

KNOXVILLE REGIONAL TRANSIT CORRIDOR STUDY

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1.0 INTRODUCTION TO PROJECT

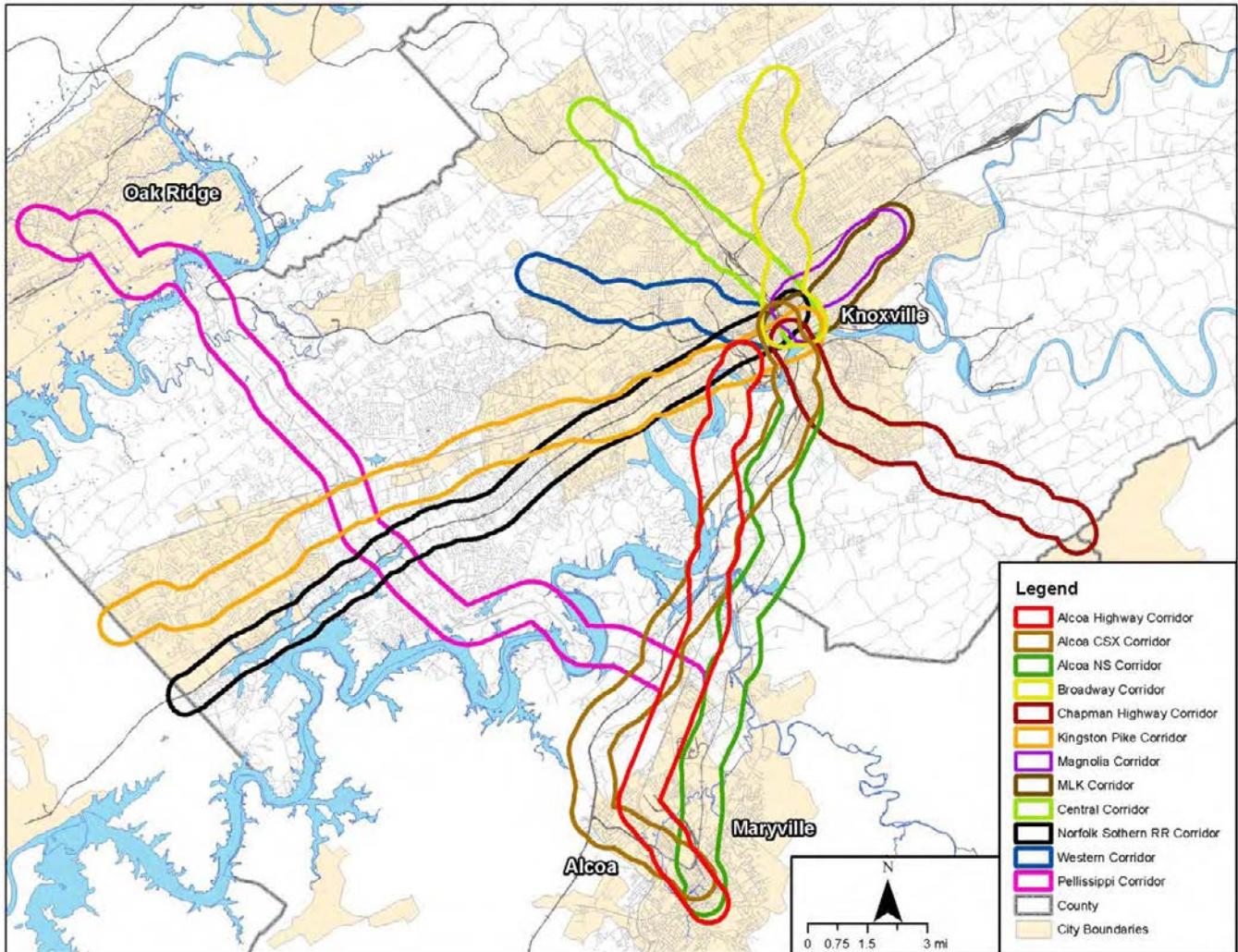
The Knoxville Regional Transportation Organization (TPO) sponsored this study, the Knoxville Regional Transit Corridor Study. The TPO was established in 1977 and is the federally designated Metropolitan Planning Organization (MPO) for the City of Knoxville and surrounding counties of Knox, Blount, Loudon, Sevier, Anderson. The TPO is responsible for developing transportation plans, programs and projects that consider all modes of transportation that support the goals of the affected communities. The Knoxville area is currently experiencing worsening congestion and air quality issues, which is a side effect of a steady population growth. Given these issues, the TPO sought guidance from the study team for improving mobility choices, improving air quality and enhancing the quality of life. The team conducted this study to further assess eight corridors that were previously identified as part of the KAT (Knoxville Area Transit) Transit Development Plan as areas for possible transit investment. Through further discussions with the TPO, four additional corridors were included in the evaluation process in order to capture a greater range of alternatives for the evaluation of implementing transit.

2.0 STUDY DESCRIPTION

The Knoxville Regional Transit Corridor Study assesses the need, and highlights a consensus for, capital investment in rapid transit service within a growing congested region between the City of Knoxville and Knox, Blount and Anderson Counties. The study also analyzes and ranks the general feasibility of several potential transit investments. Potential transit opportunities were developed to meet the transportation needs of this diverse study area. The study team sought opinions of stakeholders and study area residents to help guide the development of alternatives and gauge the support for additional analysis and advancement to a more detailed level of study. **Figure 2.1** displays the twelve corridors that were assessed through this study.

This study represents the initial phase of the planning development process for a transit investment program that intends to seek FTA New Starts or Small Starts federal funds for implementing a transit investment within the next 10 years. The project would adhere to the FTA guidelines in evaluating potential transit corridors that could apply for the New Starts or Small Starts funding mechanism without having to rely on long-term improvements. This is the first step in the process of identifying, evaluating, designing, and constructing a transportation investment in the study area. The entire process, from the beginning planning stages to start-up and operation of a new system, can require 6-10 years depending on overall project complexity, environmental impacts and funding availability. The next step in the newly adopted MAP-21 federal process would be to advance the recommended corridors through Systems Planning.

Figure 2.1 Project Corridors



3.0 PROJECT GOALS AND OBJECTIVES

Four core project goals and objectives were established for the Knoxville Regional Transit Corridor Study:

- Expand transit opportunities for existing transit users, non-drivers, and promote transit use by new riders.
- Enhance Knoxville’s image as a world class city and help the region compete with other metropolitan areas which are competing and/or already have rapid transit systems.
- Explore the role of transit technologies and how it can play in creating an efficient transportation system and a more sustainable community.
- Develop and recommend transit supportive land use guidelines, policies and tools to support Transit Oriented Development (TOD) and corridor development.

4.0 OUTREACH COORDINATION

Two rounds of outreach efforts were held, the first of which helped define the study area and identified possible technologies, the second of which assessed the consensus for the screening results. Key stakeholders were invited to outreach meetings where they could speak candidly with members of the study team. A public interest group which represented a diverse cross-section of public citizens who are interested in transit was invited to outreach meetings to learn about the study, ask questions and give feedback.

The first outreach meeting was held on Thursday, June 9, 2011. A stakeholder meeting was conducted in the morning and a public meeting was conducted in the evening with seventeen attendees at each meeting. At each meeting the study team introduced the purpose of the study, transit corridors, technologies, overview of Tier 1 & 2 screening processes, corridor demographics and introduced the TOD toolkit and its usefulness. Comments were solicited from the attendees and questions were answered.

The second outreach meeting was held on Tuesday, May 22, 2012. The meeting was a combined stakeholder and public outreach meeting with eighteen attendees. At the meeting the study team reviewed the results of the Tier 1 & 2 screening analysis, presented the top three corridors for transit investment, other recommended transit enhancements, the recommend technologies, visual simulations showing how transit will fit, and how to apply the TOD toolkit across the various corridors. The second round of outreach demonstrated the feasibility of public transit in the study area and spurred discussion of the public interest in public transportation.

5.0 CORRIDOR DESCRIPTION

The study team identified twelve corridors that warranted analysis for transit investment. These corridors are the following:

5.1 Cumberland/Kingston Pike

This corridor runs east-west within Knox County that parallels I-40 from downtown Knoxville out to the Farragut area near the Knox/Loudon County border. Beginning at the Knoxville Transit Center the corridor would extend west along Cumberland Avenue and Kingston Pike out to Watt Road.



The roadway characteristics vary along Cumberland Avenue/Kingston Pike. From east to west, it ranges from a four-lane cross section to a five-lane cross section. There is an existing at-grade roadway/railroad crossing within the corridor along Cumberland Avenue just west of the University of Tennessee (UT) campus. Average daily trips per day range from 6,990 to 36,400 AADT (2010).

Proposed changes within a portion of the corridor (within the University of Tennessee portion) would stem from the Cumberland Avenue Corridor Plan (2007). This plan proposes changes along Cumberland Avenue through the University of Tennessee such as using “road diets” to reconfigure the four travel lanes into three; adding bicycle accommodations and increasing the width of sidewalks. The plan supports TOD type development and investing in transit. The plan also recommends general design guidelines for the corridor; these include principles on building height, buildings fronting the street, environmental sustainability, parking and access, lighting, signage and landscaping.

5.2 Magnolia Avenue

Magnolia Avenue is a northeast-southwest corridor that parallels the Martin Luther King Jr. Avenue corridor within Knox County that extends from downtown Knoxville out to the Burlington area. Beginning at the Knoxville Transit Center the corridor would extend along Hall of Fame Drive to Magnolia Avenue out to the Magnolia Avenue/Prosser Road intersection.

The roadway characteristics along Magnolia Avenue consist of a four-lane divided cross section and a five-lane cross section. There are no existing at-grade roadway/railroad crossings within the corridor. Average daily trips per day range from 8,400 to 15,800 AADT (2010).

Proposed changes within the corridor include the Magnolia Corridor Plan (May 2009). This plan highlights opportunities for enhanced development along the Magnolia Avenue corridor, including the north end of downtown, the Hall of Fame-Caswell Park area, Burlington and the areas in between. The plan strives to create a “Complete Streets” corridor



through the use of landscaping, medians, bicycle lanes, enhanced sidewalks and on-street parking. The plan focuses on:

- Opportunities for more intense, mixed-use development, including a vertical mix of retail, housing and office.
- Conservation, restoration and reuse of historic resources.
- Improvements to the sidewalk, bicycle and street systems.

There are several other plans and studies that could directly or indirectly impact sections of this corridor:

- The Broadway-Central-Emory Place Small Area Plan.
- The I-275/North Central Street Corridor Study (2007).
- The Downtown North I-275 Redevelopment Plan.
- The Downtown Knoxville Design Guidelines.
- The Martin Luther King Jr. Avenue Corridor Plan.

5.3 Western Avenue

The Western Avenue corridor is an east-west corridor within Knox County that extends from downtown Knoxville out to the Fair Oaks area. Beginning at the Knoxville Transit Center the corridor would extend along Hall of Fame Drive, Summit Hill Drive and Western Avenue out to the Western Avenue/Woods-Smith Road intersection.



The roadway characteristics along Western Avenue vary between a two-lane cross section and seven-lane cross section. There are several elevated sections of the roadway near downtown Knoxville. East of the Western Avenue/Keith Avenue intersection an at-grade roadway/railroad crossing exists. According to the Transportation

Improvement Plan (TIP) future roadway improvement plans call for the elimination of this at-grade crossing. Average daily trips per day range from 15,200 to 45,500 AADT (2010).

5.4 Martin Luther King Jr. Avenue

Martin Luther King Jr. Avenue is a northeast-southwest corridor that parallels the Magnolia Avenue corridor within Knox County that extends from downtown Knoxville out to the Burlington area. Beginning at the Knoxville Transit Center the corridor would extend along Hall of Fame Drive, Summit Hill Drive and Martin Luther King Jr. Avenue out to Martin Luther King Jr. Avenue/Asheville Highway intersection.



The roadway characteristic along Martin Luther King Jr. Avenue is a two-lane cross section. There are no existing at-grade roadway/railroad crossings within the corridor. Average daily trips per day range from 5,000 to 9,800 AADT (2010).

Proposed changes within the corridor include the Martin Luther King Jr. Avenue Corridor Study (2006). The study focused on ten areas of development and/or redevelopment. Each contains goals of improving streetscape, pedestrian amenities and connectivity. The ten areas are:

- Five Points commercial area
- Burlington commercial area
- Union Square Park
- South Chestnut Street
- South Chestnut Green

- Traffic Calming at Union Square Park
- Walter P. Taylor Homes
- Linden Avenue and Parkview Avenue
- Austin Homes site
- Harrison Street and Wilson Avenue.

There are over fifty long term and short term recommendations in the plan; ranging from intersection improvements to changes in the roadway characteristics. These ten areas along Martin Luther King Jr. Avenue were identified as the areas needing immediate improvement.

5.5 Central Avenue

Central Avenue is a northwest-southeast corridor within Knox County that extends from downtown Knoxville out to the Mayview Heights area. Beginning at the Knoxville Transit Center the corridor would extend along Hall of Fame Drive, Summit Hill Drive and Central Avenue out to the Central Avenue/Emory Road intersection.

The roadway characteristic along Central Avenue ranges between two-lane, three-lane and four-lane cross sections. There is an existing at-grade roadway/railroad crossing along Central Avenue just north of Jackson Avenue. Average daily trips per day range from 3,400 to 10,000 AADT (2010).



Proposed changes within the corridor include the I-275/North Central Street Corridor Study (2007). This study presents recommendations for development and redevelopment along the Central corridor. The study focuses on certain areas for economic and mixed-use development. The areas include:

- 5th Avenue to Oldham/Woodland Avenues area
- Dempster Property area
- North Central Street corridor mixed-use development

The 2007 study identified a two-point program which addresses street improvements, building rehabilitation and high intensity land uses is recommended for the North Central corridor. This

includes improved sidewalk separation from travel lanes, reduced road cross section to two lanes with a landscaped median and street tree planting.

5.6 North Broadway

North Broadway is a north-south corridor within Knox County that extends from downtown Knoxville out to the Fountain City area. Beginning at the Knoxville Transit Center the corridor would extend along Summit Hill Drive and North Broadway out to the North Broadway /Black Oak Ridge Lane intersection.



The roadway characteristic along North Broadway ranges between three-lane, four-lane and five-lane cross sections. There are no existing at-grade roadway/railroad crossings within the corridor. Average daily trips per day range from 3,400 to 39,100 AADT (2010).

Proposed changes within the corridor include the Broadway-Central-Emory Place Small Area Plan (2007). This plan proposes developments and enhancements for the Broadway corridor and surrounding areas. Recommendations for the Broadway corridor include:

- Enhanced sidewalk systems with more separation for pedestrians through the use of landscaping
- Creating a new design-oriented zoning code for commercial uses, allowing building locations closer to sidewalks and less off-street parking. Considered a “skinny street” program in developing the code, examining on-street parking (one side) and turning lanes at major intersections.
- Enhance non-motorized transportation systems and alleys.

There is a proposed Downtown North Mixed Use District which is located along the corridor closer to downtown Knoxville. This district proposes high-density mixed use, streetscape enhancements and new mixed-use design principles for new construction.

5.7 Chapman Highway

Chapman Highway is a southeast-northwest corridor within Knox County that extends from downtown Knoxville out to the Shooks Gap/Seymour area near the Knox/Sevier/Blount County

border. Beginning at the Knoxville Transit Center the corridor would extend along Cumberland Avenue and Chapman Highway out to the Chapman Highway/Sevierville Pike intersection.

The roadway characteristic along Chapman Highway ranges between four-lane and five-lane cross sections. There is one existing at-grade roadway/railroad crossings within the corridor along Chapman Highway just south of the Blount Avenue intersection. Average daily trips per day range from 27,500 to 40,800 AADT (2010).

Proposed changes within the corridor include the Knoxville South Waterfront Action Plan (2006) and Chapman Corridor Study (2006). The northern portion of the Chapman corridor is adjacent to the proposed site for the South Waterfront project. The project's main goal is to be an “active, attractive and distinctive part of downtown



Knoxville and a gateway to diverse neighborhoods, waterfront recreation, revitalized business districts and places of employment”. This project calls for transportation improvements such as a new intersection at Henley Street and investments on August Avenue.

The Chapman Corridor study proposes the creation of a Town Center along Chapman Highway between Taliwa Court and Fronda Lane. The development of a town center would include directed residential mixed-use growth, office and commercial uses. The plan also proposes improvements to existing public and private spaces including parks and greenways. This would create a better visual connection through the use of landscaping from Chapman Highway to Sam Duff Memorial Park. The use of pedestrian paths and public-plaza spaces between Chapman Highway and the park are also proposed as enhanced uses for this area.

Some of the development policies for transportation along Chapman Highway include:

- Providing space for all transportation modes, including bicycle lanes, separated sidewalks, crosswalks and transit amenities
- Encouraging higher-density residential uses along the urban section of the corridor to take advantage of proximity to the waterfront, Knoxville's CBD and the University of Tennessee
- Enhanced bus stop locations, and bus pull-off areas to safely pick up and drop off passengers

- Establishing a better block and street network to increase connectivity and provide local alternatives to using Chapman Highway.

5.8 Alcoa Highway

Alcoa Highway is a north-south corridor that extends from downtown Knoxville in Knox County out to the Maryville area in Blount County. Beginning at the Knoxville Transit Center the corridor would extend along Cumberland Avenue onto Alcoa Highway out to the Alcoa Highway/Lamar Alexander Parkway intersection.



The roadway characteristic along Alcoa Highway ranges between a four-lane and five-lane cross section. There are no existing at-grade roadway/railroad crossings within the corridor. Average daily trips per day range from 18,200 to 56,300 AADT (2010).

Proposed changes within the corridor include the Alcoa Highway Redevelopment Project. This project proposes transportation improvements for Alcoa Highway that includes a partial access control facility to improve safety and efficiency for traffic movement. The proposed improvements to the corridor will include three 12-foot lanes in each direction, a 12-foot outside shoulder for each traffic direction, a new bypass near the airport, and a median with a concrete barrier. These proposed changes would require an increased cross section to accommodate a 138-foot right of way.

5.9 Pellissippi Parkway

A north-south corridor that extends from the Oak Ridge area in Anderson County down to the Eagleton Village area in Blount County. Beginning in the vicinity of the Oak Ridge Highway the corridor would extend along Oak Ridge Highway, Pellissippi Parkway and East Broadway Avenue out to East Broadway Avenue/Lamar Alexander Parkway intersection in Maryville, Blount County.

The roadway characteristic along Pellissippi Parkway ranges between a four-lane divided cross section, a five-lane cross section and seven-lane cross section. There is one existing at-grade

roadway/railroad crossing within the corridor along Illinois Avenue in Oak Ridge. Average daily trips per day range from 29,500 to 65,400 AADT (2010).

Proposed changes within the corridor include the Oak Ridge Energy Corridor Vision Plan. The Pellissippi Parkway corridor is also known as the Oak Ridge Energy Corridor and Technology Corridor. The Oak Ridge Energy Corridor is a partnership between the Oak Ridge Department of Energy laboratories and the surrounding



community with a vision for integrating regional and multimodal transportation options. North of the I-40/75 interchange along Pellissippi Parkway, zoning ordinances were implemented to encourage high-end business development focused on the innovative technology industry.

Other plans include the Sector Plans developed by the Knoxville and Knox County Metropolitan Planning Commission. The Pellissippi corridor is included in the Southwest and Northwest county sector plans. Both plans include several roadway improvement projects on or near the Pellissippi corridor.

5.10 Alcoa Norfolk-Southern (NS) Rail Line

This corridor runs north-south and extends from downtown Knoxville in Knox County down to the Maryville area in Blount County. Beginning approximately at Oak Avenue/Alcoa NS Rail Line crossing the alignment would extend within the existing freight rail corridor down to the Washington Street crossing. The existing active freight line currently serves the Alcoa Plant. There are 28 existing at-grade roadway/railroad crossings within the corridor along Alcoa NS rail line.



There are currently no proposed changes within the corridor. However, there are plans to revitalize downtown Alcoa which could indirectly impact this freight line.

5.11 Alcoa CSX Rail Line

The Alcoa CSX Rail Line is a southwest-northeast corridor that extends from downtown Knoxville in Knox County down to the Maryville/Alcoa area in Blount County. Beginning approximately at Oak Avenue/Alcoa CSX Rail Line crossing the alignment would extend within the existing freight rail corridor down to the Bessie Harvey Avenue crossing. There are 13 existing at-grade roadway/railroad crossings within the corridor along Alcoa CSX rail line.



There are currently no proposed changes within the corridor. However, there are plans to revitalize downtown Alcoa which could indirectly impact this freight line.

5.12 NS “A” Rail Line

This corridor runs southwest-northeast and extends from downtown Knoxville in Knox County out to the Farragut area near the Knox/Loudon County border. Beginning approximately at the Central Street/NS “A” Rail Line crossing the alignment would extend within the existing freight rail corridor out to Morton Road. There are 12 existing at-grade roadway/railroad crossings within the corridor along NS rail line.



There are currently no proposed changes within the corridor.

6.0 EXISTING STUDY AREA CONDITIONS

Existing and future population, employment, and other study area demographic indicators have been identified and analyzed, as a basis for understanding relevant study area trends. Demographic estimates and projections were obtained from the Census Bureau and Knoxville TPO covering the study area. These estimates were based on the 2010 US Census and 2010

Traffic Analysis Zones (TAZ). TAZ's were used as a geographic division of an area, typically used in travel demand modeling, for determining populations below average income and zero car households.

6.1 Population and Densities

2010 Census tracts were used to evaluate the population and densities within a $\frac{1}{4}$ and $\frac{1}{2}$ mile of each of the corridors. **Table 6.1** shows the total acres for each corridor, the total 2010 and projected 2034 population (the horizon year for the TPO regional travel demand model) within a $\frac{1}{4}$ and $\frac{1}{2}$ mile, the percent of population growth within $\frac{1}{4}$ and $\frac{1}{2}$ mile, and the population per acre within $\frac{1}{4}$ and $\frac{1}{2}$ mile. The highest percent of population growth within a $\frac{1}{4}$ and $\frac{1}{2}$ mile was found around Pellissippi Parkway, Alcoa Highway, and Alcoa CSX Rail Line. These corridors contain sprawled development and large areas of open space and agricultural uses. This type of land use make-up results in gains in population growth because such growth often occurs on undeveloped or underdeveloped land, such as farmland or open space. Corridors that had lower percentage of population growth such as Central Avenue, Magnolia Avenue and Western Avenue usually reflect areas that contain established communities.

Evaluating population densities in established corridors located near the urban core of Knoxville explains why these areas experience low percentage of population growth. The largest population densities within a $\frac{1}{4}$ mile were found around the North Broadway, Martin Luther King Jr. Avenue, and Cumberland/Kingston Pike corridors. The largest population densities within a $\frac{1}{2}$ mile were found around the Martin Luther King Jr. Avenue, North Broadway, and Western Avenue corridors.

Table 6.1 Population

CORRIDOR	Corridor in Acres	2010 Population within 1/4 mile	2010 Population within 1/2 mile	2034 Population within 1/4 mile	2034 Population within 1/2 mile	Population Growth		Population per Acre	
						Percent within 1/4 mile	Percent within 1/2 mile	1/4 mile	1/2 mile
Western Avenue	5,300	16,971	30,112	22,780	40,419	34%	34%	3.20	5.68
Central Avenue	5,479	17,205	25,495	21,989	32,584	28%	28%	3.14	4.65
Martin Luther King Jr Avenue	2,849	9,282	18,738	12,719	25,677	37%	37%	3.26	6.58
Cumberland/Kingston Pike	12,934	41,535	59,489	57,808	82,797	39%	39%	3.21	4.60
Magnolia Avenue	2,849	8,332	13,959	11,001	18,431	32%	32%	2.92	4.90
North Broadway NE	5,086	17,660	30,588	24,154	41,835	37%	37%	3.47	6.01
Chapman Highway	5,300	11,617	18,577	16,628	26,590	43%	43%	2.19	3.51
Alcoa Highway	19,199	10,047	20,845	14,704	30,507	46%	46%	0.52	1.09
Pellissippi Parkway	18,970	24,726	40,289	36,613	59,658	48%	48%	1.30	2.12
NS A Rail Line	11,520	31,423	57,056	44,375	80,574	41%	41%	2.73	4.95
Alcoa CSX Rail Line	29,203	14,857	29,203	21,558	42,375	45%	45%	0.51	1.00
Alcoa NS Rail Line	19,840	14,794	30,810	21,357	44,478	44%	44%	0.75	1.55

6.2 Employment and Densities

2010 Census tracts were used to evaluate employment and densities within a ¼ and ½ mile of each of the corridors. **Table 6.2** shows the total acres for each corridor, the total 2010 and projected 2034 employment within a ¼ and ½ mile, the percent of employment growth within ¼ and ½ mile, and employment per acre within ¼ and ½ mile. The highest percent of employment growth within a ¼ and ½ mile was found around Pellissippi Parkway, Alcoa Highway, and Alcoa CSX Rail Line. These corridors contain sprawled development and large areas of open space and agricultural uses. This type of land use make-up results in gains in employment growth because new construction will often occur on undeveloped or underdeveloped land, such as farmland or open space. Corridors that had lower percentage of employment growth such as Martin Luther King Jr. Avenue, Magnolia Avenue and North Broadway usually reflect areas that contain established business districts.

Evaluating employment densities in established corridors located near the urban core of Knoxville explains why these areas experience low percentage of employment growth. The largest employment densities within a ¼ mile were found around the Cumberland/Kingston Pike, Martin Luther King Jr. Avenue, and North Broadway corridors. The largest employment densities within a ½ mile were found around the Martin Luther King Jr. Avenue, Magnolia Avenue, and North Broadway corridors.

Table 6.2 Employment

CORRIDOR	Area in Acres	2010	2010	2034	2034	Employment Growth		Employment per Acre	
		Employment within 1/4 mile	Employment within 1/2 mile	Employment within 1/4 mile	Employment within 1/2 mile	Percent within 1/4 mile	Percent within 1/2 mile	1/4 mile	1/2 mile
Western Avenue	5,300	19,338	28,750	25,997	38,650	34%	34%	3.65	5.42
Central Avenue	5,479	18,084	28,581	23,252	36,749	29%	29%	3.30	5.22
Martin Luther King Jr Avenue	2,849	12,904	24,157	16,251	30,424	26%	26%	4.53	8.48
Cumberland/Kingston Pike	12,934	59,455	79,506	83,998	112,326	41%	41%	4.60	6.15
Magnolia Avenue	2,849	7,060	23,404	8,871	29,408	26%	26%	2.48	8.21
North Broadway NE	5,086	22,172	35,283	28,357	45,126	28%	28%	4.36	6.94
Chapman Highway	5,300	11,540	22,042	15,322	29,266	33%	33%	2.18	4.16
Aloca Highway	19,199	5,432	11,730	8,182	17,668	51%	51%	0.28	0.61
Pellissippi Parkway	18,970	9,567	15,276	14,690	23,455	54%	54%	0.50	0.81
NS A Rail Line	11,520	16,869	35,534	23,477	49,453	39%	39%	1.46	3.08
Alcoa CSX Rail Line	29,203	5,781	23,605	8,669	35,398	50%	50%	0.20	0.81
Alcoa NS Rail Line	19,840	5,455	23,417	7,960	34,169	46%	46%	0.27	1.18

6.3 Low Income Population

2010 and 2034 Traffic Analysis Zones (TAZ) data were used to evaluate population below average income within a ½ mile radius of each corridor that was carried forward through the Tier 2 analysis. TAZ’s were used for this evaluation because the information for low income population was not available at the census tract level at the time of this study.

According to the 2010 TAZ data Alcoa NS Rail Line (45.99%), Magnolia Avenue (33.27%), and Western Avenue (32.94%) were the corridors that contained the highest amount of low income population (Household income < 80% median income). In 2034 the corridors that contained the highest amount of low income population included Western Avenue (41.47%), Alcoa NS Rail Line (32.79%), and Cumberland/Kingston Pike (28.37%).

6.4 Zero Car Households

2010 and 2034 Traffic Analysis Zones (TAZ) data were used to evaluate zero car households within a ½ mile radius of each corridor that was carried forward through the Tier 2 analysis. TAZ’s were used for this evaluation because the information for zero car households was not available at the census tract level at the time of this study.

According to the 2010 TAZ data Magnolia Avenue (38.98%), Western Avenue (19.59%), and North Broadway (11.49%) were the corridors that contained the highest amount of zero car households. In 2034 the corridors that contained the highest amount of zero car households included Magnolia Avenue (26.77%), Western Avenue (16.11%), and Central Avenue (14.97%).

6.5 Land Use

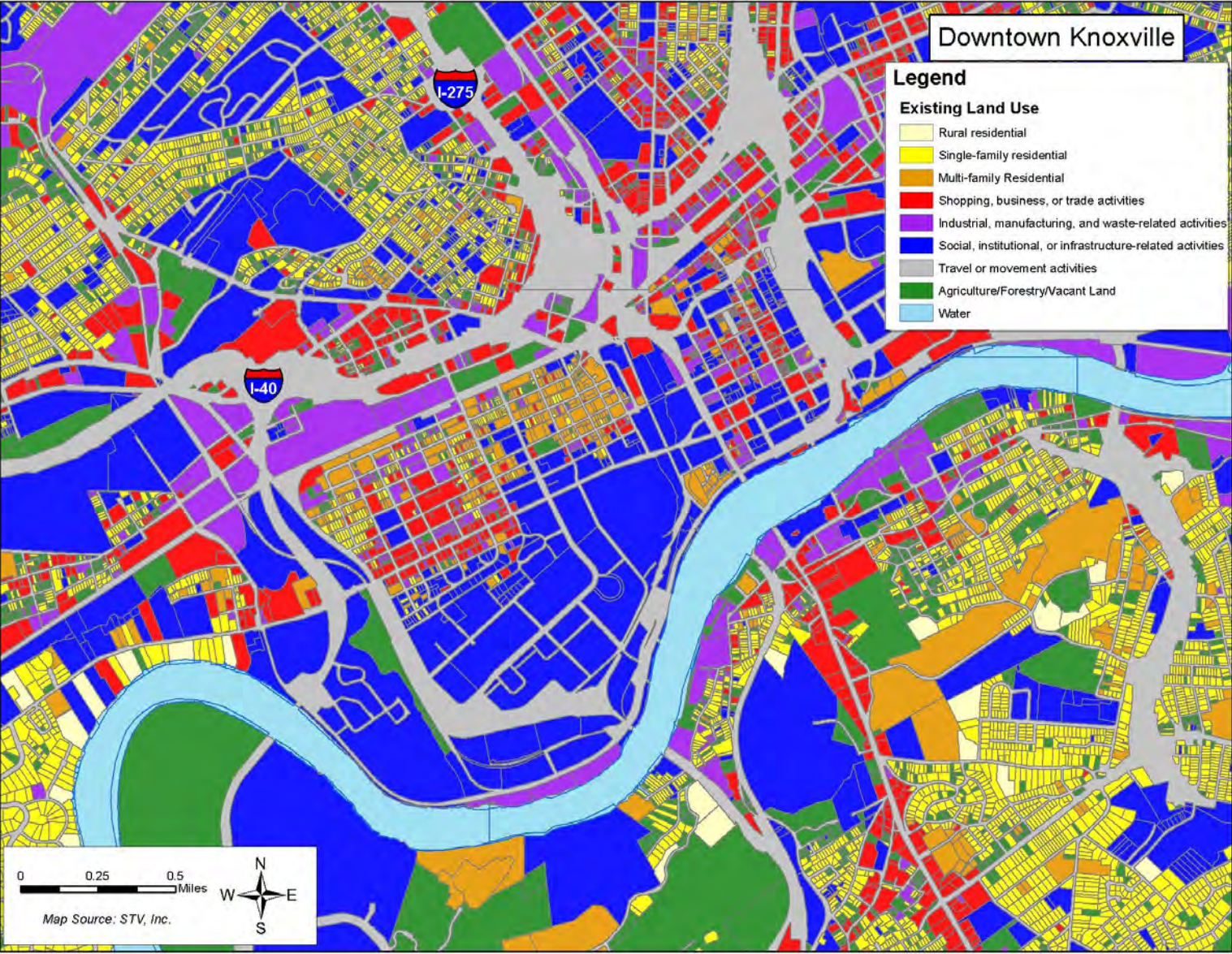
Besides identifying the number and expected growth of residents and job opportunities in the region, the types of land uses and their locations along each corridor have been examined. Additional land use characteristics are if the corridor is consistent with transit implementation and currently provides the density and intensity for acting as a trip generator/attractor. This information identifies where the population, where transportation facilities and services exist, and what potential benefits to these land uses may occur if new transit facilities are introduced along each of these corridors.

6.5.1 Downtown Knoxville

Downtown Knoxville land use is characterized by higher-density residential and commercial development such as the Tennessee Valley Authority, parking and transportation facilities such as the Knoxville Transit Center, manufacturing, and institutional uses such as the University of Tennessee and the Howard H. Baker, Jr. US Court House. **Figure 6.1** presents an overview of the land uses in Downtown Knoxville. **Appendix A** provides more detailed land use maps for the corridor.

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Figure 6.1 Downtown Knoxville Land Use

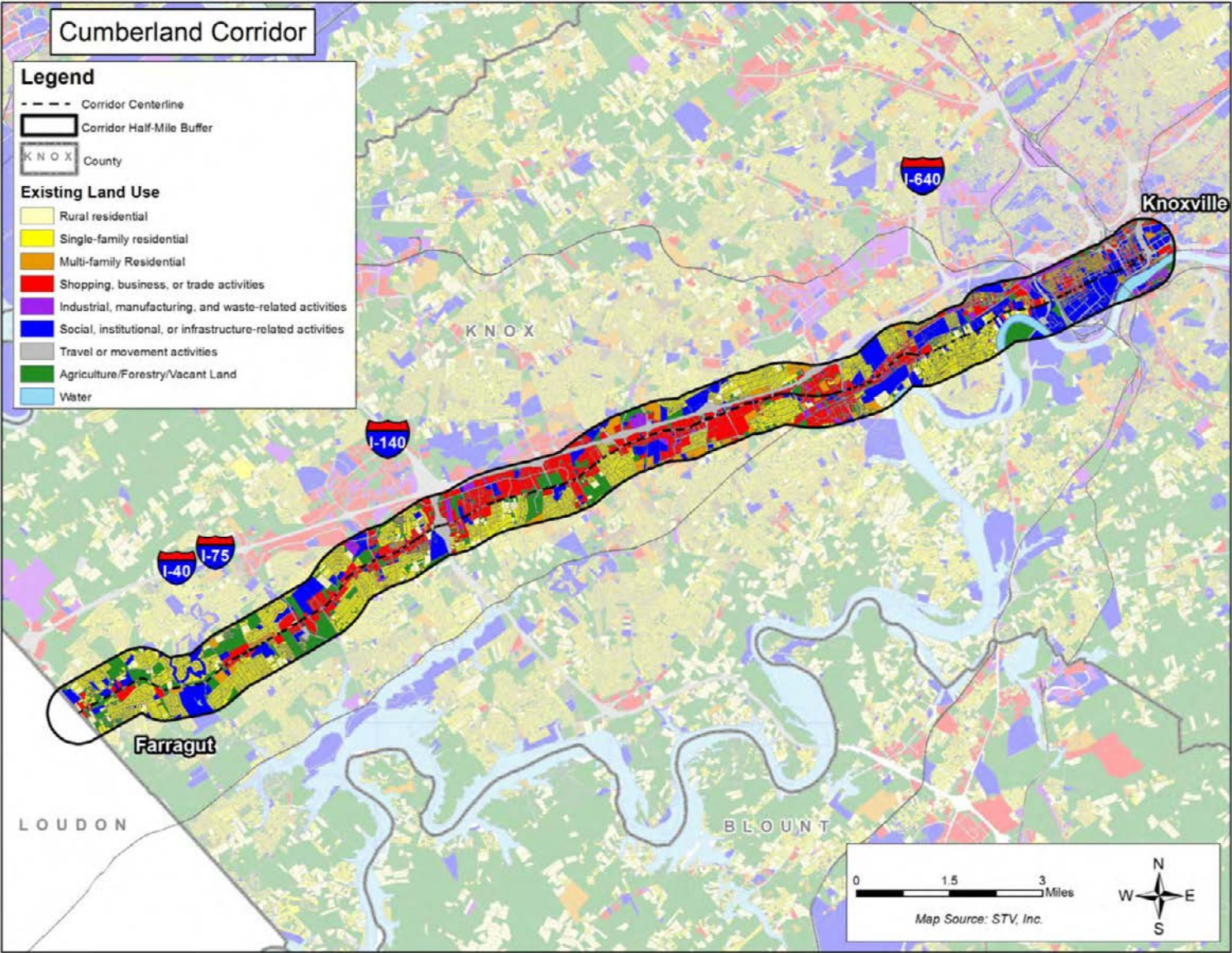


6.5.2 Cumberland/Kingston Pike

The Cumberland/Kingston Pike corridor consists of a wide range of land uses and built environments containing a mix of commercial, residential, institutional, and agricultural uses. The most prominent land uses are commercial and residential. The corridor passes directly through the center of the University of Tennessee’s campus that consists of educational facilities, college housing and commercial/retail uses. As the corridor extends west, it is lined with established residential districts, commercial districts with strip mall shopping centers, car dealerships and the West Town Mall. Suburban residential districts line the backend of the commercial district. As the corridor approaches the county line, agricultural uses are more prevalent. **Figure 6.2** presents an overview of the land uses along this corridor. **Appendix A** provides more detailed land use maps for the corridor.

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Figure 6.2 Cumberland/Kingston Pike Corridor Overall Land Use

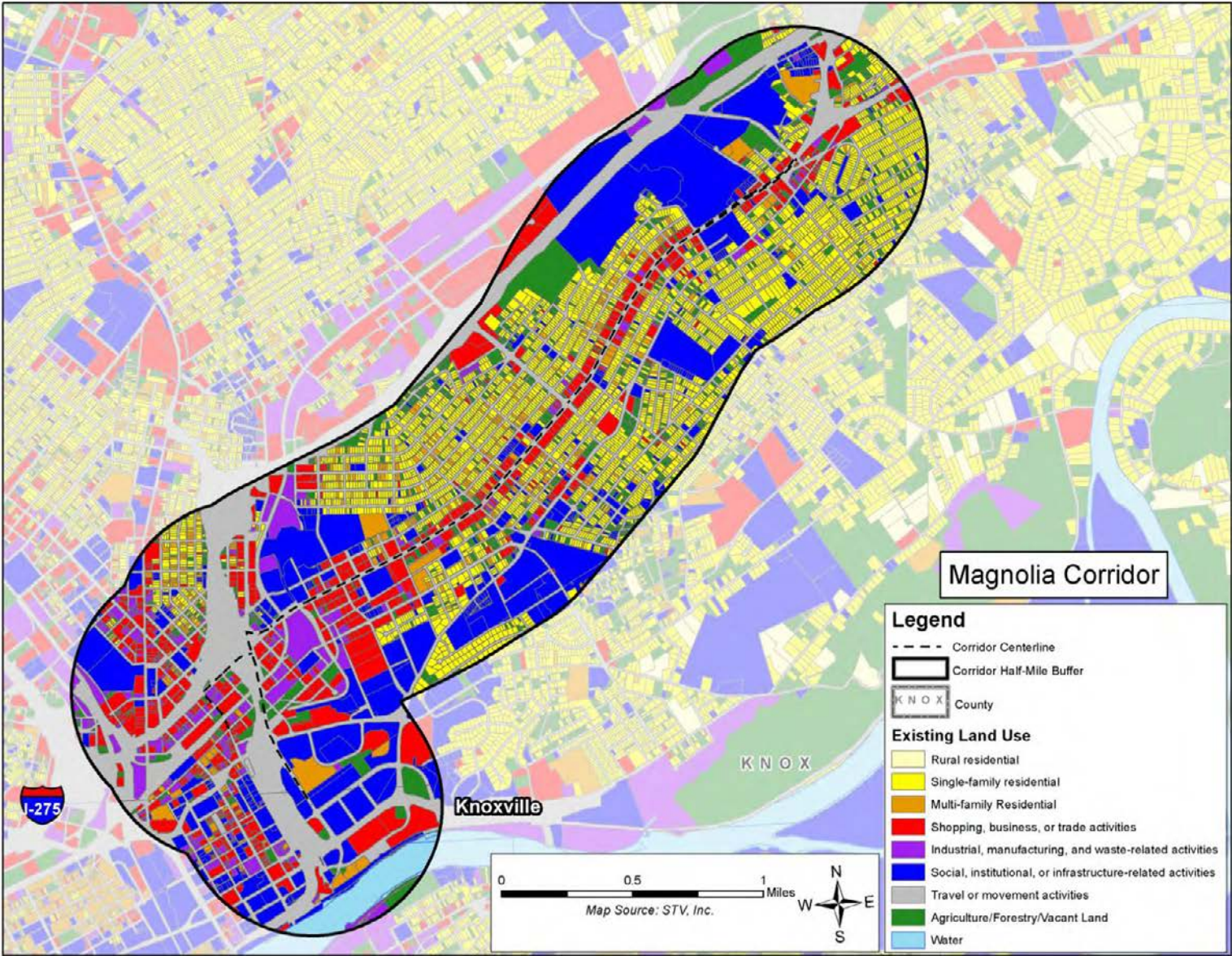


6.5.3 Magnolia Avenue

The Magnolia Avenue corridor consists of a mix of commercial, office and residential (single and multi-family) uses throughout. Heading east as the corridor transitions from Hall of Fame Drive onto Magnolia Avenue the corridor is lined with established commercial/retail uses with medium density single and multi-family residential districts intermixed along the corridor and on the backside of the commercial areas. The corridor is anchored by the Knoxville Zoo/Chilhowee Park. **Figure 6.3** presents an overview of the land uses along this corridor. **Appendix A** provides more detailed land use maps for the corridor.

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Figure 6.3 Magnolia Avenue Corridor Overall Land Use

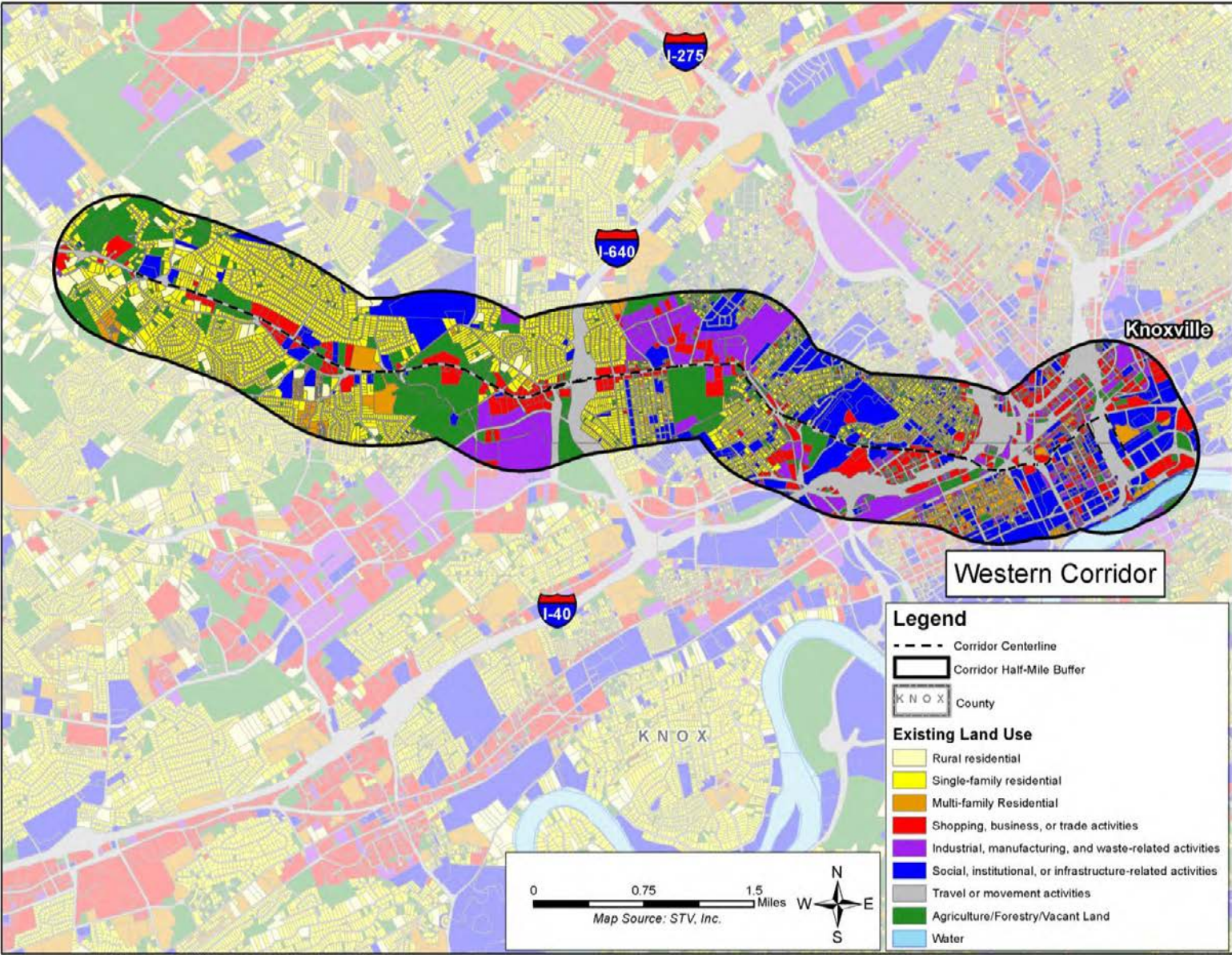


6.5.4 Western Avenue

The Western Avenue corridor consists of pockets of residential, commercial, light industrial, office, agricultural and open space uses throughout. Heading west the land uses are intermixed between low density single and multi-family residential areas, commercial and retail areas consisting of a few strip malls, industrial uses and open space. Development becomes sprawled and the land uses are more predominately agricultural, open space and residential land uses once the corridor crosses I-640. **Figure 6.4** presents an overview of the land uses along this corridor. **Appendix A** provides more detailed land use maps for the corridor.

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Figure 6.4 Western Avenue Corridor Overall Land Use

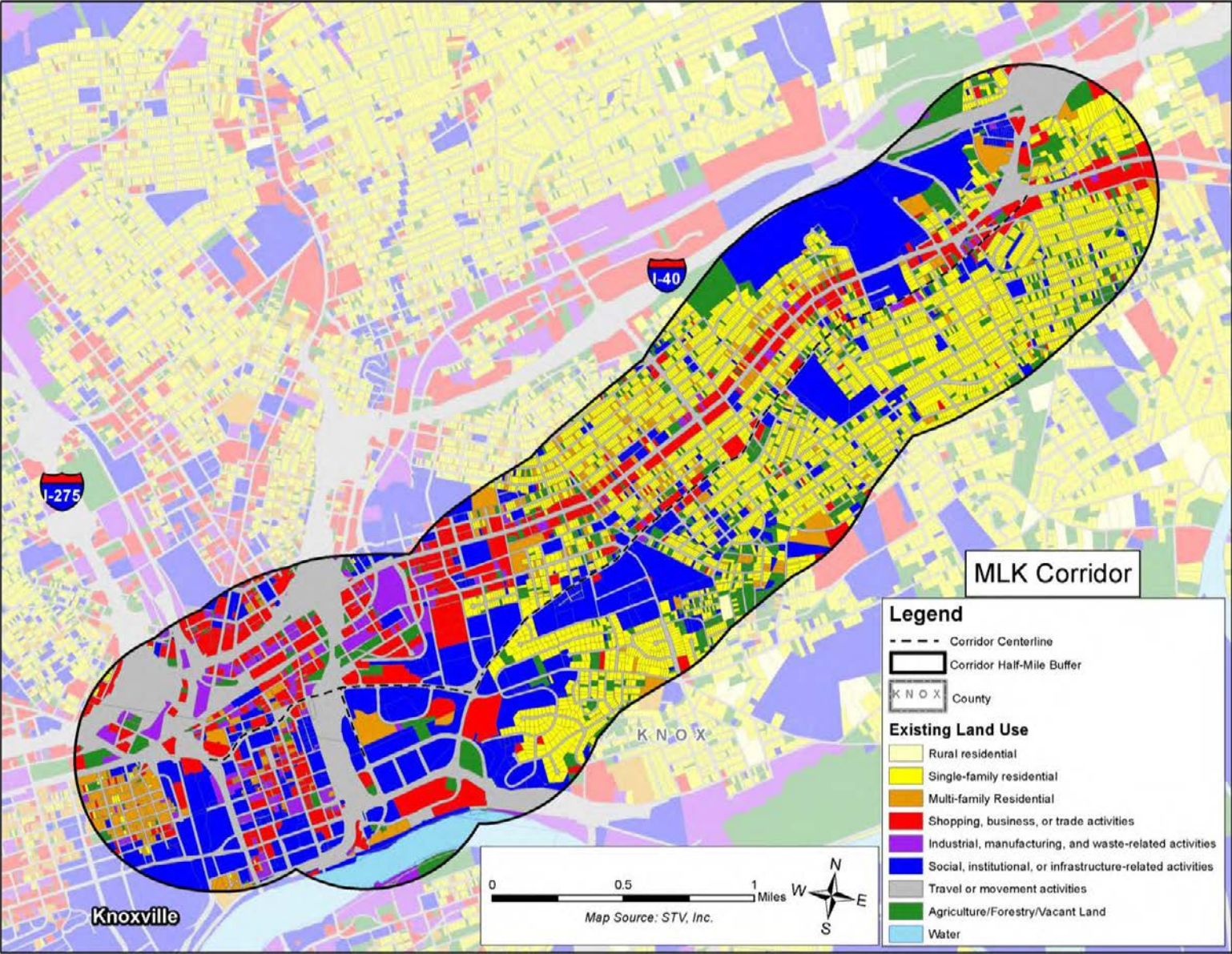


6.5.5 Martin Luther King Jr. Avenue

The Martin Luther King Jr. Avenue corridor consists of a mix of residential, commercial, and institutional land uses throughout. Heading northeast as the corridor transitions from Summit Hill Drive onto Martin Luther King Jr. Avenue, the land uses consist of a mix of institutional, commercial and residential. The middle of the corridor contains medium/low density single and multi-family residential with commercial/retail further out toward Asheville Highway. Residential districts line the back end of the commercial areas. **Figure 6.5** presents an overview of the land uses along this corridor. **Appendix A** provides more detailed land use maps for the corridor.

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Figure 6.5 Martin Luther King Jr. Corridor Overall Land Use

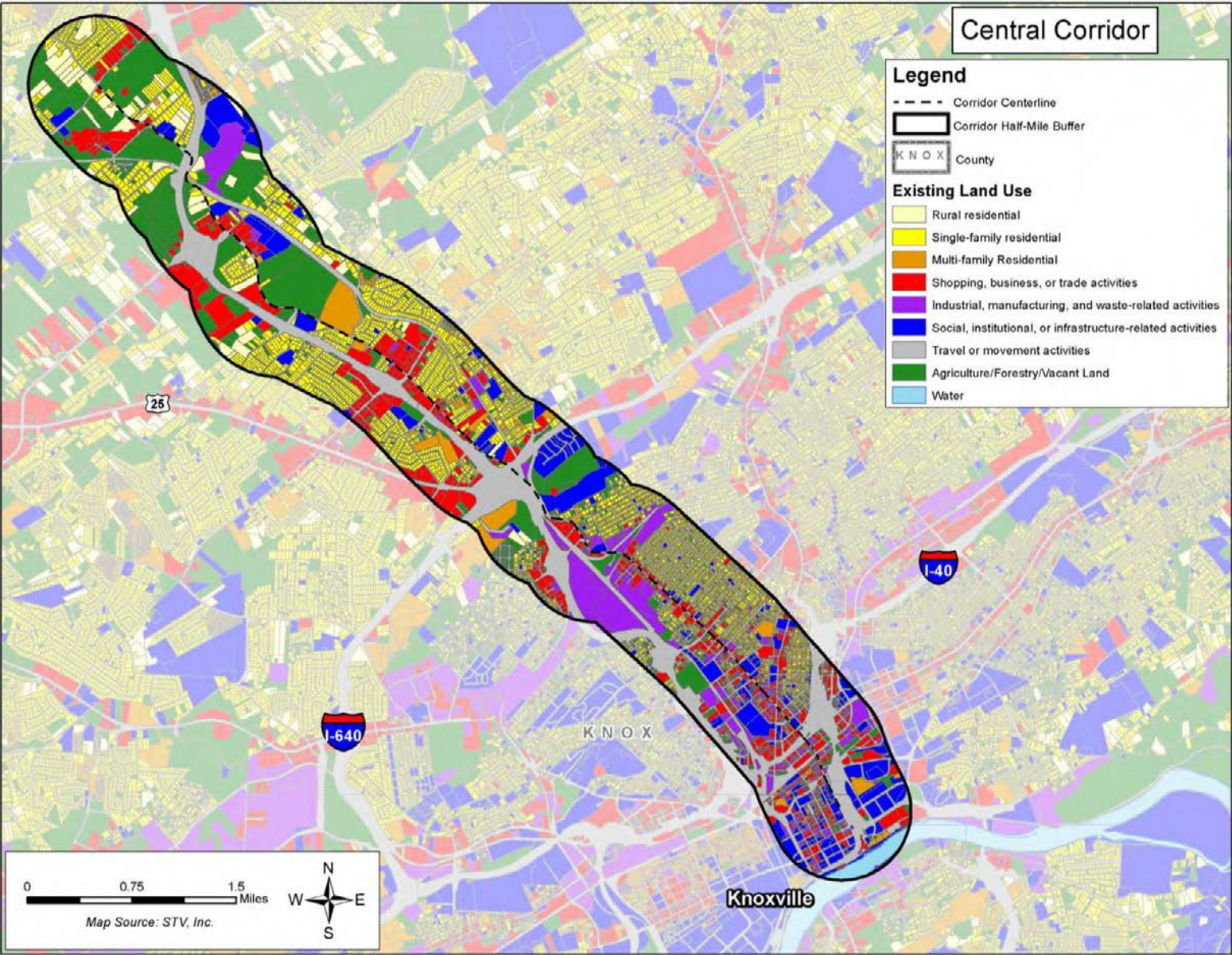


6.5.6 Central Avenue

The Central Avenue corridor consists of a mix of commercial, light industrial, office, agricultural and residential uses. The corridor passes through the Old City section of Knoxville and contains a mix of high-density residential and commercial uses as it heads northeast. At this point the land uses change mainly to commercial and residential uses with pockets of industrial uses mixed in. As the corridor stretches further to the northeast commercial and residential uses are intermixed with agricultural uses. **Figure 6.6** presents an overview of the land uses along this corridor. **Appendix A** provides more detailed land use maps for the corridor.

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Figure 6.6 Central Avenue Corridor Overall Land Use

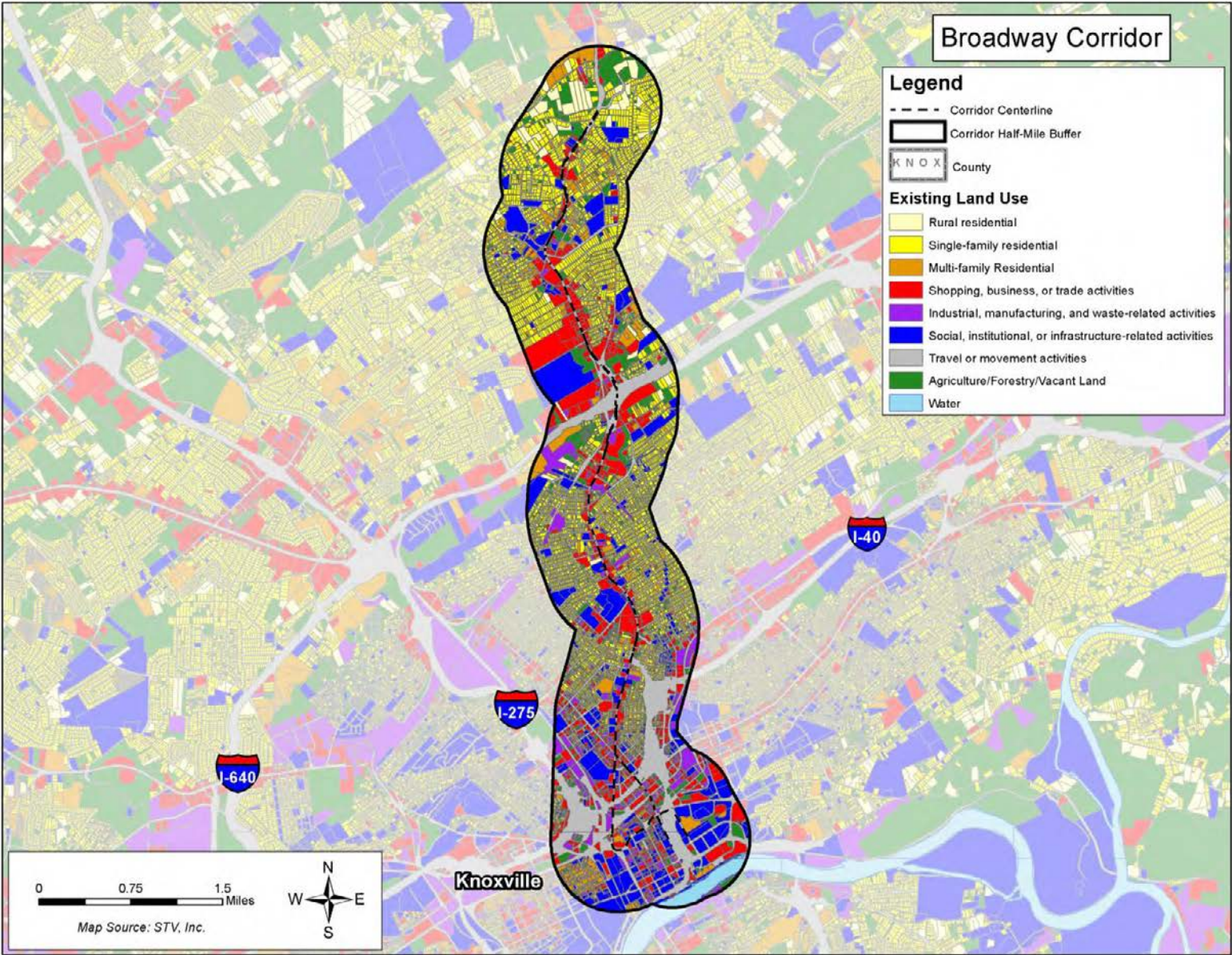


6.5.7 North Broadway

The North Broadway corridor contains a mix of commercial, residential, light office and industrial land uses. Heading north as the corridor transitions from Summit Hill Drive onto North Broadway land uses transition into industrial, commercial and residential uses. The middle of the corridor contains commercial/retail areas with a transition to residential uses further out. Residential districts line the backend of the commercial areas. **Figure 6.7** presents an overview of the land uses along this corridor. **Appendix A** provides more detailed land use maps for the corridor.

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Figure 6.7 North Broadway Corridor Overall Land Use

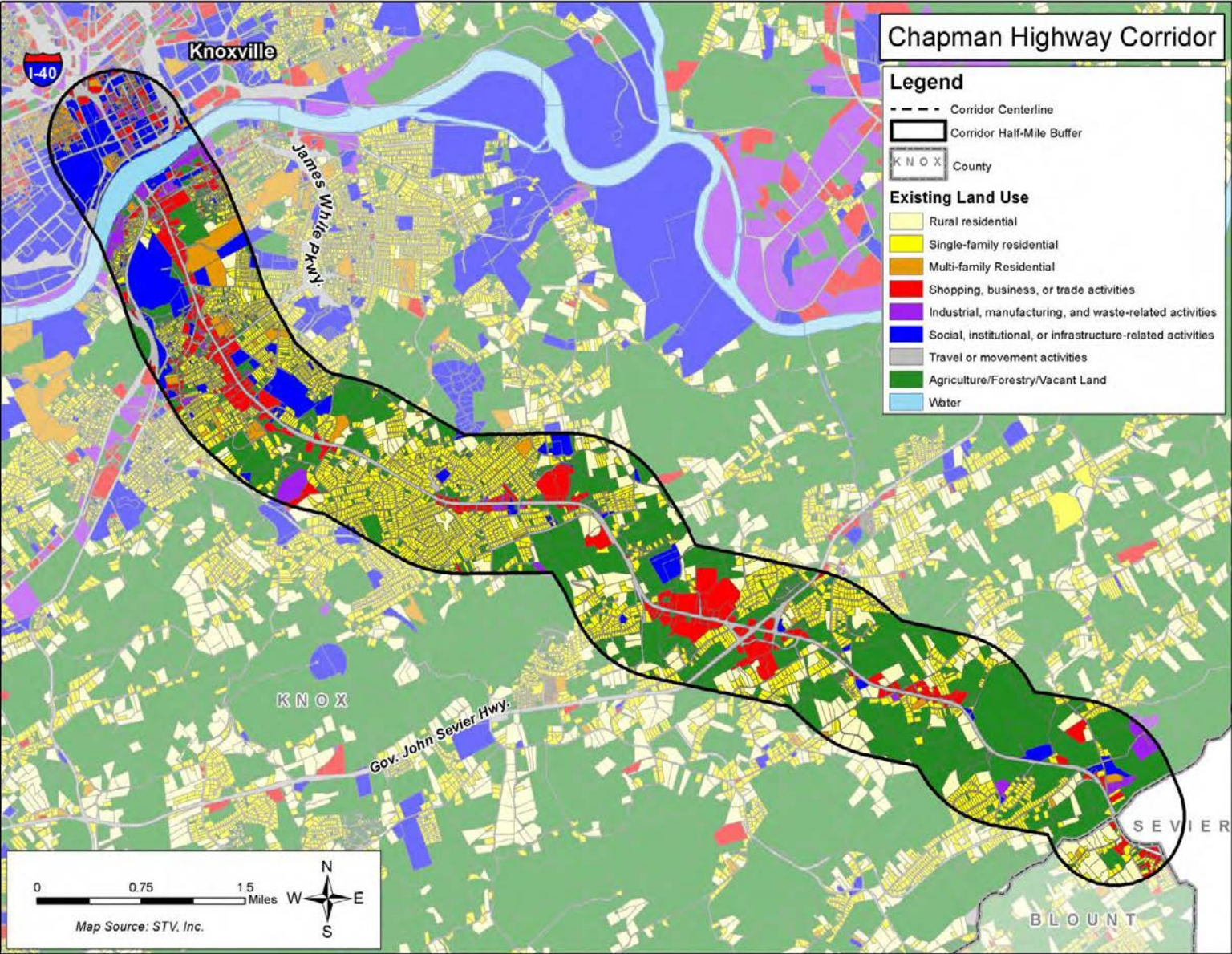


6.5.8 Chapman Highway

The Chapman Highway corridor contains a mix of commercial, institutional, residential, and agricultural uses. Heading south from Cumberland Avenue onto Chapman Highway land uses transition into institutional uses such as the Baptist Medical Complex followed by commercial and agricultural uses. The middle of the corridor contains single and multi family residential uses with pockets of commercial uses. Further out along the corridor agricultural uses are more prominent with pockets of residential areas. **Figure 6.8** presents an overview of the land uses along this corridor. **Appendix A** provides more detailed land use maps for the corridor.

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Figure 6.8 Chapman Highway Corridor Overall Land Use

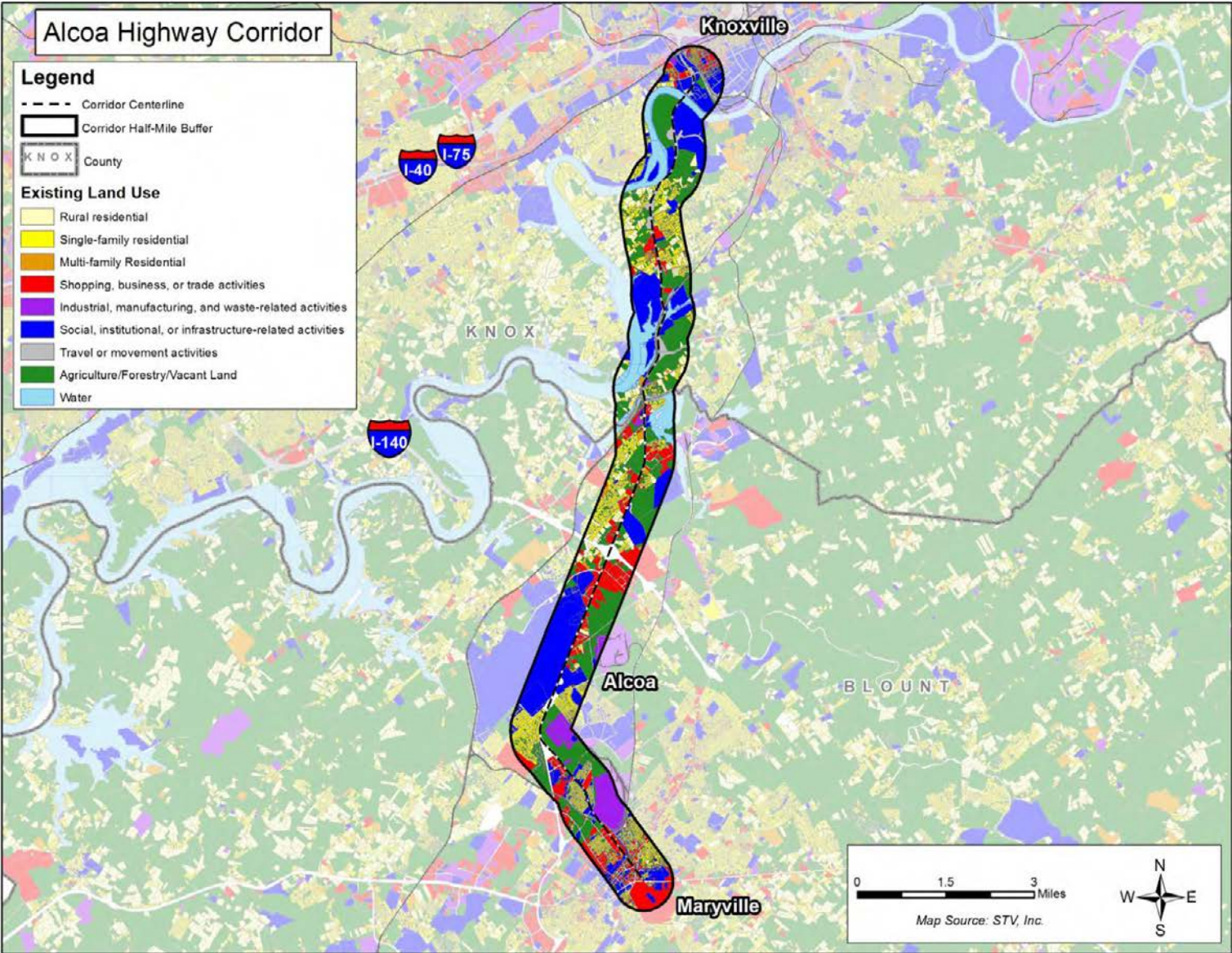


6.5.9 Alcoa Highway

The Alcoa Highway corridor contains a mix of residential, agricultural, open space, commercial, and industrial uses. Just outside of downtown Knoxville the corridor passes through the University of Tennessee Medical Center. Immediately following the corridor land uses are predominantly agricultural and residential. Heading south development becomes sprawled and the land uses consist of agricultural and residential areas. Intermixed in these land uses is the McGhee Tyson Airport just south of the I-140 interchange. Approaching Maryville the land uses transition back into commercial and residential uses. **Figure 6.9** presents an overview of the land uses along this corridor. **Appendix A** provides more detailed land use maps for the corridor.

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Figure 6.9 Alcoa Highway Corridor Overall Land Use

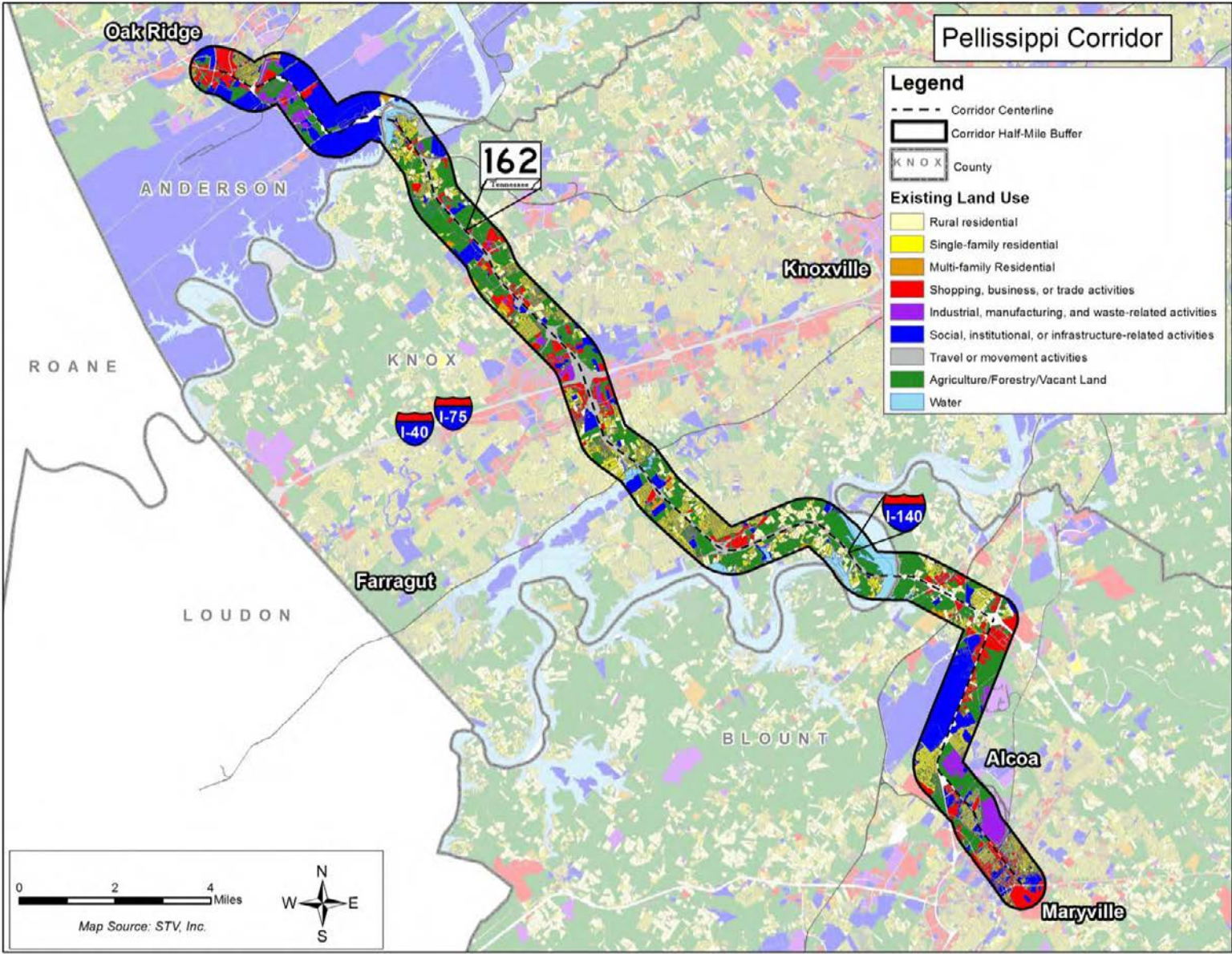


6.5.10 Pellissippi Parkway

The Pellissippi Parkway corridor contains a mix of agricultural, residential, commercial, and industrial land uses. Beginning in Oak Ridge the corridor contains a mix of commercial and industrial facilities including the Oak Ridge Department of Energy laboratories. Heading south the land uses become sprawled and consist of agricultural and residential areas with pockets of commercial uses. The middle of the corridor around I-75 the land uses transition into dense commercial and residential uses. Development becomes sprawled after crossing Sinking Creek and land uses transition back to agricultural and residential uses with pockets of commercial uses. Intermixed in these land uses is the McGhee Tyson Airport just south of the corridor. Approaching the Eagleton Village area the land uses transition back into commercial and residential uses. This corridor stretches through three different counties – Anderson, Knox, and Blount. **Figure 6.10** presents an overview of the land uses along this corridor. **Appendix A** provides more detailed land use maps for the corridor.

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Figure 6.10 Pellissippi Corridor Overall Land Use

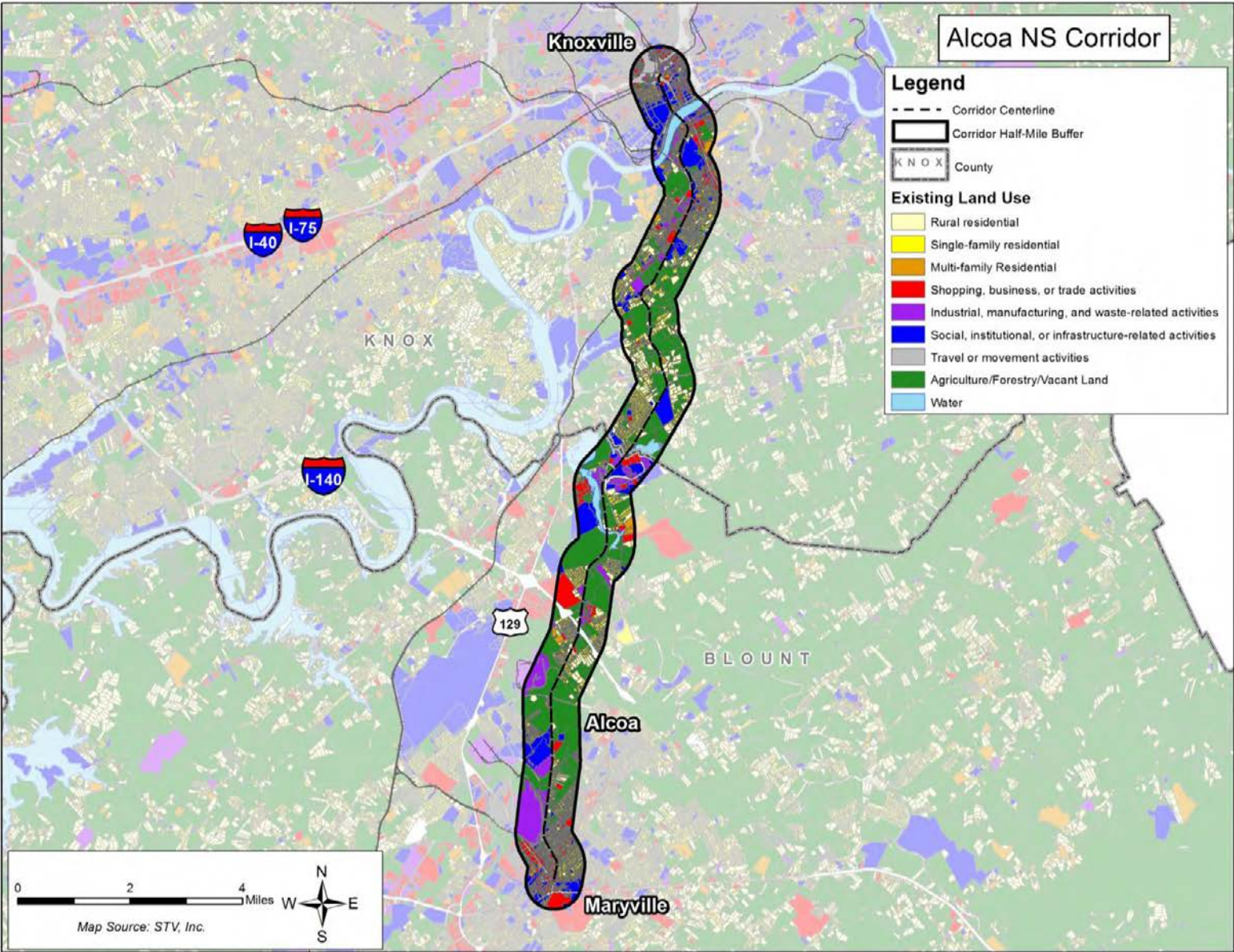


6.5.11 Alcoa NS Rail Line

The Alcoa NS Rail Line corridor contains a mix of agricultural, residential, open space, industrial uses. Heading south the corridor is lined with residential uses with small pockets of commercial, industrial and agricultural uses. Further out development becomes sprawled and the land uses consist of agricultural and residential areas. Approaching Maryville the land uses transition into industrial and residential uses. **Figure 6.11** presents an overview of the land uses along this corridor. **Appendix A** provides more detailed land use maps for the corridor.

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Figure 6.11 Alcoa NS Corridor Overall Land Use

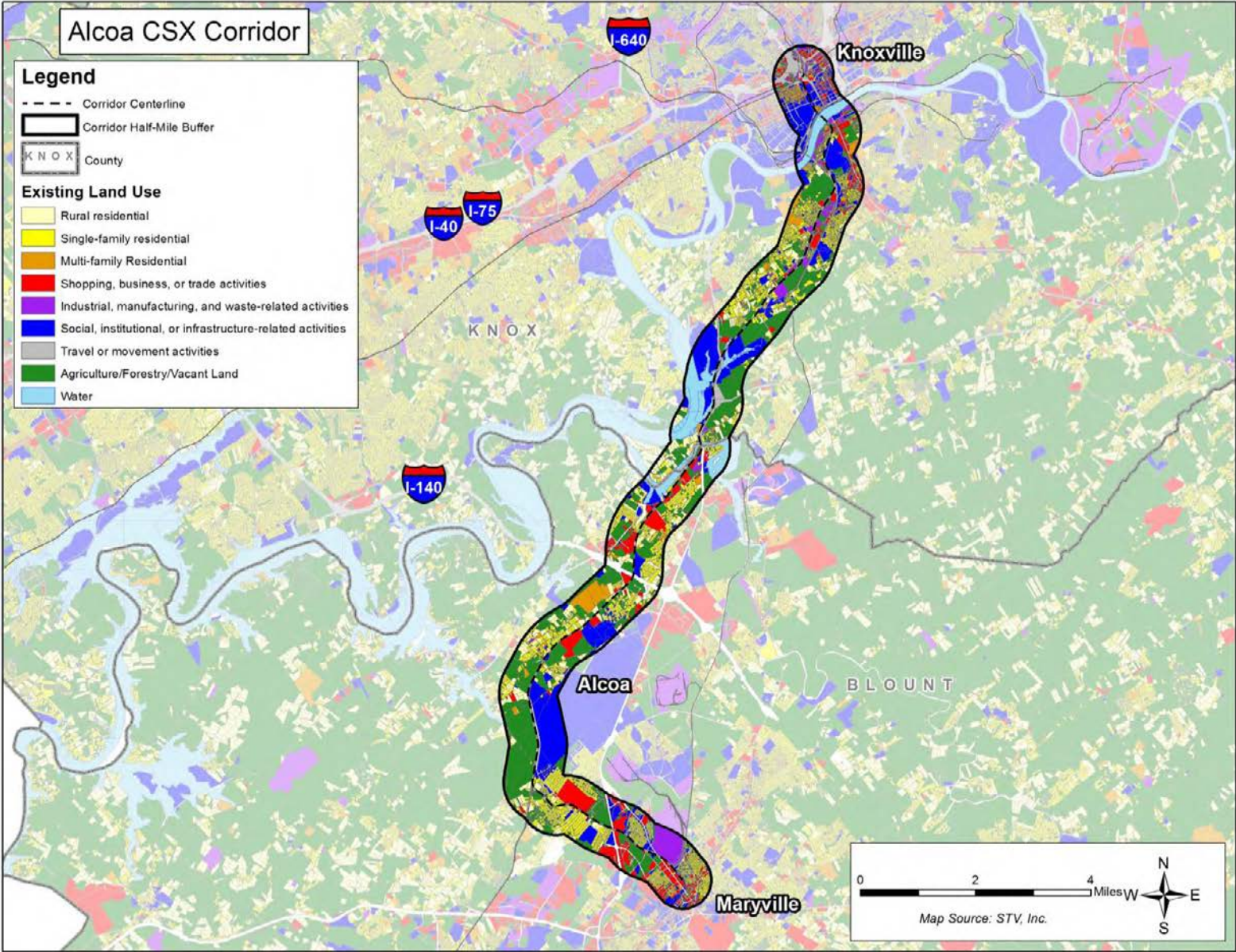


6.5.12 Alcoa CSX Rail Line

The Alcoa CSX Rail Line corridor contains a mix of residential, industrial and agricultural uses. Heading south the corridor is lined with residential uses with small pockets of commercial, industrial and agricultural uses. Further out development becomes sprawled and the land uses consist of agricultural, industrial and residential areas. Intermixed in these land uses is the McGhee Tyson Airport just south of the I-140 crossing. Approaching Maryville the land uses transition back into commercial and residential uses. **Figure 6.12** presents an overview of the land uses along this corridor. **Appendix A** provides more detailed land use maps for the corridor.

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Figure 6.12 Alcoa CSX Corridor Overall Land Use

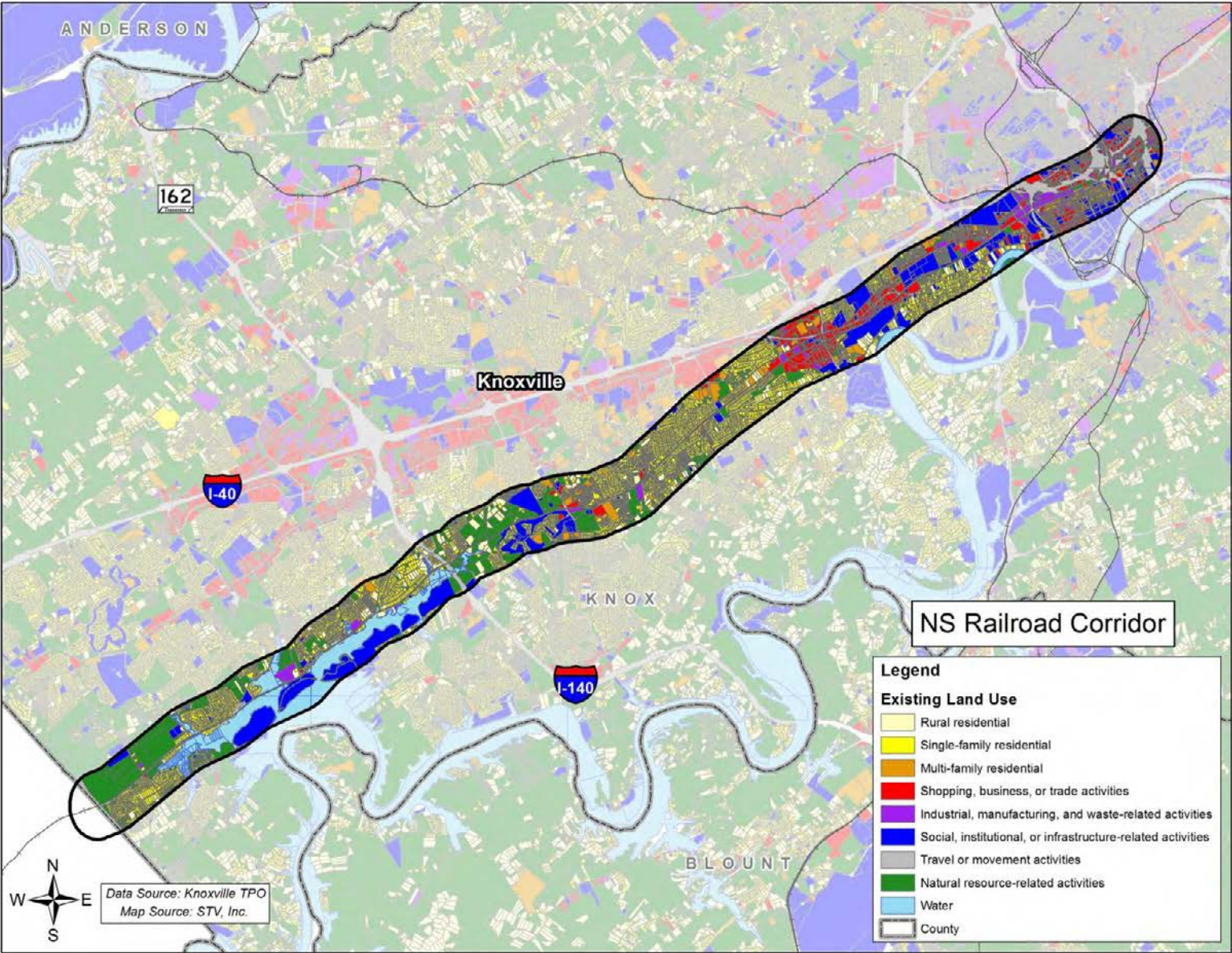


6.5.13 NS “A” Rail Line

The NS “A” Rail Line corridor contains a mix of commercial, industrial, residential and agricultural uses. The most prominent land uses are residential and agricultural. As the corridor heads west, it is lined with established single and multi-family residential, commercial and industrial uses. As the corridor approaches the county line, single family residential and agricultural uses are more prevalent. **Figure 6.13** presents an overview of the land uses along this corridor. **Appendix A** provides more detailed land use maps for the corridor.

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Figure 6.13 NS “A” Rail Corridor Overall Land Use



6.6 Major Activity Centers

Downtown Knoxville

Downtown Knoxville is the county seat of Knox County and is the home of a number of major employers such as: Tennessee Valley Authority, Knox County and State government offices, Federal Court complex and other government satellite offices. KAT's main bus terminal is situated on the eastern side of downtown Knoxville providing



the main hub to the transit users. There are cultural and entertainment districts (Market Square) and the Tennessee River waterfront, as well as central business district and Old City.

University of Tennessee

The University of Tennessee is the main institution within the University of Tennessee system serving over 28,000 students. Cumberland Avenue divides the west side of the campus from downtown Knoxville. KAT routes 10, 11, 17, and 42 serve the campus, along with various trolleys. Many of the students live off campus and either commutes via personal automobile, public transportation or walk/bicycle. The university also employs over 8,350 staff and faculty members.



Pellissippi State Community College

Pellissippi State Community College, consisting of four campuses within the greater Knoxville region provides higher education in vocational and technology fields. The main campus is located off of the Pellissippi Parkway north of I-40, the Magnolia Avenue Campus is located on Magnolia Avenue and served by KAT



route 31, the Division Street Campus is located west of Alcoa Highway off of Division Street

and served by KAT route 13, and Blount County Campus in Friendsville, TN. Overall, the college serves approximately 10,000 students and employs over 500 staff members.

UT Medical Center



The UT Medical Center is the region's major medical facility and academic medical center, located on Alcoa Highway. The medical center is served by KAT route 42.

West Town Mall



The mall is Knoxville's premier shopping destination located on Kingston Pike, just south of Exit 380 off I-40. There are approximately 150 stores. The mall is served by KAT routes 11, 18 and 90.

McGhee Tyson Airport



McGhee Tyson Airport is the main airport serving the greater Knoxville region. It is situated along the Alcoa Highway in Blount County. The airport handles majority of the commercial, general aviation, cargo and military air traffic.

Oak Ridge National Laboratory (ORNL) and other Departments of Energy Facilities



ORNL is one of the largest employment activity centers, situated in Anderson and Roane County and approximately 25 miles west of Knoxville. It is a major science and technology laboratory managed by the U.S. Department of Energy. The laboratory was established during World War II and since then conducts advanced research in scientific

discovery relating to nuclear, chemistry, and energy. There is approximately 4,600 staff members associated with the laboratory, along with an average of 3,000 guest researchers a year.

Other major energy facilities include Y-12 in Anderson County. Its primary mission is to support defense needs and assist on issues of nuclear non-proliferation. They also provide expertise to other federal agencies. There is approximately 4,700 employees and an additional 1,500 personnel that work on site from other companies.

Turkey Creek



The Turkey Creek shopping complex is made up of more than 65 shopping, dining, and commercial businesses situated across 300 acres. Located in the town of Farragut, it is the largest commercial development within the Knoxville metropolitan area.

Table 6.3 Major Potential Activity Centers Matrix

Activity Center	Statistics	KAT Bus Route	Closest Corridor
Downtown Knoxville	Central Business District housing several major employers. Metropolitan population of 691,000	Major transfer point for all routes	All corridors with the exception of Pellissippi Parkway and Alcoa CSX begin/end in downtown Knoxville
University of Tennessee	28,000 students, 8,350 employees	10, 11, 17, 42, + trolleys	Cumberland/Kingston Pike
Pellissippi State Community College	4 campuses – 10,000 students, 500 employees (overall)	13, 31	Pellissippi Parkway, Magnolia Avenue, Alcoa Highway
UT Medical Center	3,000 employees, 275,000 patients per year	42	Alcoa Highway
West Town Mall	150 Stores	11, 18, 90	Cumberland/Kingston Pike
McGhee Tyson Airport	1.7 million passengers per year	None	Alcoa Highway
Oak Ridge National Laboratory and other Departments of Energy Facilities	4,600 employees, 3,000 guest researchers	None	Pellissippi Parkway
Turkey Creek Shopping Center Area	N/A	102x	Cumberland/Kingston Pike

7.0 TRANSIT TECHNOLOGIES

7.1 Express Bus

Express bus services uses diesel or diesel/hybrid buses that operate in existing roadways with mixed traffic, making limited stops along normal bus routes to accelerate service. This type of system is referred to as an urban or regional circulator and can easily be adaptable to community and corridor needs. Express bus alignments can vary between 5 to 30 miles depending on the service provider and service area. Express bus service may only be operated during peak commuter periods, or may be operated as high-frequency service throughout the day with headways ranging from 10 to 20 minutes. Average travel speeds range from 10 to 20 miles per hour, depending on the spacing of stops, traffic conditions, and other considerations.

Additional right-of-way could be required for park-n-ride lots and minimal roadway improvements (signal improvements, queue-jumps). Typical right-of-way needs average between 8 to 14 feet. Express bus could share the existing Knoxville Area Transit bus maintenance facility.

Because express bus typically operates in a mixed-use right-of-way environment implementation costs are relatively low. Implementation costs range from \$1 to \$2 million per mile when implementing parking ride lots, signal preemption and signal priority measures, and queue jumper lanes; which would average annual O&M costs from \$2 to \$6 million.



Highlights:

- Diesel / Hybrid skip-stop urban and regional service
- Operates on roadways within mixed traffic with signal priority and/or queue jumps
- Stations can be existing bus shelters, posted stops or park-n-ride lots
- Capacity up to 85 passengers per bus
- Average speed between 10 - 20 mph depending on traffic conditions
- Limited station stops along normal bus route
- Alignment length between 5 and 30 miles
- Headways range from 10 to 20 minutes
- Cost range between \$1 to \$2 million per mile

7.2 Bus Rapid Transit

Bus Rapid Transit (BRT) system uses high-tech diesel or diesel/hybrid buses that operate on dedicated transit-ways with their own right-of-ways, High Occupancy Vehicle (HOV) lanes or existing roadways. This permanent, integrated system uses signal priority, queue jumpers, improved stations along corridors, and other techniques to increase the efficiency of bus service. This type of system is referred to as an urban or regional circulator and can be easily adaptable to community and corridor needs. BRT alignments can vary between 5 to 30 miles depending on the service area. Frequent service is provided, with headways ranging from 3 to 20 minutes. Travel speeds range from 20 to 40 miles per hour.

Additional right-of-way could be required for the dedicated transit-way, station platforms, park-n-ride lots, roadway improvements (such as grade separations, widening of intersections, widening of roadways). Typical right-of-way needs average between 12 and 32 feet, depending on operating in-street running or dedicated transit corridor, respectively. Stations are typically spaced a quarter-mile to 2 miles apart and incorporate platform stations with amenities and possible park-n-ride lots. BRT can share the Knoxville Area Transit bus maintenance facility. However, depending on the type of BRT vehicles procured there may need to be some minor modification to the maintenance facility.

Implementation costs vary widely, from \$4 to \$50 million per mile and average annual O&M costs from \$4 to \$29 million. The wide variation in costs is attributable to the vast spectrum of infrastructure elements that can be incorporated into a BRT project.



Highlights:

- Diesel / Hybrid limited stop urban and regional service
- Operates in dedicated ROW or HOV lanes to by-pass congestion
- Modern low-floor buses with multiple doors for easy boarding
- Stations can be shelters, simple platforms, or park-n-ride lots
- Capacity up to 100 passengers per bus
- Average speed between 20 - 40 mph
- Stations spaced every 0.25 to 2 miles
- Alignment length between 5 and 30 miles
- Headways range from 3 to 20 minutes
- Cost range between \$4 to \$50 million per mile

7.3 Streetcar

Streetcars are electrically-powered rail transit systems that operate within mixed traffic usually along the curb lane. It is powered by electrified overhead catenary lines. This type of system is referred to as an urban circulator and offers service to local areas connecting multiple trip destinations. They handle a smaller volume of riders and stop more frequently. The average operating length of a Streetcar system is between 5 and 15 miles, non-linear. Service runs on intervals ranging from 8 to 15 minutes with an average travel speeds from 8 to 12 miles per hour.

Typical right-of-way needs average between 5 and 20 feet. Stations are generally located approximately one-quarter mile apart and are simple stops or platforms. Streetcar would require its own maintenance facility. Streetcar implementation cost ranges from \$2 to \$25 million per mile and average annual O&M costs from \$4 to \$6 million.



Highlights:

- Electrically-powered urban circulator
- Operates on roadways within mixed traffic with signal priority
- Stations can be platforms integrated into surrounding streetscape
- Capacity for 100 to 200 passengers
- Average speed between 8 - 12 mph
- Station spaced every 0.25 mile
- Alignment length between 5 and 15 miles
- Headways range from 8 to 15 minutes
- Cost range between \$2 to \$25 million per mile

7.4 Light Rail

Light rail Transit (LRT) systems are powered by overhead electric catenary lines and typically operate on separated rights-of-way within urban areas. When necessary, light rail systems can operate in close proximity to mixed traffic, and alignments can also exist within shared space within a city street, even in mixed traffic on a limited basis. This type of system is referred to as an urban service. Alignments can range between 10 to 30 miles with a typical operating frequency of 5 to 30 minutes. Average travel speeds range from 20 to 60 miles per hour.

Additional right-of-way would be required for the dedicated transitway, station platforms, park-n-ride lots, roadway improvements (such as grade separations, widening of intersections, widening of roadways). Typical right-of-way needs average between 10 and 32 feet. Stations are typically a quarter-mile to 2 miles apart and incorporate platform stations with amenities and possible park-n-ride lots. LRT would require its own maintenance facility.

Light rail implementation cost per mile varies from \$40 to \$120 million per mile and average annual O&M costs from \$13 to \$33 million.



Highlights:

- Electric or diesel powered urban and regional service
- Operates in dedicated ROW or within mixed traffic
- Low-floor vehicle with multiple doors for easy boarding
- Stations can be platforms integrated into surrounding streetscape
- Capacity up to 300 passengers
- Travel speeds range from 20 to 60 miles per hour
- Stations spaced quarter-mile to two miles apart
- Alignments can range between 10 and 30 miles
- Headways range from 5 to 30 minutes
- Cost per mile varies from \$40 to \$120 million per mile

7.5 Commuter Rail

Commuter rail systems use an electric or diesel propelled urban passenger train and operates solely within a railroad corridor. Trains powered by a locomotive can operate in “push-pull” mode, allowing the train to be operated from either end. The trains operating in “push-pull” mode have a locomotive at one end of the train and a second control cab at the other end. Commuter rail vehicles are larger and provide more seating and less standing room due to the longer commute time involved. The service also has the ability to coexist with freight rail providers on track owned by a freight railroad; however, capacity and liability concerns often make shared track agreements difficult to achieve.

Commuter rail systems provide service between a center city and outer surrounding suburbs and operate only during the peak periods. This type of system is referred to as a regional service. Typically alignments range between 30 to 125 miles in length with service intervals of 20 to 30 minutes. Stations are generally spaced at two to five miles apart and incorporate platform stations with amenities and possible park-n-ride lots. Average travel speeds range from 30 to 60 miles per hour.

Additional right-of-way would be required for dedicated rail corridors, station platforms, park-n-ride lots, roadway improvements (such as grade separations). Typical right-of-way needs average between 24 and 48 feet. Commuter Rail would require its own maintenance facility. Implementation cost varies from \$3 to \$125 million per mile and average annual O&M costs from \$3 to \$30 million. Costs vary depending largely on the need to build new infrastructure.



Highlights:

- Electric, diesel or diesel/hybrid powered interurban and regional service
- Operates in dedicated ROW or can share track with freight
- Conventional railroad equipment with high level boarding
- Stations are large high level platforms with large parking lots
- Capacity up to 800 passengers
- Average speed between 30 - 60 mph
- Stations spaced 2 to 5 miles apart
- Alignment length between 30 and 125 miles
- Headways range from 20 to 30 minutes
- Cost range between \$3 to \$125 million per mile

7.6 Heavy Rail

Heavy rail systems, commonly referred to as subways or metros, have dedicated railway with the capacity and frequency to handle a heavy traffic volume. Service is provided by steel-wheel, electrically-powered vehicles operating two or more (most between six and ten) cars on a fully grade-separated right-of-way, in underground or elevated structures providing service to regional and urban areas. Power is delivered to the vehicle through an electrified third rail. Outside urban areas, heavy rail systems may run grade separated at ground level. Alignments stretch anywhere from 30 to 125 miles, typically operating at intervals of 5 to 10 minutes. Travel speeds range from 30 to 80 miles per hour.

Additional right-of-way would be required for dedicated rail corridors, station platforms, park-n-ride lots, roadway improvements (such as grade separations, since at-grade crossings are prohibited). Typical right-of-way needs average between 24 and 48 feet. Stations are spaced generally at a distance of approximately one mile apart in the high density urban areas and up to five miles apart in the surrounding suburban areas. Large, elaborate stations with amenities and possible park-n-ride lots are typically used. Heavy rail could share MARTA's existing maintenance facilities.

Implementation cost varies from \$100 to \$250 million per mile or more and average annual O&M costs from \$15 to \$28 million. American cities with heavy rail systems in place have high population and employment densities, and long histories of public transportation.



Highlights:

- Electric powered urban and regional service
- Operates in exclusive grade separated railroad ROW
- Third rail powered equipment with high level boarding
- Stations are multi-level with controlled access and large high level platforms
- Capacity up to 800 passengers
- Average speed between 30 - 80 mph
- Stations spaced every 1 to 5 miles
- Alignment length between 30 and 125 miles
- Headways range from 5 to 10 minutes
- Cost range between \$100 to \$250 million per mile

Table 7.1 Transit Technologies Matrix

Technology	Service Needs			Operations					Construction Costs	Operating & Maintenance Costs
	Average ROW / Typical Footprint Needs	Station Spacing	Average Length of Service	Ability to Operate in Travel Lanes	Power Source	Peak Service	Service Type	Average Operating Speed		
Express Bus	8 – 14 ft	Limited Stops Along Normal Bus Routes	5 – 30 miles	Yes – mixed traffic with signal improvements / queue jump lanes	Diesel / Diesel/hybrid	10 – 20 min	Urban / Regional Circulator	10 – 20 mph	\$1 - \$2 million	\$4 - \$10 million
BRT	12 – 32 ft	.25 – 2 miles	5 – 30 miles	Yes – dedicated ROW, HOV or mixed traffic	Diesel / Diesel/hybrid	3 – 20 min	Urban / Regional Circulator	20 – 40 mph	\$4 - \$50 million	\$4 - \$29 million
Streetcar	5 – 20 ft	.25 miles	5 – 15 miles	Yes – mixed traffic	Overhead Electric Source (Catenary)	8 – 15 min	Urban Circulator	8 – 12 mph	\$2- \$25 million	\$4 - \$6 million
LRT	10 -32 ft	.25 – 2 miles	10 – 30 miles	Yes – along side of travel lanes & in-street running	Overhead Electric Source (Catenary)	5 – 30 min	Urban / Regional	20 -60 mph	\$40- \$120 million	\$13- \$33 million
Commuter Rail	24 -48 ft	2 – 5 miles	30 – 125 miles	No – operates within railroad ROW	Electric or Diesel	20 -30 min	Regional / Interurban	30 -60 mph	\$3- \$125 million	\$3- \$30 million
Heavy Rail	24 – 48 ft	1 – 5 miles	30 – 125 miles	No – operates within railroad ROW	Electric Third Rail	5 – 10 min	Urban / Regional	30 -80 mph	\$100- \$250 million	\$15- \$28million

8.0 TIER I SCREENING ANALYSIS SUMMARY

The Tier 1 analysis was conducted as an initial screening of the corridors identified through this study effort. The corridors were subjected to a set of defined criteria that resulted in the elimination of any corridors with notable fatal flaws. The remaining corridors and any modifications from this initial screening were advanced through the Tier 2 analysis process to achieve a refined number of recommended corridors that warrant further study. The screening criteria defined for this initial screening comprised of the following:

- **Transit Technology Characteristics** - typical performance characteristics for each corridor were evaluated to determine compatibility to each of the corridors. The criteria included topography of the corridor, vehicle performance capabilities, service characteristics, and corridor length. In addition, corridors were eliminated if the modal choices were not operationally compatible with an existing rail corridor or roadway right-of-way.
- **Existing Ridership Estimates Parallel to Proposed Corridors** - existing KAT ridership numbers for bus routes that parallel the corridors were used to evaluate the existing ridership along the proposed corridors and the overall attractiveness of each corridor. Corridors were eliminated due to lack of major activity centers, pedestrian/vehicular accessibility, and physical location.
- **Population within ¼ and ½ mile of the proposed alternative** - total population and its demographic breakdown living near the proposed corridors were evaluated. Corridors were screened for populations that would benefit from increased accessibility as well as for particular population groups that may not have use of an auto and are dependent on transit.
- **Employment within ¼ and ½ mile of the proposed alternative** - total number of job opportunities were evaluated within the proposed corridors. Corridors were screened for the potential increase in job accessibility and mobility for those living in the region.
- **Regional Connectivity** – reviewed the potential for direct and efficient connection to potential markets. Corridors were screened for the ability to directly or indirectly generate trips between counties that encouraged links between persons and major activity centers across regional boundaries.
- **Preliminary Environmental Issues** - evaluated direct or indirect impacts on existing natural features within or near the project corridor. Corridors were screened through the use of GIS data for any potential conflicts between the corridors and environmental sensitivities.
- **Physical Footprint** - considered the scale (height and mass) and complexity of the project and its components (stations; structures; vehicles) compared to the scale of the

communities that the project traverses. Corridors were screened to gauge if the new footprint including structures, stations and other facilities could be installed within the boundaries of existing rights-of-ways without property acquisitions.

- **Acceptability** - comments received during outreach and other meetings were evaluated for support of corridor options that best serve the community.

8.1 Tier 1 Screening Matrix Results

The defined criterion was applied across all of the corridors and an overall ranking was assessed for each of the corridors. Corridors that achieved the lowest rankings were eliminated from advancing into the Tier 2 analysis. The Cumberland/Kingston Pike, Magnolia, Western Avenue, Central Avenue, North Broadway, Pellissippi Parkway, and Alcoa NS Rail Line corridors all advanced to the next level of screening. **Table 8.1** displays the screening results for each of the corridors.

Table 8.1 Tier 1 Corridor Analysis Results

Alternative	Transit Technology Characteristics	Ridership	Population within 1/4 and 1/2 mile of Corridor*	Employment within 1/4 and 1/2 mile of Corridor*	Regional Connectivity	Preliminary Environmental Issues	Physical Footprint	Acceptability	Advancement into Tier 2 Analysis
Cumberland/Kingston Pike	Accommodates various transit modes	192,274	High population adjacent to corridor	High number of employment centers	High Connectivity	High environmental issues	Major property impacts	High level of stakeholder support	
<i>Rating</i>									
Magnolia Avenue	Accommodates various transit modes	117,881	Low population adjacent to corridor	Low number of employment centers	Low Connectivity	High environmental issues	Minimal property impacts	High level of stakeholder support	
<i>Rating</i>									
Western Avenue	Accommodates very few transit modes	107,788	Moderate population adjacent to corridor	Moderate number of employment centers	Low Connectivity	Low environmental issues	Minimal property impacts	Moderate level of stakeholder support	
<i>Rating</i>									
Martin Luther King Jr. Avenue	Accommodates various transit modes	30,268	Low population adjacent to corridor	Moderate number of employment centers	Low Connectivity	Moderate environmental issues	Moderate property impacts	Low level of stakeholder support	
<i>Rating</i>									
Central Avenue	Accommodates various transit modes	66,847	Moderate population adjacent to corridor	Moderate number of employment centers	Low Connectivity	Low environmental issues	Major property impacts	Moderate level of stakeholder support	
<i>Rating</i>									
North Broadway NE	Accommodates various transit modes	138,790	Moderate population adjacent to corridor	High number of employment centers	Moderate Connectivity	High environmental issues	Major property impacts	High level of stakeholder support	
<i>Rating</i>									
Chapman Highway	Accommodates very few transit modes	59,992	Low population adjacent to corridor	Moderate number of employment centers	Low Connectivity	Low environmental issues	Minimal property impacts	Low level of stakeholder support	
<i>Rating</i>									
Alcoa Highway	Accommodates very few transit modes	N/A	Low population adjacent to corridor	Low number of employment centers	Moderate Connectivity	Moderate environmental issues	Minimal property impacts	Moderate level of stakeholder support	
<i>Rating</i>									
Pellissippi Parkway	Accommodates very few transit modes	N/A	High population adjacent to corridor	Low number of employment centers	High Connectivity	Moderate environmental issues	Minimal property impacts	High level of stakeholder support	
<i>Rating</i>									
Alcoa NS Rail Line	Accommodates some transit modes	N/A	Moderate population adjacent to corridor	Moderate number of employment centers	High Connectivity	Moderate environmental issues	Minimal property impacts	Moderate level of stakeholder support	
<i>Rating</i>									
Alcoa CSX Rail Line	Accommodates some transit modes	N/A	Moderate population adjacent to corridor	Moderate number of employment centers	High Connectivity	Moderate environmental issues	Minimal property impacts	High level of stakeholder support	
<i>Rating</i>									
NS "A" Rail Line	Accommodates some transit modes	183,629	High population adjacent to corridor	High number of employment centers	Moderate Connectivity	High environmental issues	Major property impacts	Low level of stakeholder support	
<i>Rating</i>									
<p>Legend High Medium Low </p> <p>* Does not factor in physical accessibility</p>									

9.0 TIER 2 SCREENING ANALYSIS SUMMARY

The Tier 2 analysis was a more detailed screening of the remaining seven corridors advanced through the previous screening process. A refined set of criterion was developed to “zero-in” on the corridors that had the best potential for advancing through the federal process while providing the most benefit to the demographic served. The screening criteria defined for the final screening comprised of the following:

- **Transit Technology Characteristics** - evaluated each of the six technologies based on route length, topography of the alignments, existing transit service, right-of-way requirements, and capital and operating costs.
- **Consistency with Local Plans supporting Goals and Objectives** – available current long range plans, transportation plans and other relevant studies conducted within the study area were reviewed and analyzed to determine if the alignment was consistent with the proposed plans.
- **System Integration** - Reviewed and analyzed the KAT bus system to determine if the proposed alignments enhanced or deterred from the existing service. Alignments were evaluated for missing connections and efficiency improvements within the study area.
- **Financial Criteria** - order of magnitude for capital and operating and maintenance (O&M) cost for each alignment and proposed technology was evaluated. Typical capital costs included structures, track work, pavement, facilities, signals, vehicles, and right-of-way. Typical O&M costs included labor, fuel or electricity, vehicle maintenance, non-vehicle maintenance, fare collection, insurance and administrative costs.
- **Preliminary Environmental Criteria** - proposed direct or indirect impact on existing natural features within or near the corridors was evaluated. Environmental sensitivities included stream crossings, parkland/open space and historic properties. Additional GIS data and a more detailed screening of these features stemming from the Tier I screening process.
- **Transportation/Engineering Criteria** - the constructability of the system was evaluated by taking into consideration the grade of the corridor, at-grade crossings and 90 degrees turns for each of the alignments.
- **Community Benefits** - population, employment, low income population, zero car households and potential parcel takings was evaluated for each of the corridors.
- **Land Use/Development and Redevelopment Opportunities** - the presence and consistency of adjacent transit supportive land uses for each of the corridors was evaluated. Land use was reviewed to determine if there are supporting uses that allow for development, redevelopment, in-fill development and transit oriented development opportunities that would further enhance the proposed transit system.

9.1 Tier 2 Screening Results

The goal of this technical evaluation was to conduct a more detailed assessment of the seven remaining alignments from the Tier 1 Analysis so that a more intelligent strategic decision can be made on the direction of future transit investments. In addition to the developed criterion that was used for this screening, a field visit was conducted to visually assess and verify the existing conditions along each of the seven corridors. Cumberland/Kingston Pike, Magnolia Avenue and North Broadway were the three corridors that scored the most favorable rankings through the detailed screening process. The results of this analysis justify the advancement of these three corridors through the FTA Project development process identified in the new federal regulations, MAP-21. **Table 9.1** displays the corridor analysis results for each of the corridors. Technology wise BRT would be the ideal technology since there are minimal design and operation limitations to that technology, unlike LRT where there are topography challenges along majority of the recommended corridors.

Table 9.1 Tier 2 Corridor Analysis Results

Alternative	Consistant with Local Plans	System Integration	Financial Criteria	Preliminary Environmental Screen	Transportation / Engineering	Community Benefits	Land Use / (Re) Development Opportunities	Recommended Corridors
Cumberland/Kingston Pike	Consistant with local plans	High level of integration opportunities	Low financial cost	Moderate environmental issues	Low engineering issues	High amount of benefits	High level of (re)development opportunities	
<i>Rating</i>	●	●	●	◐	●	●	●	
Magnolia Avenue	Consistant with local plans	High level of integration opportunities	Low financial cost	Low environmental issues	Low engineering issues	Low amount of benefits	High level of (re)development opportunities	
<i>Rating</i>	●	●	●	●	●	○	●	
Western Avenue	Consistant with local plans	Moderate level of integration opportunities	High financial cost	Low environmental issues	High engineering issues	Moderate amount of benefits	Moderate level of (re)development opportunities	
<i>Rating</i>	●	◐	○	●	○	◐	◐	
Central Avenue	Not consistent with local plans	Moderate level of integration opportunities	Moderate financial cost	Moderate environmental issues	High engineering issues	Low amount of benefits	Moderate level of (re)development opportunities	
<i>Rating</i>	○	◐	◐	◐	○	○	◐	
North Broadway NE	Consistant with local plans	High level of integration opportunities	Low financial cost	High environmental issues	Low engineering issues	High amount of benefits	High level of (re)development opportunities	
<i>Rating</i>	●	●	●	○	●	●	●	
Pellissippi Parkway	Not consistent with local plans	Low level of integration opportunities	Moderate financial cost	Moderate environmental issues	Moderate engineering issues	High amount of benefits	Low level of (re)development opportunities	
<i>Rating</i>	○	○	◐	◐	◐	●	○	
Alcoa NS Rail Line	Consistant with local plans	Low level of integration opportunities	High financial cost	High environmental issues	High engineering issues	Moderate amount of benefits	Low level of (re)development opportunities	
<i>Rating</i>	●	○	○	○	○	◐	○	
Legend	High ●	Medium ◐		Low ○				

9.2 Ridership Estimates

The Knoxville TPO 2010 travel demand model was used to estimate ridership for the recommended corridors of Cumberland/Kingston Pike, Magnolia Avenue, and North Broadway. In addition to the three recommended corridors a combined Cumberland/Kingston Pike and Magnolia Avenue alternative was modeled. This additional alternative was added because it combined a substantial residential corridor (Magnolia Avenue) with a dense commercial corridor (Cumberland/Kingston Pike) linking jobs and people. The travel modeled was coded with the following assumptions:

- Existing bus routes were treated as a BRT while operating within the corridors.
- The BRT service would charge \$1.50 fare
- A patron bias was applied toward the BRT express service with limited stops vs standard local bus service making all stops.

The travel demand modeled revealed that the North Broadway Corridor would produce the most new trips netting 3,158 new riders, followed by the combined Cumberland/Kingston Pike/Magnolia Avenue with 2,520 new riders, Cumberland/Kingston Pike with 1,795 new riders and Magnolia Avenue with 643 new riders. The following table summarizes the ridership results:

Table 9.2 Ridership Results

	Magnolia Avenue	Cumberland/Kingston Pike	North Broadway	Cumberland/Kingston Pike/Magnolia Avenue
New Riders	789	1,733	3,959	2,817
Total Riders	9,567	10,825	13,145	11,362

9.3 Financial Plan

The development of a financial plan for this study is an integral part of advancing the recommended corridors onto Systems Planning (formerly Alternatives Analysis) and Project Development (formerly Locally Preferred Alternative). This section outlines possible potential funding options for implementing transit. Existing and proposed funding sources are outlined along with additional, non-traditional funding opportunities and implementation strategies that may be available to the Knoxville Regional Transit Corridor Study. Potential funding mechanisms that are discussed below could require a voting measure by either a local, regional or state perspective. A more detailed explanation of these funding options can be found in the Knoxville Regional Transit Corridor Financial Plan.

The financial evaluation focuses on three corridors that warrant further study: the Cumberland Avenue/Kingston Pike, the North Broadway, and the Magnolia Avenue corridors. Since these corridors can draw upon the same funding sources for development, the alternatives are discussed collectively as the recommended corridors.

The approach herein is largely based on existing, proposed and potential funding sources that could be applied to major transit capital projects in the study area. The following financial documents were used to identify potential funding sources:

- Transit Financial Analysis, 2009-2034 Knoxville Regional Mobility Plan
- Transportation Planning Work Program, FY 2011-2012, Knoxville Regional Transportation Planning Organization (TPO)

These documents define the commitment levels for those projects already approved in the LRTP and provide information about other incremental funding sources that could be applied to the recommended corridors. The following outlines the various identified funding sources that could be utilized to move the recommended corridors through the planning/engineering process and into construction/operation:

9.4 Local Funding Options

Real Estate-Based Sources:

- **Tax Increment Financing** – captures revenues from increased real estate values and development levels within station areas through the definition of a "frozen tax base" before the project, and then the diversion of incremental real estate tax revenue to project revenue sources.
- **Local Improvement District (aka Business Improvement District)** – captures revenue from the local area based on a baseline tax generation from all sources and then the diversion of the incremental revenue impacts from the project to the project revenue stream.

General Government Sources:

- **Impact/Utility Fees** – one-time fees collected by local governments on new development to help pay for capital projects.
- **Bonds** – government issued General Obligation bonds used for Capital Improvement Plans (CIP) to maintain/expand infrastructure.
- **Property Tax** – government assessed millage value of properties allocating a portion of the revenues to dedicated funding for transportation.

- **Local Sales Tax** – government or authority assessed local sales tax in addition to the baseline state sales tax used for transportation spending.
- **Local Income Tax** – city or county assessed local income tax in addition to the baseline state income tax that can be based on where people live and/or work. Work-location based taxes are sometimes referred to as payroll or wage taxes and tend to be assessed by cities with a large commuter base outside of their city limits.
- **Local Food/Beverage Tax** – city or regional wide tax that can be a whole amount or a percentage of a sale.

Transportation Sources:

- **Transit Fare Increases** – an increase in the price of fare a commuter pays to ride mass transit.
- **Toll Roads** – roads can be tolled to assess a flat rate for all facility users, or set at variable rates depending on the type of vehicle.
- **Local Gas Tax** - local gas tax in addition to the baseline state gas tax for transportation spending.
- **Local Wheel Tax** – Tennessee counties are authorized under Section 5-8-102 of the Tennessee Code Annotated to impose a local motor vehicle tax to provide revenue for transportation projects.
- **Driver's License, Title Fees** – an increment on top of the state baseline fee for motor vehicle fee for driver's licenses and titles.
- **Local Parking Tax** – city or county assessed parking tax applied to commercial parking lots for transportation spending.

State Funding Options

- **Regional Transit Authority** – Tennessee Senate Bill 1471 (House Bill 1263) grants metropolitan areas the ability to create transit districts with taxing and bond-issuing authority.
- **1986 Roads Program** – state has a pay-as-you-go transportation improvement program funded via a special tax of 4 cents per gallon of gasoline and 3 cents per motor fuel.
- **State Gas Tax** – a state tax on gas that is distributed to cities and counties used to fund various projects.

Federal Funding Options

- **Metropolitan Planning Funds (Section 5303)** - discretionary national funding program for the initiation or expansion of fixed guideway transit projects.

- **New Starts/Small Starts Program (Section 5309)** – discretionary national funding program based on a formalized planning process for initiation or expansion of fixed guideway transit projects.
- **Formula Funds (Section 5307)** – appropriated annual funds dispersed to transit agencies based upon population served, service area and the amount of transit service provided.
- **Bus and Bus Facilities (Section 5339)** – funds programmed to replace, rehabilitate and purchase buses and related equipment, and to construct bus-related facilities.
- **State of Good Repair Grants (Section 5337)** – formula based program dedicated to repairing and upgrading the nations transit systems. The funds are allocated to replacement and rehabilitation or capital projects required to maintain public transportation systems in a state of good repair.
- **Congestion Mitigation and Air Quality Improvement Program** – funds programmed through the LRTP and Transportation Improvement Program.
- **Surface Transportation Program of Federal Highway Administration** – funding for highway construction and rehabilitation with flexible funding possibilities for comparable transit funding programs.

Transit Financing Sources

- **Certificates of Participation** – bonds issued to finance the purchase of the vehicles or facility construction, which are then redeemed through lease payments to bondholders.
- **Grant Anticipation Notes (GAN)/Grant Anticipation Revenue Vehicle Bonds (GARVEE)** – formula based funding for transit agencies in metropolitan areas over 200,000 in population that are permitted to borrow funds through GANs as a form of municipal security that pledges future federal funds to make debt service payments. GARVEE bonds supported by flexible funds allocated to federal highway programs that can be issued to help construct transit projects.
- **Transportation Infrastructure Finance and Innovation Act (TIFIA)** – direct loans, loan guarantees, or lines of credit not exceeding 49% for eligible surface transportation projects.
- **Other non-traditional funding sources:**
- **Public-Private Partnerships (PPPs)** – a capital funding source through private financial participation that can be used to construct various elements of a transit system.

It is essential that the investment plan for the recommended corridors first secure the financial resources to pay for the project. Similar to other large-scale transit projects, KAT, or the sponsor agency and operating agency, will need to assemble funding from multiple sources in order to meet the resource needs of the capital investment. In addition, most other existing TPO funding

is already fully committed to projects approved in the financially-constrained 2009-2034 Regional Mobility Plan for development over the next thirty years. If access to the 2009-2034 Regional Mobility Plan funds is not available for a new transit investment, additional funds will need to be identified to fill the remaining funding gap.

The goal for the financial plan is to make use of traditional funding sources where available, look for opportunities for bond financing, and be prepared, if necessary, to utilize less traditional sources to bridge the remaining funding gap and bring this project into fruition within the planned development schedule. The TPO can either leverage allocated Measure R local funds to access other funds from state and federal discretionary funding programs or identify additional local funding sources. Measure R refers to the Tennessee Senate Bill 1471 (House Bill 1263) that grants metropolitan areas the ability to create transit districts with taxing and bond-issuing authority. An example for Knoxville to adhere to is the process in which Nashville implemented their transit district. MAP-21, the new USDOT reauthorizing surface transportation program through 2014 also requires transit agencies who are FTA grantees to develop a Transit Asset Management Plan in order to develop a capital asset inventory of their entire service, identify the conditions of those assets, and develop an investment prioritization. This new regulation will add additional requirements to KAT, the TPO and possibly a much larger regional transit agency, if deemed appropriate.

10.0 PROJECT RECOMMENDATIONS

The Knoxville Regional Transit Corridor Analysis study has inventoried and interpreted existing and future conditions and developed and evaluated corridors and technologies to address mobility needs. This analysis has led to the recommendation of advancing the North Broadway, Cumberland/Kingston Pike and Magnolia Avenue corridors for further study.



Recommended transit operations vary between BRT lanes separated from general travel lanes to operating in mixed-traffic on an arterial network. Systems that operate in dedicated BRT lanes are common, however, have a higher capital cost due to the need to install additional infrastructure and possible right-of-way needs. The system can be fully separated from all traffic and cross-streets utilizing grade separations, or be a combination where there are signalized intersections with the cross-streets.

Mixed-traffic operations tend to operate in the curb lane and allow general purpose vehicles to operate within the same travel lane in order to allow access to the properties and not prohibit access. One feature that can encourage through traffic to avoid this lane is through signage and lane stripping. Signage is the most basic form of marking a lane as a BRT service; it often includes the use of a “diamond” lane symbol. Restricting general purpose vehicles during specific times of the day is another way to enhance BRT operations. By placing signage along the corridor in both directions, it is possible then to restrict vehicles during the peak hours.



Implementing alternative pavement color through colored asphalt or concrete can reinforce the notion that a particular lane is either reserved or in-use by BRT.

Other options include utilizing delineators such as raised pavement markings, raised curbs, bollards, or bumps in pavement. Thought the delineators should take into account the ability for general purpose vehicles to cross over in order to access driveways.

BRT stations should reflect the level of investment and permanence of the system. They should welcome passengers and feature a comfortable, attractive design. Stations should provide a variety of passenger amenities, including real-time information displays, benches, substantial shelters, and security features.



10.1 North Broadway

The existing mix of commercial, residential, light office and industrial land uses make this a viable corridor for implementing a sustainable transit system. In addition to the land uses the corridor contains several key transit oriented elements such as high population and employment densities, and existing mixed uses (residential and commercial) near downtown Knoxville. The roadway cross section would not offer adequate space for adding dedicated BRT lanes while maintaining a sufficient amount of automobile capacity. However, the corridor does favor the

ability to implement signal pre-emption and signal priority due to the limited roadway widths. The proposed Broadway-Central-Emory Place Small Area Plan and the Downtown North Mixed Use Districts plans will further enhance the North Broadway corridor and surrounding areas increasing the need for a state-of-art rapid transit system along this corridor.

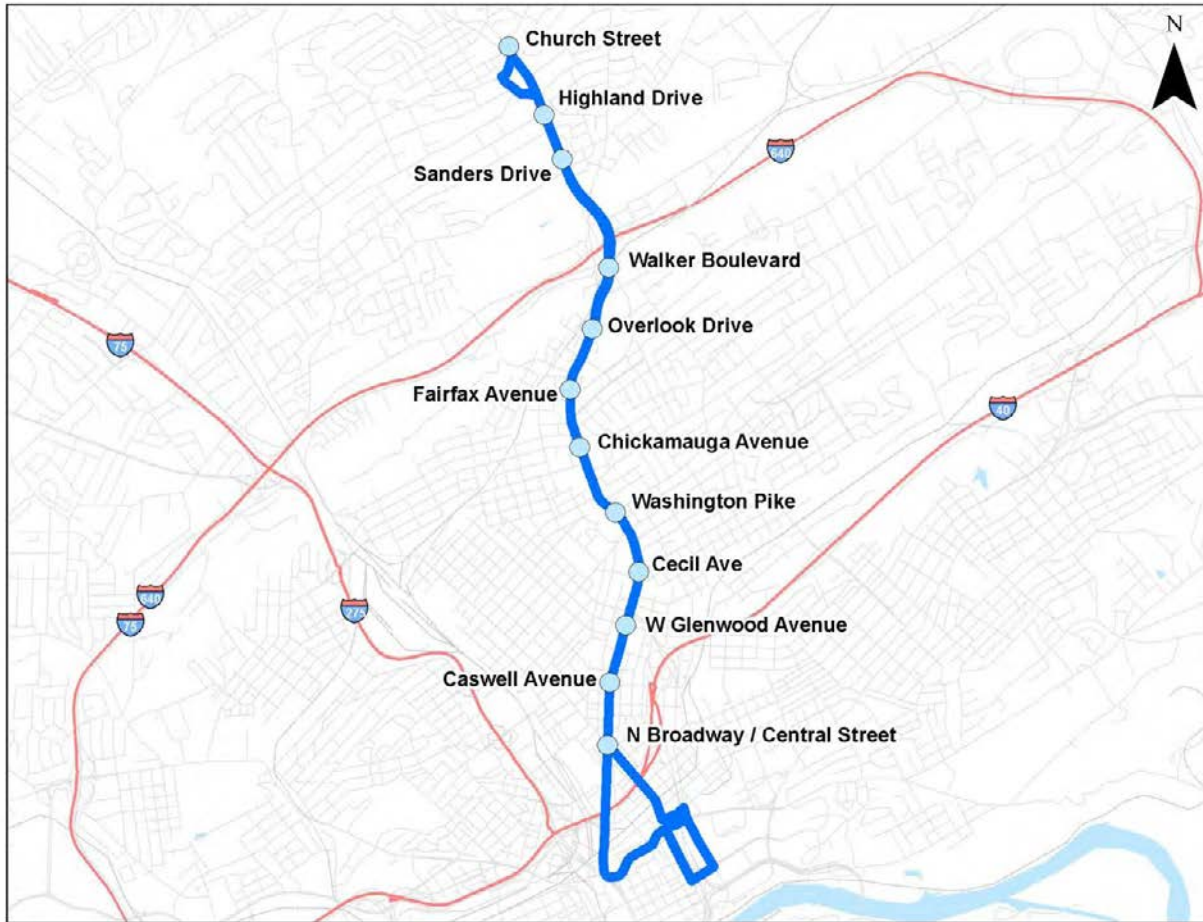
Transit Operations

This corridor would utilize in-street BRT, operating in mixed-traffic. At the existing signalized intersections, signal prioritization or queue jumper lanes would be implemented in order to improve the operation efficiency of the corridor. The curb lane would operate as a BRT lane, along with the general purpose travel lane in order to continue to provide access the various parcels along North Broadway.

Stations

During the analysis, the Team evaluated station locations, taking into account surrounding land use, roadway networks and existing KAT bus station locations. Twelve (12) station locations were identified along the corridor. Further analysis would be required to determine which stations would function as park-n-rides, walk-up stations, or even incorporate mixed-use development. **Figure 10.1** displays the potential station locations.

Figure 10.1 North Broadway Proposed Stations



Costs

Capital costs were developed utilizing the standard format of FTA’s Standard Cost Categories (SCC) (see **Table 10.1**). This is composed of a series of standard design items that can be evaluated between the various New Starts candidate projects. Each project has to establish a unit cost, through the use of FTA’s unit cost database, previous projects by similar transit agencies, and/or evaluation of a combination of the database and current transit projects in the construction phase.

Typically, BRT demonstrates relatively lower capital costs per mile versus steel wheel transit technologies. Capital costs were developed under two scenarios (high/low). The first scenario (high) was to assume that the curb lane would be upgraded through roadway sub grades, new curb and gutter, pavement marking upgrades for BRT use, upgrades to the traffic signal operations (queue jumper lanes and signal pre-emption), and installing Intelligent Transportation Systems (ITS); which would be key pieces in educating the public about the operations of the BRT system. The 12 stations would be constructed with enhanced features (pay-stations, ITS and

variable message systems, and any typical amenities within a transit station), 2 park-n-ride lots along the corridor to provide commuters another option for accessing downtown Knoxville, and enhancing the pedestrian and bicycle access to the stations. The costs also assumed there would be the need for utility relocations along the corridor for stations, non-motorized improvements, and other potential issues that may arise during further engineering analysis. A new maintenance facility, along with 8 BRT vehicles are included in the cost of the service to account for the need to train staff on the new types of vehicles, acquire new parts, and have a separate facility since the existing KAT maintenance facility is at over-capacity.

The other scenario (low) would only include constructing new curb and gutter along portions of the corridor, pavement marking upgrades for BRT use, upgrades to the traffic signal operations (queue jumper lanes and signal pre-emption), and installing Intelligent Transportation Systems (ITS). Only half of the proposed stations would be constructed with enhanced features (pay-stations, ITS and variable message systems, and any amenities within a transit station), 1 park-n-ride lot, and enhancing the pedestrian and bicycle access to only the BRT stations. A new maintenance facility, along with 8 BRT vehicles are included in the cost of the service to account for the need to train staff on the new types of vehicles, acquire new parts, and have a separate facility since the existing KAT maintenance facility is at over-capacity, however, the facility would not be designed nor constructed to same specifications as under the high cost scenario.

Table 10.1 North Broadway Capital Cost Estimate

(2011 Dollars in Millions)

CAT No.	Description	<i>High N Broadway</i>	<i>Low N Broadway</i>
	Length (Mile):	4.70	4.70
	Number of Stations:	12	12
	Number of Revenue Vehicles:	8	8
10	GUIDEWAY & TRACK ELEMENTS	\$2.9	\$2.9
20	STATIONS, STOPS, TERMINALS, INTERMODAL	\$2.3	\$1.0
30	SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	\$7.3	\$3.6
40	SITWORK & SPECIAL CONDITIONS	\$7.1	\$4.7
50	SYSTEMS	\$6.6	\$6.6
Construction Subtotal (Sum Categories 10 - 50)		\$26.1	\$18.8
60	ROW, LAND, EXISTING IMPROVEMENTS	\$0.0	\$0.0
70	VEHICLES	\$29.9	\$29.9
80	PROFESSIONAL SERVICES	\$10.6	\$7.6
90	UNALLOCATED CONTINGENCY	\$20.0	\$16.9
	Art in Transit	\$0.3	\$0.2
Total Project Cost		\$86.9	\$73.4
	Cost per mile	18.48	15.61

10.2 Cumberland/Kingston Pike

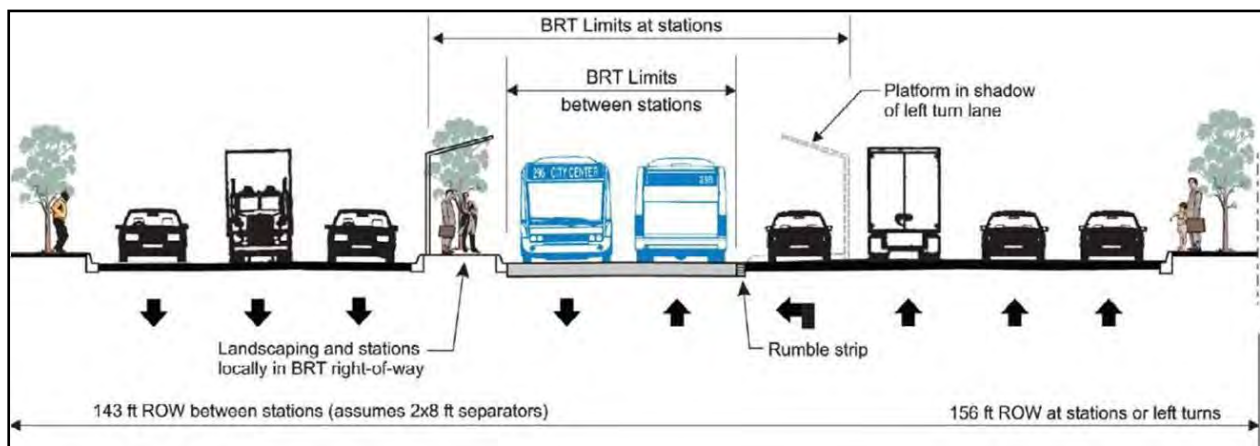
This corridor is lined with commercial and residential areas throughout with the east end of the corridor passing directly through the center of the University of Tennessee’s campus and the west end of the corridor passing through a major retail area the West Town Mall. A corridor with these types of uses could support a new transit investment with ridership during the peak hours, off-peak, and a reverse commute demand. Areas that contain a major university and several retail areas usually show ridership demand during the off-peak hours due to class schedules and retail shift work. It also creates a reverse commute demand for students travel to/from their residence to school and for employees travel to/from their residence to retail areas located further out along the corridor.

The Cumberland Avenue Corridor Plan recommends implementing “road diets” which could further enhance the pedestrian friendliness of this corridor. However, it is important that any changes to the corridor should include enhancements for an on-street rapid transit system. Coordination on the road diet plans for transit accommodations should begin immediately.

Transit Operations

This corridor would utilize two operating characteristics due to the differences in land use and densities along the corridor. Transit operations would utilize both in-street BRT operations (operating in mixed-traffic along the curb lane) and dedicated BRT travel lanes (operating in the median of Cumberland Avenue). At the existing signalized intersections, signal prioritization and queue jumper lanes would be implemented in order to improve the operation efficiency of the corridor, provide left turns to general purpose vehicles, and provide pedestrian movements. Within the in-street operations (Concord Road to West Town Mall), BRT would operate within the curb lane along with the general purpose vehicles. Within the dedicated BRT lanes (along Cumberland Avenue through the University of Tennessee), the service would operate within the median, prohibiting general purpose vehicles from utilizing the BRT lanes; as depicted in **Figure 10.2**. Stations would be constructed within the median at intersections, with pedestrian access to the stations provided at signalized intersections.

Figure 10.2 – Possible Dedicated BRT operations within the median



Stations

During the analysis, the Team evaluated station locations, taking into account surrounding land use, roadway networks and existing KAT bus station locations. Twenty (20) station locations were identified along the corridor. Further analysis would be required to determine which stations would function as park-n-rides, walk-up stations, or even incorporate mixed-use development. **Figure 10.3** displays the potential station locations.

Figure 10.3 Cumberland / Kingston Pike Proposed Stations



Costs

Capital costs were developed under the two scenarios (high/low) (see **Table 10.2**). Under the first scenario (high), within the Downtown portion and through the University of Tennessee portion of the corridor, capital costs were developed assuming that the curb lane would be upgraded through roadway sub grades, new curb and gutter, and pavement marking upgrades for BRT use. From Old Kingston Pike to the West End Mall, BRT would operate in a dedicated median BRT corridor that would prohibit operations with general purpose traffic. Those improvements would also include upgrades to the traffic signal operations (queue jumper lanes and signal pre-emption), and installing Intelligent Transportation Systems (ITS); which would be key pieces in educating the public about the operations of the BRT system. The 20 stations would be constructed with enhanced features (pay-stations, ITS and variable message systems, and any typical amenities within a transit station), two (2) park-n-ride lots along the corridor (providing commuters another option for accessing downtown Knoxville), and enhancing pedestrian and bicycle access from the surrounding neighborhoods to the stations. The costs also

assumed there would be the need for utility relocations along the corridor for stations, non-motorized improvements, and other potential issues that may arise during further engineering analysis. A new maintenance facility, along with 12 BRT vehicles are included in the cost of the service to account for the need to train staff on the new types of vehicles, acquire new parts, and have a separate facility since the existing KAT maintenance facility is at over-capacity.

The other scenario (low) would only include constructing new curb and gutter along the entire corridor, pavement marking upgrades for BRT use, upgrades to the traffic signal operations (queue jumper lanes and signal pre-emption), and installing Intelligent Transportation Systems (ITS). Only half of the proposed stations would be constructed with enhanced features (pay-stations, ITS and variable message systems, and any typical amenities within a transit station), 1 park-n-ride lot, and enhancing the pedestrian and bicycle access to only the BRT stations. A new maintenance facility, along with 12 BRT vehicles are included in the cost of the service to account for the need to train staff on the new types of vehicles, acquire new parts, and have a separate facility since the existing KAT maintenance facility is at over-capacity, however, the facility would not be designed nor constructed to same specifications as under the high cost scenario.

Table 10.2 Cumberland/Kingston Pike Capital Cost Estimate

(2011 Dollars in Millions)

CAT No.	Description	<i>High Cumberland</i>	<i>Low Cumberland</i>
	Length (Mile):	7.90	7.90
	Number of Stations:	20	20
	Number of Revenue Vehicles:	12	12
10	GUIDEWAY & TRACK ELEMENTS	\$22.0	\$17.2
20	STATIONS, STOPS, TERMINALS, INTERMODAL	\$3.8	\$1.6
30	SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	\$10.9	\$5.5
40	SITWORK & SPECIAL CONDITIONS	\$20.8	\$18.4
50	SYSTEMS	\$11.1	\$11.1
Construction Subtotal (Sum Categories 10 - 50)		\$68.5	\$53.8
60	ROW, LAND, EXISTING IMPROVEMENTS	\$0.0	\$0.0
70	VEHICLES	\$44.9	\$44.9
80	PROFESSIONAL SERVICES	\$27.7	\$21.8
90	UNALLOCATED CONTINGENCY	\$42.3	\$3.6
	Art in Transit	\$0.7	\$0.1
Total Project Cost		\$184.17	\$124.06
	Cost per mile	23.31	15.70

10.3 Magnolia Avenue

This corridor contains a mix of residential and commercial uses and contains a wide roadway cross section ideal for implementing a dedicated rapid transit system. This corridor will also draw ridership from the Martin Luther King Jr. Avenue corridor which was screened out in the first round. The Magnolia Corridor Plan introduces opportunities for more intense, mixed-use development and improved sidewalk, bicycle and street system. The Land Use Tool kit developed for this study uses elements from the Magnolia Corridor Plan and incorporates a dedicated transit way for a new BRT system along this corridor. **Figure 10.4** captures all of the elements of a pedestrian, bicycle and transit friendly corridor. The figure also depicts how the BRT system could be branded so that it stands out to potential patrons.

Figure 10.4 Transit Friendly Corridor along Magnolia Avenue



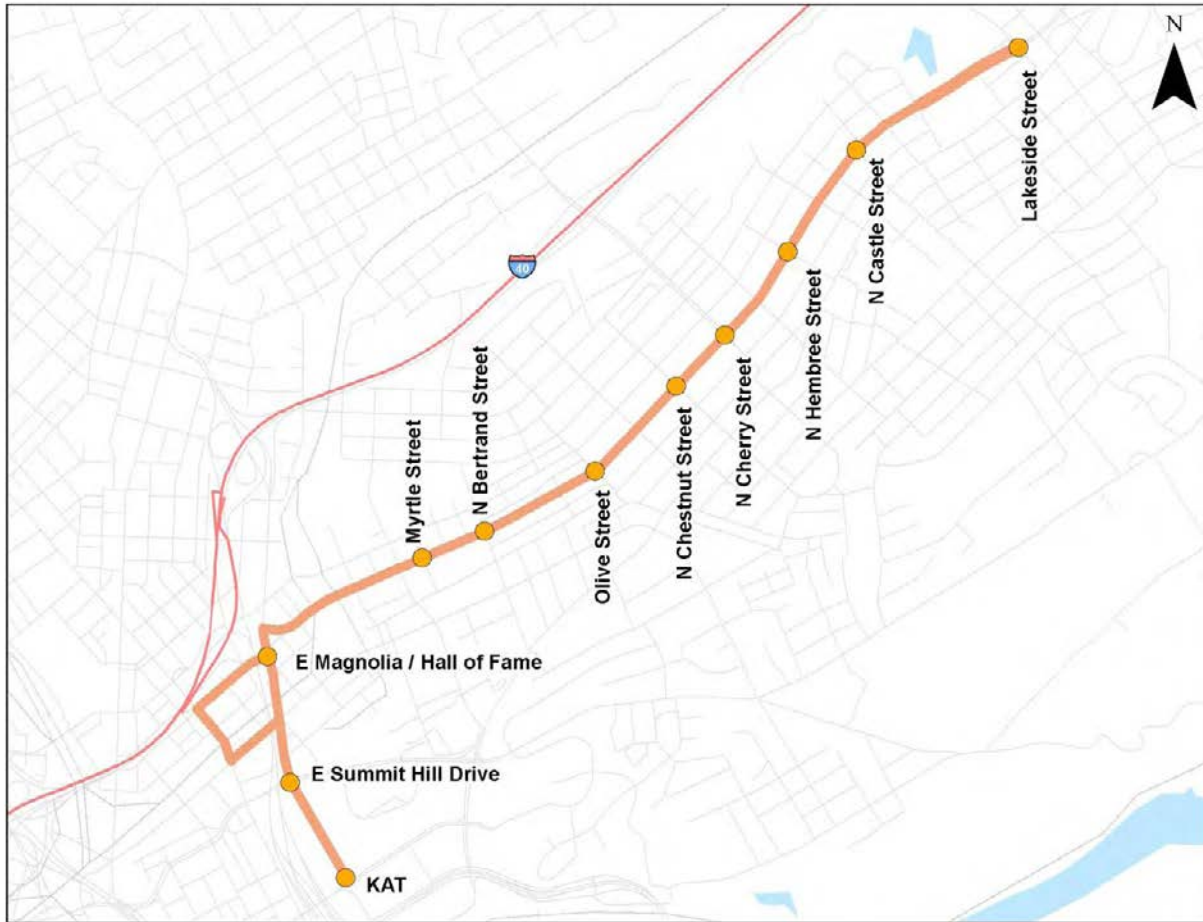
Transit Operations

This corridor would utilize in-street BRT operations in downtown Knoxville and along Mulvaney Street, operating in mixed-traffic. Median dedicated BRT operations would exist along Magnolia Avenue. At the existing signalized intersections, signal prioritization or signal preemptions would be implemented in order to improve the operation efficiency of the corridor. Due to the wide typical cross-section of Magnolia Avenue, BRT would operate in dedicated BRT lanes adjacent to two general purpose travel lanes in each direction in order to continue to provide access the various parcels along Magnolia Avenue.

Stations

During the analysis, the Team evaluated station locations, taking into account surrounding land use, roadway networks and existing KAT bus station locations. 10 station locations were identified along the corridor. **Figure 10.5** displays the potential station locations.

Figure 10.5 Magnolia Avenue Proposed Stations



Costs

Capital costs were developed under two scenarios (high/low) (see **Table 10.3**). The first scenario (high) was to assume that the portion along Magnolia Avenue would operate in dedicated BRT transit lanes within the median and require minimal to no right-of-way requirements, along with median station platforms, and no grade-separations at intersections. Along Hall of Fame Drive, the BRT system would operate along the curb lane and the curb lane would be upgraded through roadway sub grades, new curb and gutter, pavement marking upgrades for BRT use. Along the entire corridor, upgrades to the traffic signal operations (queue jumper lanes and signal pre-emption), and installing Intelligent Transportation Systems (ITS) are assumed; which would be key pieces in educating the public about the operations of the BRT system. The 10 stations would be constructed with enhanced features (pay-stations, ITS and variable message systems, and any typical amenities within a transit station), 2 park-n-ride lots along the corridor to provide commuters another option for accessing downtown Knoxville, and enhancing the pedestrian and bicycle access to the stations. The costs also assumed there would be the need for utility relocations along the corridor for stations, non-motorized improvements, and other potential

issues that may arise during further engineering analysis. A new maintenance facility, along with 8 BRT vehicles are included in the cost of the service to account for the need to train staff on the new types of vehicles, acquire new parts, and have a separate facility since the existing KAT maintenance facility is at over-capacity.

The other scenario (low) would only include constructing new curb and gutter along Magnolia Avenue and Hall of Fame Drive, pavement marking upgrades for BRT use, upgrades to the traffic signal operations (queue jumper lanes and signal pre-emption), and installing Intelligent Transportation Systems (ITS). Only half of the proposed stations would be constructed with enhanced features (pay-stations, ITS and variable message systems, and any typical amenities within a transit station), 1 park-n-ride lot, and enhancing the pedestrian and bicycle access to only the BRT stations. A new maintenance facility, along with 8 BRT vehicles are included in the cost of the service to account for the need to train staff on the new types of vehicles, acquire new parts, and have a separate facility since the existing KAT maintenance facility is at over-capacity, however, the facility would not be designed nor constructed to same specifications as under the high cost scenario.

Table 10.3 Magnolia Avenue Capital Cost Estimate

(2011 Dollars in Millions)

CAT No.	Description	<i>High Magnolia</i>	<i>Low Magnolia</i>
	Length (Mile):	3.60	3.60
	Number of Stations:	10	10
	Number of Revenue Vehicles:	8	8
10	GUIDEWAY & TRACK ELEMENTS	\$15.0	\$11.4
20	STATIONS, STOPS, TERMINALS, INTERMODAL	\$1.9	\$0.8
30	SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	\$7.3	\$3.6
40	SITWORK & SPECIAL CONDITIONS	\$10.8	\$8.4
50	SYSTEMS	\$5.3	\$5.3
Construction Subtotal (Sum Categories 10 - 50)		\$40.2	\$29.6
60	ROW, LAND, EXISTING IMPROVEMENTS	\$0.0	\$0.0
70	VEHICLES	\$29.9	\$29.9
80	PROFESSIONAL SERVICES	\$16.3	\$12.0
90	UNALLOCATED CONTINGENCY	\$25.9	\$21.4
	Art in Transit	\$0.4	\$0.3
Total Project Cost		\$112.7	\$93.2
	Cost per mile	31.32	25.89

Next Steps

In addition to these three corridors the study team proposes that a combined Cumberland/Kingston Pike and Magnolia Avenue corridor be further analyzed. These corridors have two distinctly different types of population densities, destinations, and land uses that when combined have the potential to generate a strong demand for a high quality comprehensive mass transit system.

General recommendations for immediate, short term and long term improvements are provided for all of the corridors that were screened through this process. These recommendations are broad enough so that they can be applied to various corridors with similar characteristics. In addition, portions of each corridor could be implemented in stages, thus still providing opportunities to improve connectivity and utilize federal grants. There is ability to implement portions of each corridor recommendations at the same time implement longer term

recommendations for each corridor. Immediate recommendations are quick fixes that can be easily implemented in within 1-2 years by maintenance crews. Short Term recommendations are improvements that should be briefly evaluated and implemented over the next 1-5 years. Long Term recommendations are substantial improvements that need to be thoroughly evaluated and implemented over the next 5-10 years. Below are the recommendations for the Knoxville Regional Transit Corridor Analysis study.

11.0 RECOMMENDATIONS

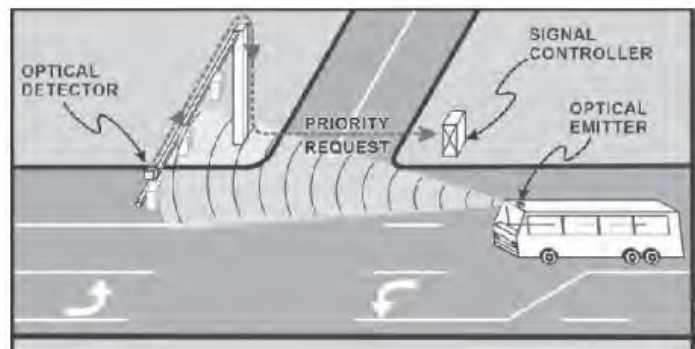
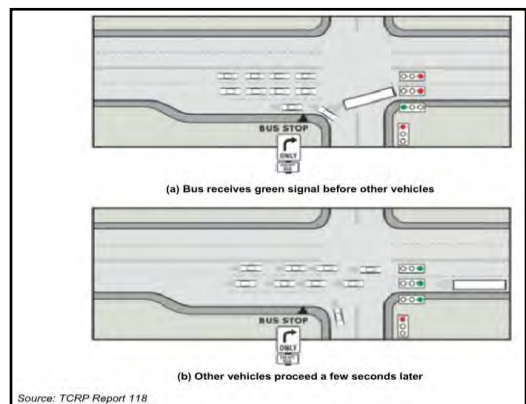
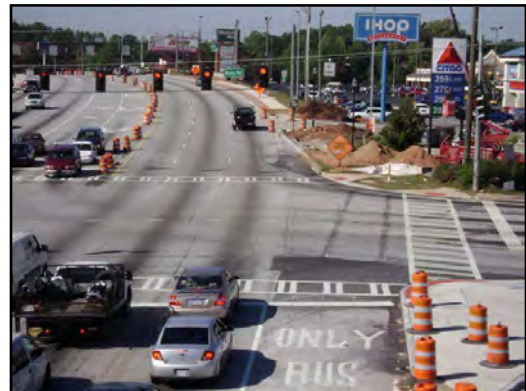
11.1 Immediate Recommendations

Recommended Corridors – advance all or as many of the recommended corridors into the newly adopted federal MAP-21 Systems Planning process.

Signal Timing – evaluate the current signal timing throughout each of the corridors or the entire KAT’s bus system to see if they can be optimized. Modifying the signal timing can add 10 – 20% more capacity along the roadway and also decrease the amount of travel time for existing buses.

Queue Jump Lanes – allow buses the ability to jump in front of automobiles queued at an intersection and cross that intersection before automobiles can proceed. Queue jumps lanes have proven to be an effective way to achieve time savings for buses operating along corridors which do not have the capacity for dedicated bus lanes. Queue jump lanes provide a certain level of time savings the bus would not otherwise receive.

Transit Signal Priority – gives an advantage to transit vehicles operating along a roadway. There are several variations to signal priority such as extending the green time, advancing the green time for buses. Signal priority can be used all day, during peak hours or at



some other defined time period. It can also be used at a single location, throughout an entire corridor, or timed after the bus schedule given priority to behind scheduled buses. Using signal priority improves travel times, increases patrons appeal to riding transit, keeps the buses on schedule, and decreases lost revenue.

Dedicated/Designated Bus Lanes – evaluate each of the corridors to see if a dedicated or designated bus lane would be appropriate. Dedicated on-street lanes would be for bus use only and are appropriate for corridors that have a medium to high volume of buses with a solid ridership base and a roadway level of service (LOS) of A through C. This could be as simple as striping the lane and putting up signs or as complex as making the lane a different color and adding a raised curb barrier. Designated bus lanes would be for intermixed bus and vehicle traffic appropriate for corridors that have a low to high volume of buses with a roadway LOS of A through D. These designated areas could be easily striped and signed. Other forms of designated bus lanes include high occupancy vehicles (HOV) lanes or high occupancy transit (HOT) lanes. Either scenario could restrict the use of the lane for peak periods only, or during off-peak periods.

Real Time Traveler Information – providing riders with the most up to date schedule information and next bus arrival times would help attract additional ridership. This can be achieved through various forms of communication including Tennessee’s 511 program, variable message signs, twitter alerts, email, etc. With the increasing use of smart phones, smart tablets and other media devices riders could access the most up-to-date arrival times without waiting for periods of time at stops. Providing passengers with real time information has proven to increase the acceptance of transit as a viable transportation option resulting in an increase in ridership.

Increase Frequency / Decrease Headways – evaluate, either through the ridership model or through an actual live test, increasing the frequency of bus service along the corridors. Some of KAT’s existing bus service has headways anywhere from an hour to half hour service. Decreasing the headways may net new riders, increasing the ridership along that corridor. Test runs with an appropriate amount of advertising would be more effective and would paint a true picture of ridership gains than trying to model the net gain in ridership.

11.2 Short Term Recommendations

Regional Transit Authority – will need to be formed in order to provide inter-county transit service, especially for transit investments along the Pellissippi Parkway and Alcoa Highway. In 2009 Tennessee Senate Bill 1471 was signed into law establishing the ability to form a regional

transit authority as way to stay competitive with other US regions. A regional transit authority will provide the opportunity to propose dedicated regional revenue sources that can be pulled from various funding sources. It also allows bonds to be issued by the authority so that they can act fast on travel demand and development opportunities.

Express Bus Service – through this study it was evident that express bus service be implemented along the Pellissippi Parkway and Alcoa Highway. These two corridors have pockets of growth that could support a limited stop bus service. Both of these corridors could benefit from designated bus lanes with transit oriented development around station areas. The mix of land uses around the station areas will help support the growth of transit and the implementation of transit overlay districts. The McGhee Tyson Airport would generate a good ridership base for both of these corridors. Other than taxi and car services there is no mass transit access to the airport.

An express service along Pellissippi Parkway would provide connections to/from the Maryville, McGhee Tyson Airport, Pellissippi State Technical Community College, Oak Ridge National Laboratories, Department of Energy Facilities and Oak Ridge.

An express service along Alcoa Highway would provide connections to/from the Alcoa, Maryville, McGhee Tyson Airport, University of Tennessee Medical Center, the University of Tennessee, and down town Knoxville.

Urban Circulator – investigate the need for a circulator route that connects destinations such as the Old Baptist Hospital, University of Tennessee and the University of Tennessee Medical Center to downtown Knoxville. This route could also help foster the Knoxville South Waterfront redevelopment project.

Corridor Investment – investigate the opportunity to implement a portion of the either of the three recommended corridor investments. Moving a portion of either the Cumberland/Kingston Pike, North Broadway, or Magnolia Avenue corridor through the New Starts process could provide a short term investment; such as moving the Magnolia Avenue corridor recommendations forward for a portion of the corridor would provide short term success in not only implementing a BRT system, but revitalizing the corridor.

11.3 Long Term Recommendations

Transit Alliance / Transit Citizen Leadership Academy – the formation of transit alliance or citizen leadership group helps educate the greater masses about the benefits of mass transit. It also serves as tool for solving transit related issues such as missing links and other service needs. Education is a key component for gaining momentum and public support for implementing new transit services and substantial transit improvements. Educational programs help people of all ages understand how public transit works and why it is important at a local, regional and state level. The American Public Transportation Association (APTA) could be a good tool for starting an education program. They current conduct a national “Public Transportation: Takes Us There” education and outreach campaign that could be used as a starting point for forming the leadership academy.

Transit Overlay Districts - should be applied to all of the corridors to enhance the need for transit and encourage transit supportive land uses. These districts help “focus” sustainable growth in areas that could benefit from transit and transit type enhancements such as mixed use developments and pedestrian/bicycle friendly neighborhoods. It is important to note that transit overlay districts can only be implemented in corridors that include a sustainable mass transit system.

Federal Funding – apply to the FTA for Very Small Starts, Small Starts or New Starts funding to evaluate the recommended corridors. Funding for the top most viable corridors should be sought to advance these corridors through the newly adopted MAP-21 process. In addition some of the immediate recommendation improvements should be advanced through the Very Small Starts or Small Starts programs. The New Starts program has been streamlined through the MAP-21 program. Improvements include the efficiency of administering grant programs by consolidating several programs such as the Rural Area Formula Grant and creating new programs such as the Transit-Oriented Development Planning Pilot. Both of these programs are just two examples of funding sources that could be used to implement some of the short term recommendations.

11.4 Transit Oriented Development (TOD) Toolkit

The TOD Toolkit serves the purpose of educating and informing local citizens and policymakers on the importance of expanding transit opportunities in their communities. The Toolkit covers best practices nationwide, highlighting those most applicable to the specific attributes of Knoxville, to provide a context for public discussions going forward. Looking ahead, the Toolkit will support development of transit supportive land use policies and list tools to support TOD and corridor development in Knoxville.

The Toolkit describes the prevalent modes of transit in use across the United States, as well as the characteristics and metrics of station locations in urban core and urban periphery contexts. Two types of TOD result from these characteristics to form either nodal or linear types of development. The Toolkit clearly defines Transit Oriented Development and illuminates the added value to communities and cities that potentially result from successful implementation. Key points regarding station area development are addressed in the Toolkit, including public /private partnerships models of development and the flexibility of the TOD model in avoiding a one-size-fits all solution.

The Toolkit goes on to describe the main reasons why cities and communities would adopt TOD through the use of case studies across the United States and data from many sources. The reasons supporting TOD include increased mobility, positive land use outcomes, environmental benefits, value creation and economic development, and the possibility of good place-making and design. The Toolkit briefly describes strategies for implementation drawn from best practices in the United States and identifies prevalent funding models for transit from recent examples.



Transit oriented development (TOD) is typically defined as more compact development within easy walking distance of transit stations (typically a half mile) that contains a mix of uses such as housing, jobs, shops, restaurants and entertainment.

WHAT IS TOD?



TOD SHOULD:

- Encourage people to walk, bike, *AND* take transit
- Increase transit ridership
- Provide a rich mix of land uses
- Increase land values for public and private sectors
- Create a sense of place and community

A component of the Toolkit is a poster (see Figure 11.1) that illustrates how TOD optimizes land uses, offers economic benefit, provides environmental benefits, and increases housing affordability. The poster also provides a visual of the potential recommendations and how the improvements would look along certain portions of the corridor. The poster provides different land use and density opportunities at specific locations along Magnolia Avenue and Cumberland/Kingston Pike corridors to allow readers the ability to understand how TOD and densities affect development.

Figure 11.1 TOD Toolkit Poster



11.5 Next Steps / Implementation

Initial steps: Refined corridor selection and review, existing plans assessment and community outreach

The initial steps toward implementation of transit corridors for Knoxville include corridor verification by transportation experts in coordination with public transportation agencies. Further analysis of corridor alignments, right of way capacity, potential ridership, and sources of funding among many other variables would be considered for corridors identified in the Tier II analysis. In anticipation of launching a larger community outreach effort, existing plans in and around the corridors should be assessed. These plans – many of which are highlighted in the TOD Toolkit presentation – provide valuable information on existing and proposed land uses, community goals, and potential design responses. The wealth of information found in such planning efforts however dated should be regarded as a valuable resource. A community outreach effort should commence for each of the selected corridor(s) as well. This could include live events such as meetings, informational sessions, and workshops as well as the launching of digital resources such as project, interactive, and data gathering web-sites. Informational materials such as the TOD Toolkit can be used across all of these platforms as a way of introducing TOD ideas, process, and benefits.

Identification of development opportunities and planning thresholds review

Potential transit corridors should be evaluated for development opportunities on parcels that support broad land use and planning goals as identified in the public engagement process. Many variables should be taken into consideration including parcel size, existing building conditions, proximity to open space networks, existing public transit connections, and transit compatible land uses and densities. A qualitative analysis can be undertaken for the designated corridors which identify neighborhood centers, historic districts, and well-known amenities and destinations as well as assets within particular areas that may be only known to local communities. This survey and exploration of existing conditions along the corridors, together with dimensional characteristics for differing transit modes, will help to establish recommendations for station locations and related development opportunities.

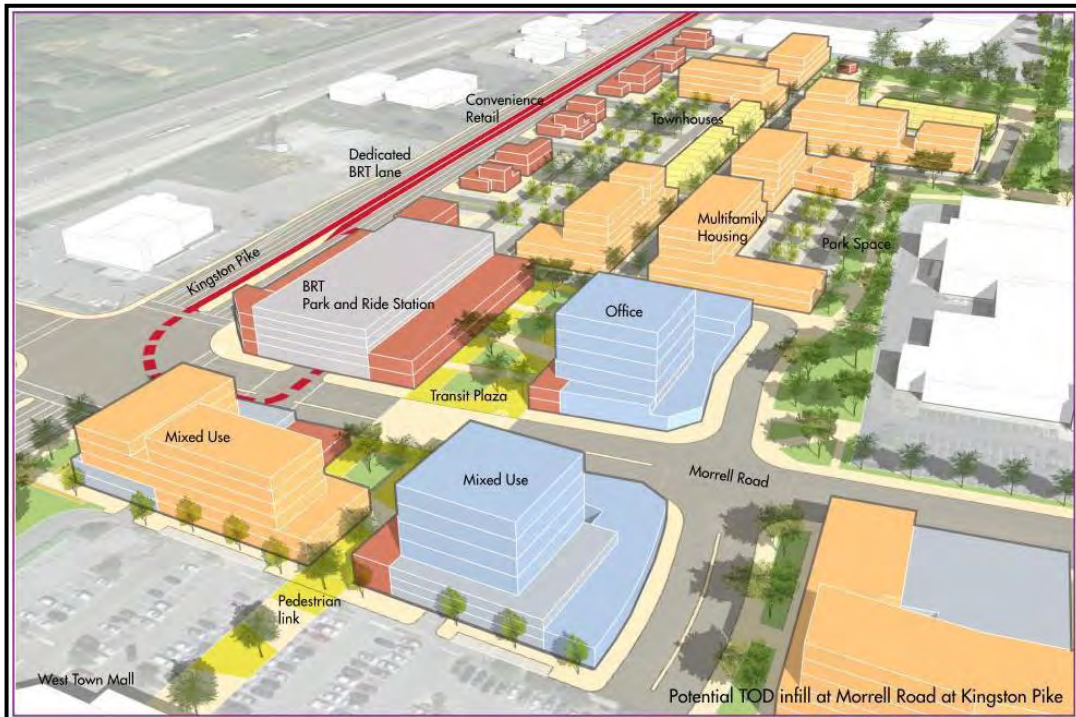
Transit oriented development works best when opportunities for both residential and commercial uses exist at proposed station redevelopment areas, as seen in Figure 11-2 depicting potential development opportunities near the proposed Magnolia Avenue Corridor (Pellissippi Community College Station) and Figure 11-3 of the proposed Cumberland/Kingston Pike (West Town Mall Station). The spatial mismatch between jobs and residents, typical of most cities across the United States, is present in Knoxville. Increased transit ridership and properly design transit

oriented development nodes can go a long way to bridging this gap by delivering more people to employment centers and by co-locating people and jobs.

Figure 11.2 Pellissippi Community College Station Development Opportunities



Figure 11.3 West Town Mall Station Development Opportunities



Transit corridors typically connect more dense urban cores to less dense areas well outside of city centers that are often more exclusively residential and typically car-oriented. This transition from urban to suburban and even rural is often referred to as a - transect – in which distinct thresholds or zones can be characterized by differing densities, land use mixes, and transportation options. Planning along transit corridors should align with identified thresholds and zones - such as downtown, established neighborhoods, newer neighborhoods, commercial corridors, and undeveloped outskirts. Density thresholds and land use options should be identified for each zone to help guide decisions regarding new development along transit corridors.



Zoning recommendations and design guidelines

Within specific transit corridors and at proposed station development areas, existing zoning must often be changed so as to allow for transit oriented development. Parcels zoned as single use commercial, residential, or industrial often need to be changed to mixed-use categories or sometimes combined so as to make more integrated developments possible. Traditional zoning which typically specifies single use categories and a hierarchy of land uses, often precludes transit oriented development and needs to be amended or overridden by such zoning measures such as special district zoning, corridor overlay zoning, planned unit development zoning and/or form based zoning. Traditional zoning can produce a patchwork of single-use districts unrelated to one another, and with no regard for street hierarchy, massing or urban design considerations. Special district zoning can be applied to a transit station area to set standards for a mix of uses, and higher densities and can even incorporate design guidelines so as to produce a distinct “district” that achieves the goals of transit oriented design. Corridor overlay zoning, ideally suited to transit corridors, can align with density and land use thresholds identified above, for an entire corridor and adjacent land uses. Such a technique maintains existing zoning and “overlays” additional requirements or provisions for land uses not previously allowable. Corridor zoning can also identify special districts within the designated corridors with additional zoning provisions to again help facilitate transit oriented design. Planned unit zoning allows for a

broader more comprehensive zoning structure that encompasses a large planning area and allows for a mix of compatible land uses, options to parcel land, and an overall design as planned by a singular developer. Planned unit development typically delivers a “master planned” project with a high degree of design and development specificity.

Form based zoning has recently gained in popularity across the United States as it enables aspects of urban design and good city building to take precedence over the more technical and segregating tendencies of traditional zoning. Form based zoning designates the desired build-to envelopes for individual parcels while allowing a wide variety of land uses rather than merely specifying lot coverage and singular land uses. This provides less prescriptive land use control and more prescriptive physical form requirements – helping to forward urban design goals and better dimensional designation for the public realm. Form based zoning puts greater emphasis on the physical form of the city rather than land use, and typically provides a clear visualization of allowable development. Overall, a variety of techniques are available in reconsidering existing zoning for transit corridors. Together they can greatly increase the success of new land planning while also attracting investment for existing communities.

Specific design guidelines can be incorporated into zoning ordinances to provide further specificity for individual parcels, corridors, or transit oriented districts. Ideally design guidelines can help to ensure a high-quality built environment while also allowing substantial leeway for investors in meeting those guidelines. In terms of built form, design guidelines can specify density, active ground floor uses, minimum and maximum lot coverage, streetwall adherence, and even the visibility of surface or structured parking. Such guidelines can specify build-to heights, setbacks, and in some case recommend fenestration, materials, and façade articulation requirements. Guidelines for the public realm can designate bikelane provisions and, sidewalk characteristics – width, planting, furniture and materials – while also ensuring that connections to existing parks, trails, and open space networks are maintained by future developers. Developed in concert with public input and review, design guidelines can help to ensure that community goals are met while also streamlining the public approvals process. They can be beneficial to both neighborhoods and developers as a way of illuminating unknowns in the design and building of new transit oriented developments.

Appendix A: Corridor Figures

Appendix B: Corridor Analysis Presentation

Appendix C: TOD Toolbox Poster

Appendix D: TOD Toolbox Presentation