignment;
- Connects to the Airport and to the city of Alcoa and the Alcoa plant; and,
- Opportunity for commuter or light rail line to shape future development.

Areas that Need Improvement

- Passes through relatively low density, less developed area;
- Many portions of the line are single tracked, limiting potential service frequency and operational options;
- Widening to increase rail capacity could require costly "cut and fill" in many areas; and,
- Negotiations for use of freight rail lines is often difficult, and trackage rights expensive.

Figure 3-87
Alcoa-Knoxville Rail Corridor
Population Density

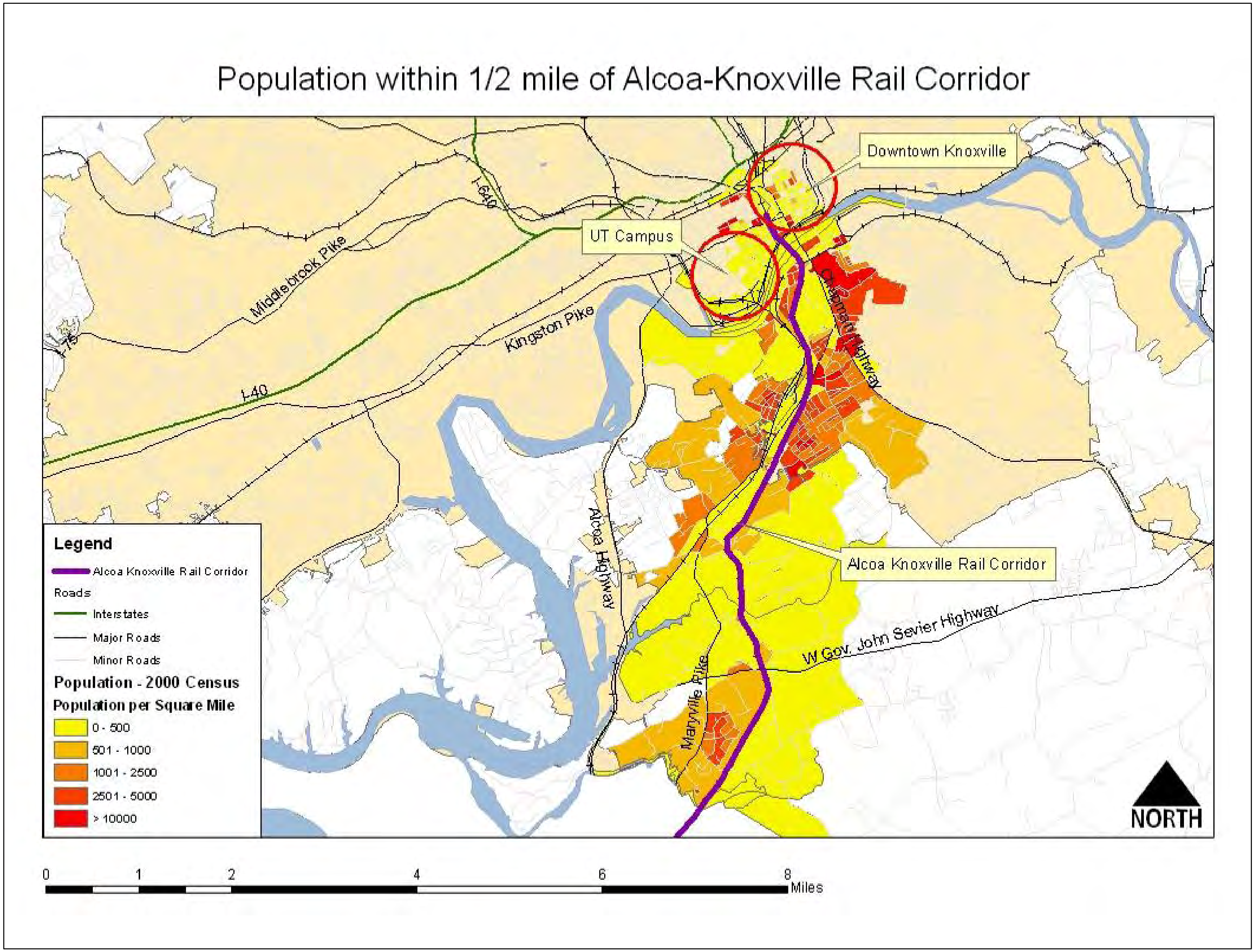


Figure 3-88
Alcoa-Knoxville Rail Corridor
Population Change (2006 – 2035)

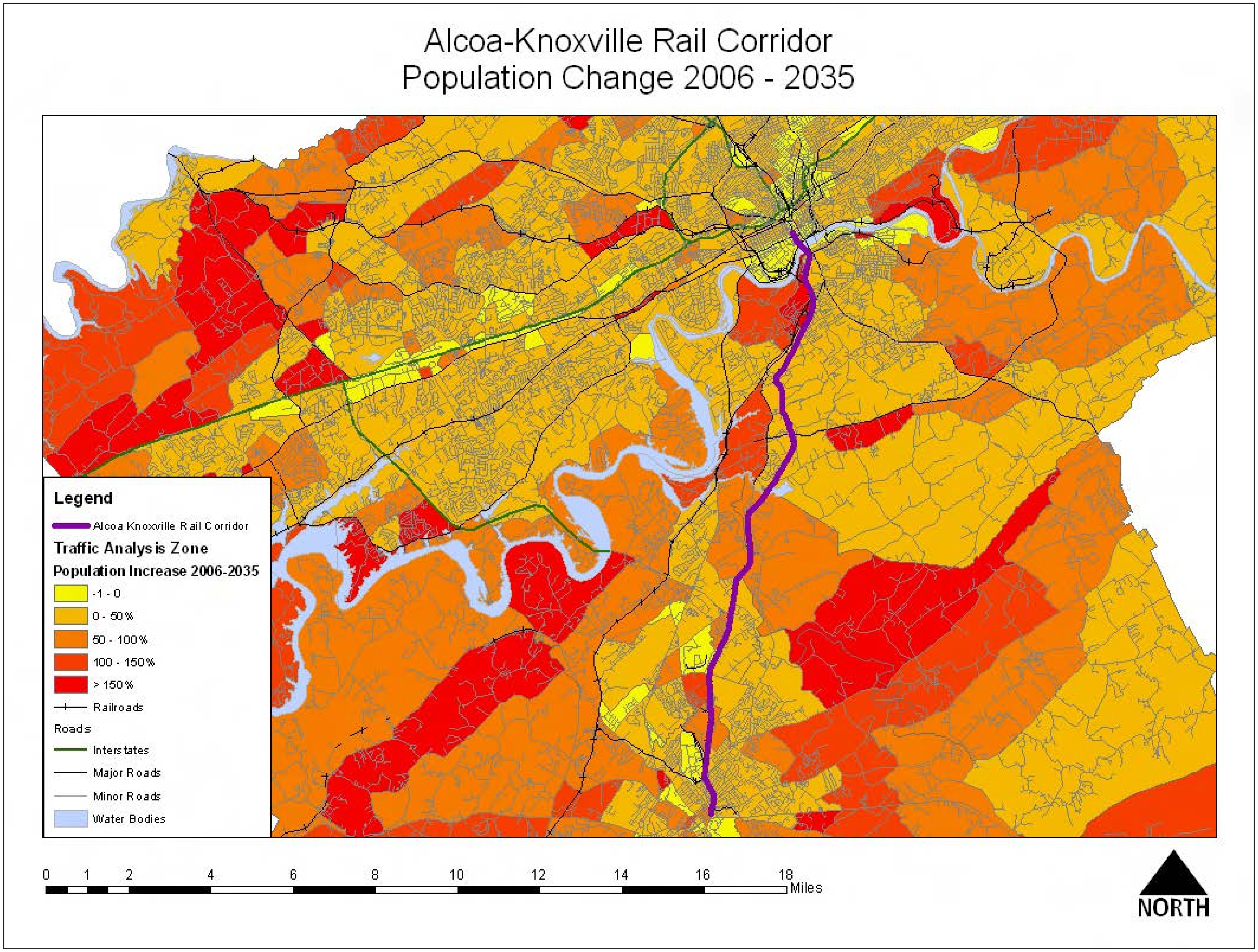


Figure 3-89
Alcoa-Knoxville Rail Corridor
Employment Locations

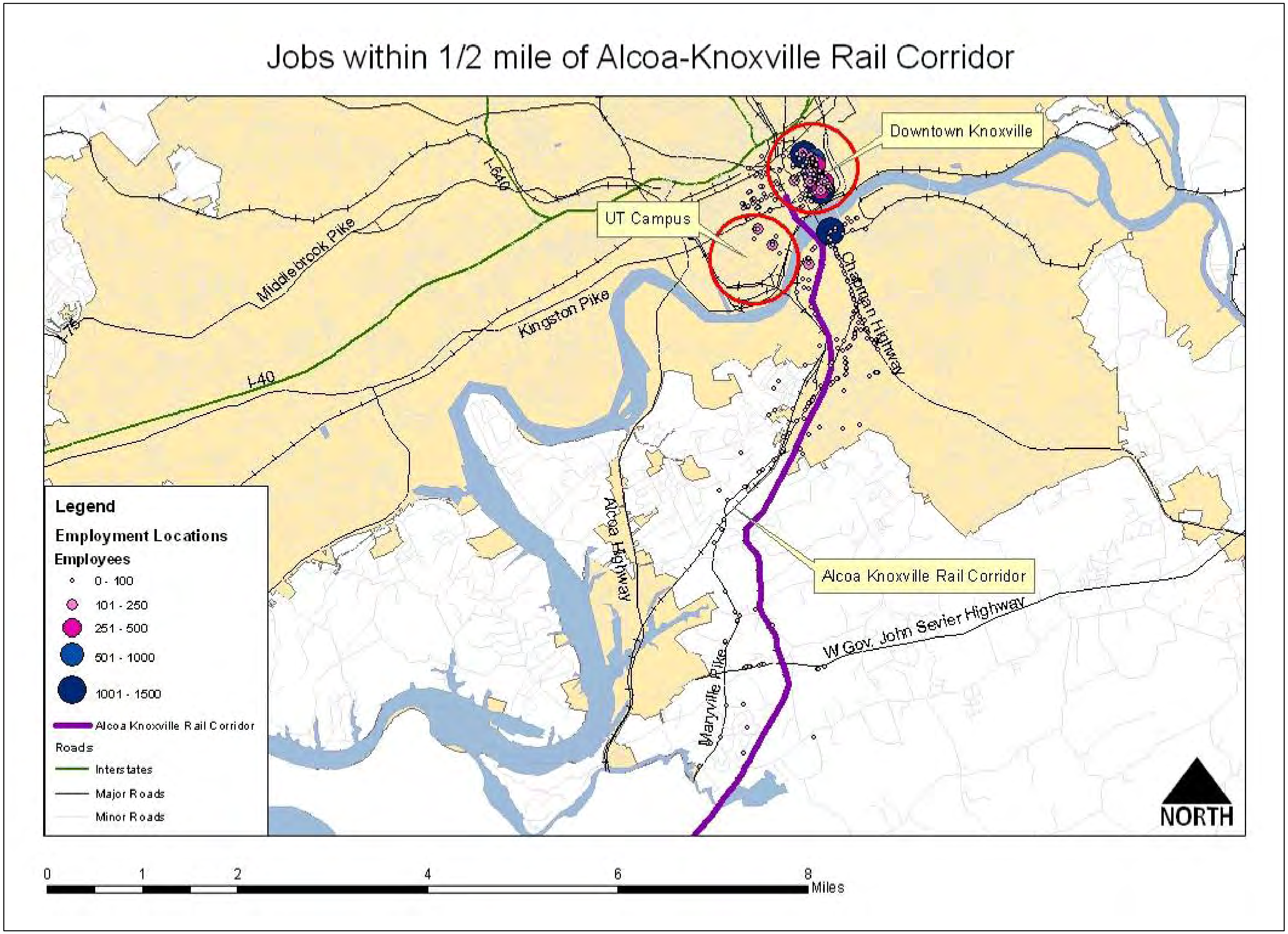


Figure 3-90
Alcoa-Knoxville Rail Corridor
Employment Change (2006 – 2035)

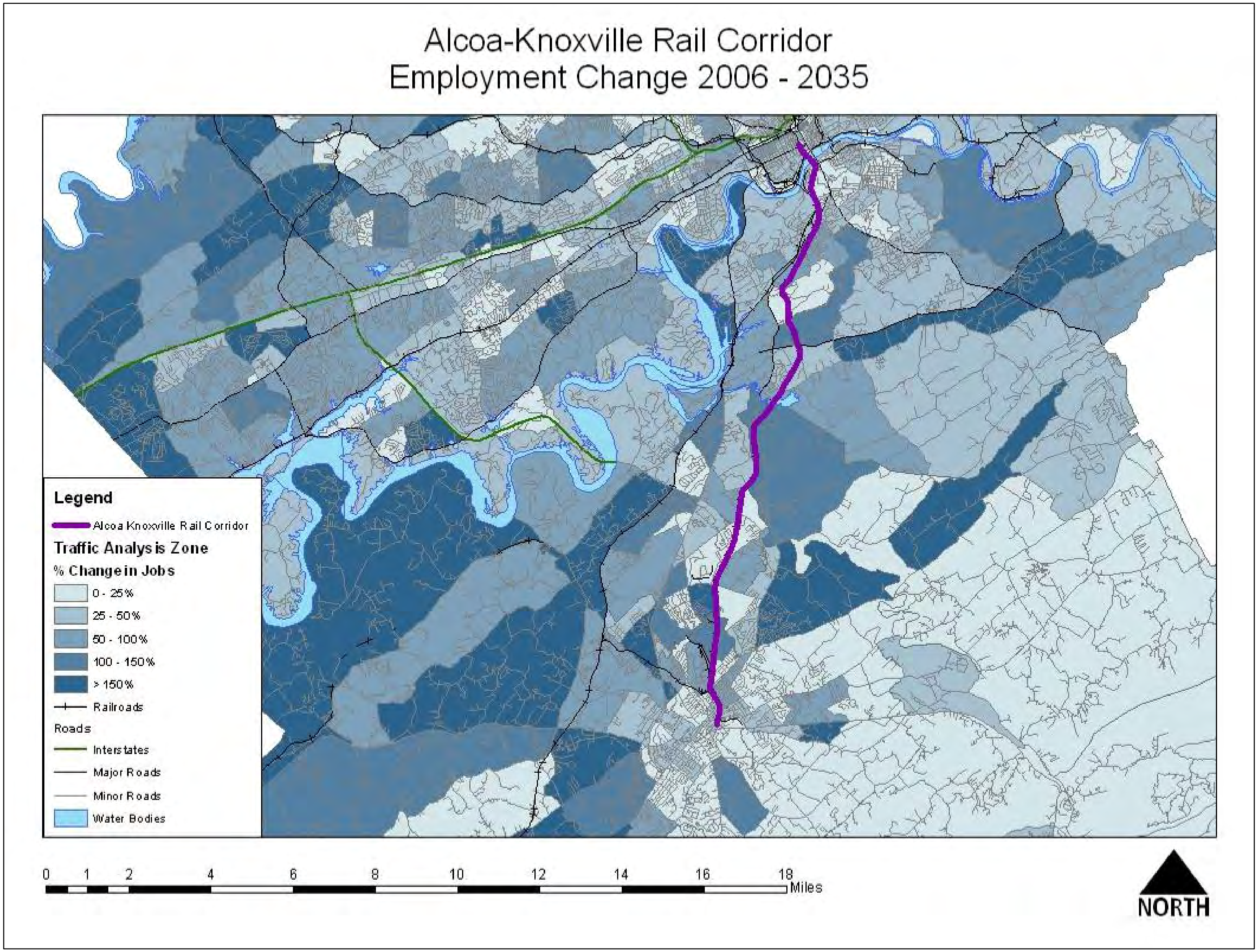
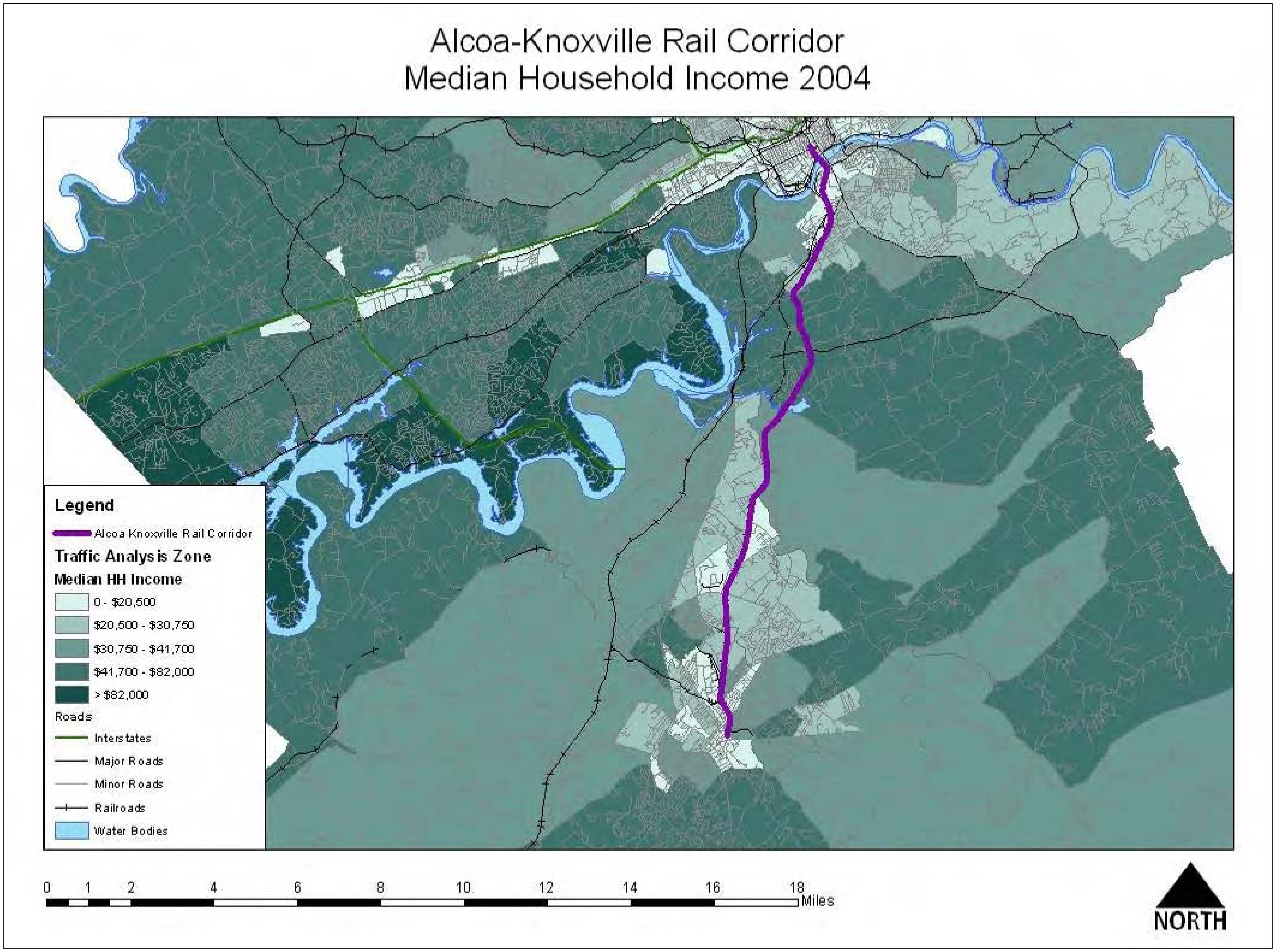


Figure 3-91
Alcoa-Knoxville Rail Corridor
Median Household Income



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4. Cost Estimates

Operating and capital costs were assessed for each of the eight corridors.

Operating costs were estimated by estimating the length and operating speed of each corridor. Bus rapid transit (BRT) and light rail transit (LRT) corridors were estimated to operate at 15 mph (including stops) while commuter rail corridors were estimated to operate at 20 mph.

The operating time required to make a complete trip was estimated based on length and assumed operating speed of the corridor. The required number of vehicles was estimated based on the cycle time for a single trip and the proposed frequency of service. A frequency of every ten minutes during the peak and every 20 minutes during the off-peak was used for BRT and LRT service, while commuter rail was estimated at every 30 minutes during peak hours only.

The number of revenue hours required was calculated by multiplying the number of required vehicles and the number of service hours. Operating costs were estimated by converting the daily revenue hours to annual revenue hours by multiplying 254 days (for weekdays) and 110 days (for weekends).

The annual operating cost was estimated by multiplying the number of required revenue hours by a cost per revenue hour. For BRT, the cost per revenue hour was estimated to be $56.64 (the cost per KAT revenue hour from 2007 NTD data) plus an additional $75,000 per track mile in maintenance costs. For LRT, the cost per revenue hour used was $200.00, based on light rail operating costs for various systems in the eastern part of the United States. The commuter rail cost estimate used $636.70 per revenue hour, which is the reported cost per revenue hour for the Music City Star in Nashville.

The capital cost estimate took into account three components: required vehicle cost, station construction cost, and guideway construction cost.

The required vehicle cost was based on the number of peak vehicles required to run each service based on the frequencies described above. These were multiplied by the cost per vehicle, which was estimated at $800,000 per articulated BRT vehicle, $4.14 million per articulated LRT vehicle, and $5.0 million per diesel multiple unit for commuter rail.

The station construction cost estimated the number of required stations based on the length of each corridor. No station locations were assessed for each corridor, so the cost estimate is a general number. For BRT and light rail corridors, stations were estimated to be 0.5 miles apart. Thus, a corridor of 7.0 miles would have 14 stations. The cost used for a BRT station was $250,000 and the cost used for a light rail station was $500,000.

For commuter rail the stations were estimated to be 1.0 miles apart, which is based on the scale and speed of commuter rail service. Stations were estimated to cost approximately $250,000.

Guideway construction costs were estimated on a per-mile basis. Guideway miles are essentially double the corridor length, since it was assumed that each corridor would be double-tracked. For BRT the guideway cost was estimated to be $5 million per mile for low-end BRT and $25 million per mile for high-end BRT. The difference provides a high and low boundary of costs based on the level of right of way improvements that are required. The LRT guideway cost was estimated at $45 million per mile.

For the two commuter rail corridors there were no assumed guideway costs, since rail presently exists on each of these corridors. However, in some places the commuter rail is single tracked. Thus, the guideway costs for commuter rail do not take into account the cost of double tracking the corridor. Additionally, no costs were assigned to lease each corridor from their respective owners.

Tables 4-1 and 4-2 summarize the estimated operating costs and capital costs, respectively, for implementing high capacity transit in each of the eight corridors. For the two rail corridors, Norfolk Southern and Alcoa-Knoxville, operating and capital cost estimates were performed only for the commuter rail option. For the remaining six corridors, operating cost estimates were calculated for both a BRT and LRT option. Capital cost estimates were calculated for three different options, low-end BRT, high-end BRT, and LRT.

Considering only capital costs, implementing commuter rail in either the Norfolk Southern or Alcoa-Knoxville rail corridors would be the least expensive options. Because these corridors already exist as active freight rail lines, the only capital costs for implementing commuter rail service would be the purchase of vehicles and construction of stations. Furthermore, because commuter rail stations are located at greater intervals than either BRT or LRT stations, total station costs are lower than for many of the BRT/LRT corridors. In the remaining six corridors, the capital costs of implementing low or high-end BRT or LRT are directly related to the length of the corridor. Therefore the MLK Jr. corridor, at 4.2 miles, would be the least expensive option, while the Chapman Highway/James White Parkway, at 8.5 miles, would have the highest capital costs. In all cases, the most expensive low-BRT option would still be less costly to implement than the least expensive high-BRT option. The same holds true for high-BRT versus LRT, with the exception of the Chapman Highway high-BRT option, which is estimated to have slightly higher capital costs than a light rail line on the MLK Jr. corridor.

Operating costs are also closely related to the length of the corridor, but the number of vehicles in service and number of service hours are also significant factors in determining operating costs. Of the six corridors with a BRT option, the MLK Jr. corridor is estimated to have the lowest operating costs, due to the short distance of the corridor and low number of vehicles operating during peak and off-peak periods. The Magnolia Avenue and Cumberland Avenue/Kingston Pike Corridors are also estimated to have annual operating costs below $2 million for BRT. The Chapman Highway/James White Parkway Corridor has the highest estimated BRT operating costs. For LRT, the MLK Jr. and Magnolia corridors are estimated to have the lowest operating costs, while the Western Ave. and Chapman Highway corridors have the highest estimated operating costs. The cost of operating commuter rail in the Norfolk Southern rail corridor is estimated to be more expensive than operating BRT in any of the non-rail corridors, but less expensive than operating a light rail line. However, the cost of operating commuter rail in either of the rail corridors is likely to be much more expensive than has been estimated, due to the omission of leasing costs from the estimates.

Table 4-1
Operating Cost Estimates

1. Cumberland Avenue/Kingston Pike

	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
BRT	7.5	15	30	66	10	7	4	20	4	11	20	4	12	23,568	$56.64	$1,334,892	$562,500	$1,897,392
LRT	7.5	15	30	66	10	7	4	20	4	11	20	4	12	23,568	$200.00	$4,713,600		$4,713,600

2. Norfolk Southern Rail Corridor

	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
Commuter Rail	7.3	20	22	48	30	2	6		1	2				3,556	$636.70	$2,264,105		$2,264,105

3. Western Avenue

	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
BRT	8.3	15	33	73	10	8	4	20	4	11	20	4	12	24,584	$56.64	$1,392,438	$622,500	$2,014,938
LRT	8.3	15	33	73	10	8	4	20	4	11	20	4	12	24,584	$200.00	$4,916,800		$4,916,800

4. North Broadway Street

	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
BRT	7.7	15	31	68	10	7	4	20	4	11	20	4	12	23,568	$56.64	$1,334,892	$577,500	$1,912,392
LRT	7.7	15	31	68	10	7	4	20	4	11	20	4	12	23,568	$200.00	$4,713,600		$4,713,600

5. Martin Luther King Jr. Avenue

	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
BRT	4.2	15	17	37	10	4	4	20	2	11	20	2	12	12,292	$56.64	$696,219	$315,000	$1,011,219
LRT	4.2	15	17	37	10	4	4	20	2	11	20	2	12	12,292	$200.00	$2,458,400		$2,458,400

6. Magnolia Avenue

	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
BRT	4.5	15	18	40	10	4	4	20	2	11	20	2	12	12,292	$56.64	$696,219	$337,500	$1,033,719
LRT	4.5	15	18	40	10	4	4	20	2	11	20	2	12	12,292	$200.00	$2,458,400		$2,458,400

7. Chapman Highway/James White Parkway

	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
BRT	8.5	15	34	75	10	8	4	20	4	11	20	4	12	24,584	$56.64	$1,392,438	$637,500	$2,029,938
LRT	8.5	15	34	75	10	8	4	20	4	11	20	4	12	24,584	$200.00	$4,916,800		$4,916,800

8. Alcoa-Knoxville Rail Corridor

	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
Commuter Rail	16.1	20	48	106	30	4	6		1	2				6,604	$636.70	$4,204,767		$4,204,767

Table 4-2
Capital Cost Estimates

1. Cumberland Avenue/Kingston Pike

	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
BRT	7.5	15	$5,000,000	$75,000,000	7	$800,000	$5,600,000	15	$250,000	$3,750,000	$84,350,000
BRT High	7.5	15	$25,000,000	$375,000,000	7	$800,000	$5,600,000	15	$250,000	$3,750,000	$384,350,000
LRT	7.5	15	$45,000,000	$675,000,000	7	$4,140,000	$28,980,000	15	$500,000	$7,500,000	$711,480,000

2. Norfolk Southern Rail Corridor

	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
Commuter Rail	7.3	N/A	N/A	N/A	2	$5,000,000	$10,000,000	8	$250,000	$2,000,000	$12,000,000

3. Western Avenue

	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
BRT	8.3	16.6	$5,000,000	$83,000,000	8	$800,000	$6,400,000	17	$250,000	$4,250,000	$93,650,000
BRT High	8.3	16.6	$25,000,000	$415,000,000	8	$800,000	$6,400,000	17	$250,000	$4,250,000	$425,650,000
LRT	8.3	16.6	$45,000,000	$747,000,000	8	$4,140,000	$33,120,000	17	$500,000	$8,500,000	$788,620,000

4. North Broadway Street

	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
BRT	7.7	15.4	$5,000,000	$77,000,000	7	$800,000	$5,600,000	16	$250,000	$4,000,000	$86,600,000
BRT High	7.7	15.4	$25,000,000	$385,000,000	7	$800,000	$5,600,000	16	250000	$4,000,000	$394,600,000
LRT	7.7	15.4	$45,000,000	$693,000,000	7	$4,140,000	$28,980,000	16	$500,000	$8,000,000	$729,980,000

5. Martin Luther King Jr. Avenue

	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
BRT	4.2	8.4	$5,000,000	$42,000,000	4	$800,000	$3,200,000	9	$250,000	$2,250,000	$47,450,000
BRT High	4.2	8.4	$25,000,000	$210,000,000	4	$800,000	$3,200,000	9	$250,000	$2,250,000	$215,450,000
LRT	4.2	8.4	$45,000,000	$378,000,000	4	$4,140,000	$16,560,000	9	$500,000	$4,500,000	$399,060,000

6. Magnolia Avenue

	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
BRT	4.5	9	$5,000,000	$45,000,000	4	$800,000	$3,200,000	9	$250,000	$2,250,000	$50,450,000
BRT High	4.5	9	$25,000,000	$225,000,000	4	$800,000	$3,200,000	9	$250,000	$2,250,000	$230,450,000
LRT	4.5	9	$45,000,000	$405,000,000	4	$4,140,000	$16,560,000	9	$500,000	$4,500,000	$426,060,000

7. Chapman Highway/James White Parkway

	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
BRT	8.5	17	$5,000,000	$85,000,000	8	$800,000	$6,400,000	17	$250,000	$4,250,000	$95,650,000
BRT High	8.5	17	$25,000,000	$425,000,000	8	$800,000	$6,400,000	17	$250,000	$4,250,000	$435,650,000
LRT	8.5	17	$45,000,000	$765,000,000	8	$4,140,000	$33,120,000	17	$500,000	$8,500,000	$806,620,000

8. Alcoa-Knoxville Rail Corridor

	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
Commuter Rail	16.1	N/A	N/A	N/A	4	$5,000,000	$20,000,000	17	$250,000	$4,250,000	$24,250,000

5. Evaluation Matrices

Two evaluation matrices were prepared for the eight corridors assessed: one for both quantitative and qualitative issues. Those matrices are shown in Tables 5-1 and 5-2, respectively. The matrices summarize the relative merits of the corridors examined.

Based on this preliminary analysis, the Cumberland Avenue/Kingston Pike Corridor seems to have the greatest potential for enhanced transit service to facilitate transit oriented development, particularly in the area of the corridor east of Alcoa Highway. The corridor connects directly to downtown Knoxville, serves the densely populated University of Tennessee area and could facilitate further transit-oriented development in that corridor. The Cumberland corridor has fewer obstacles to service development than many of the other corridors and has high transit ridership on existing routes. However, the current development plan for the corridor proposed to reconstruct the roadway to eliminate a lane in each direction to allow for on-street parking and curb extensions. While these changes would improve the quality of streetscape in the corridor, they would essential preclude development of premium transit service. Another challenge is presented by the residential areas west of Alcoa Highway which have been developed at densities that are not high enough to support premium transit service.

Magnolia Avenue has high existing transit ridership, high residential and employment densities, and a relatively flat alignment in the part of the corridor nearest to downtown. Magnolia Avenue's connection to downtown is indirect, but an adequate connection to the new downtown transit center could be made. Perhaps most importantly, the wide right-of-way on Magnolia Avenue would make implementation of premium transit service in the corridor relatively simple. Martin Luther King Jr. Avenue, which runs approximately parallel to Magnolia, is also a viable option and would allow for significant redevelopment of under-utilized property in that corridor.

Western Avenue also has relatively high transit ridership and higher than average population and employment densities. The connection to downtown via Summit Hill Drive is good, but the terrain of some of the surrounding areas could pose a problem for development and/or redevelopment in the corridor.

Most of the other corridors that were examined have multiple flaws or issues that would make them less desirable choices for development of premium transit service. Most of the other corridors have significantly lower population and employment densities and existing transit ridership. Several of the corridors – particularly the rail corridors to the south – are not served by existing transit service, making it difficult to determine the potential market for upgraded transit service. In these corridors, implementation of express or local bus service would be an important first step in developing the corridors as potential sites for premium bus or rail transit. A number of the other corridors have issues related to the rugged terrain that surrounds downtown Knoxville that would make it difficult to develop rail lines or the critical higher-density housing, commercial and mixed-use development that would be necessary to support a major investment in a premium transit system.

Table 5-1
Quantitative Evaluation Matrix

Corridor	Guideway Miles	Existing Annual Ridership	Average Population Density (people per square mile)	Average Employment Density (jobs per square mile)	Captial Cost Estimate	Annual Operations and Maintenance Cost Estimate
1. Cumberland Avenue/Kingston Pike	15	Route 10 - 19,013 Route 11 A/B - 216,617 Route 50C - 143,671 Route 90 A/B 165,296	1,610	2,300	BRT Low - $84.3 million BRT High - $384.3 million LRT - $711.5 million	BRT - $1.9 million LRT - $3.7 million
2. Norfolk Southern Rail Corridor	N/A	Route 10 - 19,013 Route 11 A/B - 216,617 Route 50C - 143,671 Route 90 A/B 165,296	1,404	1,000	Commuter Rail - $12 million	Commuter Rail - $2.3 million
3. Western Avenue	16.6	Route 11 A - 216,617 Route 15 - 3,133 Route 101x - 11,371 Route 102x - 19,960	2,200	2,100	BRT Low - $93.7 million BRT High - $425.7 million LRT - $730 million	BRT - $2.0 million LRT - $4.9 million
4. North Broadway Street	15.4	Route 22 - 172,591	1,830	2,100	BRT Low - $86.6 million BRT High - $394.6 million LRT - $399.1 million	BRT - $1.9 million LRT - $4.7 million
5. Martin Luther King Jr. Avenue	8.4	Route 31 - 194,166 Route 90 A/B - 165,296	2,680	3,300	BRT Low - $47.5 million BRT High - $215.5 million LRT - $399.1 million	BRT - $1.0 million LRT - $2.5 million
6. Magnolia Avenue	9	Route 31 - 78,971 Route 90 A/B - 92,555	2,600	2,400	BRT Low - $75.3 million BRT High - $343.3 million LRT - $634.8 million	BRT - $1.5 million LRT - $3.7 million
7. Chapman Highway/James White Parkway	13.4	Route 40 A/B - 78,971 Route 41 - 92,555	1,000	1,400	BRT Low - $95.7 million BRT High - $435.7 million LRT - $806.6 million	BRT - $2.0 million LRT - $4.9 million
8. Alcoa-Knoxville Rail Corridor	N/A	Route 40 A/B - 78,971	1,275	1,550	Commuter Rail - $24.3 million	Commuter Rail - $4.2 million

Table 5-2
Qualitative Evaluation Matrix

Corridor	Land Use	Pedestrian Conditions	Connectivity to Downtown	Connectivity to South Waterfront Development	Connectivity to Cumberland Avenue Corridor	TOD Potential
1. Cumberland Avenue/ Kingston Pike	Medium to high density mixed use downtown and along Cumberland Avenue. Lower-to-mid density residential and commercial/retail along Kingston Pike.	Sidewalks available in downtown and near downtown. Sidewalks intermittent or non-existent along outer portions of the corridor.	Excellent, connects directly to downtown via Cumberland/Main	None	Yes	East of Alcoa Hwy has highest potential for TOD. Some redevelopment and infill opportunities west of Cherokee Country Club.
2. Norfolk Southern Rail Corridor	Light to medium industrial uses between downtown and Third Creek. Low to medium density commercial between Thrid Creek and Morrell Road.	Rail corridor has low pedestrian access. Corridor is isolated, with wooded areas or industrial uses along most of its length.	Fair to poor, connects north of downtown, approximately 0.5 miles from CBD.	None	Operates parallel to Cumberland, appoximately 0.4 miles from the corridor	Some potential around downtown terminal. Some redevelopment potnetial between Kingston Pike and Royal Crown Drive.
3. Western Avenue	Industrial, public housing, cemetary near downtown. Underutilized retail section mid-corridor. Lower density beyond Hinton Road.	Sidewalks available in downtown and near downtown. Sidewalks intermittent or non-existent along outer portions of the corridor.	Good, connects via Summit Hill Drive	None	None	Some redevelopment of public housing has occurred near downtown. Some potential for redevelopment of older commercial/retail centers or infill development mid-corridor. Topography could limit redevelopment opportunities.
4. North Broadway Street	Industrial, institutional, cemetary and small-scale commercial near downtown - some infill occurring. Lower density commercial/retail further north, with lower density housing behind retail. Higher density areas between I-40 and I-640.	Sidewalks available in downtown and near downtown. Sidewalks intermittent or non-existen along outer portions of the corridor.	Excellent to good, connects via Broadway	None	None	Some redevelopment potential in oder neighborhodds, particularly just north of downtown. Possible redevelopment or infill development north of I-640. Topography could limit development potential in northern portion of corridor.
5. Martin Luther King Jr. Avenue	Light industrial and medium density residential, including public housing, near downtown. Small single family homes, institutional and commercial uses further east. Ripe for redevelopment. Density somewhat higher and more varied along Magnolia Ave.	Sidewalks available throughout most of the corridor, intermittent or non-exisitent in short segment at northeastern end.	Good, connects via Summit Hill Drive	None	None	Significant redevelopment potential throughout corridor.
6. Magnolia Avenue	Light industrial and medium density residential, including public housing, near downtown. Transitions to mixed use corridor of single family homes and commercial development from Summit Hill to end of corridor.	Sidewalks generally available throughout corridor.	Good, connects via Church Avenue	None	None	Some redevelopment potential at commercial sites throughout corridor.
7. Chapman Highway/ James White Parkway	Suburban commercial corridor, with lower density commercial development to Sevier Hwy. Transitions to mostly rural development south of Sevier Hwy.	Sidewalks present only along east side of Chapman between Tennessee River and Moody Avenus. Few barriers between pedestrians and traffic.	Excellent to good, connects via James White Parkway	None	None	Some redevelopment potential, particularly between downtown and Sevier Hwy. Topography may limit development in some areas.
8. Alcoa-Knoxville Rail Corridor	Lower density suburban and rural residential development. Land use intensity is greater at southern end of corridor in Alcoa.	Little or no pedestrian facilities/access.	Good to fair, possible connectio via rail alignment near World's Fair Park	Possible	None	TOD would require development of new towns around rail stations in corridor.

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6. Next Steps

This corridor analysis is a preliminary step towards identifying corridors in the Knoxville region with potential for developing higher capacity transit services or transit enhancements. Further analysis will be necessary to determine which, if any, of the analyzed corridors have the necessary ridership and land use, development and/or redevelopment potential to support higher capacity transit service and TOD. A feasibility study should be conducted to prioritize the corridors according to their potential for supporting enhanced transit services and feasibility of implementation, in addition to eliminating any corridors where development of higher capacity transit may be infeasible or merely impractical. If federal funding will be sought to implement transit enhancements in one or more corridors, an alternatives analysis based on FTA New Starts criteria will need to be conducted on those corridors in which transit improvements have the most potential for development.

Other possible funding sources for implementation of transit enhancements include:

- Local funding, from general revenues at the municipal or county level, or dedicated transit funding generated by a new tax. Property taxes and sales taxes are among the options typically used for local transit funding.

- Private funding or combinations of private and public funding scenarios such as tax increment financing or value capture mechanisms which capture a portion of the property value increase generated by the transportation improvement to secure funding to construct and operate the improvement.

- State transportation grants, either through existing state funding transportation funding programs or new grants provided by the state legislature.

- Federal funding programs administered by the State Department of Transportation or the Knoxville TPO, such as CMAQ funds, enhancement grants, safety grants or other grants that provide project funding for roadway and other transportation projects.

- Recent legislation passed in Tennessee allow for the creation of Regional Transit Authorities (RTA). RTAs are often an effective organization structure that can implement large scale corridor systems. RTAs often are structured to allow for the ability to tax or issue bonds allowing them to fund significant capital projects.

Nationally, more emphasis is being placed on developing passenger rail corridors. Therefore, corridors in Knoxville should continue to be studied to determine future potential.

There appear to be two distinct possibilities for high capacity transit in Knoxville. One would be a commuter or light rail project using local funding or through a New Start process or Small Start federal funding process. A second option would be development of bus rapid transit either using local funding or funding through the federal government's Very Small Starts program. Corridors with average daily ridership over 3,000 riders per day can be eligible for this program, which is restricted to projects with an initial capital cost of less than $50 million. A good example of a Very Small Starts program is the Kansas City Max Bus Rapid Transit project. This is the type of system that could be appropriate for Cumberland Avenue because it mixes separate guideway operations and on-street operations (where right-of-way is not sufficient to allow a separate lane). Currently none of the corridors reviewed has average daily ridership over 3,000 riders but if a preferred corridor can be identified, strategies including increasing bus frequencies and encouraging transit-friendly land use and zoning policies would position Knoxville to begin a process of creating high capacity transit operations.

Cleveland Euclid Corridor Bus Rapid Transit Vehicle

The following discussion provides an overview of the current state of federal transit programming for high capacity transit projects focusing on Small Starts and Very Small Starts.

Cleveland Euclid Corridor Bus Rapid Transit Station

The significant difference between New Starts projects and Small Starts and Very Small Starts projects is the size, scope, and cost of the project. New Starts projects involve new fixed guide-way transit systems through new corridors, which immediately make these projects very expensive and therefore associated with significant risk in terms of the relationship between their cost and their actual community benefit. Small Starts projects, in comparison, are smaller in scope, and less expensive. Specifically, Small Starts grants are capped at $75 million with total project costs of no more than $250 million. While no specific grant cap is given for Very Small Starts, total project costs for these projects cannot be more than $50 million, suggesting that the grant itself cannot be more than approximately $40 million, or 80 percent of the total project cost. Given the smaller federal investment, the degree of FTA involvement and the threshold for demonstrating the cost effectiveness of the project is much lower for Small Starts, and actually presumed for Very Small Starts projects.

Kansas City MAX Bus Rapid Transit Vehicle

Table 6-1 contains the basic technical prerequisites for BRT projects to be considered as Small Starts or Very Small Starts. As the table shows, for the most part, the prerequisites between the two categories are the same, with the cost of the project being the primary distinction between the two. While there is a distinction between the two categories regarding transit stations, the basic service requirements of ten- to 15-minute headways for 14 hours a day, perhaps the most challenging operational criteria that must be met, are the same for either category. The Very Small Starts category must demonstrate at least 3,000 daily boarding in the proposed corridor, whereas Small Starts projects are subject to a more rigorous cost benefit analysis.

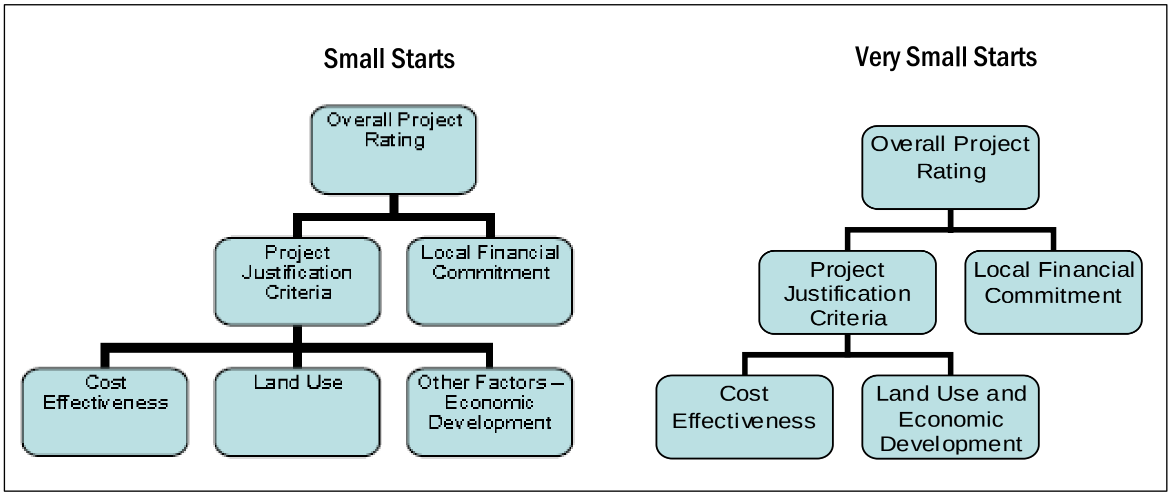
Kansas City MAX Bus Rapid Transit Station

Table 6-1
Technical Prerequisites

Small Starts	Very Small Starts
$250 maximum project cost/ $75 million maximum grant	$50 maximum project cost/less than $3 million per mile (not including cost of buses)
Substantial Transit Stations	Transit Stations
Signal Priority/Pre-emption	
Low Floor/Level Boarding Vehicles	
Special Branding of Service	
Frequent Service – ten-minute peak/15-minute off-peak headways	
Service offered at least 14 hours per day	
Demonstrated cost effectiveness in terms of user benefit	Existing corridor ridership exceeding 3,000 boardings per day

Figure 6-1, also provided by FTA, illustrates the basic structure for evaluating Small Start and Very Small Start projects. While the basic criteria categories are similar, the evaluation processes for each are different in one important way. While the criteria threshold for judging Small Starts projects is less than that for New Starts projects, Small Starts project still must perform the same basic evaluations for cost effectiveness, land use compatibility, economic development impacts, and local financial commitment as a part of their Alternatives Analysis in order to receive ratings in each category. These categories are *High, Medium-High, Medium, Medium-Low,* and *Low*. In order to be certified as a Small Start project and given approval to move forward to the project development phase, Small Start projects must receive an overall project rating of *medium*.

Figure 6-1
Evaluation Rating Structure



In contrast, due the small size of Very Small Starts projects, the FTA presumes that the project cost benefit, land-use compatibility, and economic development impact are neutral, and automatically assumes a medium rating for these projects. Further, as long as a Very Small Start project can demonstrate a legitimate local financial commitment, the FTA presumes a medium rating for this evaluation measure as well. The criteria for local financial commitment are:

- Funds are identified and available for the local share of the capital cost (at least 20 percent of total capital cost);
- The additional operating and maintenance costs of the project must be less than five percent of the agency's total operating budget; and,
- The agency is in reasonably good financial condition.

In essence, the FTA will automatically certify a project as a Very Small Starts project and allow it to proceed to the project development phase as long as it meets the technical prerequisites in Table 6-1 and can demonstrate the local financial commitment. In fact, FTA has identified these technical criteria for Very Small Starts because they ensure that projects produce "significant transportation benefits at a very low cost." Therefore, FTA has already determined that projects meeting these technical criteria are cost-effective and no further analysis is required. However, achieving the Very Small Starts designation does not imply a funding grant, but simply the ability to continue through the project development phase. Their funding will be determined primarily at the discretion of the administration and Congress as a part of the enactment of the President's budget.

Once a project has been designated as Small Starts or Very Small Starts, the project enters into the project development phase, which combines both preliminary engineering and final design. During this phase, the FTA and project sponsor develop a financial assistance package. This package, referred to as the Project Construction Grant Agreement (PCGA), defines the project, including cost, scope, and schedule; establishes the maximum level of federal financial assistance; and, defines the terms and conditions of that assistance. However, firm funding commitments, embodied in the

PCGA, will not be made until the project's development and design has progressed to the point where its scope, costs, benefits, and impacts are considered firm and final.

Small Starts projects must be ready to be implemented within the fiscal year that the project is recommended for funding and included in the President's budget, while Very Small Starts projects cannot be recommended funding until they are ready to be implemented. For almost all projects, specific funding recommendations and grants occur over several years, although projects with total costs under $25 million can be funded in one year. Again, as the Section 5309 grant program is discretionary, final decisions regarding which eligible projects are included in the President's enacted budget are made by the administration and Congress through the legislative process. A recommendation for funding in no way guarantees funding.