NORTHEAST ST. BETHLEHEM TRANSPORTATION STUDY

City of Clarksville, Montgomery County, TN

Prepared For:
City of Clarksville
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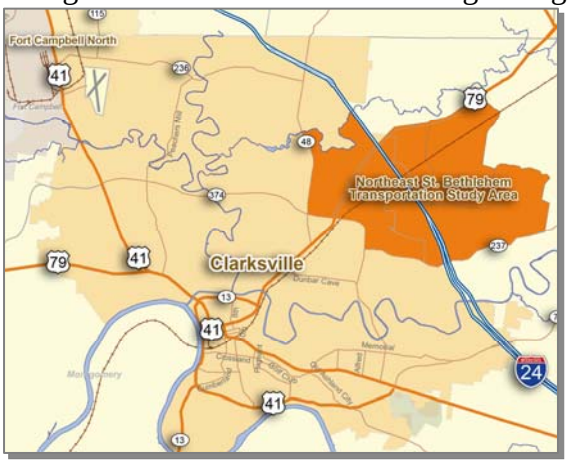
EXECUTIVE SUMMARY

The Northeast St. Bethlehem area, like much of Clarksville's urbanized area, is undergoing significant growth. The Gateway Medical Center is under construction and the infrastructure for the Clarksville/Montgomery County Corporate Park has been completed. The Study Area's central location, proximity to the interstate, availability of developable land and availability of infrastructure make the area attractive to residential and commercial developers. As a result, the City has been faced with a growing number of rezoning requests, and this trend is expected to continue through 2030, the horizon year of this study.

A significant element in addressing this growth is an update of Clarksville Urbanized Area Metropolitan Planning Organization's (CUAMPO) 2002 Travel Demand Model (TDM). Given the underlying principles for completing this St. Bethlehem area transportation study, in the absence of an update to the TDM, the City of Clarksville and Montgomery County would not be able to as effectively forecast its infrastructure needs, plan for a more efficient transportation network, and identify potential new or expanded transportation corridors in order to preserve future right-of-way, as may be needed.



Accordingly, this report summarizes the results of the *Northeast St. Bethlehem Transportation Study*, which focused on the first of two general phases of work:

Phase 1: Develop a Preferred Transportation Network Alternative

- Achieving uniformity and/or prioritization of land use and access management principles applied to the Study Area.
- Travel Demand Forecasting and Modeling;
- Transportation Network Analysis; and

Phase 2: Interchange Justification Report

- Preparing a formal Interstate Access Request if warranted, in the I-24 corridor to be approved by the Tennessee Department of Transportation (TDOT) and the Federal Highway Administration (FHWA).

The study's work plan assumed that any work on Phase 2 would be totally dependent on the outcome of the Phase 1 work. That is, advancing the study effort to include a formal interchange justification study in the Northeast St. Bethlehem Study Area would be directly dependent on the travel demand modeling performed under the study, should travel demand indicate a requirement for a new interstate crossing or limited access to the interstate system.

Growth Factors

At the beginning of the study, the CUAMPO TDM's base year was 2002 and the future year planning horizon was 2030. Under this study, a new base year (2005) was modeled and the 2030 future year remained the same. For the new base year, the socio-economic database and growth forecasts for the refined-area model was updated in order to be valid for the year 2005. It was also updated for the year 2030 to reflect recent development activity and current development trends in the Study Area. Because detailed socioeconomic data updates for the entire County were not conducted, the previous countywide growth control totals were maintained outside the Study Area.

Forecast data for the Study Area includes the following (these and other growth considerations are presented in more detail in Section 3 of this report):

Housing

- 2,548 housing units in year 2005 based on new housing permits → 934 new housing units over the past five years equaling a 58% increase over the past five years;
- 3,982 housing units in year 2030 in the original TDM (year 2002); and
- 6,581 housing units in year 2030 based on preliminary subdivision lots → *a 65% increase over the original Travel Model forecast*.

It should be noted that the housing unit forecast for 2030 does not represent build-out of the Study Area. While most of the Study Area west of I-24 will be fully developed by 2030, less than half of the Study Area east of I-24 is assumed to be built-out in the year 2030.

Employment

- 15,583 jobs in year 2005 based on development activity and aerial photography interpretation;
- 18,749 jobs in year 2030 in the original TDM (year 2002); and
- 26,611 jobs in year 2030 based on development activity (such as the new Gateway Medical Center) and vacant land currently zoned for industrial and commercial development → *a 42% increase over the original TDM forecast.*

The employment forecast for 2030 reflects only present commercial and industrial zoning and does not represent build-out of the Study Area. Because future rezoning to commercial and industrial purposes are not considered, these forecasts are reflective of real development trends since year 2000 and are not based on speculation.

Analysis Methodology

As previously stated, two planning years were modeled for this project: 2005 (a new base year) and 2030 (the study horizon year). A series of TDM runs were conducted to identify future travel volumes, patterns and resulting capacity deficiencies of both the existing network (2005 base year) and the anticipated 2030 conditions.

The study horizon year (2030) was further segregated into E+C (Existing + Committed projects, per the CUAMPO long range and growth plans) in addition to a future "build" scenario that incorporated the E+C projects, as well as other network improvements identified as viable candidates under this study.

As described in more detail in the Appendix A of this report, the forecast travel demand and trip distribution was analyzed within the study modeling areas. Specific groupings of roadway improvements were created so that potential alternatives for relieving congestion could be evaluated. These "scenarios" were modeled, providing a comparative assessment of general transportation needs in the area.

Based on the results of these TDM runs, a balanced and realistic set of recommended improvements was developed for the 2030 Study Area transportation network, including proposed improvements to the bicycle and pedestrian network. To complete the recommendations and ensure proper integration of the multimodal elements presented with this study's findings, proposed typical roadway sections by proposed functional classifications were developed. These are incorporated into this report in Appendix B and discussed in more detail in Section 5.

When examining the TDM results outside the Study Area, it is important to note that these figures are estimates. To accurately draw conclusions outside the Study Area, the full TDM will need to be updated and that was not in the scope of work for this study.

Summary Recommendations

As described in more detail in Section 4 of this report, recommendations for a preferred transportation network were developed under three primary categories:

1. 2030 Recommended Roadway Improvements

   (Transportation network segments recommended that accommodate forecast network general capacity demand.)

2. Recommended Operational Improvements

   (Ancillary improvements for roadway segments and intersection improvements not included in the general 2030 capacity improvements, e.g., various spot improvements recommended in the network for roadway shoulder, railroad grade crossing, sidewalk and other similar improvements.)

3. Recommended Multi-Modal Improvements

   (Various recommended bicycle, pedestrian and transit improvements.)

Estimated opinions of probable construction costs were developed for recommended improvements under each of these categories. Detailed costs and assumed priorities are provided in Section 4. Summary costs by category are provided in the following Table ES-1. The estimated cost distribution by jurisdiction is summarized in Table ES-2.

Table ES-1: Program-Level Costs by Improvement Category
(Recommended Area Improvements)

CATEGORY	COST (x1000)
2030 Recommended Roadway Improvements	$ 196,374
Recommended Operational Improvements	$ 6,583
Recommended Multimodal Improvements	$ 11,081
TOTAL	**$ 214,038**

Table ES-2: Program-Level Costs by Jurisdiction
(Recommended Area Improvements)

CATEGORY	COST (x1000)
Federal/State	$ 135,047
Montgomery County	$ 15,049
City of Clarksville [1]	$ 63,942
TOTAL	**$ 214,038**

Note:
1 Includes major structure costs for Dunlop lane crossing of I-24 and Jack Miller Thoroughfare

Section 7 of this report contains detailed tabulations of costs for recommended improvements.

It was determined as part of this study that a new interchange at I-24 and Dunlop Lane is not justified based on traffic projections through the 2030 horizon year.

Recommended Program Milestones and Improvements Sequencing

The following summarizes the general sequence of recommended program-level milestones and sequencing of improvement recommendations contained in this report.

The results of this study underscore the continued need for the City of Clarksville, Montgomery County, TDOT, and the FHWA to work in concert to further plan, design and implement an effective and efficient transportation network for the Study Area. Additionally, as this study concluded, the transportation issues when considering the entirety of Montgomery County cannot be undervalued with respect to the impact of improvements in the I-24 corridor and major arteries connecting the primary transportation and development corridors.

Table ES-3: Sequencing Priorities

Recommendation	Remarks
Detailed Update of County TDM Data	Under this study, detailed socioeconomic data updates for the County (outside of the Study Area) were presented as an option, but not implemented. Therefore, the growth forecasts for the Study Area were updated while maintaining the previous countywide growth control totals. Given the recent trends in explosive growth outside the immediate Study Area, a detailed update of the entire county model is recommended.
Long-Range Plan Update	The Regional Planning Commission (RPC) and he CUAMPO should maintain their present course to update their LRTP, incorporating the finding of this study and development trends that have developed since this Northeast St. Bethlehem Area Study was commissioned. The detailed update of the County TDM data, as noted above, is recommended to be included in that LRTP update. This study confirmed the need for the projects found in the current Transportation Improvement Program.
Initiate project development activities for Interchange Modification Studies (IMODs) in the I-24 Corridor.	Studies at I-24 and the following interchanges are recommended (in decreasing order of importance): • I-24 @ Wilma Rudolph/Guthrie Hwy • I-24 @ Rossview Road • I-24 @ Trenton Road Note: Depending on results of detailed County socioeconomic data update and continuing development patterns and timing of these studies, the Wilma Rudolph/Guthrie Hwy and Rossview Road interchanges may need to be studied in combination. Incorporate Priority 2 approach segments of Wilma Rudolph/Guthrie Hwy, Rossview and Trenton Roads as described in this report into the study requirements.
Advance project development for Phase 1 of Dunlop Lane Improvements	Improve roadway to Arterial Boulevard section from Ted Crozier Blvd. to International Blvd.
Advance project development for Jack Miller Blvd	Advance detailed project planning and design for Phase 1 (Wilma Rudolph Blvd. to Needmore Road)
Complete planning, design and implementation of Professional Park Drive	Dunlop Lane to Cardinal Lane
Advance project development for Dunlop Lane extension	International Blvd to Rossview Road

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 Study Purpose

Planned improvements and approved development in the Northeast St. Bethlehem area are expected to increase traffic demand on the area's existing transportation network, thereby resulting in capacity and safety deficiencies.

This report documents the results of the *Northeast St. Bethlehem Transportation Study*, which focused on the first of two general phases of work:

Phase 1: Develop a Preferred Transportation Network for the Northeast St. Bethlehem Area

- Travel Demand Forecasting and Modeling;
- Transportation Network Analysis; and
- Achieving uniformity and/or prioritization of land use and access management principles applied to the Study Area.

Phase 2: If Warranted, Prepare an Interchange Justification Study

- Preparing a formal Interchange Justification Study (IJS), if warranted, in the I-24 corridor, to be approved by the Tennessee Department of Transportation (TDOT) and the Federal Highway Administration (FHWA).

Figure 1: General Location Map

1.2 Definition of Study Area

The St. Bethlehem area of Clarksville is located in northeast Clarksville along Interstate 24 (I-24). The project location is shown in Figure 1. The Study Area, which is approximately 40 square miles, is comprised of the traffic analysis zones (TAZs) shown in Figure 2.

For this study, the TAZs were disaggregated into smaller zones to ensure better traffic loading onto the surrounding roadway system. This included more roadway network in the Study Area than the Clarksville Urbanized Area Metropolitan Planning Organization's (CUAMPO) original model.

1.3 Methodology

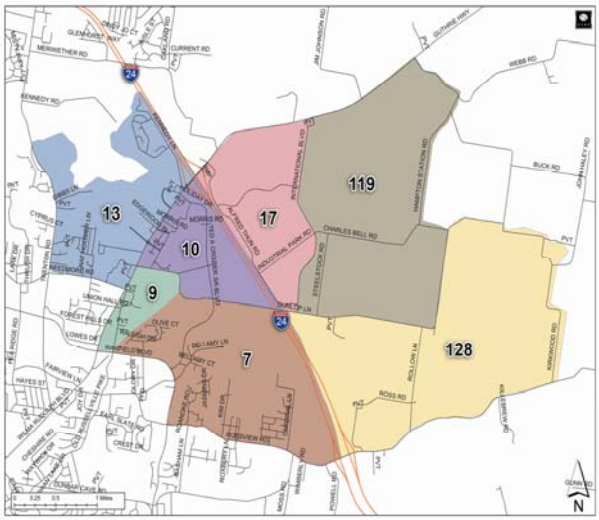
The CUAMPO's Montgomery County Travel Demand Model (TDM) was used to determine the future transportation network needs of the Study Area by forecasting future traffic flows in the Study Area.

A refined-area TDM was created for this study. In a refined model, the Study Area is given greater detail in the model, while the area outside the Study Area remains the same. The transportation network modeled in the Study Area was expanded, and the

TAZs in the Study Area were disaggregated to better load traffic on the more extensive roadway network, to place more trips on the roadway network that previously remained internal to the larger TAZs, and to create more origins and destinations within the Study Area.

While the travel model was refined for the Study Area, the base year of the entire TDM moved from year 2002 to 2005. The traffic assignment performance of the TDM with additional network and TAZs was compared to year 2002 traffic counts throughout Montgomery County to revalidate the TDM, and the traffic assignment performance of the TDM in year 2005 was compared to year 2005 traffic counts. In addition, recent development activity and growth trends were used to update the growth forecasts for the Study Area for the year 2030, while maintaining the previous countywide growth control totals.

Figure 2: Study Area Location Map



The refined model was then run a number of times to:

- determine general transportation needs in the area;
- identify areas with insufficient vehicular capacity;
- identify potential alternatives for relieving congestion; and
- determine the results of the final roadway improvement recommendations.

When examining the TDM results outside the Study Area, it is important to note that these figures are estimates. To accurately draw conclusions outside the Study Area, the full TDM will need to be updated, and that was not in the scope of work for this study.

The study methodology is discussed in greater detail in Appendix A of this report.

2.0 EXISTING CONDITIONS

2.1 Regional Context

Clarksville and Montgomery County are located in Middle Tennessee, directly off of I-24, approximately 40 miles northwest of Nashville. With a population of more than 107,000 (U.S. Census 2005 population estimate), Clarksville is the fifth largest city in Tennessee, and it is the third fastest growing city in Tennessee. Clarksville is home to Fort Campbell Army Post in northwest Clarksville on the Tennessee-Kentucky border and Austin Peay State University, which is adjacent to the Central Business District (CBD). These institutions, along with interstate access, are key factors in Clarksville's growth.

2.2 Study Area Treatment in Local Planning Documents

2.2.1 Planning Areas

The Study Area falls within two Clarksville-Montgomery County Regional Planning Commission planning areas: the *Rossview Planning Area* and the *Trenton Planning Area*. Both planning areas have experienced significant growth in the past decade, and the pace of development is expected to continue given the area's central location, proximity to the interstate, availability of developable land and availability of infrastructure. Population projections in the *Clarksville/Montgomery County Land Use Study Update* indicate this area will continue to be one of the fastest growing sectors in Montgomery County over the next two decades.

2.2.2 Urban Growth Boundary & Planned Growth Areas

In 2000, the Clarksville-Montgomery County Regional Planning Commission (CMCRPC) prepared the *Clarksville-Montgomery County Growth Plan*. The *Growth Plan*, which has a twenty-year time frame, contains three main elements:

- Urban Growth Boundary (UGB),
- Planned Growth Areas (PGAs), and
- Rural Areas (RAs).

As illustrated in Figure 3, the western portion of the Study Area falls within the current city limits and the UGB. In the UGB, full services are either available or have the potential to be available over the twenty-year planning period.

The eastern portion of the Study Area falls outside the present city limits and the UGB, but within PGA #4. According to the *Growth Plan*, PGAs "have a history of low to moderate levels of residential development or are in the path of projected growth trends in the County." This is an appropriate characterization of the St. Bethlehem area because, as development pressures increase in Clarksville, many of the large undeveloped parcels are being rezoned to single-family residential to absorb the growth. Because PGA #4 contains the Clarksville-Montgomery County Industrial Park, it is the only PGA that has access to City

utilities in sufficient quantity to sustain moderate levels of development density. According to the *Growth Plan*, PGA #4 was not included in the UGB because, when the *Growth Plan* was created in 2000, it was unlikely the area would be annexed into the City during the plan's twenty-year planning period.

2.3 Land Use

2.3.1 Current Land Use

Figure 4 illustrates current land uses in the Study Area. As this graphic illustrates, the St. Bethlehem area is one of the most diversified areas of the county in terms of land use. The majority of the Study Area east of I-24 remains rural, and it contains some of the best remaining agricultural land in the area.

The majority of the residential land uses in the Study Area are single-family homes found west of I-24, south of Dunlop Lane and north of Wilma Rudolph Boulevard. There is a small portion of multi-family housing along the Wilma Rudolph Boulevard corridor, but the bulk of existing housing is medium to low density and suburban in character.

The area is also home to the majority of the County's large-scale industrial employers. These sites are concentrated in and around the Clarksville-Montgomery County Industrial Park and along the Wilma Rudolph Boulevard corridor.

Finally, the majority of the Study Area's commercial base is located on Wilma Rudolph Boulevard. The development along Wilma Rudolph Boulevard is characterized by auto-oriented retail and service-based uses. This area, including the Governor's Square Mall, has become a regional attractor due to its large number of restaurants and retail stores. Wilma Rudolph Boulevard contains land uses that are major traffic generators for the Study Area.

2.3.2 Future Land Use

While much of the land in the Clarksville-Montgomery County Industrial Park is currently vacant (see Figure 4), the City's provision of infrastructure in the Clarksville-Montgomery County Industrial Park shows the community's commitment to encouraging future industrial development in the area. There are several large parcels (ranging from 20 acres to 1,000 acres) that are available for development. Should one of these larger sites be secured, the impacts to the Study Area's transportation network would be dramatic.

Figure 3: Clarksville-Montgomery County Growth Plan Map (2000)

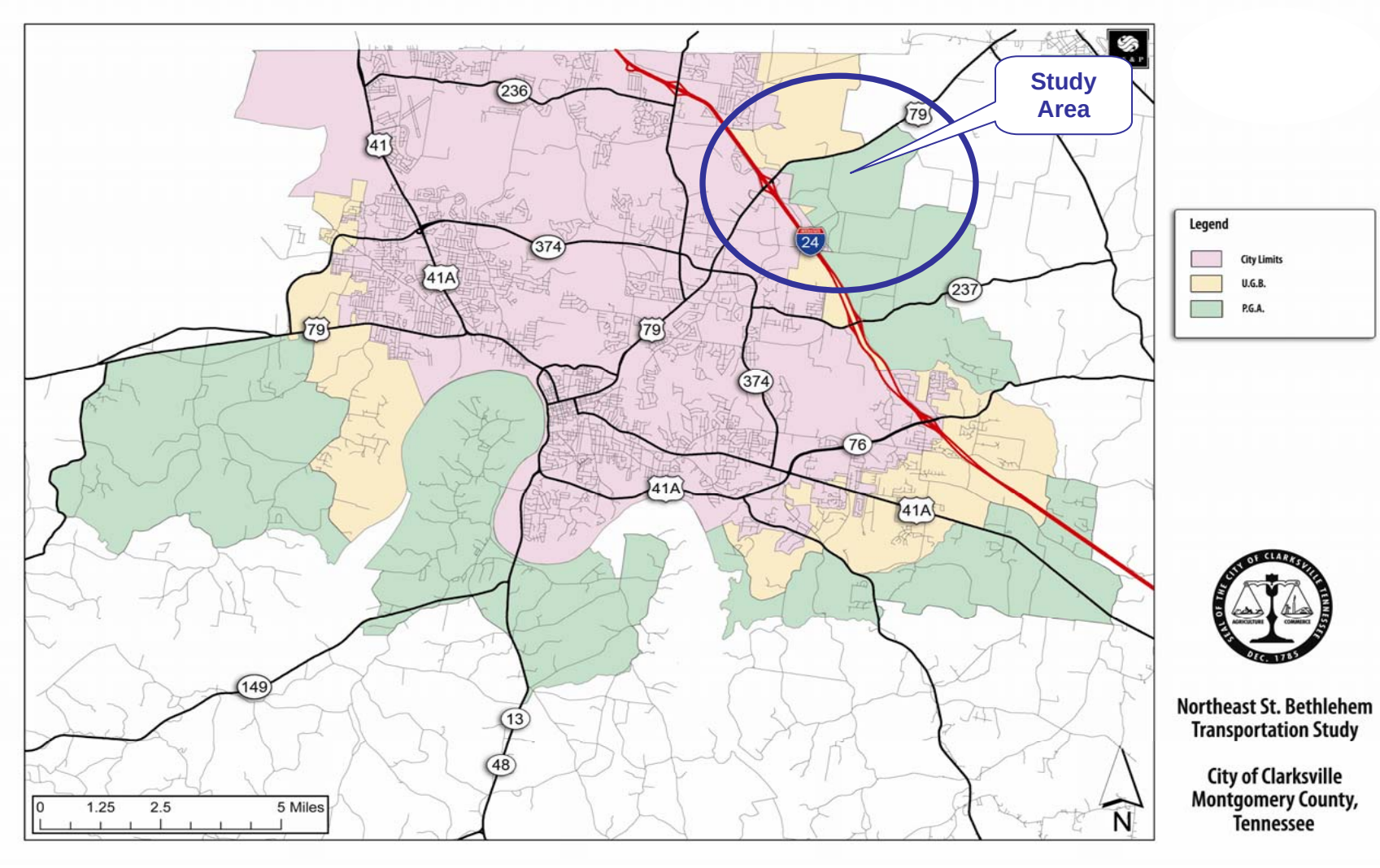
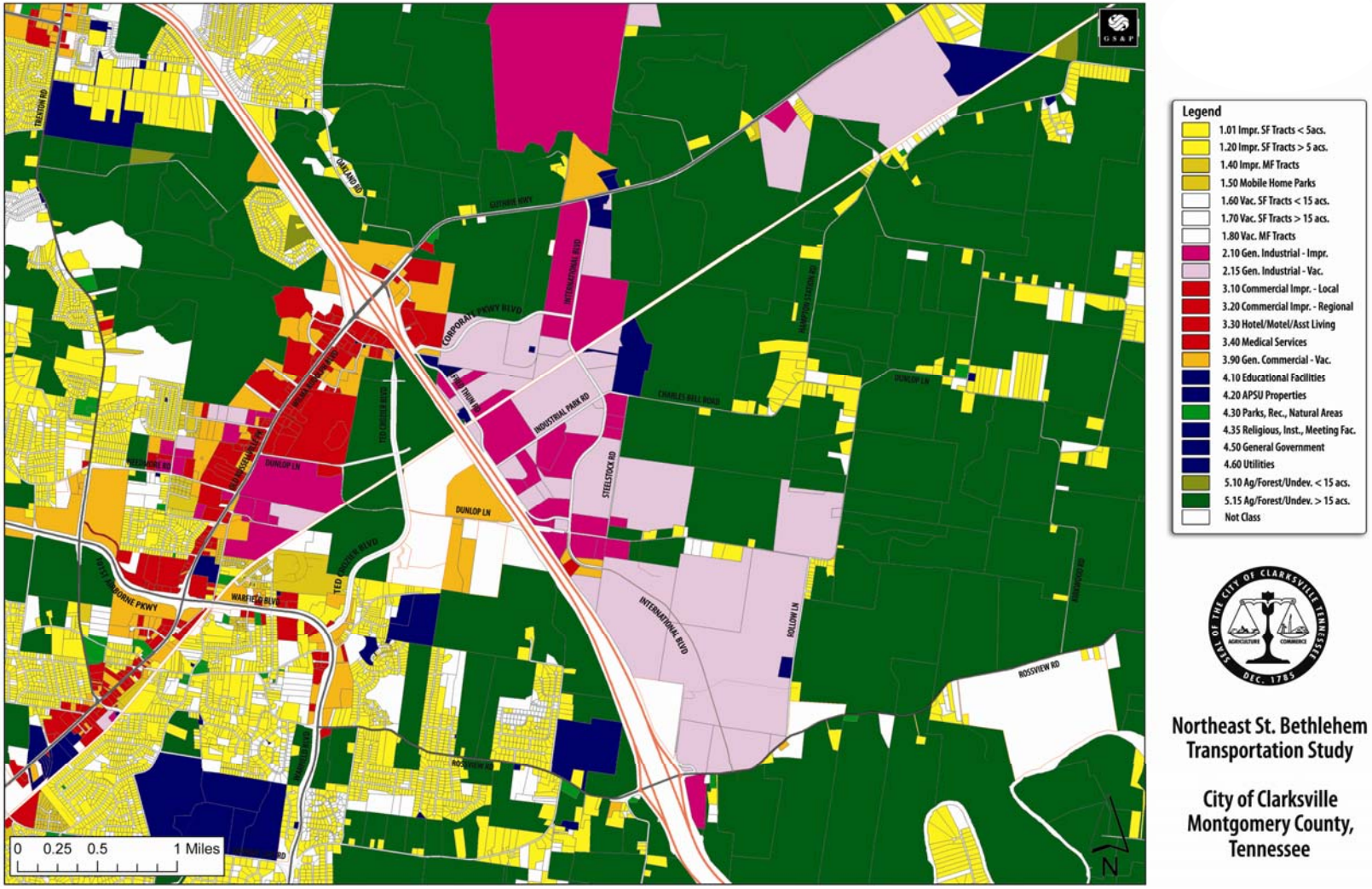


Figure 4: Study Area Land Use Map



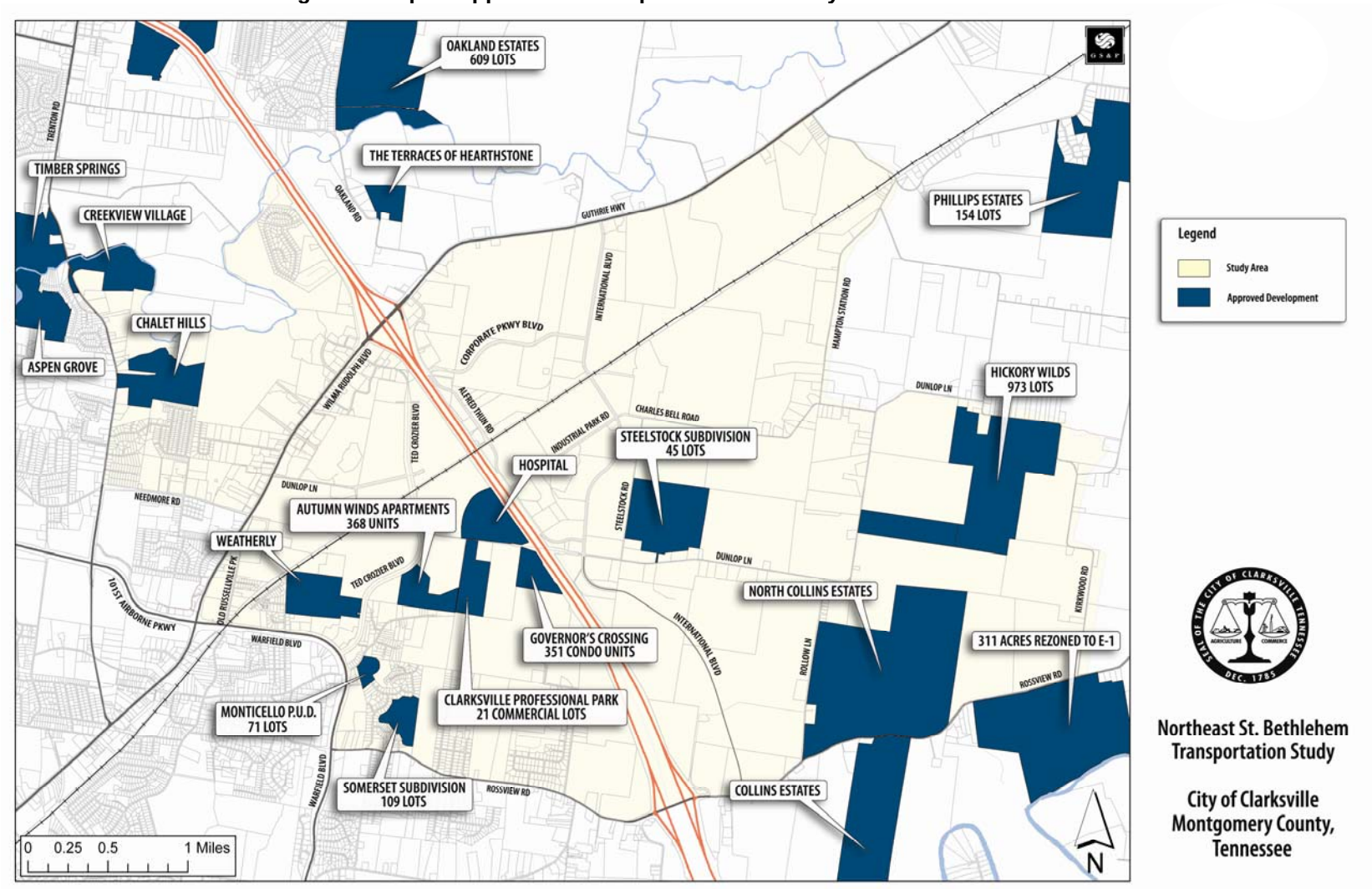
Much of the farmland east of I-24 is facing significant development pressure. Although it is currently zoned Agricultural, several large parcels have recently been rezoned for the development of large residential subdivisions. Figure 5 provides a snapshot of the large number of subdivisions and commercial developments that are approved for development in the Study Area.

The growth in St. Bethlehem is not limited to residential growth. More commercial and institutional land uses are expected in the future. The Gateway Medical Center, which is currently under construction on Dunlop Lane, will have significant effects on the area's transportation network. The hospital, which contains 12,000 square feet of office space and 270 beds, will generate a substantial amount of traffic. The construction of a new hospital has already encouraged the development of office space around the hospital. This trend will likely continue and spread to development along Ted Crozier Boulevard.

The growth forecasting and travel demand forecasting used over the course of this study, which are described in the TDM Report in Appendix A, are based, in part, on zoning and land use. Future land use is a key issue when it comes to the accuracy of TDM forecasting. In the case of residential land use, the study's TDM forecast reflects both approved developments and current residential subdivision zoning. In the case of industrial and commercial land uses, the study's 2030 forecast reflects the current zoning rather than full build-out of the Study Area. If rezonings in response to proposed developments continue to occur, there will be more housing units in the Study Area than the 2030 TDM forecasts.

Policy recommendations are addressed in greater detail in Section 6.1, but Clarksville's land use plan (and corresponding zoning ordinance) should be updated to reflect the community's goals and objectives as those objectives evolve. Land use and transportation decisions can then be made in accordance with those plans.

Figure 5: Map of Approved Development in the Study Area



3.0 TRAVEL DEMAND MODEL

The following sections provide an overview of the TDM process. The full TDM Report can be found in Appendix A.

3.1 Refined-Area Model Development

The transportation network and TAZ structure within the Study Area were not sufficiently represented in the Montgomery County model to produce satisfactory data for this project. Thus, a refined-area travel model was created for this study.

As previously stated, in a refined model, the Study Area is given greater detail in the model, while the area outside the Study Area remains the same. The transportation network in the Study Area was expanded and the TAZs in the Study Area were disaggregated to create more origins and destinations.

The CUAMPO Model's base year was 2002, and the ultimate future year was 2030. Two years were modeled for this project: 2005 (a new base year) and 2030 (the future year remained the same). The socioeconomic database for the refined-area model was updated in order to be valid for the year 2005. It was also updated for the year 2030 to reflect recent development activity and current development trends in the Study Area.

3.2 Base Network Update

The following roads were added to the model base network in the Study Area to provide more detail:

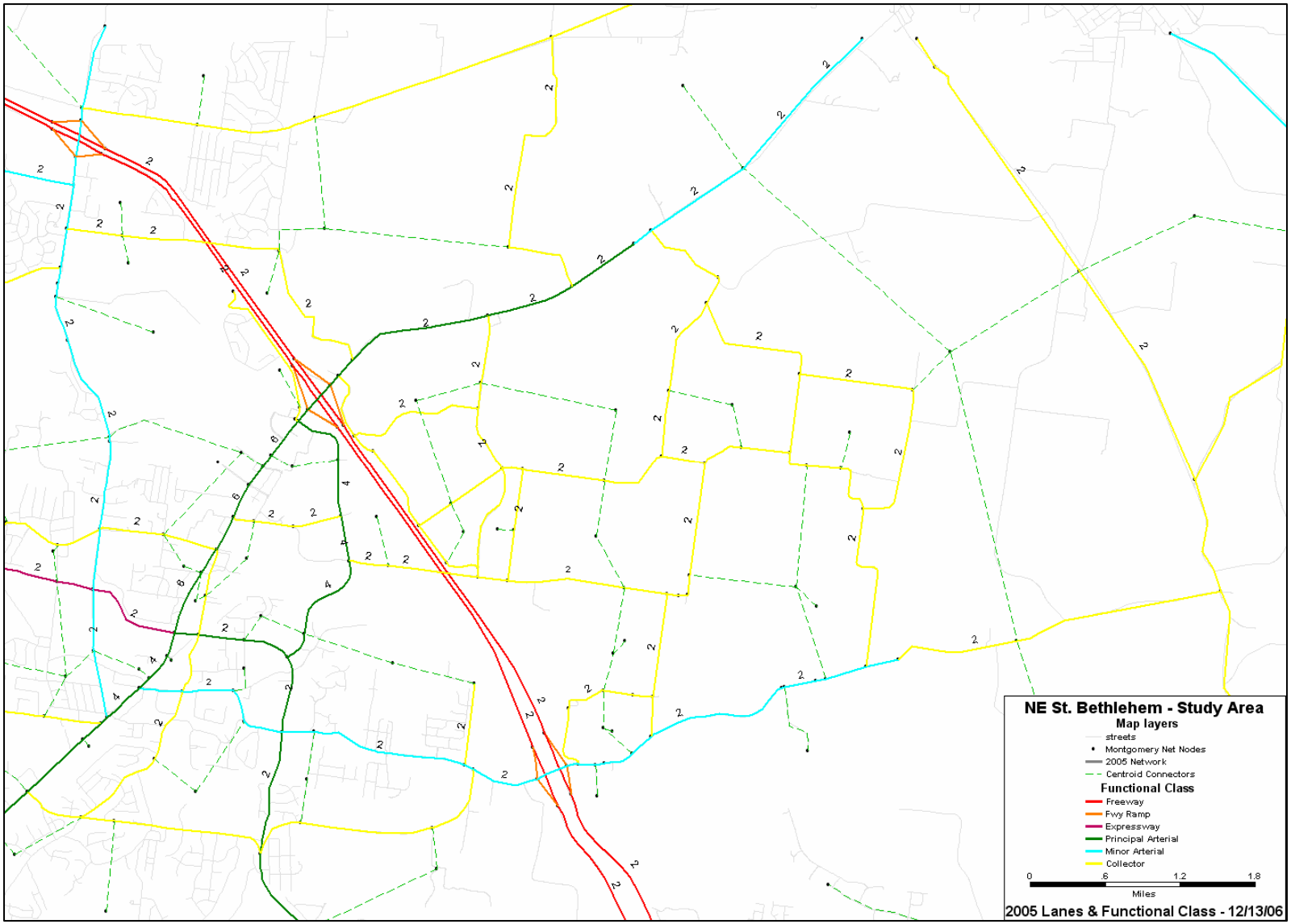
- Cardinal Lane
- Kennedy Lane
- Corporate Parkway Boulevard
- Kirkwood Road
- Buck Road
- Rollow Lane
- Ross Road
- Steelstock Road
- Charles Bell Road
- Industrial Park Boulevard

In addition, the alignments of Ted Crozier Boulevard and Dunlop Lane were updated to reflect their actual alignment.

A field check was also performed to verify the number of lanes for all roads in the Study Area. The existing base year network was then updated to reflect these numbers.

The refined-area model base network is illustrated in Figure 6 and described in greater detail in Appendix A.

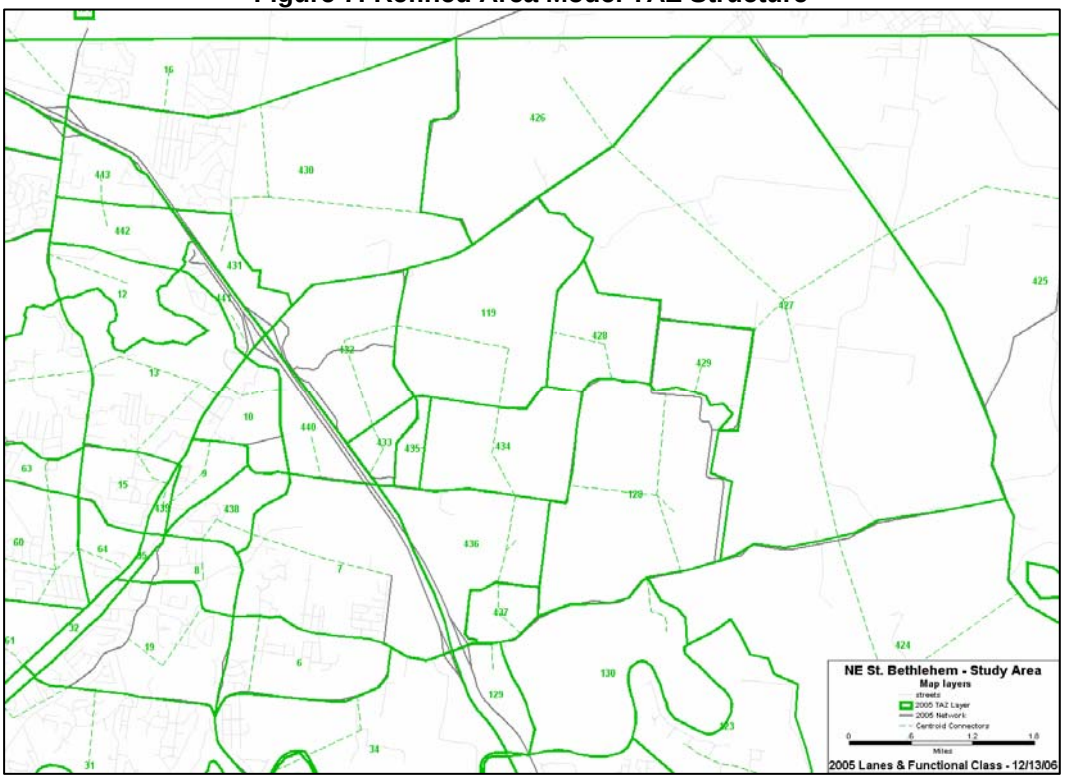
Figure 6: Refined Area Model Base Network with Total Lanes



3.3 Travel Analysis Zone Disaggregation

In general, the TAZs in the Study Area were split so that major roadways would not cross a zone boundary. This ensures that the TAZs load traffic on the surrounding roadway network because roadways that pass through TAZs tend to load poorly. The TAZs were also split so that the original boundaries were preserved. The ten TAZs that make up the Study Area in the existing model were split to create 25 TAZs in the refined-area model (see Figure 7).

Figure 7: Refined Area Model TAZ Structure



3.4 Growth Forecasts

As part of the refinement of the TDM for the St. Bethlehem Study Area, the socioeconomic database for the existing TAZs was disaggregated for the year 2002 to reflect the boundaries of the new disaggregated TAZs. To move the base year of the TDM to the year 2005, the socioeconomic database for the new TAZs was moved up to the year 2005 to reflect current development activity and trends, and the TDM modeled network was updated to the year 2005 to reflect roadway improvements completed since the year 2002. Finally, new TAZ growth forecasts to the year 2030 were developed to reflect current development activity and trends in the Study Area while maintaining the countywide year 2030 growth controls of the existing TDM.

While no new special generators were added in the Study Area, special attention was given to the projected future employment at the proposed Gateway Medical Center being constructed along Dunlop Lane.
The results of socioeconomic forecasts for the Study Area are summarized below. Additional information on the methodology used to calculate these figures is outlined in Appendix A.

3.4.1 Housing

The forecast for housing units in the St. Bethlehem Study Area is summarized as follows:

- 716 housing units in year 1990 (US Census).
- 1,614 housing units in year 2000 (US Census).
- 1,711 housing units in year 2002 in the original Montgomery County Travel Demand Model (TDM).
- 2,116 housing units in year 2002 based on new housing permits (based on address specific matching to the TAZs).
- 2,548 housing units in year 2005 based on new housing permits → 934 new housing units over the past five years = a 58% increase over past five years.
- 3,982 housing units in year 2030 in the original TDM.
- 6,581 housing units in year 2030 based on preliminary subdivision lots → *a 65% increase over the original Travel Model forecast.*

The Study Area's portion of model area housing increases from 3.2% in year 2002 for the original Travel Model to 6.4% in revised year 2030 forecast for the Study Area. If the pace of growth over the past five years was continued to year 2030, the housing unit estimate in year 2030 would be only 10% higher than the new housing unit forecast for the Study Area. *It should be noted that the housing unit forecast for 2030 does not represent build-out of the Study Area.* While most of the Study Area west of I-24 will be fully developed by 2030, less than half of the Study Area east of I-24 will be built-out in the year 2030.

3.4.2 Employment

The Study Area employment forecasts are summarized below:

- 14,353 jobs in year 2002 in original Travel Demand Model.
- 15,583 jobs in year 2005 based on development activity and aerial photography interpretation.
- 18,749 jobs in year 2030 in the original TDM.
- 26,611 jobs in year 2030 based on development activity (such as the new Gateway Medical Center) and vacant land currently zoned for industrial and commercial development → *a 42% increase over the original TDM forecast.*

The Study Area's portion of Montgomery County TDM employment is assumed to remain constant at 26.5% between 2002 and 2030. However, if the pace of growth between year 2002 and year 2005 was continued to the year 2030, the job

forecast for year 2030 would be only 3% lower. *The employment forecast for 2030 reflects only present commercial and industrial zoning and does not represent build-out of the Study Area.* Because future rezonings to commercial and industrial purposes are not considered, these forecasts are reflective of real development trends since year 2000 and are not based on speculation.

4.0 RECOMMENDED STUDY AREA IMPROVEMENTS

4.1 2030 Recommended Network Improvements

The roadway improvements included in the 2030 recommended roadway network are outlined in Table 1 and illustrated in Figure 8. The recommended roadway network changes in the Study Area are highlighted in Figure 9. Figure 10 illustrates the recommended roadway network changes from a countywide view. The map ID numbers in Table 1 correspond to the segment numbers on Figures 8 and 9.

Table 1: 2030 Recommended Roadway Improvements

Map ID	Roadway Segment	From	To	Existing Lanes	2030 Lanes
1	I-24/Trenton Rd Interchange	WB Off-Ramp EB On-Ramp		1	2
2	I-24/Wilma Rudolph Blvd Interchange	All Ramps		1	2
3	I-24/ Rossview Rd Interchange	NB off-ramp and SB on-ramp		1	2
4	I-24	South of SR 76	Ft. Campbell Blvd	4	6
5	Guthrie Hwy/Hwy 79	I-24	Oakland Rd	4	6
6	Guthrie Hwy/Hwy 79	Oakland Rd	International Blvd	2	4
7	Rossview Rd	Warfield Blvd	Cardinal Ln	2	4
8	Rossview Rd	Cardinal Ln	Kirkwood Rd	2	4
9	Trenton Rd	101st Airborne Pkwy	Tiny Town Rd	2	4
10	Dunlop Lane	Ted Crozier Blvd	International Blvd	2	4
11	Jack Miller Thoroughfare	Wilma Rudolph Blvd	Needmore Rd	0	4
12	Dunlop Lane	Existing Dunlop Rd	Rossview Rd	0	2
13	Professional Park Drive	Dunlop Ln	Cardinal Ln/ Rossview Rd	0	3
14*	SR 374 (Warfield Blvd)	Stokes Rd	Dunbar Cave Road	2	4/5
15*	Tiny Town Road	Peachers Mill Rd	Trenton Rd & north to I-24	2	5
16*	SR 112	McAdoo Creek Rd	SR 76	2	5
17*	SR 374	SR 149	SR76	0	2

* Map ID numbers 14-17 are TIP projects that are outside the Study Area. These improvements are included in the 2030 Transportation Network.

Figure 8: 2030 Recommended Roadway Improvements (Study Area View)

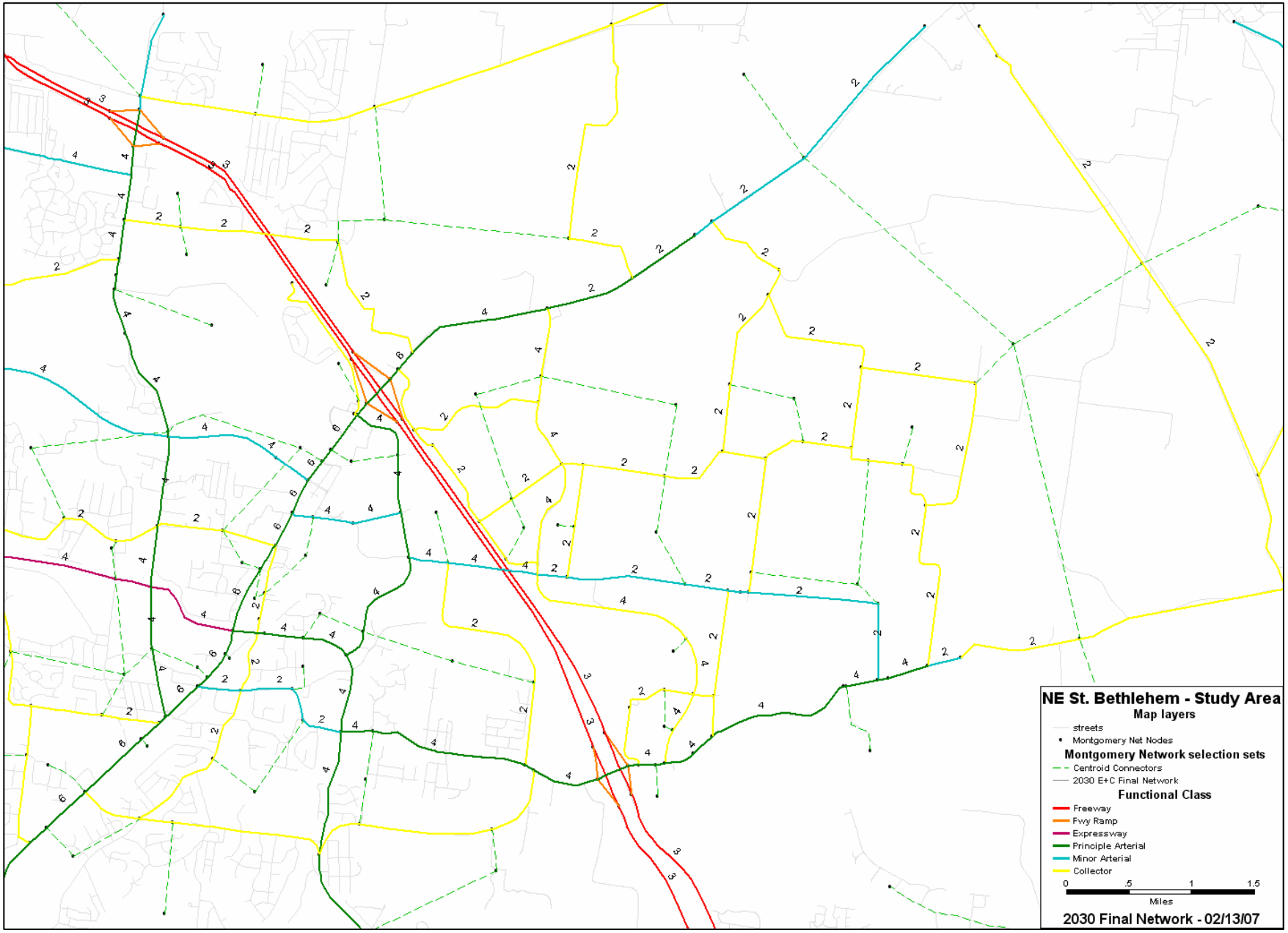


Figure 9: Recommended Roadway Improvements (Study Area View)

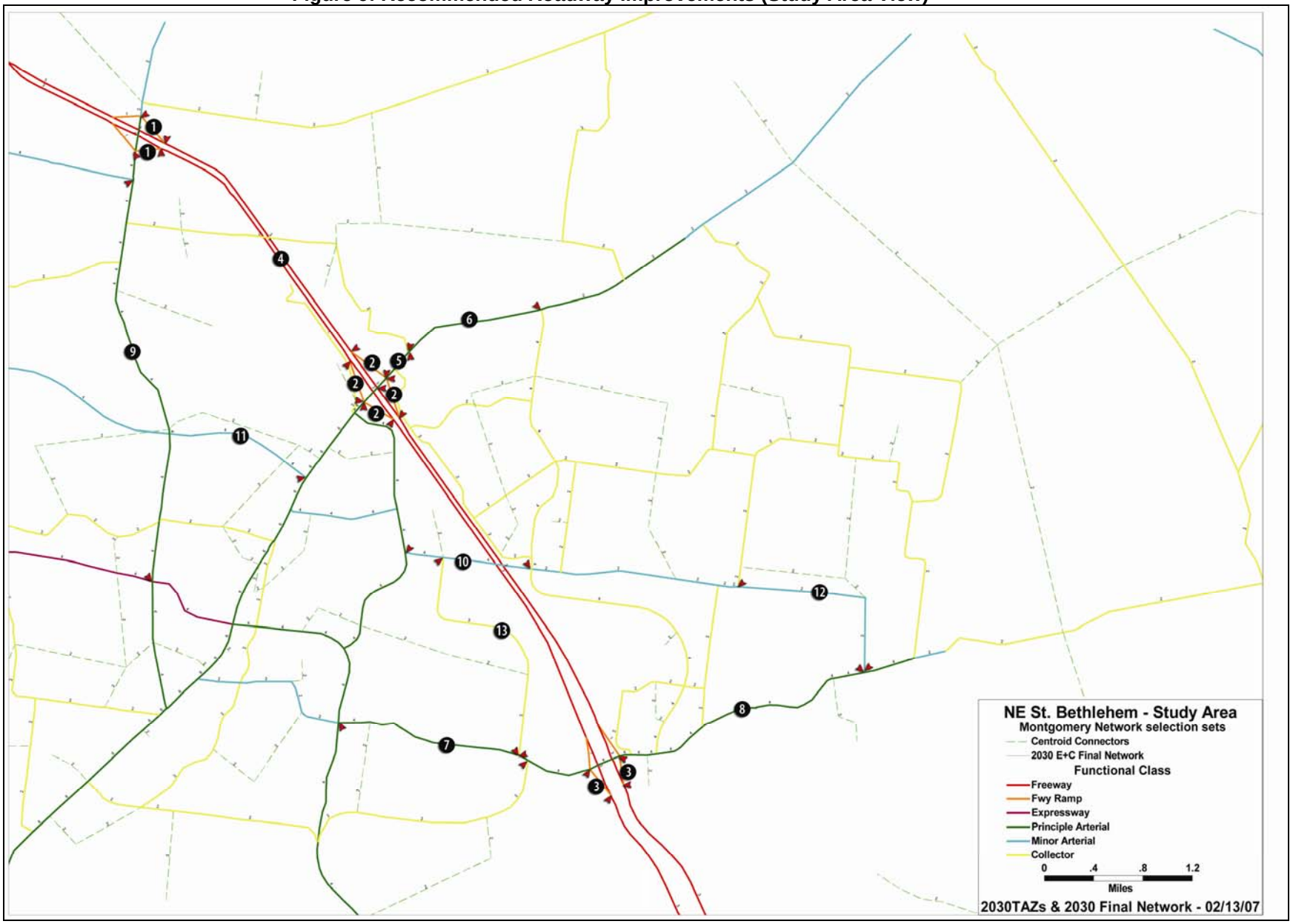
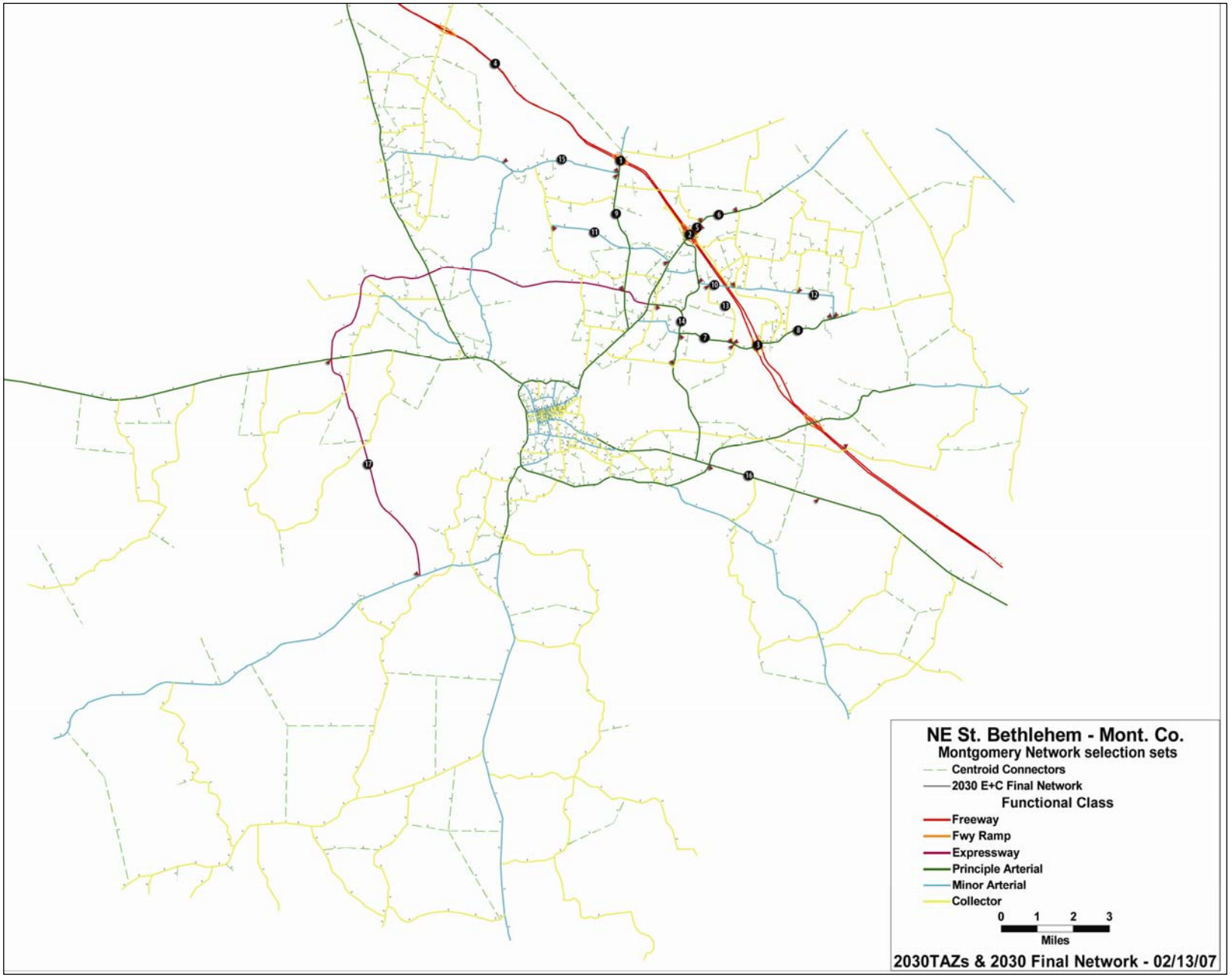


Figure 10: 2030 Recommended Roadway Improvements (County View)



4.2 Recommended Operational Improvements

A total of six intersections and 19 roadway segments were visited during a field review on Thursday, February 15, 2007 between 8:00 AM and 12:00 PM. Each roadway and intersection was evaluated for safety concerns and/or capacity issues. Intersection geometrics, traffic control equipment, pavement markings, signage and nearby commercial access point locations were documented and reviewed to develop a list of potential improvements that would maximize the safety and efficiency of the intersections and roadways not addressed in the recommended roadway improvements. Potential improvements include enhancing railroad crossings, widening shoulders, closing nearby commercial driveways that interfere in the operation of the intersection and roadway vertical alignment modifications.

Because not all of the intersections could be visited during peak hours, issues relative to congestion were not considered during this evaluation. Before funds are allocated for operational improvements, it is recommended that a more detailed investigation in each location be conducted to consider both operational and safety improvement needs.

4.2.1 Roadways

Table 2 lists the roadway segments that were evaluated and potential improvements identified during the field review.

Table 2: Operational Assessment, Roadways

Roadway Segments	Potential Improvements
Alfred Thun Rd	Improve railroad crossing
Charles Bell Rd	Add/widen shoulders
Corporate Pkwy Blvd	No obvious safety or operational concerns noted at this location
Dunlop Ln	Add/widen shoulders and reconstruction for vertical sight distance
Guthrie Hwy	No obvious safety or operational concerns noted at this location
Hampton Station Rd	Improve pavement at Railroad Crossing
Industrial Park Rd	No obvious safety or operational concerns noted at this location
International Blvd	No obvious safety or operational concerns noted at this location
Kirkwood Rd	Add/widen shoulders and modify 90 degree turns
Needmore Rd	Close commercial driveway with angled parking
Old Russellville Pke	Add curb and gutter, sidewalks, relocate mail box and trash bins
Rollow Ln	Add/widen shoulders and reconstruction for vertical sight distance
Rossview Rd	Add/widen shoulders and reconstruction for vertical sight distance
Steelstock Rd	No obvious safety or operational concerns noted at this location
Ted Crozier Blvd	No obvious safety or operational concerns noted at this location
Warfield Blvd	No obvious safety or operational concerns noted at this location
Wilma Rudolph Blvd	Add sidewalks in commercial areas

Substandard shoulders create an unsafe travelway with little or no room for vehicles to recover once they leave the paved lane area. Some areas were identified that had vertical profiles that limited the available sight distance. While the traffic volumes are low at this time, many of these safety issues will worsen as more traffic is attracted to this area and more driveways are introduced onto roadways.

4.2.2 Intersections

Table 3 shows the recommended improvements identified in the field investigation at each of the primary intersections within the Study Area. The need for pedestrian improvements was noted at two intersections that appeared to have adjacent pedestrian destinations with no controlled pedestrian access.

Table 3: Operational Assessment, Intersections

Intersection		Potential Improvements
Wilma Rudolph Blvd	Dunlop Lane	Needs pedestrian signals and crosswalks
Wilma Rudolph Blvd	Needmore Rd	Needs pedestrian signals, crosswalks and closure of commercial driveway
Warfield Blvd	Ted Crozier Blvd	No obvious safety or operational concerns noted at this location
Warfield Blvd	Rossview Rd	No obvious safety or operational concerns noted at this location
International Blvd	Charles Bell Rd	No obvious safety or operational concerns noted at this location
Guthrie Hwy	Hampton Station Rd	No obvious safety or operational concerns noted at this location

The need for additional capacity improvements, such as additional through and turn lanes, would need to be evaluated by collecting traffic information during the peak hours of operation and assessing the intersection configuration and operational changes necessary to optimize the level of service during these peak times. This level of detail was not included in this study.

4.3 Recommended Bicycle & Pedestrian Improvements

In order to accommodate the growth anticipated in the St. Bethlehem and Clarksville area, a multimodal approach to transportation should be adopted. The foundation for this approach is laid in the in the CUAMPO's *Clarksville Area 2030 Long Range Transportation Plan* (*LRTP*), which was adopted in June 2005.

The *LRTP* states that community facilities (such as schools, parks, and churches) should be connected to each other and to residential developments. The *LRTP* also includes planned bike, pedestrian and multi-use paths in the Study Area. Multi-modal recommendations contained in the *LRTP* are outlined in Table 4.

Table 4: Multimodal Improvements Contained in the LRTP

Road	Facility	From	To
Wilma Rudolph Blvd	Sidewalks (Critical Corridor)	Warfield Blvd	I-24
Trenton Rd	Multi-Use Path	Wilma Rudolph Blvd	Tylertown Rd
Warfield Blvd	Multi-Use Path	101st Division Pkwy	Richview Rd
Dunlop Ln	Bike Route	Wilma Rudolph Blvd	Port Royal Rd
Rossview Rd	Bike Route	Warfield Blvd	Port Royal Rd
Rossview Rd	CTS Fixed Route Bus Service	N/A	N/A
Rossview Rd & I-24	Park & Ride Facility	N/A	N/A

To create a safe and usable bicycle and pedestrian network that will accommodate the anticipated growth in the area, additional bicycle and pedestrian facilities are needed. Figure 11 illustrates the recommended bicycle and pedestrian improvements that were identified for the Study Area based on both the community's needs and interests and the TDM results for the 2030 recommended network. Figure 11 also illustrates the community facilities in the area and the bicycle and pedestrian facilities already included in the *LRTP*.

These improvements, which include adding sidewalks, bike routes and multi-use paths, will provide improved accessibility and mobility for cyclists and pedestrians. The recommendations can be broken down into two general categories:

- Projects to be developed in conjunction with recommended roadway improvements, and
- Projects that require retrofitting existing roadways where no improvements are anticipated.

Table 5, below, outlines these categories of improvements.

Additional public input should be gathered and engineering studies specific to each roadway should be conducted prior to the implementation of these facilities.

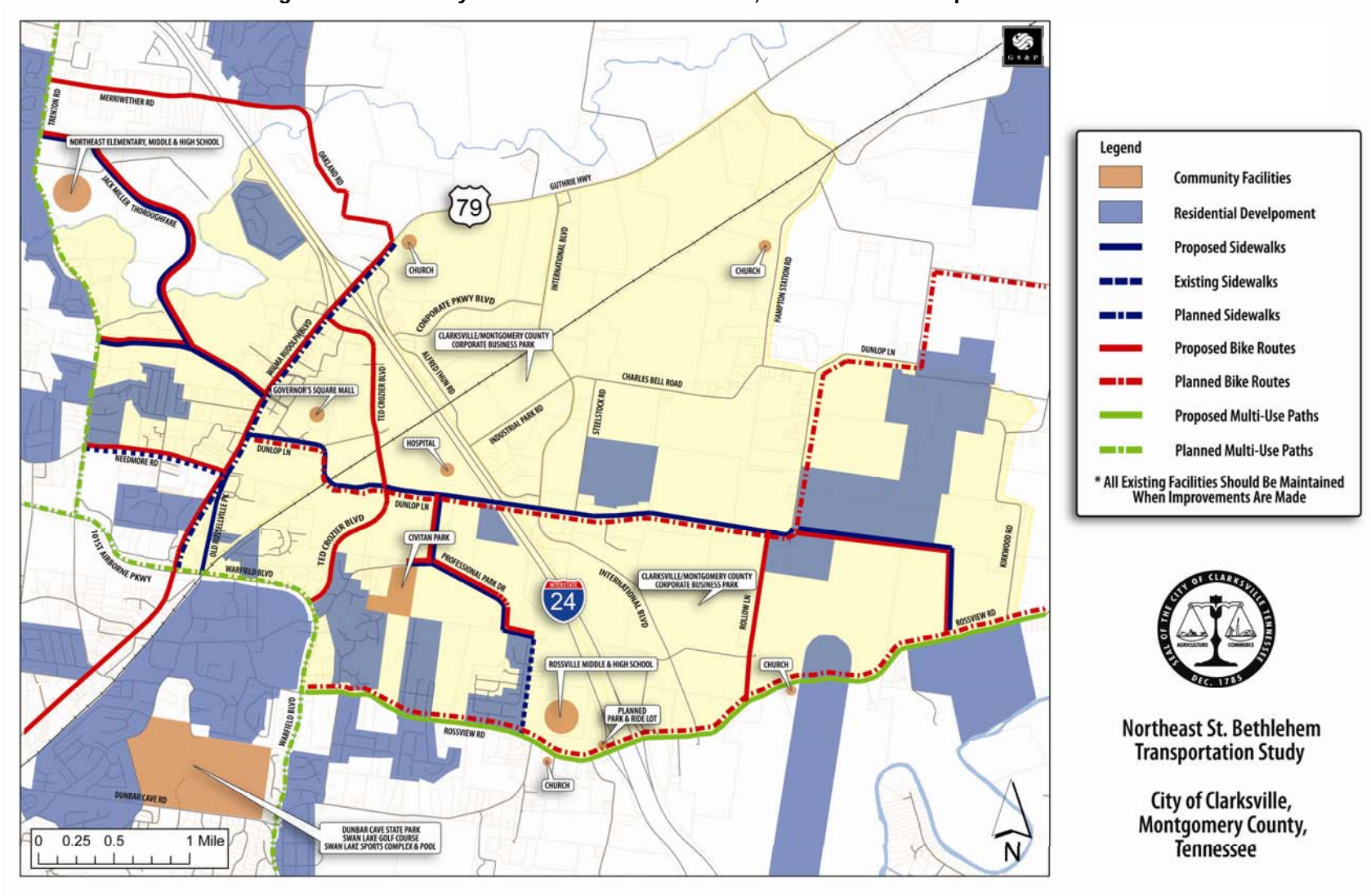
Table 5: Bicycle and Pedestrian Network Recommendations

Road	Facility	From	To
Projects to be Developed in Conjunction with Recommended Roadway Improvements*			
Jack Miller Thoroughfare	Sidewalks + Bike Routes**	Wilma Rudolph Blvd	Needmore Rd
Dunlop Ln	Sidewalks + Bike Routes**	Ted Crozier Blvd	International Blvd
Dunlop Ln Extension	Sidewalks + Bike Routes**	Existing Dunlop Ln	Rossview Rd
Rossview Rd	Multi-Use Path	Warfield Blvd	Kirkwood Rd
Professional Park Dr	Sidewalks + Bike Routes**	Dunlop Ln	Cardinal Ln/Rossview Rd
Trenton Rd	Multi-Use Path	101st Airborne Pkwy	Tiny Town Rd
Projects Requiring Retrofits			
Wilma Rudolph Blvd	Sidewalks + Bike Routes**	Outside Project Area	Oakland Rd
Ted Crozier Blvd	Bike Route**	Wilma Rudolph Blvd	Rossview Rd
Dunlop Ln	Sidewalks + Bike Routes**	Wilma Rudolph Blvd	Ted Crozier Blvd
Dunlop Ln	Sidewalks + Bike Routes**	International Blvd	Dunlop Ln Extension
Dunlop Ln	Bike Route**	Dunlop Ln Extension	County
Warfield Blvd	Multi-Use Path	101st Airborne Pkwy	Outside Project Area
Needmore Rd	Bike Route**	Wilma Rudolph Blvd	Trenton Rd
Oakland/Merriwether Rd	Bike Route**	Guthrie Hwy	Trenton Rd
Rollow Ln	Bike Route**	Dunlop Ln	Rossview Rd
Old Russellville Pke	Sidewalks	Wilma Rudolph Blvd	St. Bethlehem Elementary School

* Sidewalks should be included in the design of all commercial streets and residential major street construction projects (in accordance with the City of Clarksville Sidewalk Program Ordinance).

**Bicycle facilities should include design features on all new and reconstructed streets to provide a minimum level of safety and comfort to bicyclists. The features include, at a minimum, pavement widths that allow bicyclists to comfortably share the roadway with automobiles, bicycle safe drainage grates and bicycle sensitive detectors at signals. Bike lanes can be non-painted (or integrated) depending on the context of the corridor.

Figure 11: 2030 Bicycle and Pedestrian Network, Recommended Improvements



5.0 PROPOSED ROADWAY TYPICAL SECTIONS

Table 6 outlines the 2030 recommended network improvements. The typical section reference number in Table 6 corresponds to the ID number on the typical sections in Appendix B.

Because Dunlop Lane is a critical pedestrian corridor, its typical section has been enhanced in Figure 12 to highlight how the roadway might feel for pedestrians and cyclists.

Figure 12: Enhanced Typical Section for Dunlop Lane

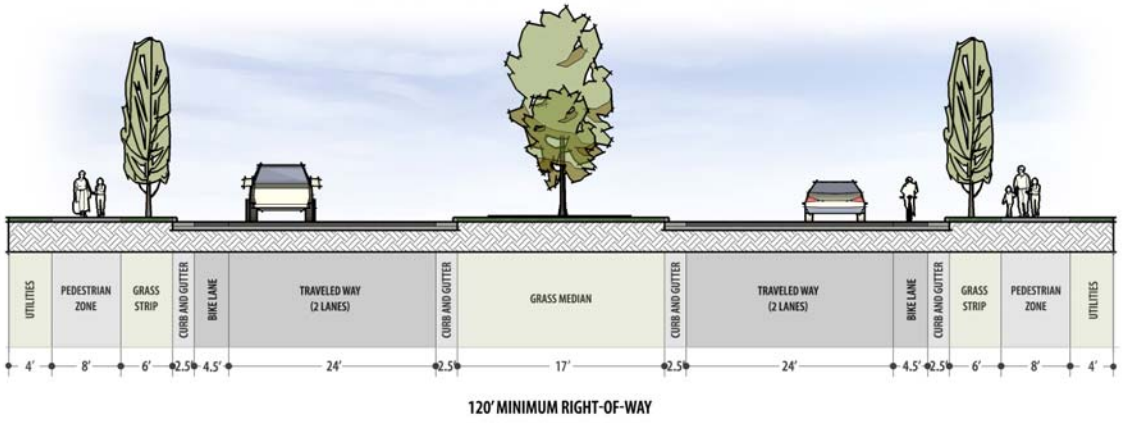


Table 6: Typical Sections for Recommended Improvements

Typical Section Reference Number	Roadway	From	To	Type of Typical Section	Bike Lanes	Sidewalks	Multi-Use Paths	Functional Classification	
								Existing	Proposed
2	Dunlop Ln	Ted Crozier Blvd	International Blvd	Arterial Blvd: 4 lanes with median	X	X		Minor Arterial	Arterial Blvd
3	Dunlop Ln	International Blvd	Rossview Rd	Minor Arterial: 2 lanes	X	X		Collector	Minor Arterial
1A	Wilma Rudolph/Guthrie	I-24	Oakland Rd/Meriwether Rd	Principal Arterial: 6 lanes with median	X	X		Principal Arterial	Principal Arterial
1B	Wilma Rudolph/Guthrie	Oakland Rd/Meriwether	International Blvd	Principal Arterial: 4 lanes no median				Principal	Principal Arterial
4	Professional Park Drive	Dunlop Lane	Cardinal Lane	Collector: 2 lanes with center turn lane	X	X		N/A	Collector
1C	Trenton Rd	Wilma Rudolph Blvd	Tiny Town Rd	Principal Arterial: 4 lanes no median			X	Minor Arterial	Principal Arterial
1C	Rossview Rd	Warfield Blvd	Kirkwood Rd	Principal Arterial: 4 lanes no median			X	Minor Arterial	Principal Arterial
2	Jack Miller Thoroughfare	Wilma Rudolph Blvd	Needmore Rd	Arterial Blvd: 4 lanes with median	X	X		N/A	Arterial Blvd
5A	I-24	South of SR 76	Fort Campbell Blvd/US41	Interstate: 6 lanes with median				Freeway	Freeway

Typical Section Reference Number	Interchange	Ramp (Direction)	Function of Ramp	Number of Lanes	
				Existing	Proposed
5B	I-24@Wilma Rudolph/Guthrie	All 4 On/Off Ramps		1	2
5B	I-24@Rossview	WB	Off	1	2
5B		EB	On	1	2
5B	I-24@Trenton	EB	On	1	2
5B		WB	Off	1	2

6.0 IMPLEMENTATION

6.1 Policy Recommendations

Land use planning and transportation planning must be coordinated for policies and plans to be effective. There are several large parcels in the St. Bethlehem area that have been rezoned from agricultural to residential as subdivision developments are proposed. If this trend continues, there will be even more housing units in the Study Area than the 2030 TDM forecasts, because the TDM does not represent full build-out of the Study Area. If this policy continues, the TDM will need to be updated with the new data so that it can remain effective at forecasting deficiencies.

One way to achieve a more coordinated land use planning and transportation planning process is through the comprehensive planning process. In a comprehensive plan, the community establishes its vision through the public participation process for a 15-30 year planning period. The comprehensive plan informs the community's land use plan (and corresponding land use map). The City's Zoning Ordinance can then be used as a tool for the implementation of the land use plan. Once these tools are updated to reflect the community's evolving goals and objectives, the CUAMPO's *LRTP* can be more effective at planning for future transportation needs.

6.2 Prioritization

Within the general Northeast St. Bethlehem Study Area, the proposed improvements are prioritized to aid in the planning and implementation of future roadway improvements. Three priority levels were used in classifying the recommended improvements, according to the following criteria:

- **Priority Level 1** was assigned to interstate ramps, major arterial connections, high-volume corridors and boundary roadways in the Study Area. These roadways will see the most demand in the Study Area and will do the most to channel outside traffic away from the interior of the Study Area.
- **Priority Level 2** includes roadway improvements on arterials, secondary high volume roadways and parallel routes to major arterials. The routes that parallel major arterials not only provide access to development within the Study Area, but they relieve traffic conditions on the major arterials. Parallel routes also provide connectivity within the Study Area for travelers that do not necessarily need to use the boundary roadways in order to reach their desired destination.
- **Priority Level 3** roadway improvements are for roads that would offer increased connectivity within the Study Area, access to particular sections of the Study Area and secondary parallel routes. These roads are not as important to the transportation system as a whole, but instead might be contingent on proposed development.

Table 7 shows the recommended roadway improvement projects prioritized into the levels listed above. The suggested priorities are subject to change as the demands of specific developments occur.

Table 7: Prioritized Roadway Improvement Projects

Roadway Segment	From	To	Priority	Existing Lanes	2030 Lanes
I-24/Trenton Rd Interchange	WB off-ramp EB on-ramp		1	1	2
I-24/Wilma Rudolph Blvd Interchange	All Ramps		1	1	2
I-24/ Rossview Rd Interchange	WB off-ramp EB on-ramp		1	1	2
I-24	South of SR 76	Ft. Campbell Blvd	1	4	6
Guthrie Hwy/Hwy 79	I-24	Oakland Rd	2	4	6
Guthrie Hwy/Hwy 79	Oakland Rd	International Blvd	2	2	4
Rossview Rd	Warfield Blvd	Cardinal Ln	2	2	4
Rossview Rd	Cardinal Ln	Kirkwood Rd	2	2	4
Trenton Rd	101st Airborne Pkwy	Tiny Town Rd	2	2	4
Dunlop Lane	Ted Crozier Blvd	International Blvd	2	2	4
Jack Miller Thoroughfare	Wilma Rudolph Blvd	Needmore Rd	2	0	4
Dunlop Lane	Existing Dunlop Rd	Rossview Rd	3	0	2
Professional Park Drive	Dunlop Ln	Cardinal Ln/ Rossview Rd	3	0	3

Many of the priority level 1 priority projects can be moved forward simultaneously. The Interchange improvements require interchange modification studies per TDOT and FHWA standards.

6.3 Environmental Constraints

A preliminary environmental screening was conducted for the Study Area so that potential environmental concerns are identified early in the planning process. These concerns are considered in the report recommendations. The results of the environmental screening are shown graphically in Figure 12. The environmental constraints for each recommended improvement are summarized in Table 8.

This screening includes a basic records check for known wetlands listed in the National Wetlands Inventory (NWI), Federal Emergency Management Agency's (FEMA) flood zones, properties listed in the National Register of Historic Places (NRHP) and EPA's EnviroMapper. This screening does not include ecologically sensitive sites, threatened or endangered wildlife or archeological sites.

A more comprehensive analysis of the potential environmental constraints in the area should be conducted once preferred alignments are determined.

Table 8: Environmental Constraints for Recommended Improvements

Roadway	Location	Environmental Constraint
Rossview Rd	South side of Rossview Rd, between Rollow Ln and Kirkwood Rd	White Chapel (NRHP Site)
Rossview Rd	North side of Rossview Rd, west of I-24	Rossview Middle and High School (Community Facility)
Professional Park Dr	Terminus of Bellamy Ln	Civitan Park (Community Facility and 4(f) resource
Professional Park Dr	Terminus of Cardinal Ln	Harper Cemetery
Wilma Rudolph Blvd	101st Airborne Pkwy to Ted Crozier Blvd	Potential Hazardous Materials & Underground Storage Tanks
US Hwy 79/Guthrie Hwy	Intersection with International Blvd	Potential Hazardous Materials & Underground Storage Tanks
US Hwy 79/Guthrie Hwy	I-24 to International Blvd	Cemeteries
Rossview Rd	Wilma Rudolph Blvd to Kirkwood Rd	Cemeteries
Trenton Rd	East side of Trenton Rd, south of Merriwether Rd	Northeast Elementary, Middle and High School (Community Facilities)

6.3.1 Wetlands

All wetland impacts require confirmation by, and coordination with, the appropriate permitting agencies. All projects that have the potential to discharge dredged or fill materials into waters of the United States, including wetlands, require a Section 404 permit from the U.S. Army Corps of Engineers pursuant to Section 404 of the Clean Water Act. Projects that alter state waters or wetlands and do not require an individual Section 404 permit must obtain an Aquatic Resource Alteration (ARAP) Permit from the State of Tennessee. Other agencies, such as the U.S. Fish and Wildlife Service and the Environmental Protection Agency (EPA) may be involved in the permitting process as well.

Wetlands listed on the NWI in the Study Area are shown in Figure 13. *There are no known wetlands which are likely to limit the recommended improvements included in this study.*

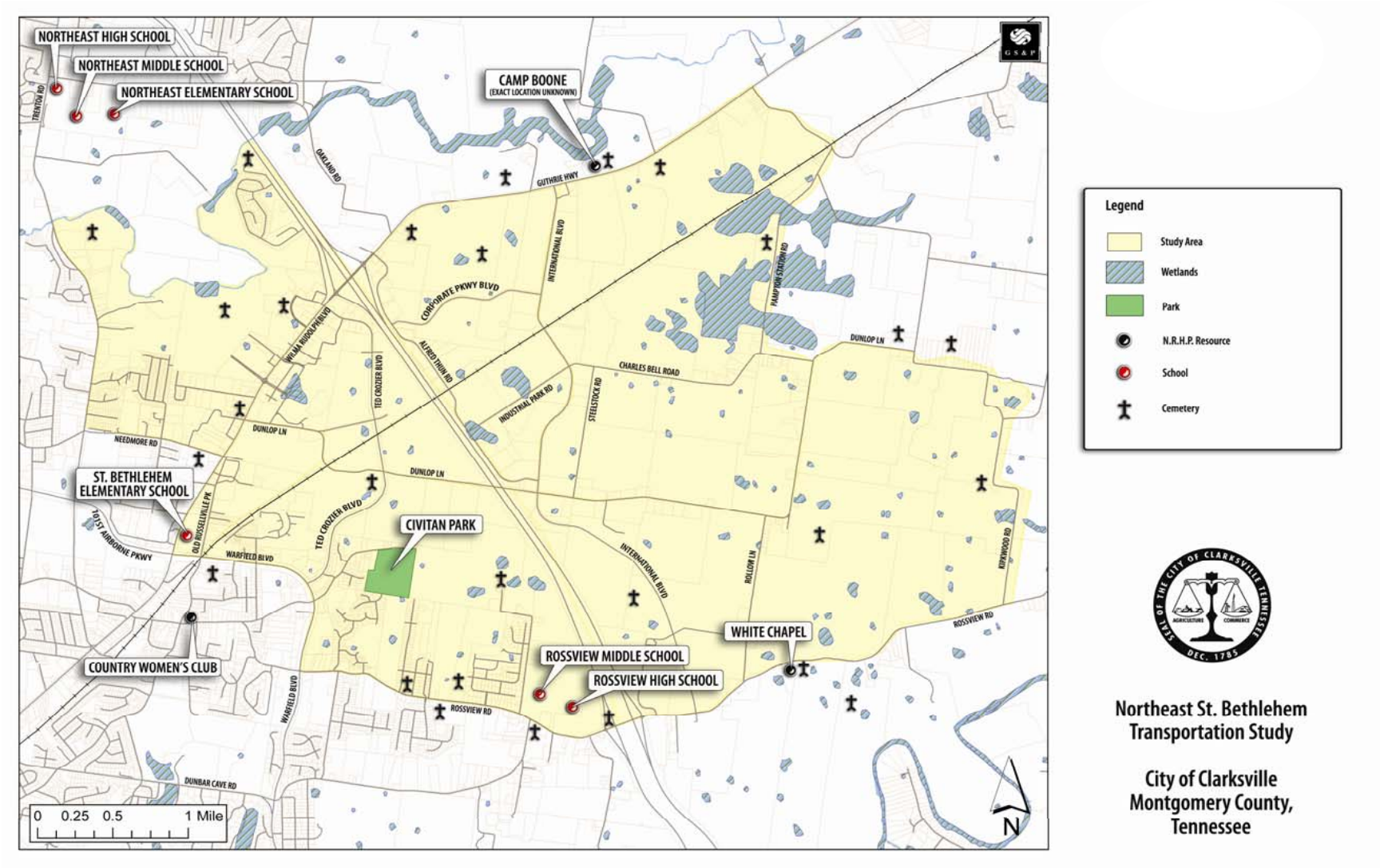
6.3.2 Floodplains

Alterations to floodplains require permits similar to those listed under wetlands. *There are no floodplains in the Study Area that would have an affect on the study recommendations.*

6.3.3 Historic Resources

If federal funding is used or if the project requires federal permitting, Section 106 of the National Historic Preservation Act of 1966 requires federal agencies to review all actions that may affect a property listed on the NRHP or NRHP-eligible properties. Section 4(f) of the Department of Transportation Act of 1966 states that the administration may not approve the use of land from a significant publicly owned park, recreation area, or wildlife and waterfowl refuge, or any significant historic site unless there is no feasible and prudent alternative and the action includes all possible planning to minimize harm resulting from such use.

Figure 13: Environmental Constraints Map



The State Historic Preservation Office (SHPO) records were reviewed to determine if any known historic resources are located in the project area. There are two sites listed on the NRHP which should be considered when implementing report recommendations. Camp Boone was a Civil War training camp for the Confederacy. Its exact location is controversial, but it is believed to be along the north side of U.S. Highway 79/Guthrie Highway near Spring Creek Village Road. The second site listed in the NRHP is White Chapel on Rossview Road. This five-acre site is on the south side of Rossview Road, east of Rollow Lane. The approximate locations of these sites are show in Figure 13. *Avoiding impacts to these properties should be considered in all phases of project development, particularly if federal funding or federal permitting is involved in the project.*

6.3.4 Community Facilities

Care should be taken to design improvements in a way that minimize impacts to cultural resources along roadways in the Study Area. As illustrated in Figure 10, several schools exist along the Study Area transportation network. In addition, Civitan Park is located at the end of Bellamy Lane, south of Dunlop Lane and east of I-24. When implementing the extension of Professional Park Drive, adverse impacts and/or Section 4(f) use of Civitan Park should be avoided if federal funding is used.

6.3.5 Cemeteries

A number of cemeteries exist along the Study Area transportation network. They are shown in Figure 13. Tennessee state law includes a variety of provisions that are applicable to the discussion of cemeteries. Two of these laws, the Desecration of a Venerated Object statute (TCA 39-17-311) and the Abuse of Corpse statute (TCA 39-17-312) provide for protection against intentional disturbance of cemeteries, burial sites and human remains.

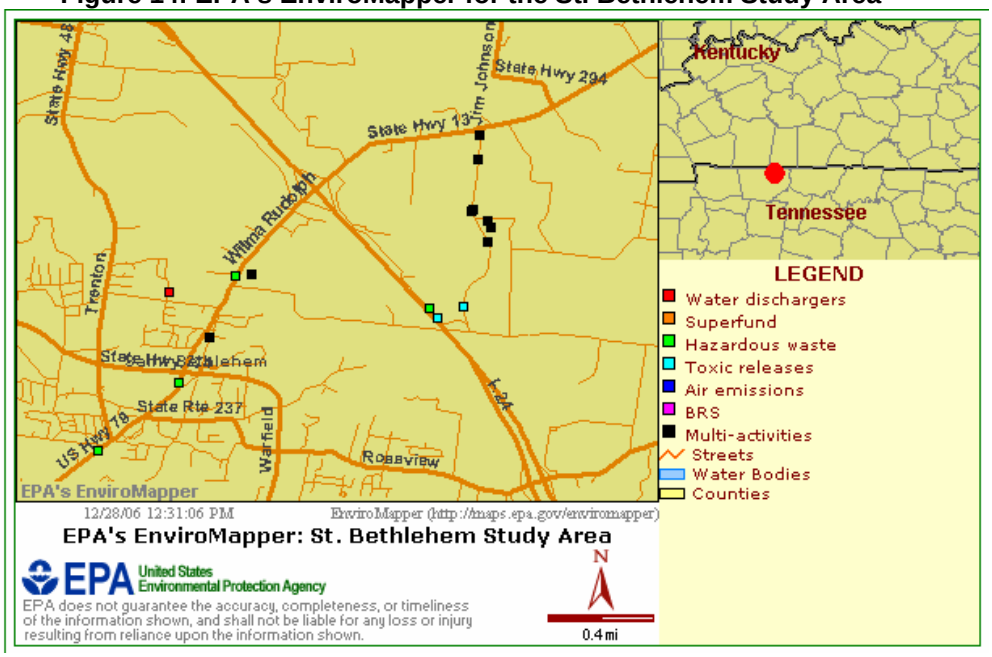
In accordance with these state laws, avoidance measures should be employed during roadway improvements in order to minimize disturbance of the site. In particular, care should be taken during the implementation of study recommendations for Rossview Road west of I-24 and Guthrie Hwy east of I-24. In addition, Harper Cemetery, which is located at the current northern terminus of Cardinal Lane, should be avoided when connecting Cardinal Lane to Professional Park Drive.

6.3.6 Potential Hazardous Material Sites

EnviroMapper is a web-based interactive mapping tool for viewing and querying environmental information. It generates maps of a geographic area that contain environmental information stored in EPA's EnviroFacts warehouse. The type of environmental information includes: Superfund sites, drinking water, toxic releases, air emissions, hazardous waste and water discharge permits. Figure 14 shows sites in the St. Bethlehem area that are on EPA's EnviroMapper. It is important to note that the sites listed on this map are not necessarily contaminated sites that will restrict roadway improvements.

When implementing study recommendations, a Phase I Environmental Assessment will be needed in order to determine what hazardous sites and/or underground storage tanks may be encountered during construction. In the event hazardous substances/waste are encountered within the proposed right-of-way, their disposition shall be subject to the applicable section of the Federal Resource Conservation and Recovery Act, as amended; and the Comprehensive Environmental Response, Compensation and Liability Act, as amended; and the Tennessee Hazardous Waste Management Act of 1983.

Figure 14: EPA's EnviroMapper for the St. Bethlehem Study Area



6.4 Access Policies and Guidelines

Access management is the practice of controlling the access and roadway geometrics for connections to the local transportation network. The primary goals of access management are to improve roadway safety, improve traffic operations, protect taxpayer's investments in roads and create better conditions for pedestrians. Some secondary goals include opportunities to beautify areas and to reduce cut through traffic on residential roads.

Various techniques can be used including medians, deceleration, acceleration lanes and connectivity. The use of these features has proven to increase safety and efficiency on the roadways and extend the functionality of the transportation network.

Several of these access management issues were recently addressed in the City of Clarksville's ordinance amending the official code relative to driveway access (Ordinance 107-2006-06). It is the recommendation of this Study that City policy

in the area of access management be broadened to encompass more definitive guidelines for all classifications of transportation facilities within its jurisdiction and to help preserve the safety and efficiency of the area transportation network as development occurs.

These considerations are recommended to include:

- Expanded and/or additional roadway classification guidelines;
- Refined connectivity guidelines for development and supporting transportation network improvement requirements;
- Interchange access spacing; and
- Median treatment guidelines for proposed arterial roadways, streets and boulevards.

A concern that often arises at the local level is that access controls could impede economic development. It is understandable that local governments are interested in increasing their tax base through development. What is often not understood is that not managing access can have long-term adverse impacts on both the transportation function and economic development potential of an area. Access management plans and requirements can also help to discourage the division of roadway frontage into small lots with constrained development potential, and help to preserve larger parcels for higher quality development with good internal circulation and access design.

These and other access management considerations are described in more detail in Appendix C of this report.

Table 9: Recommended Roadway Classification Guidelines

Design Criteria	Freeway	Arterial	Collectors		Local	
			Major	Minor	Residential	Frontage
Volume Range (vehicle trips/day)	n/a	>10,000	4,500 to 10,000	1,000 to 4,500	<1,000	n/a
Right-of-way Width (min. feet)	240	120*	80*	60	50	40
Number of Lanes (minimum)	4	5**	3**	2	2	2
Design Speed	55+	50	40	30	30	n/a
Interchange Spacing (miles)	1.0 *** 2.0 **** 3.0 *****	n/a	n/a	n/a	n/a	n/a
Interchange Spacing, > 45 mph (min. feet)	n/a	660	440	440	125	125
Interchange Spacing, < 45 mph (min. feet)	n/a	440	245	245	125	125
Median Spacing, directional (min. feet)	n/a	1,320	660	660	n/a	n/a
Median Spacing, full (min. feet)	n/a	2,640	2,640	1,320	n/a	n/a
Signal Spacing (min. feet)	n/a	2,640	2,640	1,320	1,000	1,000

Notes:

* Medians and/or shoulders and ditches may increase needed right-of-way width.

** Two way left turn lanes may be replaced with medians and dedicated turn lanes.

*** CBD or CBD Fringe in Cities in Urbanized Area

****Existing Urbanized Areas Other Than CBD or CBD Fringe

***** Transitioning Urbanized Areas and Urban Areas Other than CBD, CBD Fringe or Existing Urbanized Area

7.0 ESTIMATED COSTS OF RECOMMENDED PLAN

The estimated costs associated with the recommended improvements are summarized in Tables 10 though 16. Table 10 is a summary of the program-level costs for all jurisdictions. Tables 11 through 13 categorize the improvement costs by jurisdiction (federal/state, county and city). Tables 14 through 16 categorize the improvement costs by improvement category (roadway, operational and multimodal).

The estimated costs are based on general assumptions for design, construction, materials and utility relocation. No estimated costs were included for projects included in the TIP, since their costs have already been estimated. Future planning and design should include more refined cost estimations for each recommended improvement.

Table 10: Program-Level Cost Summary by Jurisdiction (ALL OBLIGATIONS)

DESCRIPTION	FROM	TO	RECOMMENDED IMPROVEMENTS	COST (x1000) [2]
2030 Recommended Roadway Improvements				
I-24	South of SR 76	Fort Campbell Blvd/US 41	Interstate: 6 lanes with median [3, 5]	52,500
I-24 @ Wilma Rudolph Blvd/Guthrie Hwy	All 4 Ramps		Add 1 Lane Each Ramp [4]	500
I-24@Trenton	EB ON, WB OFF		Add 1 Lane Each Ramp [4]	500
I-24@Rossview	EB ON, WB OFF		Add 1 Lane Each Ramp [4]	500
Wilma Rudolph/Guthrie Hwy	I-24	Oakland Rd/ Meriwether Rd	Principal Arterial: Add 1 Lane Each Direction	1,600
Wilma Rudolph/Guthrie Hwy	Oakland Rd/Meriwether Rd	International Blvd	Principal Arterial: Add 1 Lane Each Direction	4,300
Rossview Rd	Warfield Blvd	Kirkwood Rd	Principal Arterial: Add 1 Lane Each Direction	19,000
Trenton Rd	Wilma Rudolph	Tiny Town Rd	Principal Arterial: Add 1 Lane Each Direction	16,200
Jack Miller Thoroughfare	Wilma Rudolph	Needmore Rd	Arterial Blvd: New 4 Lane Roadway [5]	30,000
Dunlop Lane	Ted Crozier Blvd	International Blvd	Arterial Blvd: Widen from 2 to 4 Lanes [5]	6,800
Dunlop Lane	International Blvd	Rossview Rd	Minor Arterial: New 2 Lane Roadway	5,300
Professional Park Drive	Dunlop Lane	Cardinal Lane	Collector: New 2 Lane Roadway	5,100
			Subtotal	**$ 142,300**
Recommended Operational Improvements				
Kirkwood Rd	Dunlop Ln	Rossview Rd	Widen Shoulders	460
Rossview Rd	Warfield Blvd	Kirkwood Rd	Widen Shoulders and Improve Vertical Profile	1,550
Dunlop Ln	Wilma Rudolph Blvd	Kirkwood Rd	Widen Shoulders and Improve Vertical Profile	1,000
Rollow Ln	Dunlop Ln	Rossview Rd	Widen Shoulders and Improve Vertical Profile	590
Hampton Station Rd	Guthrie Hwy	Charles Bell Rd	Smooth Railroad Crossing	5
Charles Bell Rd	International Blvd	Dunlop Ln	Widen Shoulders	370
Alfred Thun Rd	Guthrie Hwy	International Blvd	Smooth Railroad Crossing	5
Old Russelville Pke	Needmore Rd	Warfield Blvd	Add Curb and Gutter and Sidewalk	570
Needmore Rd	Wilma Rudolph Blvd	Trenton Rd	Close Commercial Driveway with Angled Parking	10
Wilma Rudolph Blvd	Warfield Blvd	I-24	Add Sidewalk	210
			Subtotal	**$ 4,770**

Table 10 Continued: Program-Level Cost Summary by Jurisdiction (ALL OBLIGATIONS)

DESCRIPTION	FROM	TO	RECOMMENDED IMPROVEMENTS	COST (x1000) [2]
Recommended Mulitmodal Improvements				
Jack Miller Thoroughfare	Wilma Rudolph Blvd	Needmore Rd	Sidewalks + Bike Routes [1]	-
Dunlop Ln	Ted Crozier Blvd	International Blvd	Sidewalks + Bike Routes [1]	-
Dunlop Ln Extension	Existing Dunlop Ln	Rossview Rd	Sidewalks + Bike Routes [1]	-
Rossview Rd	Warfield Blvd	Kirkwood Rd	Multi-Use Path [1]	-
Professional Park Dr	Dunlop Ln	Cardinal Ln/Rossview Rd	Sidewalks + Bike Routes [1]	-
Trenton Rd	101st Airborne Pkwy	Tiny Town Rd	Multi-Use Path [1]	-
Wilma Rudolph Blvd	Warfield Blvd	Oakland Rd	Sidewalks + Bike Routes	1,000
Ted Crozier Blvd	Wilma Rudolph Blvd	Rossview Rd	Bike Route	830
Dunlop Ln	International Blvd	Dunlop Ln Extension	Sidewalks + Bike Routes	2,600
Dunlop Ln	Dunlop Ln Extension	County	Bike Route	660
Warfield Blvd	101st Airborne Pkwy	Outside Project Area	Multi-Use Path	280
Needmore Rd	Wilma Rudolph Blvd	Trenton Rd	Bike Route	350
Oakland/Merriwether Rd	Guthrie Hwy	Trenton Rd	Bike Route	1,130
Rollow Ln	Dunlop Ln	Rossview Rd	Bike Route	420
Old Russellville Pke	Wilma Rudolph Blvd	St. Bethlehem ES	Sidewalks	760
			Subtotal	**$ 8,030**
			TOTAL	**$ 155,100**
			Estimated Planning and Engineering Contingency @ 20%	**$ 31,020**
			Subtotal	**$ 186,120**
			Project Development, Administration and Management	**$ 27,918**
			GRAND TOTAL	**$ 214,038**

Notes:
1 Costs for multimodal improvements integrated into new roadway sections are included in unit costs for roadway Improvements.
2 Estimated construction costs assume full-depth construction of pavement areas. Engineering, utility relocation, and right-of-way costs are not included.
3 The estimated construction costs for interstate mainline assumes widening for two travel lanes and two shoulders.
4 The estimated construction costs for interstate ramps assume widening for one travel lane and one shoulder.
5 Structure costs have been added for Dunlop Lane, Jack Miller Thoroughfare, and I-24. I-24 structure widening costs include five potential structures. Wilma Rudolph Blvd does not include potential retaining walls.

Table 11: Program-Level Cost Summary by Jurisdiction (FEDERAL/STATE OBLIGATIONS[6])

DESCRIPTION	FROM	TO	RECOMMENDED IMPROVEMENTS	COST (x1000) [2]
2030 Recommended Roadway Improvements				
I-24	South of SR 76	Fort Campbell Blvd/US41	Interstate: 6 lanes with median [3, 5]	52,500
I-24 @ Wilma Rudolph Blvd/Guthrie Hwy	All 4 Ramps		Add 1 Lane Each Ramp [4]	500
I-24@Trenton	EB ON, WB OFF		Add 1 Lane Each Ramp [4]	500
I-24@Rossview	EB ON, WB OFF		Add 1 Lane Each Ramp [4]	500
Wilma Rudolph/Guthrie Hwy	I-24	Oakland Rd/ Meriwether Rd	Principal Arterial: Add 1 Lane Each Direction	1,600
Wilma Rudolph/Guthrie Hwy	Oakland Rd/Meriwether Rd	International Blvd	Principal Arterial: Add 1 Lane Each Direction	4,300
Rossview Rd	Warfield Blvd	Kirkwood Rd	Principal Arterial: Add 1 Lane Each Direction	19,000
Trenton Rd	Wilma Rudolph	Tiny Town Rd	Principal Arterial: Add 1 Lane Each Direction	16,200
			Subtotal	**$ 95,100**
Recommended Operational Improvements				
Rossview Rd	Warfield Blvd	Kirkwood Rd	Widen Shoulders and Improve Vertical Profile	1,550
Wilma Rudolph Blvd	Warfield Blvd	I-24	Add Sidewalk	210
			Subtotal	**$ 1,760**
Recommended Mulitmodal Improvements				
Rossview Rd	Warfield Blvd	Kirkwood Rd	Multi-Use Path [1]	-
Trenton Rd	101st Airborne Pkwy	Tiny Town Rd	Multi-Use Path [1]	-
Wilma Rudolph Blvd	Outside Project Area	Oakland Rd	Sidewalks + Bike Routes	1,000
			Subtotal	**$ 1,000**
			TOTAL	**$ 97,860**
			Estimated Planning and Engineering Contingency @ 20%	**$ 19,572**
			Subtotal	**$ 117,432**
			Project Development, Administration and Management Contingency @ 15%	**$ 17,615**
			GRAND TOTAL	**$ 135,047**

Notes:
1 Costs for multimodal improvements integrated into new roadway sections are included in unit costs for roadway Improvements.
2 Estimated construction costs assume full-depth construction of pavement areas. Engineering, utility relocation, and right-of-way costs are not included.
3 The estimated construction costs for interstate mainline assumes widening for two travel lanes and two shoulders.
4 The estimated construction costs for interstate ramps assume widening for one travel lane and one shoulder.
5 Structure costs have been added for Dunlop Lane, Jack Miller Thoroughfare, and I-24. I-24 Structure Widening costs include 5 potential structures. Wilma Rudolph Blvd does not include potential retaining walls.
6 State Projects with Federal Funds (I-24) Assumed at 80% Federal Funds and 20% State Funds.

Table 12: Program-Level Cost Summary by Jurisdiction (MONTGOMERY COUNTY OBLIGATION)

DESCRIPTION	FROM	TO	RECOMMENDED IMPROVEMENTS	COST (x1000) [2]
2030 Recommended Roadway Improvements				
Dunlop Lane	International Blvd	Rossview Rd	Minor Arterial: New 2 Lane Roadway	5,300
			Subtotal	**$ 5,300**
Recommended Operational Improvements				
Kirkwood Rd	Dunlop Ln	Rossview Rd	Widen Shoulders	460
Dunlop Ln	Wilma Rudolph Blvd	Kirkwood Rd	Widen Shoulders and Improve Vertical Profile	500
Rollow Ln	Dunlop Ln	Rossview Rd	Widen Shoulders and Improve Vertical Profile	590
Hampton Station Rd	Guthrie Hwy	Charles Bell Rd	Smooth Railroad Crossing	5
Charles Bell Rd	International Blvd	Dunlop Ln	Widen Shoulders	370
			Subtotal	**$ 1,925**
Recommended Mulitmodal Improvements				
Dunlop Ln Extension	Existing Dunlop Ln	Rossview Rd	Sidewalks + Bike Routes [1]	-
Rossview Rd	Warfield Blvd	Kirkwood Rd	Multi-Use Path [1]	-
Dunlop Ln	International Blvd	Dunlop Ln Extension	Sidewalks + Bike Routes	2,600
Dunlop Ln	Dunlop Ln Extension	County	Bike Route	660
Rollow Ln	Dunlop Ln	Rossview Rd	Bike Route	420
			Subtotal	**$ 3,680**
			TOTAL	**$ 10,905**
			Estimated Planning and Engineering Contingency @ 20%	**$ 2,181**
			Subtotal	**$ 13,086**
			Project Development, Administration and Management Contingency @ 15%	**$ 1,963**
			GRAND TOTAL	**$ 15,049**

Notes:
1 Costs for multimodal improvements integrated into new roadway sections are included in unit costs for roadway Improvements.
2 Estimated construction costs assume full-depth construction of pavement areas. Engineering, utility relocation, and right-of-way costs are not included.

Table 13: Program-Level Cost Summary by Jurisdiction
(CITY OF CLARKSVILLE OBLIGATION)

DESCRIPTION	FROM	TO	RECOMMENDED IMPROVEMENTS	COST (x1000) [2]
2030 Recommended Roadway Improvements				
Jack Miller Thoroughfare	Wilma Rudolph	Needmore Rd	Arterial Blvd: New 4 Lane Roadway [5]	30,000
Dunlop Lane	Ted Crozier Blvd	International Blvd	Arterial Blvd: Widen from 2 to 4 Lanes [5]	6,800
Professional Park Drive	Dunlop Lane	Cardinal Lane	Collector: New 2 Lane Roadway	5,100
			Subtotal	**$ 41,900**
Recommended Operational Improvements				
Dunlop Ln	Wilma Rudolph Blvd	Kirkwood Rd	Widen Shoulders and Improve Vertical Profile	500
Alfred Thun Rd	Guthrie Hwy	International Blvd	Smooth Railroad Crossing	5
Old Russelville Pke	Needmore Rd	Warfield Blvd	Add Curb and Gutter and Sidewalk	570
Needmore Rd	Wilma Rudolph Blvd	Trenton Rd	Close Commercial Driveway with Angled Parking	10
			Subtotal	**$ 1,085**
Recommended Mulitmodal Improvements				
Jack Miller Thoroughfare	Wilma Rudolph Blvd	Needmore Rd	Sidewalks + Bike Routes [1]	-
Dunlop Ln	Ted Crozier Blvd	International Blvd	Sidewalks + Bike Routes [1]	-
Professional Park Dr	Dunlop Ln	Cardinal Ln/Rossview Rd	Sidewalks + Bike Routes [1]	-
Ted Crozier Blvd	Wilma Rudolph Blvd	Rossview Rd	Bike Route	830
Warfield Blvd	101st Airborne Pkwy	Outside Project Area	Multi-Use Path	280
Needmore Rd	Wilma Rudolph Blvd	Trenton Rd	Bike Route	350
Oakland/ Merriwether Rd	Guthrie Hwy	Trenton Rd	Bike Route	1,130
Old Russellville Pke	Wilma Rudolph Blvd	St. Bethlehem ES	Sidewalks	760
			Subtotal	**$ 3,350**

Table 13 Continued: Program-Level Cost Summary by Jurisdiction (CITY OF CLARKSVILLE OBLIGATION)

TOTAL	**$**	**46,335**
Estimated Planning and Engineering Contingency @ 20%	**$**	**9,267**
Subtotal	**$**	**55,602**
Project Development, Administration and Management Contingency @ 15%	**$**	**8,340**
GRAND TOTAL	**$**	**63,942**

Notes:
1. Costs for multimodal improvements integrated into new roadway sections are included in unit costs for roadway Improvements.
2. Estimated construction costs assume full-depth construction of pavement areas. Engineering, utility relocation, and right-of-way costs are not included.
3. Structure costs have been added for Dunlop Lane, Jack Miller Thoroughfare, and I-24. I-24 Structure Widening costs include 5 potential structures.

Table 14: Program-Level Cost Detail by Improvement Category (RECOMMENDED ROADWAY IMPROVEMENTS[6])

DESCRIPTION	FROM	TO	RECOMMENDED IMPROVEMENTS	COST (x1000) [2]
2030 Recommended Roadway Improvements				
I-24	South of SR 76	Fort Campbell Blvd/US 41	Interstate: 6 lanes with median [3, 5]	52,500
I-24 @ Wilma Rudolph Blvd/Guthrie Hwy	All 4 Ramps		Add 1 Lane Each Ramp [4]	500
I-24@Trenton	EB ON, WB OFF		Add 1 Lane Each Ramp [4]	500
I-24@Rossview	EB ON, WB OFF		Add 1 Lane Each Ramp [4]	500
Wilma Rudolph/Guthrie Hwy	I-24	Oakland Rd/ Meriwether Rd	Principal Arterial: Add 1 Lane Each Direction	1,600
Wilma Rudolph/Guthrie Hwy	Oakland Rd/ Meriwether Rd	International Blvd	Principal Arterial: Add 1 Lane Each Direction	4,300
Rossview Rd	Warfield Blvd	Kirkwood Rd	Principal Arterial: Add 1 Lane Each Direction	19,000
Trenton Rd	Wilma Rudolph	Tiny Town Rd	Principal Arterial: Add 1 Lane Each Direction	16,200
Jack Miller Thoroughfare	Wilma Rudolph	Needmore Rd	Arterial Blvd: New 4 Lane Roadway [5]	30,000
Dunlop Lane	Ted Crozier Blvd	International Blvd	Arterial Blvd: Widen from 2 to 4 Lanes [5]	6,800
Dunlop Lane	International Blvd	Rossview Rd	Minor Arterial: New 2 Lane Roadway	5,300
Professional Park Drive	Dunlop Lane	Cardinal Lane	Collector: New 2 Lane Roadway	5,100
			Subtotal	**$ 142,300**
			Estimated Planning and Engineering Contingency @ 20%	**$ 28,460**
			Subtotal	**$ 170,760**
			Project Development, Administration and Management Contingency @ 15%	**$ 25,614**
			GRAND TOTAL	**$ 196,374**

Notes:

1 Costs for multimodal improvements integrated into new roadway sections are included in unit costs for roadway Improvements

2 Estimated construction costs assume full-depth construction of pavement areas. Engineering, utility relocation, and right-of-way costs are not included.

3 The estimated construction costs for interstate mainline assumes widening for two travel lanes and two shoulders.

4 The estimated construction costs for interstate ramps assume widening for one travel lane and one shoulder.

5 Structure costs have been added for Dunlop Lane, Jack Miller Thoroughfare, and I-24. I-24 structure widening costs include five potential structures. Wilma Rudolph Blvd does not include potential retaining walls.

6 State Projects with Federal Funds (I-24) Assumed at 80% Federal Funds and 20% State Funds.

Table 15: Program-Level Cost Detail by Improvement Category (RECOMMENDED OPERATIONAL IMPROVEMENTS)

DESCRIPTION	FROM	TO	RECOMMENDED IMPROVEMENTS	COST (x1000) [1]
Recommended Operational Improvements				
Kirkwood Rd			Widen Shoulders	460
Rossview Rd			Widen Shoulders and Improve Vertical Profile	1,550
Dunlop Ln			Widen Shoulders and Improve Vertical Profile	1,000
Rollow Ln			Widen Shoulders and Improve Vertical Profile	590
Hampton Station Rd			Smooth Railroad Crossing	5
Charles Bell Rd			Widen Shoulders	370
Alfred Thun Rd			Smooth Railroad Crossing	5
Old Russelville Pke			Add Curb and Gutter and Sidewalk	570
Needmore Rd			Close Commercial Driveway with Angled Parking	10
Wilma Rudolph Blvd			Add Sidewalk	210
			Subtotal	**$ 4,770**
			Estimated Planning and Engineering Contingency @ 20%	**$ 954**
			Subtotal	**$ 5,724**
			Project Development, Admininstration and Management Contingency @ 15%	**$ 859**
			GRAND TOTAL	**$ 6,583**

Notes:
[1] Estimated construction costs assume full-depth construction of pavement areas. Engineering, utility relocation, and right-of-way costs are not included.

Table 16: Program-Level Cost Detail by Improvement Category (RECOMMENDED MULTIMODAL IMPROVEMENTS)

DESCRIPTION	FROM	TO	RECOMMENDED IMPROVEMENTS	COST (x1000) [2]
Recommended Mulitmodal Improvements [3]				
Jack Miller Thoroughfare	Wilma Rudolph Blvd	Needmore Rd	Sidewalks + Bike Routes [1, 4]	-
Dunlop Ln	Ted Crozier Blvd	International Blvd	Sidewalks + Bike Routes [1, 4]	-
Dunlop Ln Extension	Existing Dunlop Ln	Rossview Rd	Sidewalks + Bike Routes [1, 4]	-
Rossview Rd	Warfield Blvd	Kirkwood Rd	Multi-Use Path [1]	-
Professional Park Dr	Dunlop Ln	Cardinal Ln/ Rossview Rd	Sidewalks + Bike Routes [1, 4]	-
Trenton Rd	101st Airborne Pkwy	Tiny Town Rd	Multi-Use Path [1]	-
Wilma Rudolph Blvd	Outside Project Area	Oakland Rd	Sidewalks + Bike Routes [1, 4]	1,000
Ted Crozier Blvd	Wilma Rudolph Blvd	Rossview Rd	Bike Route [4]	830
Dunlop Ln	Wilma Rudolph Blvd	Ted Crozier Blvd	Sidewalks + Bike Routes [4]	2,600
Dunlop Ln	Dunlop Ln Extension	County	Bike Route [4]	660
Warfield Blvd	101st Airborne Pkwy	Outside Project Area	Multi-Use Path	280
Needmore Rd	Wilma Rudolph Blvd	Trenton Rd	Bike Route [4]	350
Oakland/Merriwether Rd	Guthrie Hwy	Trenton Rd	Bike Route [4]	1,130
Rollow Ln	Dunlop Ln	Rossview Rd	Bike Route [4]	420
Old Russellville Pke	Wilma Rudolph Blvd	St. Bethlehem ES	Sidewalks	760
			Subtotal	**$ 8,030**
			Estimated Planning and Engineering Contingency @ 20%	**$ 1,606**
			Subtotal	**$ 9,636**
			Project Development, Administration and Management Contingency @ 15%	**$ 1,445**
			GRAND TOTAL	**$ 11,081**

Notes:

1 Costs for multimodal improvements integrated into new roadway sections are included in unit costs for roadway Improvements.

2 Estimated construction costs assume full-depth construction of pavement areas. Engineering, utility relocation, and right-of-way costs are not included.

3 Sidewalks should be included in the design of all commercial streets and residential major street construction projects (in accordance with the City of Clarksville Sidewalk Program Ordinance).

4 Bicycle facilities should include design features on all new and reconstructed streets to provide a minimum level of safety and comfort to bicyclists. The features include, at a minimum, pavement widths that allow bicyclists to comfortably share the roadway with automobiles, bicycle safe drainage grates and bicycle sensitive detectors at signals. Bike lanes can be non-painted (or integrated) depending on the context of the corridor.

Appendix A

- Travel Demand Model Report

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Introduction

The Montgomery County Travel Demand Model (TDM) [1]was used to determine the future transportation network needs of the Study Area. A travel demand model uses a set of travel analysis zones (TAZs) and a travel network connecting the TAZs to predict area-wide travel patterns. A model uses population demographics, land uses within the TAZs, the characteristics of the travel network links, and the spatial relationship between the zones and network to make the travel predictions.

The Montgomery County travel demand model was designed to be used on a county-wide basis. However, the transportation network of the Northeast St. Bethlehem Study Area was not sufficiently represented in the County model to produce satisfactory information for major city and county maintained roadways for this project. Thus, a refined-area travel model was created for this study.

In a refined model, the area in question (the Study Area) is given greater detail in the model, while the area outside the Study Area remains the same. The transportation network modeled in the Study Area was expanded, and the TAZs in the Study Area were disaggregated to better load traffic on the more extensive roadway network, to place more trips on the roadway network that previously remained internal to the larger TAZs, and to create more origins and destinations within the Study Area (i.e., more trip interactions between the new smaller TAZs than occurred between the larger TAZs).

While the travel was being refined for the Study Area, the base year of the entire Montgomery County TDM moved from year 2002 to the year 2005. The traffic assignment performance of the TDM with additional network and TAZs was compared to year 2002 traffic counts throughout Montgomery County to revalidate the TDM, and the traffic assignment performance of the TDM in year 2005 was compared to year 2005 traffic counts. As part of the study, recent development activity and growth trends were used to update the growth forecasts for the Study Area for the year 2030 while maintaining the previous countywide growth control totals.

The refined model was then run a number of times to determine general transportation needs in the area, particular areas with insufficient vehicular capacity, potential alternatives for relieving congestion, and the results of the final roadway improvement recommendations.

[1] Provided by the Clarksville Urbanized Area Metropolitan Planning Organization.

Existing Model

The Montgomery County travel demand model is part of a two-county model that covers Montgomery County, Tennessee and Christian County, Kentucky. Though the assumptions for each county affect the model results of the other, the model is only run for one county at a time. The model uses TransCAD (version 4.8) as its software platform. The model uses a sequential demand modeling arrangement to predict vehicle trips: trip generation, trip distribution, mode choice, and traffic assignment.

The existing model bases its roadway adequacy estimates on the 30th highest hour of the year, which is also the design hour volume (DHV) used by the Tennessee Department of Transportation (TDOT), instead of the 100th highest hour, which is more typical of travel urban demand models. This will yield more conservative results – greater transportation improvement needs if the minimum acceptable level-of-service (LOS) is D in urban areas. [The difference between the 30th highest hour and 100th highest hour is about 20% in traffic volumes. Thus, a LOS E for the 30th highest hour is a LOS D for the 100th highest hour, and so forth.]

TRAFFIC ANALYSIS ZONES

The TAZ structure contains the socio-economic information for generating trips to be loaded onto the surrounding roadway network (that is being modeled). TAZs provide the origins and destinations for all the travel demand model trips. There are 202 TAZs in the existing Montgomery County model.

TAZ Attributes

The attributes of each individual TAZ reflect the specific socio-economic characteristics of that TAZ. These characteristics will determine how many trips are produced and attracted to each TAZ and the purposes of those trips. The land use and population demographic inputs for the TAZs are listed below:

- Population
- Employment
- Retail Employment
- Non-retail Employment
- Vehicles
- Households
- Dwelling Units
- Workers
- Population per Household
- Vehicles per Household
- Households per Dwelling Unit
- Area Type

Each TAZ is assigned one of four possible area types: Central Business District (CBD), Urban, Suburban, or Rural. These area types affect the behavior of trips (i.e., typically

the trip length distribution) in the TAZs. An "Area Type" field is also present in the transportation network's characteristics to affect travel time and roadway capacity.

Demographic Data

The socio-economic data for the existing model is based on the Census Transportation Planning Package (CTPP) from the 2000 Census and other data available from the States of Tennessee and Kentucky.

TRANSPORTATION NETWORK

A transportation network represents roads, highways, interstates, and any other built ways upon which to travel, including transit lines, bike-ways, or HOV lanes. The Montgomery County model is limited to roadways.

Network Attributes

The attributes associated with each piece of the roadway network help determine how attractive a road is to be used for a trip. High-capacity and high-speed roads tend to attract more traffic because they minimize the travel-time between zones. The roadway characteristics used by the model are listed below:

- Functional Class
- Area Type
- Lanes
- Capacity per Lane
- Total Peak Capacity (in each direction)
- Total Daily Capacity (both directions)
- Peak Speed
- Off-peak Speed
- Daily Base Travel Time

Only the functional class, area type, and number of lanes are independent input variables. All the other roadway characteristics are determined by the values present in these three fields. The speeds and capacities of the roadway network for the various functional classes and area types are summarized below in Table 1.

Table 1 – Roadway Network Speed Capacity Values

Functional Classification	Area Type	Vehicle Capacity per Lane	Daily Vehicle Capacity per Lane	Free-flow Speed (mph)	Congested Speed (mph)
Freeway	Rural	1,750	11,667	70	65
	Suburban	1,750	12,500	65	60
	Urban	1,750	14,000	60	55
	CBD	1,750	17,500	55	50
Freeway Ramp	Rural	700	4,667	45	40
	Suburban	700	5,000	40	35
	Urban	700	5,600	35	30
	CBD	700	7,000	30	25
Expressway	Rural	1,400	9,333	55	50
	Suburban	1,400	10,000	50	45
	Urban	1,400	11,200	45	40
	CBD	1,400	14,000	40	35
Principal Arterial	Rural	1,200	8,000	53	47
	Suburban	1,200	8,571	45	41
	Urban	1,200	9,600	40	35
	CBD	1,200	12,000	35	32
Minor Arterial	Rural	1,000	6,667	50	45
	Suburban	1,000	7,143	40	35
	Urban	1,000	8,000	35	30
	CBD	1,000	10,000	30	26
Collector	Rural	800	5,333	45	40
	Suburban	800	5,714	33	33
	Urban	800	6,400	30	25
	CBD	800	8,000	25	22
Centroid Connector	Rural	3,000	30,000	25	22
	Suburban	3,000	30,000	25	22
	Urban	3,000	30,000	25	20
	CBD	3,000	30,000	25	15

MODEL PROCESS

Trip Generation

Trip generation is the first step in the demand modeling process. Trip generation is a process which estimates the number of trips produced or attracted by a particular land use or collection of land uses. Within a travel demand model, the trip generation step calculates the number of trips produced and attracted by each TAZ in the model. The attributes of each TAZ determine how many trips are generated. There are usually a number of trip purposes which are calculated separately. The trip purposes contained in the Montgomery County model are:

- Home Based Work (HBW) – home to work trips

- Non-Home Based (NHB) – trips originating from a non-home location
- Home Based Other (HBO) – home to other location, including recreation, personal business, etc.
- Commercial Vehicle (CMV) – trips made for business by commercial vehicles
- External-Internal (EI) – trips made from outside the modeled area to a destination inside the modeled area

External Trips

External-External (EE) trips are those that have both ends of the trip outside the county, but use the Study Area to get to their destination. EE trips are handled differently by the model than the other trip purposes. Instead of calculating the number of EE trips based on the TAZ attributes, a pre-determined number of EE trips were used. The EE trips, including their origin and destination zones, were based on field traffic counts and standard growth factor techniques were used to estimate future EE volumes.

Special Generators

Special generators are sites which exhibit trip behavior that cannot be replicated by the standard trip generation equations. Usually special generators are unique or rare in nature, such as a sports arena or airport, or have a special population of trip-makers, such as a university or other school. Special generators that were incorporated into the Montgomery County travel model were Gateway Medical Center, Austin Peay University, Draughons Junior College, and public schools (K-12). Trips for the special generators are calculated separately from the rest of the model TAZs. Although the Fort Campbell Military Base is partially located in Montgomery County, the Montgomery County TDM excludes the geographic area of the military base, and treats trips for the military base as external to the TDM (i.e., external-external and external-internal trips).

(See Appendix A for a graphical representation of the model trip generation.)

Trip Distribution

Trip distribution is the second step of the traditional modeling process. In the trip distribution step, origin-destination pairs are created from the individual trip-ends produced in the trip generation step. That is, trip generation calculates how many trips are being produced; whereas, trip distribution calculates where those trips are going.

The Montgomery County model uses a traditional gravity model methodology to calculate trip distribution. The gravity model methodology says that the desirability of a particular destination is greater with greater “mass” but the desirability also decreases with increased travel time from the origin.

Each trip purpose is distributed separately because travel behavior differs according to trip purpose. For example, people will generally travel longer for work than for groceries, and thus will make different destination choices for each purpose.

Mode Choice

Mode Choice is the third step of the traditional modeling process. All origin-destination trip pairs estimated in trip distribution are in person-trips. To convert the person-trips to vehicle-trips, an auto occupancy factor was applied for each trip purpose. The auto occupancy factors are presented below in Table 2.

Table 2 – Auto Occupancy Factors

Trip Purpose	Auto Occupancy Factor
HBW	1.08
HBO	1.20
NHB	1.15
CMV	1.00
EI	1.00

No transit modes are included in the Montgomery County model.

Traffic Assignment

The final step in the modeling process is the traffic assignment. In this step the vehicle-trips calculated from the origin-destination pairs are assigned to the network. The Montgomery County model uses an iterative, user equilibrium assignment. This methodology re-assigns some vehicles from the previous iteration. If certain network facilities are overloaded (and, hence, slow and congested) then some vehicles can be re-assigned to reasonable alternative routes.

Refined-Area Model Development

The Study Area for the NE St. Bethlehem project is roughly bounded by Rossview Drive on the south, Trenton Road on the west, Port Royal Road on the east, and the Montgomery County Line on the north. Today, the area is a mix of residential, commercial, and industrial development, with a significant amount of open land (vacant and agricultural) still undeveloped for urban purposes.

The transportation network and TAZ structure within the Study Area was not sufficiently represented in the Montgomery County model to produce satisfactory data for this project, examining the adequacy of major city and county maintained roadways as well as State maintained roadways. Thus, a refined-area travel model was created for this study.

In a refined model, the area in question (the Study Area) is given greater detail in the model, while the area outside the Study Area remains the same. The transportation in the Study Area was expanded and the TAZs in the Study Area were disaggregated to create more origins and destinations within the Study Area.

It was desired to model two years for this project: 2005 (a new Base year) and 2030 (the existing Future year). The existing TDM base year is 2002 and the ultimate future year is also 2030. The socio-economic database for the refined-area model was updated in order to be valid for the year 2005, and it was also updated for the year 2030 to reflect recent development activity and current development trends in the Study Area.

BASE NETWORK UPDATE

The following roads were added to the model base network in the Study Area to provide more detail:

- Cardinal Lane
- Kennedy Lane
- Corporate Parkway Blvd
- Kirkwood Road
- Buck Road
- Rollow Lane
- Ross Road
- Steelstock Road
- Charles Bell Road
- Industrial Park Boulevard

In addition, the alignment of the following roads was updated to reflect their actual alignment:

- Ted Crozier Boulevard
- Dunlop Lane

Also, a field check was performed to verify the number of lanes for all roads in the Study Area. The existing base year network was then updated to reflect these numbers.

The refined-area model base network is shown in Figure 1.

TAZ DISAGGREGATION

In general, the TAZs in the Study Area were split so that major roadways would not cross a zone boundary. This ensures that the TAZs load traffic on the surrounding roadway network because roadways that pass through TAZs tend to load poorly. The TAZs were also split so that the original boundaries were preserved. The ten TAZs that make up the Study Area in the existing model were split to create twenty-five TAZs in the refined-area model. The TAZ aggregate equivalency is shown below in Table 3. The new TAZs were connected to the roadway network with new centroid connectors, where appropriate.

Table 3 – Refined-Area Model TAZ Equivalency

Existing Model TAZ	Refined-Area Model TAZs
7	7 438
9	9 439
10	10 440
12	12 442 443
13	13 441
14	430 431
17	432 433
119	119 434 435
128	128 436 437
426	426 427 428 429

The TAZ structure for the refined-area model is shown in Figure 2.

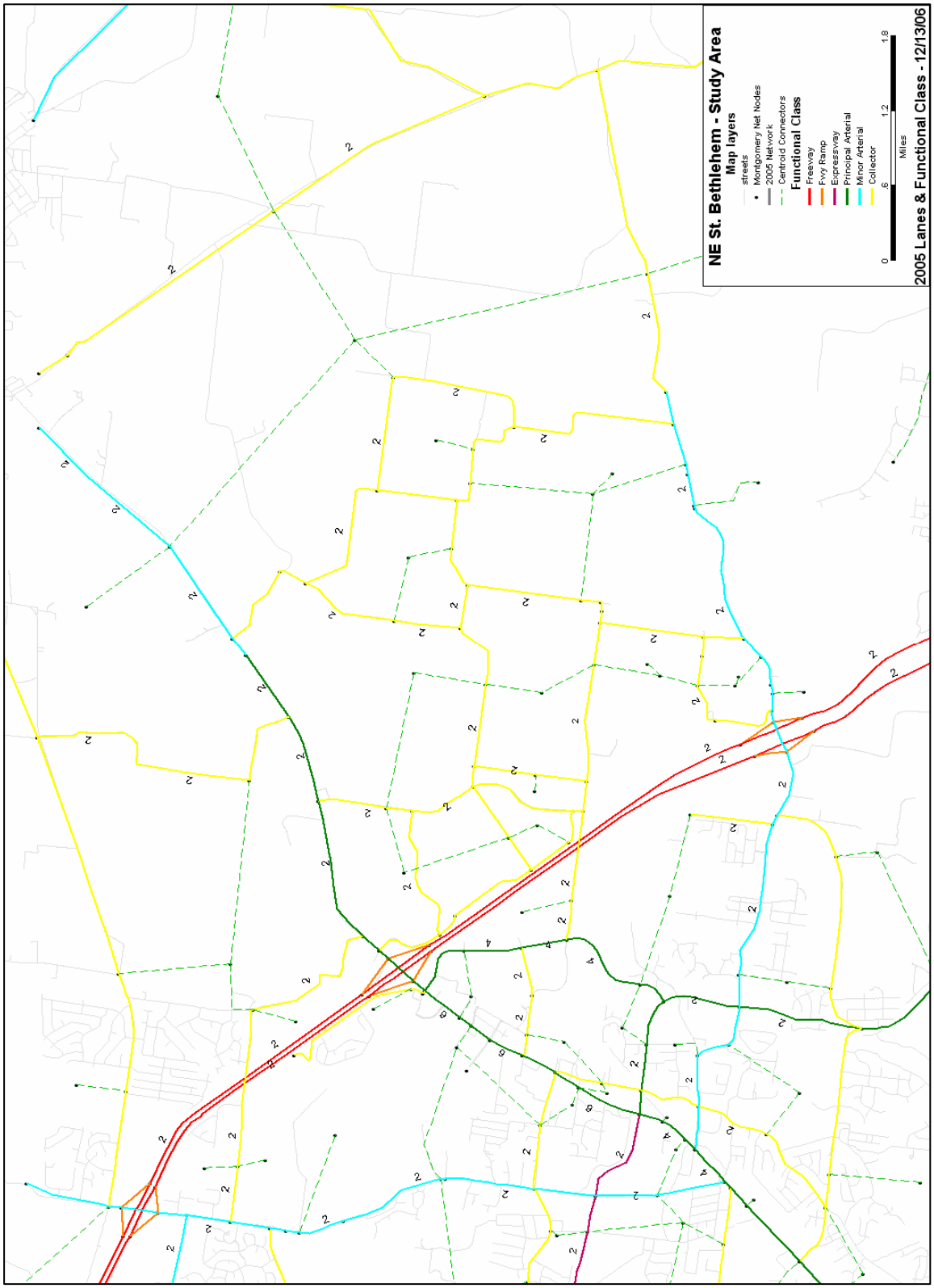


Figure 1 – Refined-Area Model Base Network with Total Lanes

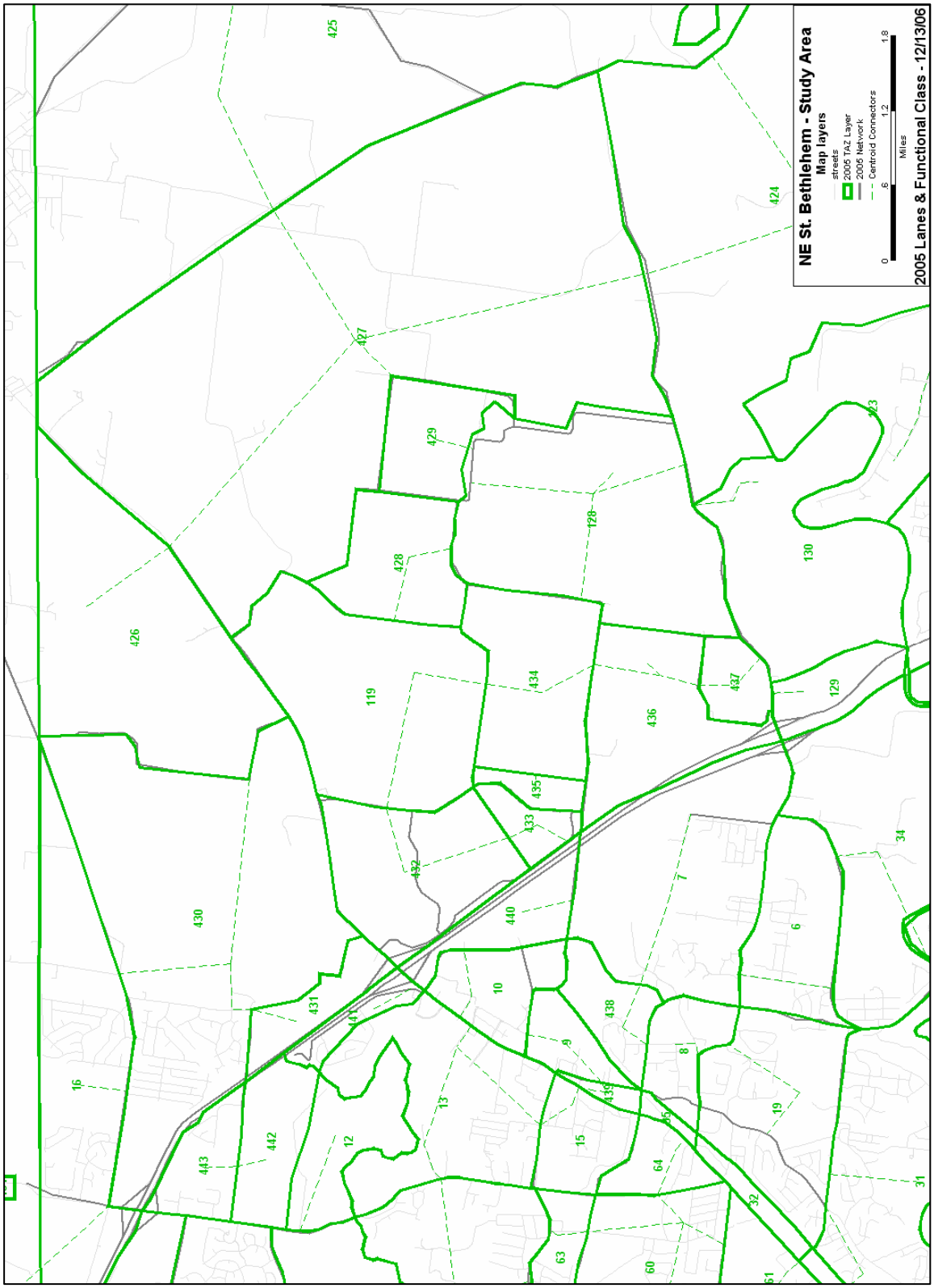


Figure 2 – Refined-Area Model TAZ Structure

Once the refined TAZs were defined, the socio-economic information for the original TAZs was disaggregated for the year 2002, updated to the year 2005, and revised for the year 2030 based on current development activity and trends in the Study Area. While no new special generators were added, special attention was given to the projected future employment at the proposed Gateway Medical Center being constructed along Dunlop Lane in TAZ 440.

Growth Forecasts

As part of the refinement of the Montgomery County TDM for the Northeast St. Bethlehem Study Area, the socio-economic database for the existing TAZs was disaggregated for the year 2002 to reflect the boundaries of the new disaggregated TAZs. To move the Base year of the TDM to the year 2005, the socio-economic database for the new TAZs was moved up to the year 2005 to reflect current development activity and trends, and the TDM modeled network was updated to the year 2005 to reflect roadway improvements completed since the year 2002. Finally, new TAZ growth forecasts to the year 2030 were developed to reflect current development activity and trends in the Study Area while maintaining the countywide year 2030 growth controls of the existing TDM.

FORECAST SUMMARY

The socio-economic forecasts for the Northeast St. Bethlehem Transportation Study Area are as follows for housing units:

- 716 housing units in year 1990 (US Census).
- 1,614 housing units in year 2000 (US Census).
- 1,711 housing units in year 2002 in the original Montgomery County Travel Demand Model (TDM).
- 2,116 housing units in year 2002 based on new housing permits (based on address specific matching to the TAZs).
- 2,548 housing units in year 2005 based on new housing permits → 934 new housing units over the past five years = a 58% increase over past five years.
- 3,982 housing units in year 2030 in the original TDM.
- 6,581 housing units in year 2030 based on preliminary subdivision lots → a 65% increase over the original Travel Model forecast.

The Study Area's portion of Model Area housing increases from 3.2% in year 2002 for the original Travel Model to 6.4% in revised year 2030 forecast for the Study Area. If the pace of growth over the past five years were continued to year 2030, the housing unit estimate in year 2030 would be only 10% higher than the new housing unit forecast for the Study Area. It should be noted that the housing unit forecast for 2030 does not represent build-out of the Study Area. While most of the Study Area will be fully developed west of Interstate 24 by the year 2030, less than half of the Study Area east of Interstate 24 will be built-out in the year 2030.

The Study Area employment forecasts are as follows:

- 14,353 jobs in year 2002 in original Travel Demand Model.
- 15,583 jobs in year 2005 based on development activity and aerial photography interpretation.
- 18,749 jobs in year 2030 in the original TDM.

- 26,611 jobs in year 2030 based on development activity (such as the new Gateway Medical Center) and vacant land currently zoned for industrial and commercial development → **a 42% increase over the original TMD forecast.**

The Study Area's portion of Montgomery County TMD employment is assumed to remain constant at 26.5% between 2002 and 2030. However, if the pace of growth between year 2002 and year 2005 were continued to the year 2030, the job forecast for year 2030 would be only 3% lower. **The employment forecast for 2030 reflects only present commercial and industrial zoning and does not represent build-out of the Study Area.** Because future rezonings to commercial and industrial purposes are not considered, these forecasts are reflective of real development trends since year 2000 **and are not based on speculation.**

2002 TRAVEL ANALYSIS ZONE DATABASE DISAGGREATION

Travel Analysis Zone Splits

In the refinement of the TDM for the Northeast St. Bethlehem Study Area Study, the existing ten TAZs were disaggregated into 25 TAZs to ensure better traffic loading onto the surrounding roadway system (that included more roadway network than the original model). The boundaries of the existing TAZs were respected in the new TAZ geography so that the new zones could be correlated or aggregated to the old zones. Finally, the Alliance Transportation Group of Texas (who prepared the original model) verified that the TAZ disaggregation did not adversely affect the calibration (performance) of the 2002 base year travel model.

2002 TAZ Database Refinement

To generate the year 2002 housing unit estimate for the disaggregated TAZs for the NE St. Bethlehem Study Area the following procedure was followed:

- The 2000 population (from the 2000 Census Block Statistics) for the new TAZ was used initially to disaggregate housing units of original TAZs to new TAZs.
- Next, address-specific new housing unit permits (provided by the City of Clarksville and Montgomery County) for years 2000 and 2001 (assuming housing unit occupancy occurs) 3 to 6 months from issue of permit) were matched to the new TAZs and added to the housing units reported in the 2000 Census Block Statistics. (This method was considered more accurate than the 2002 housing unit estimate in the original model.)
- Finally, minor adjustments were made to the initial disaggreation of housing units by population to reflect the estimate using address-specific new housing unit permits.

For the year 2002 disaggregated TAZ employment, the following methodology was used:

- Year 2000 population was used initially to disaggregate employment from the original TAZs to new TAZs.
- Next, proper disaggregation was verified by information on the top ten employers (as recorded in Clarksville Metropolitan Area Long Range Transportation Plan) and 1998 and 2004 aerial photography. (Employment was flipped in the original TAZ 7 and TAZ 9 for the proper location of Trane.)

2005 TAZ Database Creation

To move the Base year of the TDM up to the year 2005, the TAZ socio-economic database had to be updated to the year 2005 also. The method to generate the year 2005 housing unit estimate for the disaggregated TAZs for the NE St. Bethlehem Study Area and the Balance of Montgomery County Travel Demand Model was as follows:

- The countywide control totals for the year 2005 housing unit estimates for Montgomery County and Christian County came from US Bureau of Census housing unit estimates for 2005.
- The year 2005 housing unit estimates for all TAZs in Montgomery County were based on the addition of address-specific new housing unit permits for years 2000 through 2004 (assuming housing unit occupancy occurs 3 to 6 months from issue of permit) to the number of housing units in the year 2000 from the 2000 Census Block Statistics.
- Next, the year 2005 housing unit estimates for TAZs in the portion of Christian County (that is included in the Montgomery County TDM) were based on maintaining the proportional share of housing units in the Montgomery County TDM to all of Christian County in year 2000 times the 2005 US Bureau of Census housing unit estimate for all of Christian County.

For the 2005 TAZ employment database, the following procedures were used:

- The source of the countywide control totals was 2005 employment data for Montgomery County and Christian County come from Woods & Poole Economics (which uses the US Bureau of Labor Statistics database for 2005).
- The Study Area's year 2005 total employment was derived by maintaining the Study Area's portion of the Montgomery County employment from 2002.
- Finally, the Study Area's year 2005 employment by TAZ was verified on the basis of several sources → the top 10 employers in the Long Range Transportation Plan, industrial activity from the Clarksville-Montgomery County Industrial Development Board, the number of occupied parking spaces in 2004 aerial photography for industrial uses, and factoring up employment in the commercial (retail) use areas to achieve the control total.
- The balance of Travel Model year 2005 total employment was based on maintaining the Model Areas' portion of Montgomery County and Christian County employment from 2002.

- Finally, the balance of Travel Model year 2005 employment by TAZ was derived from interpolation of original TAZ employment estimates for 2002 and 2010 by TAZ and adjustment to 2005 Balance of Travel Model employment control totals.

2030 TAZ Database Projection

Because of development activity since year 2002 (including residential subdivions and rezonings to commercial and industrial use), a new forecast of employment growth was prepared for the year. The following methodology was used for the year 2030 housing unit estimate for the disaggregated TAZs for the NE St. Bethlehem Study Area and the balance of the Montgomery County TDM:

- First, a comparison was made of the population forecasts from several sources. The population estimates for year 2020 from the Clarksville-Montgomery County Growth Plan, the Tennessee Advisory Commission on Intergovernmental Relations, and Woods & Poole Economics were found to be comparable.
- Next, countywide controls totals were established. Because the employment and population forecasts of Woods & Poole Economics (2006 Edition) are interconnected, the household estimates of Woods & Poole for year 2030 were converted to housing units using the vacancy rate in 2005 and maintaining the number of housing units in Ft. Campbell (in Montgomery County) relatively constant. Woods & Poole forecasts were also used for Christian County.
- Then, the year 2030 housing unit estimates for TAZs in the Northeast St. Bethlehem Study Area were developed on the basis of information of preliminary subdivision lots through August 2006 and a graphic of development activity provided by the Clarksville-Montgomery County Regional Planning Commission (see Figure 3). These preliminary subdivision lots were added to the year 2005 housing unit estimate by TAZ to reach the year 2030.

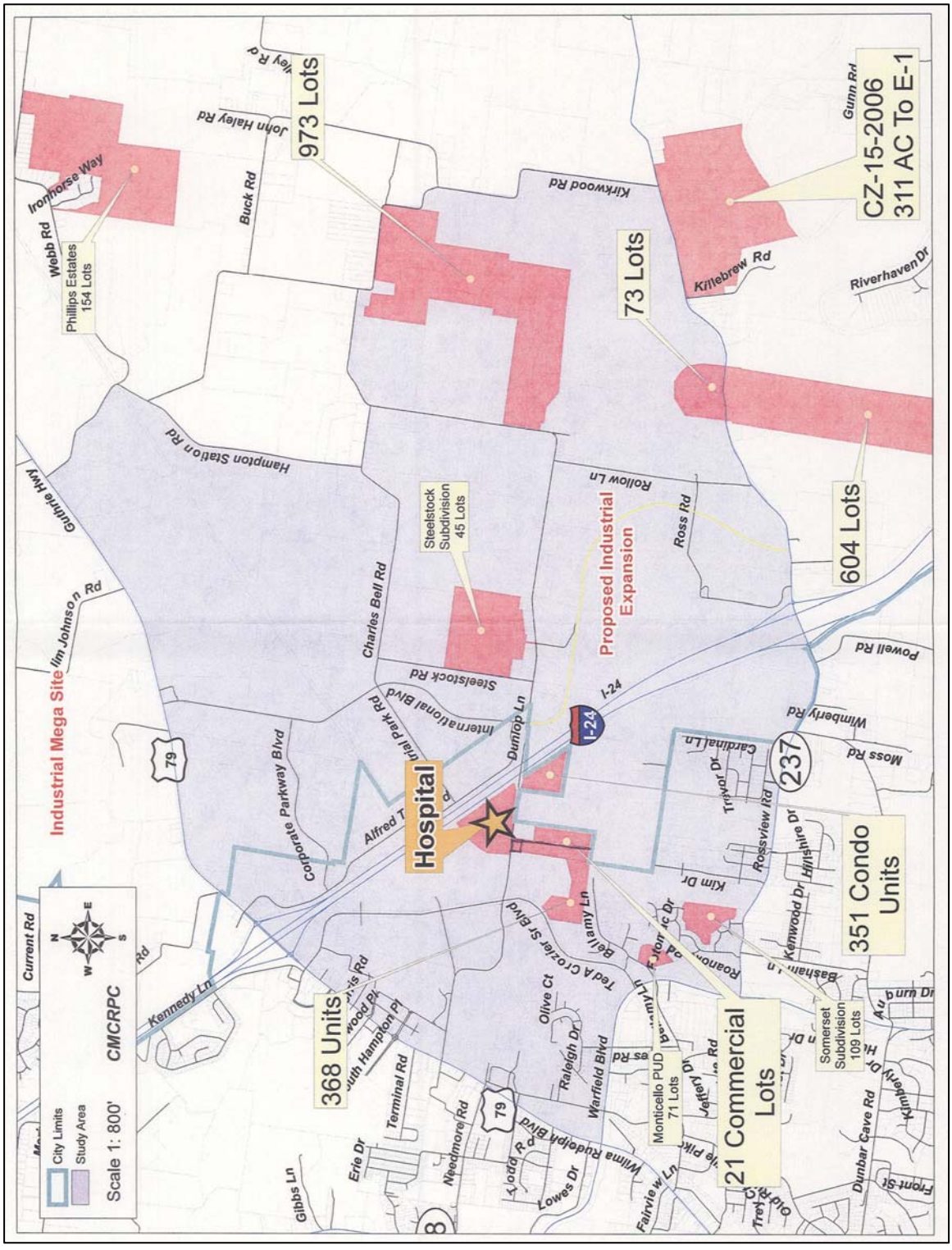


Figure 3: Development Activity

A reasonableness check on the year 2030 forecast for each TAZ was made through comparison with original travel model forecast for 2030 with the decade of growth in 1990s (1990 and 2000 Census Block Statistics) assumed for another 30 years, and with the five years for growth between 2000 and 2005 pushed out another 30 years. Outside the Study Area, the year 2030 housing unit estimates by TAZ from the original travel model were retained. The housing projections for each TAZ in the Study Area are summarized below in Table 4. Figure 4 shows the original 2002 housing numbers associated with the existing model's TAZ structure, and Figure 5 shows the updated housing numbers for 2005 and 2030 with the refined-area model TAZ structure.

Table 4 – Study Area Housing Forecast

Original TAZ	Original 2002 Housing	Refined-Area TAZ	1990 Housing (Census)	2000 Housing (Census)	Original 2002 Disaggregated Housing	Updated 2002 Housing by Permit (2000 Census + 2000-2001 Permits)	Updated 2005 Housing by Permit (2000 Census + 2000-2004 Permits)	Original Disaggregated 2030 Housing
7	516	7	108	273	65	405	536	529
		438	77	221	188	260	273	428
9	143	9	9	94	3806	94	94	192
		439	17	37	50	37	37	75
10	3	10	0	2	4508	2	2	3
		440	2	1	125	1	1	2
12	96	12	2	3	0	3	3	12
		442	21	19	2	19	19	56
		443	11	68	6	68	72	211
13	323	13	138	300	1131	546	599	886
		441	1	0	59	14	39	47
14	345	430	85	313	23	363	534	973
		431	8	8	1	10	10	25
17	2	432	2	2	492	2	2	3
		433	0	0	0	0	0	0
119	66	119	28	44	707	45	49	85
		434	0	20	464	22	23	38
		435	0	0	0	0	0	0
128	42	128	42	36	1207	37	37	68
		436	6	4	111	4	4	8
		437	2	1	37	1	1	2
426	175	426	27	28	182	29	30	57
		427	92	108	877	120	147	218
		428	27	10	102	11	12	20
		429	11	22	210	23	24	44
Total	**1711**		**716**	**1614**	**14353**	**2116**	**2548**	**3982**

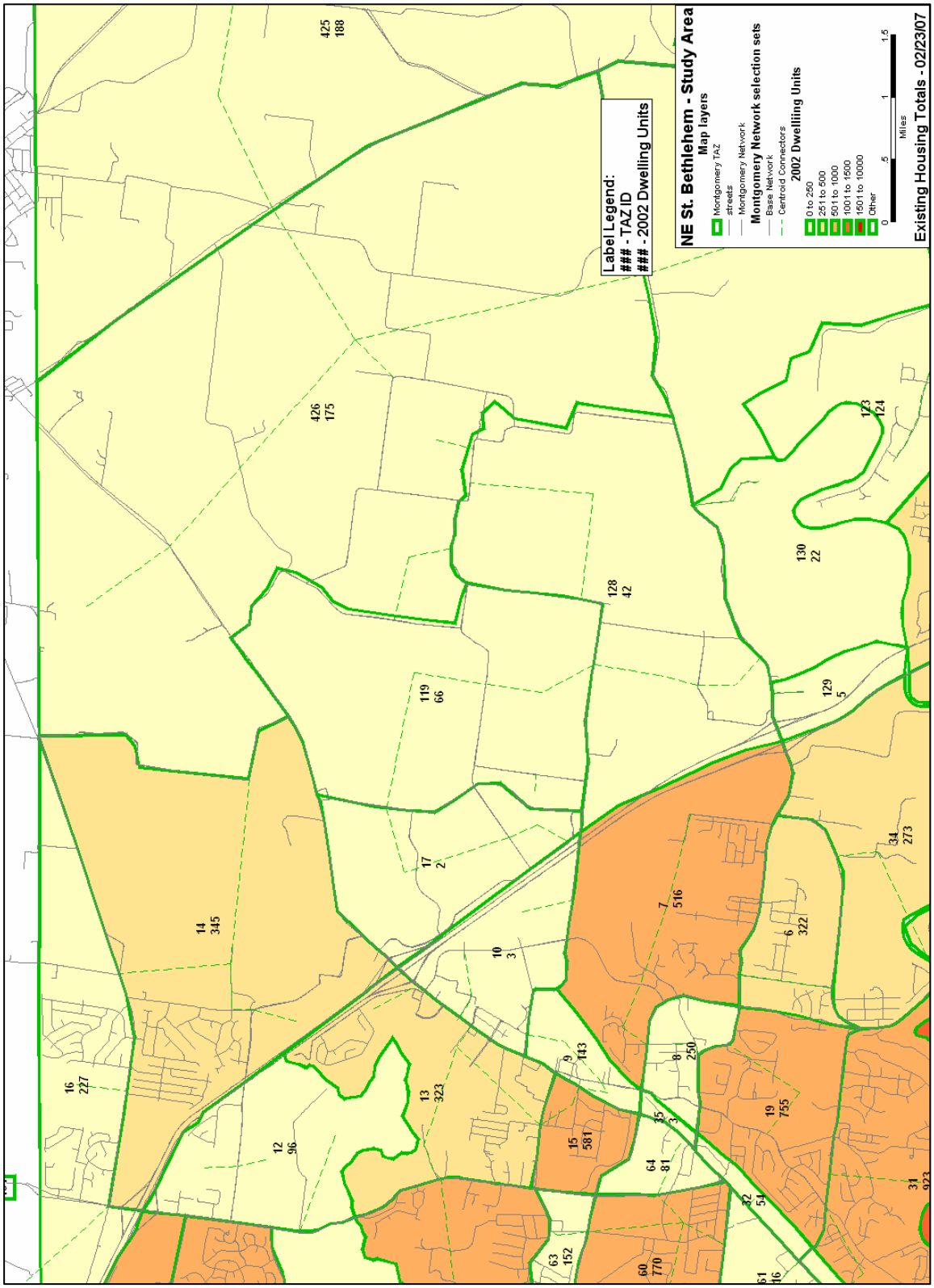


Figure 4: Existing Model 2002 Housing

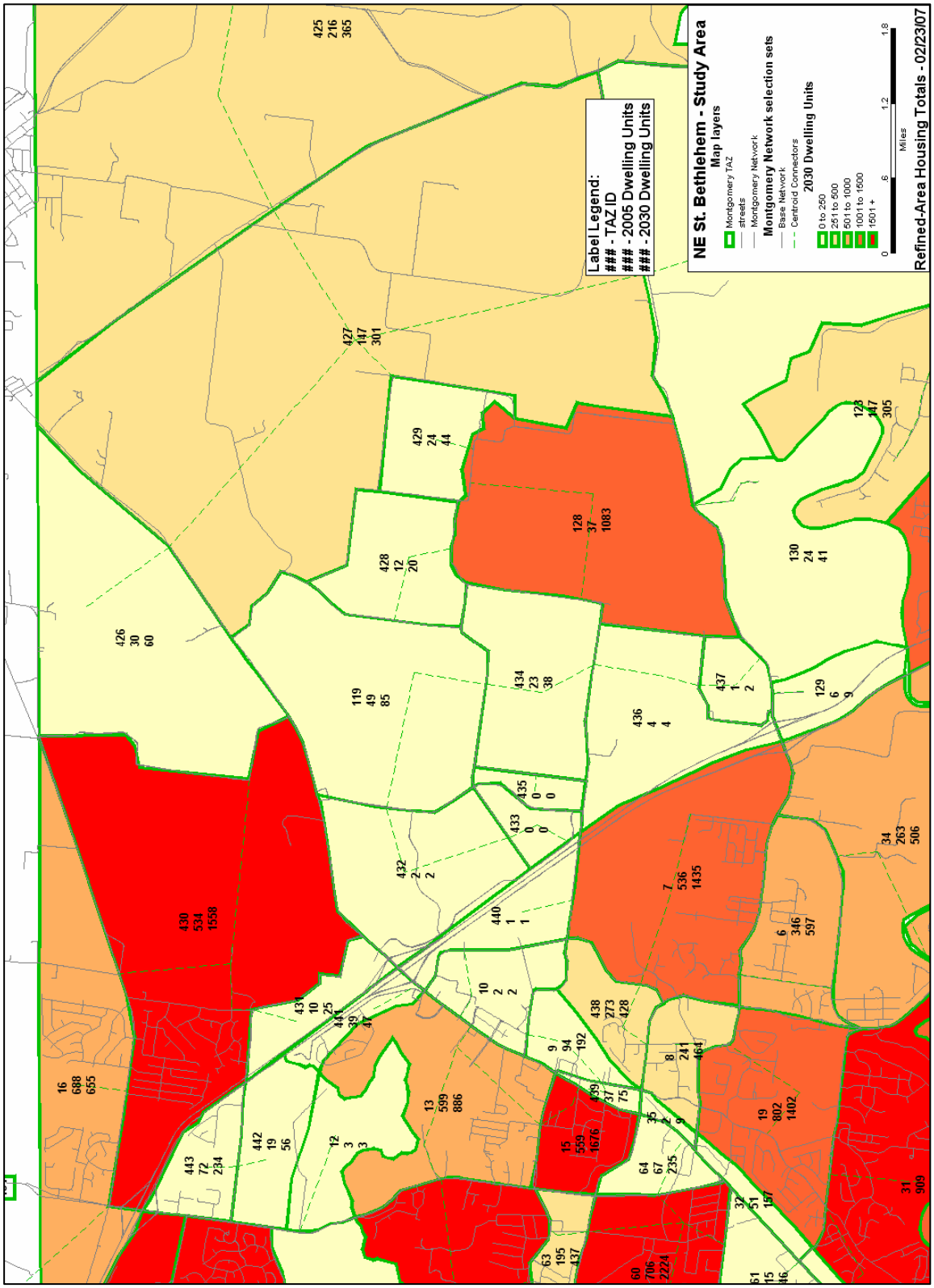


Figure 5 – Refined-Area Model Housing for 2005 and 2030

The following methodology was used to create new year 2030 employment forecasts for the disaggregated TAZs for the Northeast St. Bethlehem Study Area and the balance of Montgomery County TDM:

- For year 2030 employment data for Montgomery County and Christian County, Woods & Poole Economics (using US Bureau of Labor Statistics database forecast for year 2030) forecasts were used for countywide control totals.
- The year 2030 employment control total for the Study Area was based on maintaining the Study Area's portion of the employment in the year 2002.
- The Study Area year 2030 employment by TAZ based on a number of sources:
  - A review of the Gateway Medical Center site plan yielded 1096 employees.
  - A graphic of development activity provided by the Clarksville-Montgomery County Regional Planning Commission (see Figure 3) was examined.
  - A review of vacant land, as currently zoned for industrial and commercial uses (based on zoning district maps for the Study Area), was made using 2004 aerial photography. Employment was determined assuming 10 employees per gross acre.
  - A comparison was made with the original 2030 TAZ TDM forecast to verify that the new employment forecast by TAZ met or exceeded the prior forecast.
  - Finally, the Study Area control total was achieved by factoring industrial employment per acre (roughly 5 employees per gross acre).
- For the balance of the TDM model area, the year 2030 total employment was based on maintaining the Model Areas' portion of Montgomery County and Christian County employment from 2002.
- For the balance of the TDM model area, the year 2030 employment by TAZ was derived by adjusting the original 2030 TAZ employment estimates to the 2030 employment control total for the balance of the TDM model area.

The employment projections for each TAZ in the Study Area are summarized below in Table 5. Figure 6 shows the original 2002 employment numbers associated with the existing model's TAZ structure, and Figure 7 shows the updated employment numbers for 2005 and 2030 with the refined-area model TAZ structure.

A complete listing of housing units and employment for every TAZ in the entire Model Area is found in Appendix B.

Table 5 – Study Area Employment Forecast

Original TAZ	Original* 2002 Emp	Refined-Area TAZ	Original Disaggregated 2002 Employment	Updated 2005 Employment	Original Disaggregated 2030 Employment	Updated 2030 Employment
7	253	7	65	65	2756	440
		438	188	207	1630	407
9	3856	9	3806	3918	581	4043
		439	50	55	202	180
10	4633	10	4508	4958	3442	5283
		440	125	140	1721	1736
12	8	12	0	10	12	10
		442	2	250	61	408
		443	6	30	215	155
13	1190	13	1131	1246	1397	1896
		441	59	69	73	169
14	24	430	23	23	296	1815
		431	1	40	8	290
17	492	432	492	1290	1022	1753
		433	0	640	0	690
119	1171	119	707	1101	1027	1332
		434	464	10	674	704
		435	0	110	0	341
128	1355	128	1207	50	1679	281
		436	111	0	154	1850
		437	37	0	51	810
426	1371	426	182	182	196	760
		427	877	877	945	946
		428	102	102	110	102
		429	210	210	227	210
Total	**14353**		**14353**	**15583**	**18479**	**26611**

* Note: 2002 Employment for TAZ 7 and 9 flipped

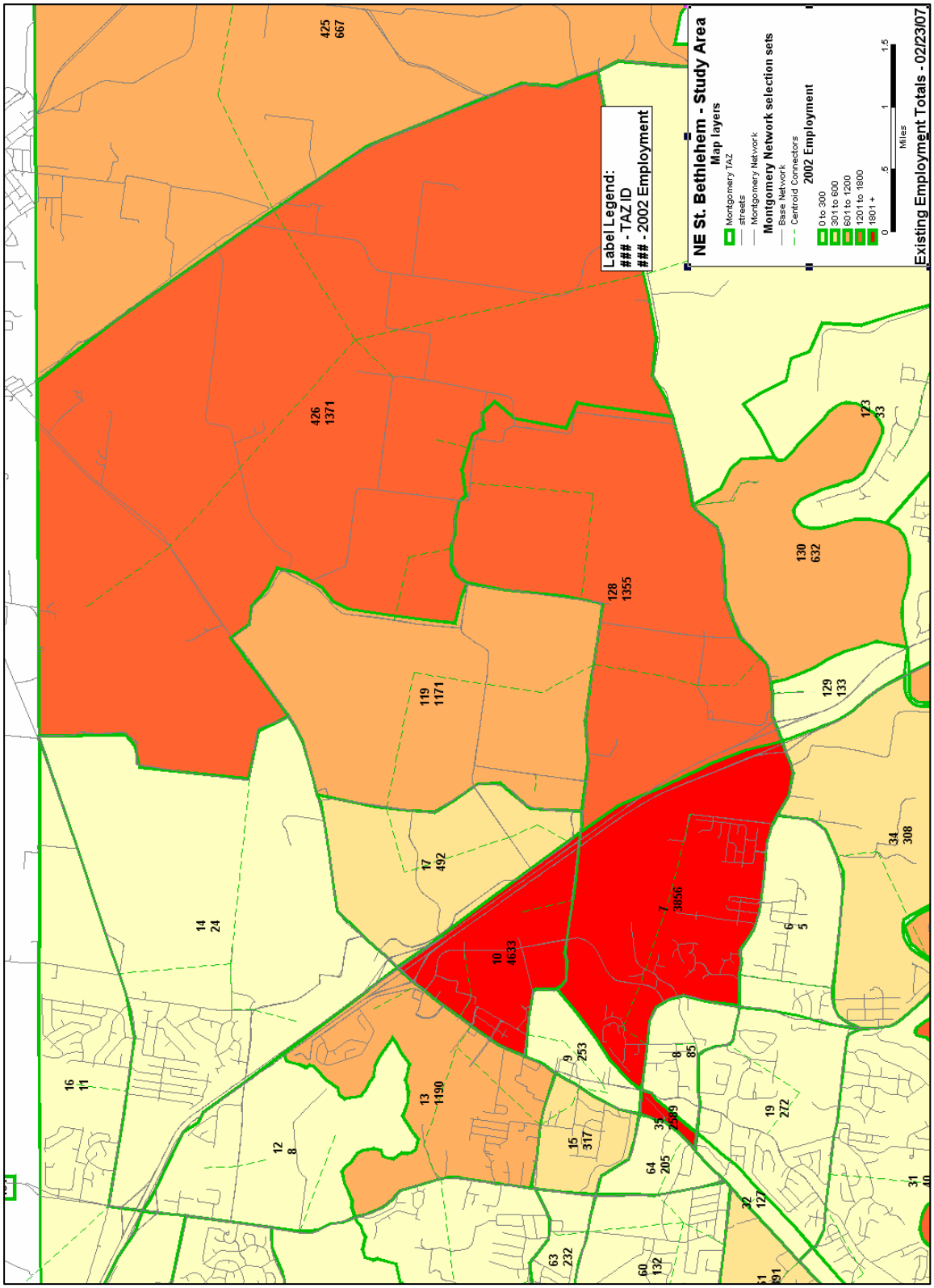


Figure 6: Existing Model 2002 Employment

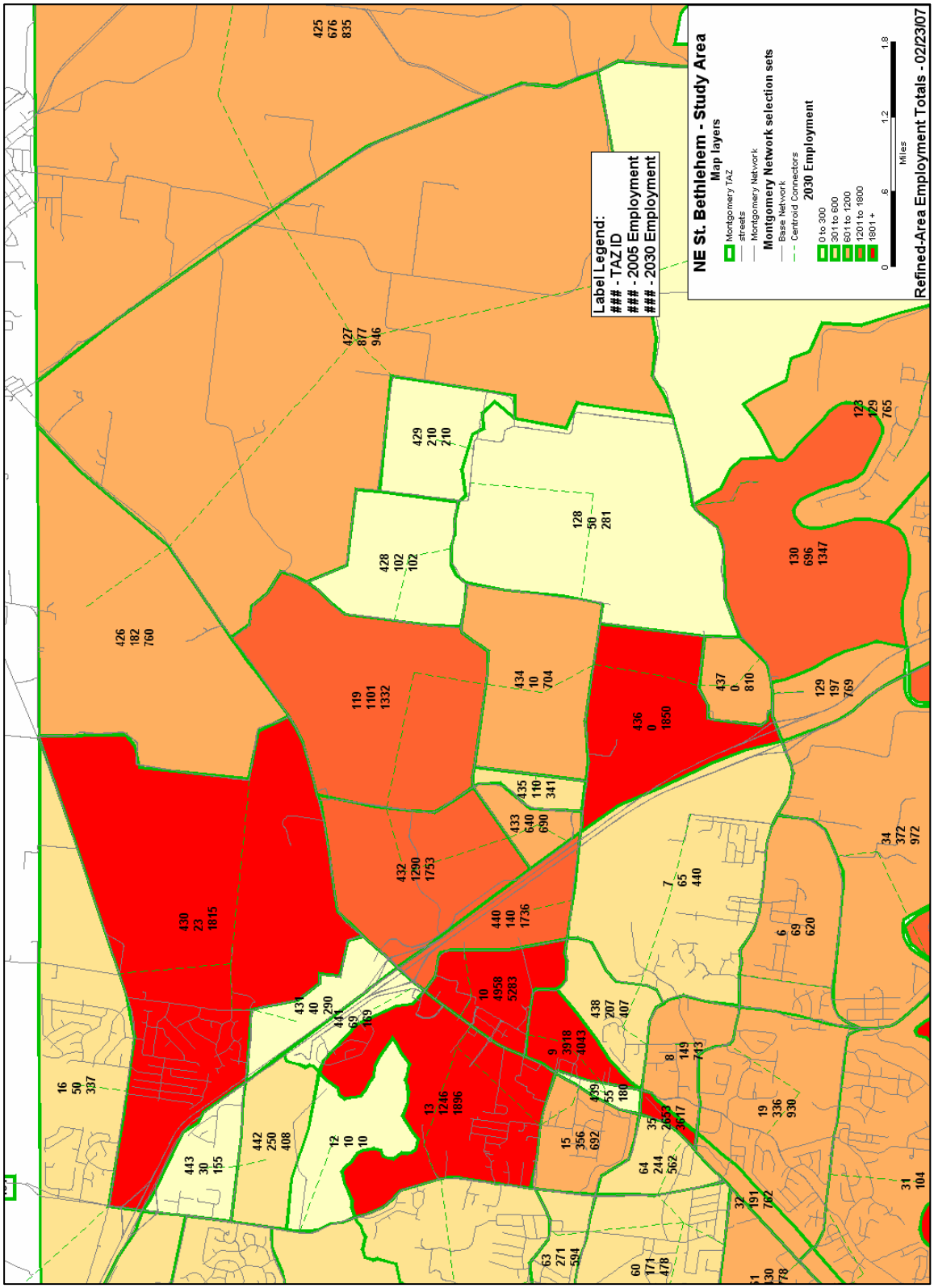


Figure 7 – Refined-Area Employment for 2005 and 2030

Refined-Area Model 2030 E+C Results

2030 E+C NETWORK

In consultation with the City of Clarksville, an Existing plus Committed (E+C) projects list was identified for the future year 2030. These roadway improvement projects were based on the Countywide Transportation Improvement Program (TIP) and Long Range Transportation Plan (LRTP) but also include other projects deemed significant by the City. Table 6 summarizes the roadway improvements in the Study Area that are part of the 2030 E+C Network.

Table 6 – 2030 E+C Study Area Network Changes

Map ID	Roadway	Improvement	Project Termini	Basis
1	International Blvd	Roadway extension - 4 lanes	Dunlop Ln to Rossview Rd	Completed
2	Warfield Blvd	Widen from 2 lanes to 4 lanes	Stokes Rd to Dunbar Cave Rd	TIP
3	Tiny Town Rd	Widen from 2 lanes to 4 lanes	Peacher's Mill Rd to Trenton Rd; Trenton Rd north to I-24	Committed
4	101st Airborne Pkwy	Widen from 2 lanes to 4 lanes	Wilma Rudolph Blvd to Ft. Campbell Blvd	Committed
5	I-24	Widen from 4 lanes to 6 lanes	South of SR 76 to Ft. Campbell Blvd	LRTP
6	Trenton Rd	Widen from 2 lanes to 4 lanes	Wilma Rudolph Blvd to Tiny Town Rd	LRTP
7	Trenton Rd	Reclassify from Minor Arterial to Principal Arterial	Wilma Rudolph Blvd to Tiny Town Rd	

The 2030 E+C network is shown in Figure 8, and the Study Area network changes are highlighted in Figure 9.

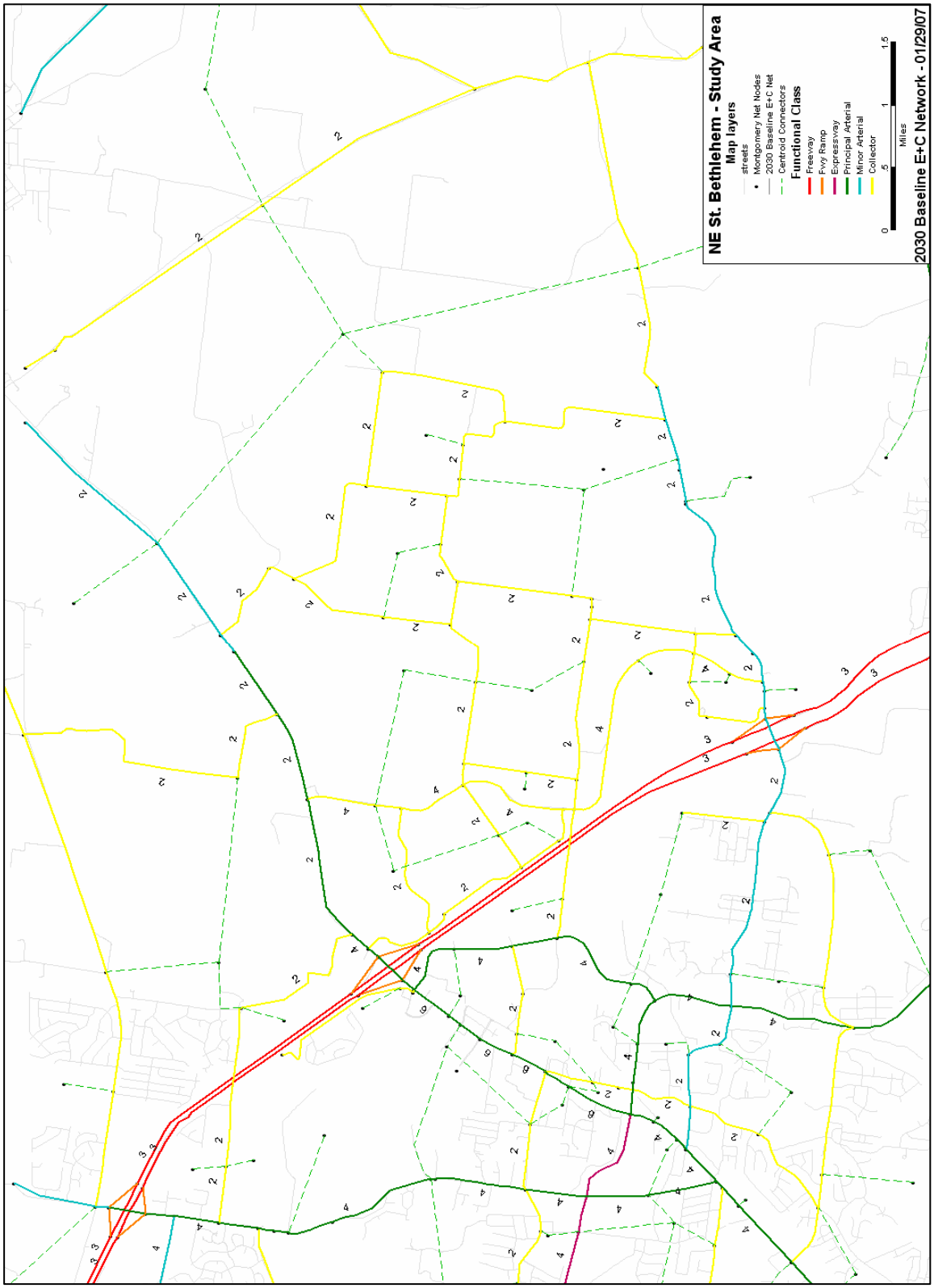


Figure 8 – 2030 E+C Network with Total Lanes

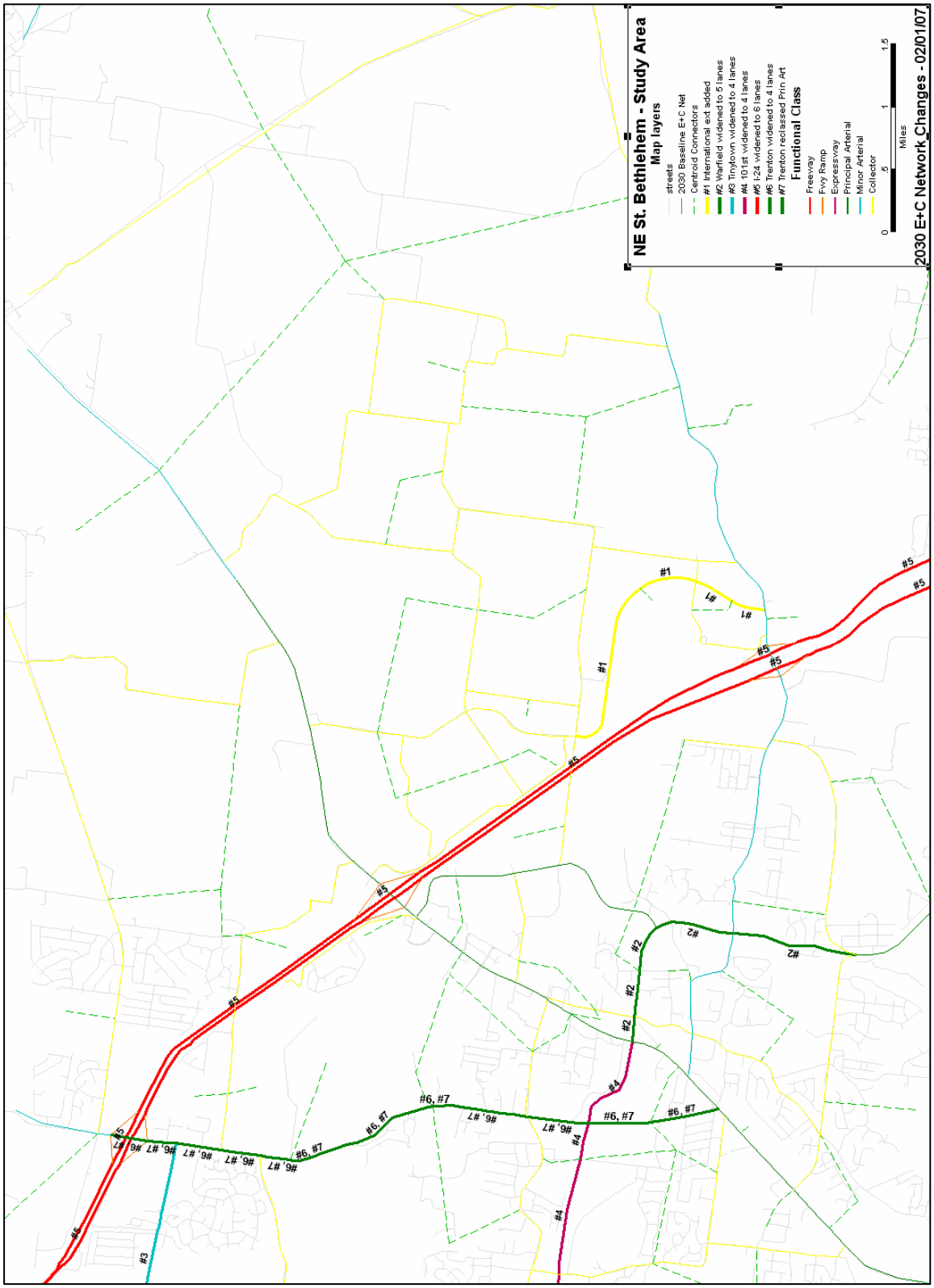


Figure 9 – 2030 E+C Network Changes

TRAFFIC ASSIGNMENT / LOS

The results of the traffic assignment for the 2030 E+C Network are shown in Figure 8. In order to assess the results, a Level of Service (LOS) has been provided on each roadway segment. The LOS is an estimation of the delay experienced by drivers along a roadway. The LOS is defined using the letters A through F. LOS A represents the best level of service and generally describes free flow traffic operation with very low delay. LOS F represents the worst operating conditions in which there is considerable congestion and delay. The LOS is based on the ratio of the traffic volume estimated for a roadway and the ultimate traffic capacity of that roadway (the volume-capacity ratio, or v/c). A roadway becomes more congested as the volume on the roadway approaches its capacity. The ranges of v/c used to determine the LOS are presented in Table 7. These ranges are based on the observed capacities that are approximately LOS E.

Table 7 – V/C Ranges by LOS Category – LOS E Capacities

Level of Service	V/C Range
A or B	0.0 - 0.7
C	0.7 - 0.8
D	0.8 - 1.2
E	1.2 - 1.5
F	1.5 +

2030 E+C RESULTS

In consultation with the City of Clarksville, it was determined that LOS C was the desirable minimum LOS threshold for the roadway network. The Study Area roadways that are predicted to operate at LOS D or worse are presented in Table 8. The Study Area roadway LOS is shown in Figure 10.

Table 8 – 2030 E+C Roadway Operational Deficiencies

Level of Service	Roadway	Termini
D	I-24	North of Rossview Rd
	Needmore Rd	West of Trenton Rd
	101st Airborne Pkwy	West of Wilma Rudolph Blvd
	Tiny Town Rd	West of Trenton Rd
	Wilma Rudolph Blvd	I-24 to Trenton Rd
	Wilma Rudolph Blvd	West of Old Trenton Rd
	Wilma Rudolph Blvd	I-24 to Oakland Rd
	Guthrie Hwy	East of International Blvd
	Merriweather Rd	Oakland Rd west to centroid connectors
	Rossview Rd	Wilma Rudolph Blvd to Old Russellville Pk
	Rossview Rd	Warfield Blvd to I-24
	Rossview Rd	Rollow Ln east to centroid connector
	Dunlop Ln	Hospital entrance (centroid connector) east to International Blvd
E	Merriweather Rd	Trenton Rd east to centroid connector
	Wilma Rudolph Blvd	Trenton Rd to Old Trenton Rd
	Wilma Rudolph Blvd	Between the I-24 ramps
	Guthrie Hwy	Oakland Rd to International Blvd
	Rossview Rd	Between the I-24 ramps
	I-24	South of Rossview Rd
F	I-24 Ramps at Trenton	WB Off-ramp and EB On-ramp
	I-24 Ramps at Wilma Rudolph	All ramps
	I-24 Ramps at Rossview	NB Off-ramp and SB On-ramp
	Oakland Rd	Wilma Rudolph Blvd to Merriweather Rd
	Dunlop Ln	Wilma Rudlolph east to centroid connector
	Dunlop Ln	Ted Crozier Blvd east to Hospital entrance (centroid connector)
	Rossview Rd	I-24 to International Blvd

Note – The deficiency at Dunlop Lane from Wilma Rudolph Boulevard was due to an error in coding. The field check revealed that Dunlop Lane is already a four-lane roadway east of Wilma Rudolph Boulevard instead of the two-lane roadway that was coded into the existing Montgomery County model and the refined-area model. Therefore, although the number of lanes on this stretch of Dunlop Lane was increased for future runs, it was not viewed as an improvement and so is not listed in the Alternatives section below.

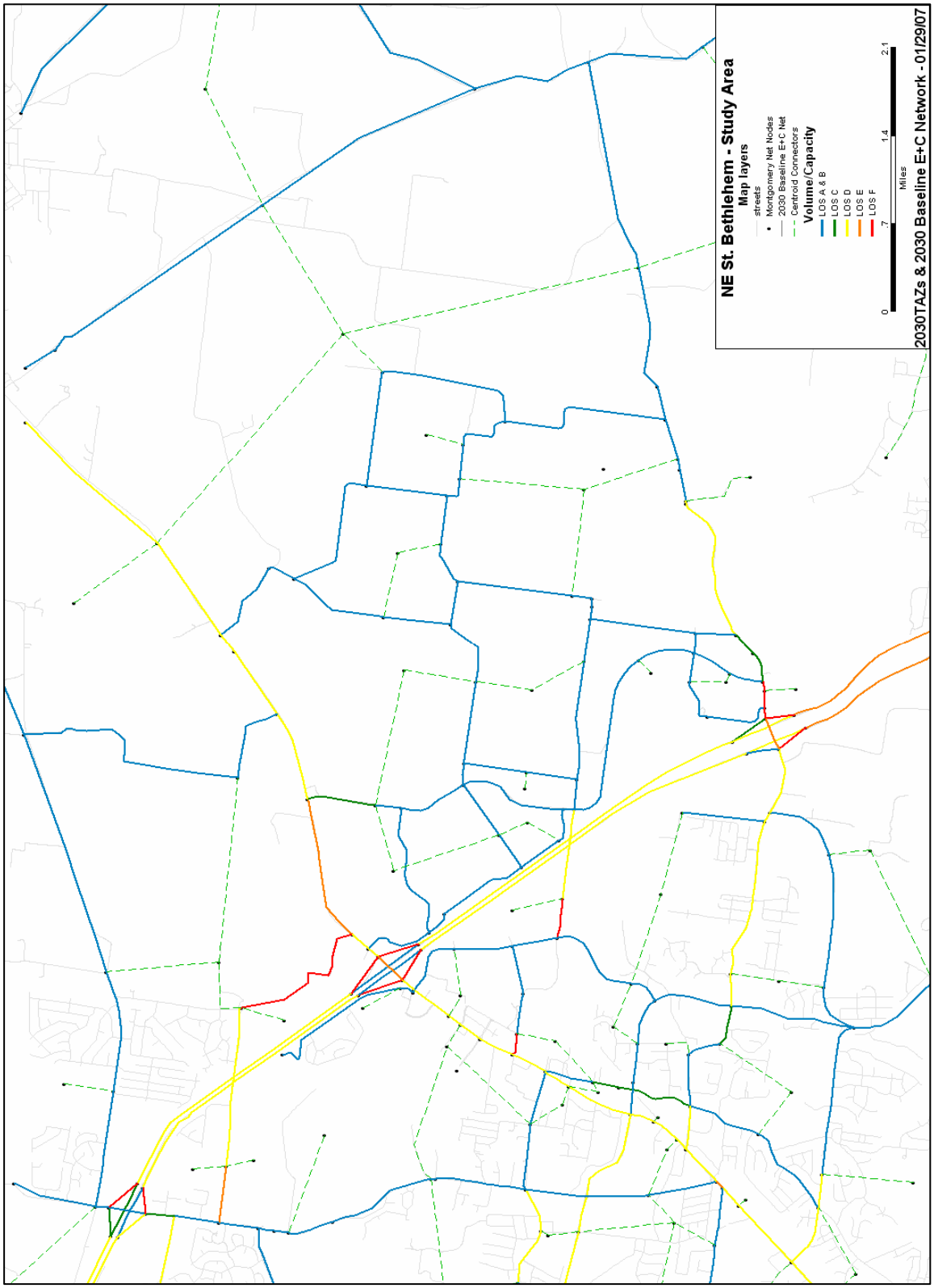


Figure 10 – 2030 E+C Network LOS

2030 Alternative Network Model Results

Two alternative scenarios were tested to address the estimated future deficiencies. The alternatives were developed so that competing improvements were placed in different scenarios. In this way judgments regarding the effectiveness of the competing improvements could be made. Except where noted, the roadway improvements that were a part of the 2030 E+C network are also a part of the alternative scenario networks.

2030 SCENARIO A

Scenario A Network Improvements

The potential roadway improvements included in Scenario A are presented below in Table 9.

Table 9 - 2030 Scenario A Network Changes

Map ID	Roadway	Improvement	Project Termini
8	I-24 Ramps at Trenton	Widen from 1 lanes to 2 lanes	All ramps
9	Jack Miller Thoroughfare	New Road - 4 lanes	Wilma Rudolph Blvd to Needmore Rd
10	Rossview Rd	Widen from 2 lanes to 4 lanes	Warfield Blvd to Cardinal Ln
11	Rossview Rd	Widen from 2 lanes to 4 lanes	Wilma Rudolph Blvd to Warfield Blvd
12	I-24 Ramps at Rossview	Widen from 1 lanes to 2 lanes	NB Off-ramp and SB On-ramp
13	Professional Park Dr	New Road - 2 lanes	Cardinal Ln to Dunlop Ln
14	Rossview Rd	Widen from 2 lanes to 4 lanes	Cardinal Ln to Kirkwood Rd
15	I-24 Ramps at Wilma Rudolph	Widen from 1 lanes to 2 lanes	All ramps
16	Wilma Rudolph Blvd	Widen from 4 lanes to 6 lanes	I-24 to Oakland Rd
17	Wilma Rudolph Blvd	Widen from 2 lanes to 4 lanes	Oakland Rd to International Blvd
18	Jack Miller Thoroughfare	New Road - 4 lanes	Needmore Rd to Ft. Campbell Blvd
19	Rossview Rd	Reclassify from Minor Arterial to Princicpal Arterial	Wilma Rudolph Blvd to Kirkwood Rd

The 2030 Scenario A network is shown in Figure 11, and the Study Area network changes are highlighted in Figure 12.

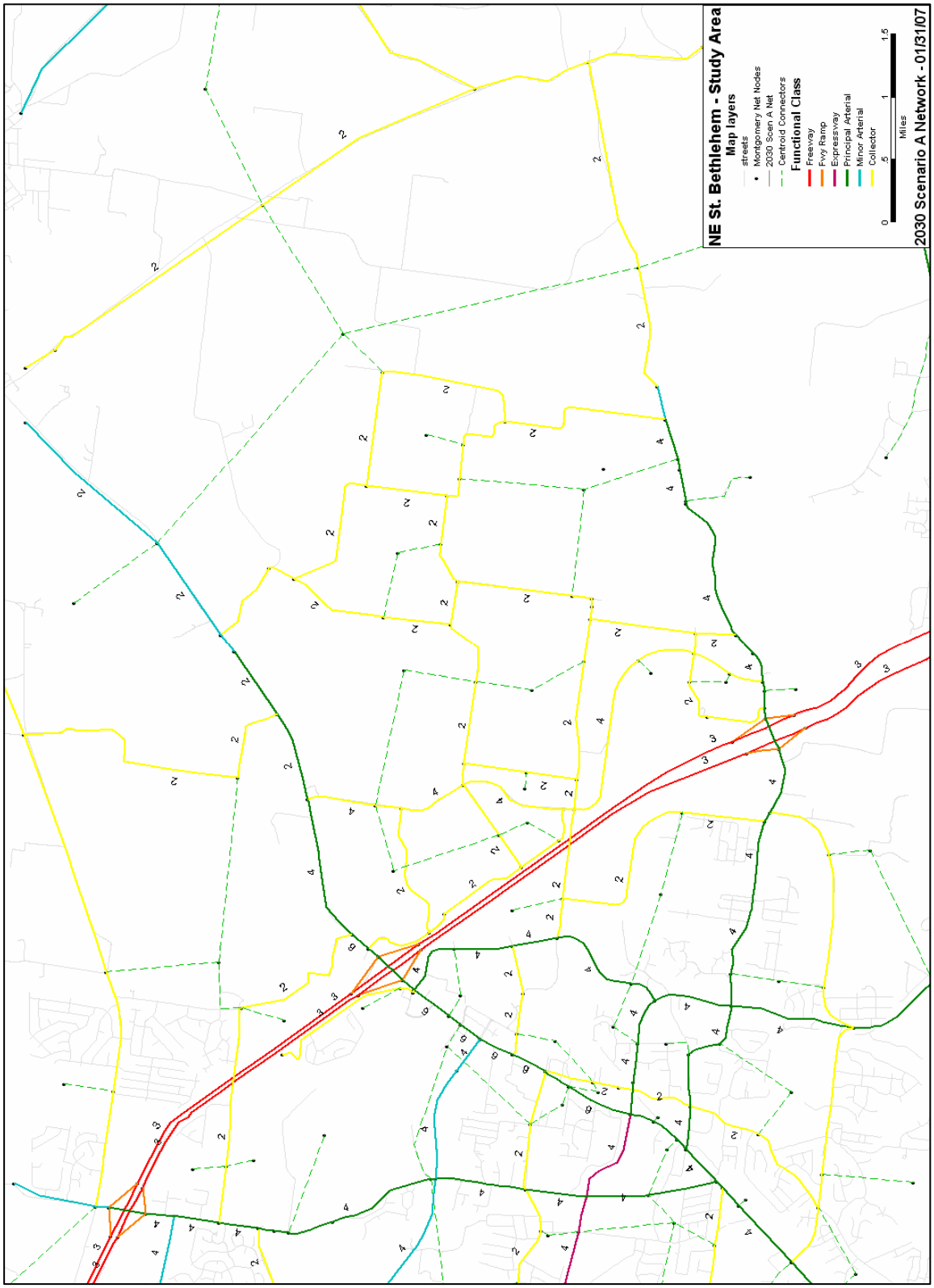


Figure 11 – 2030 Scenario A Network with Total Lanes

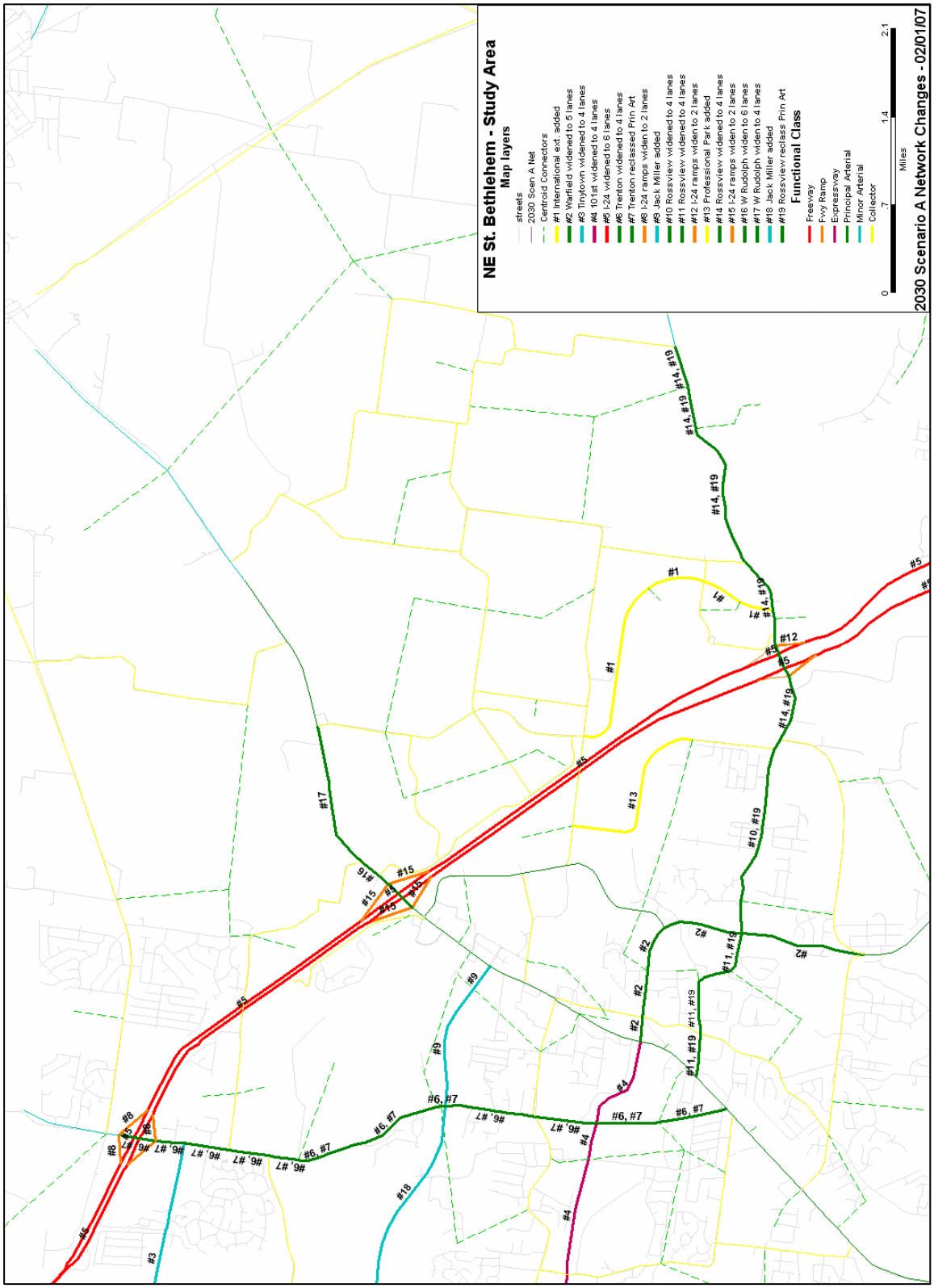


Figure 12 – 2030 Scenario A Network Changes

Scenario A Results

The Study Area roadways that are predicted to operate at LOS D or worse under scenario A are presented in Table 10, and the Study Area roadway LOS is shown in Figure 13.

Table 10 – 2030 Scenario A Roadway Operational Deficiencies

Level of Service	Roadway	Termini
D	I-24	North of Wilma Rudolph Blvd
	I-24	Southbound from Wilma Rudolph Blvd to Rossview Rd
	I-24 Ramps at Trenton	WB Off-ramp and EB On-ramp
	I-24 Ramps at Wilma Rudolph	NB On-ramp and SB Off-ramp
	Tiny Town Rd	West of Trenton Rd
	Wilma Rudolph Blvd	I-24 to Dunlop Ln
	Wilma Rudolph Blvd	101st Airborne Pkwy to Rossview Rd
	Wilma Rudolph Blvd	West of Old Trenton Rd
	Guthrie Hwy	East of Jim Johnson Rd
	Merriweather Rd	Trenton Rd east to centroid connectors
	Oakland Rd	Wilma Rudolph Blvd to Merriweather Rd
	Dunlop Ln	Hospital entrance (centroid connector) east to International Blvd
	Rossview Rd	Dunbar Cave Rd to International Blvd
E	Wilma Rudolph Blvd	Rossview Rd to Old Trenton Rd
	I-24	South of Rossview Rd
F	I-24 Ramps at Rossview	NB Off-ramp and SB On-ramp
	Dunlop Ln	Ted Crozier Blvd east to Hospital entrance (centroid connector)

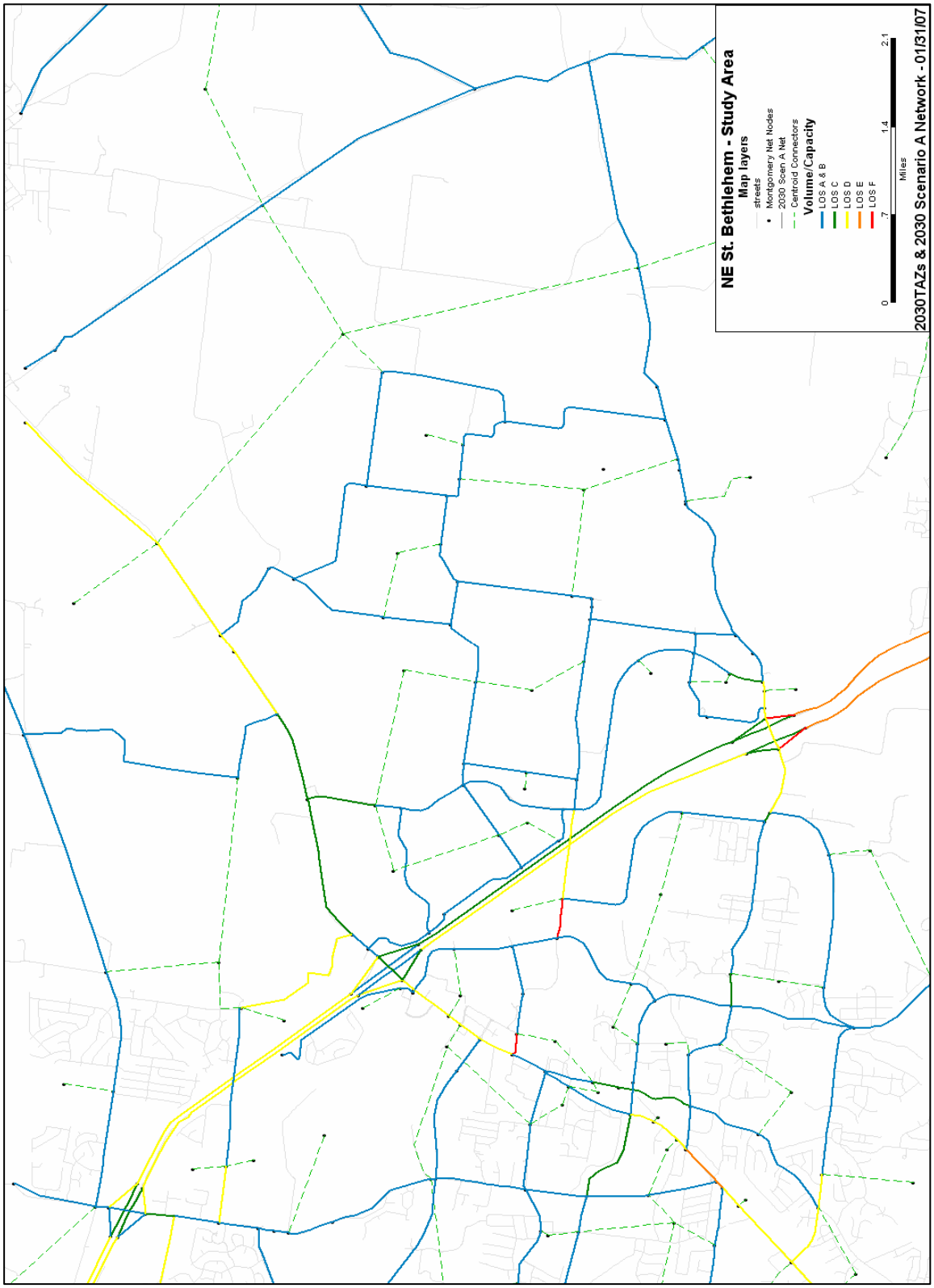


Figure 13 – 2030 Scenario A Network LOS

2030 SCENARIO B

Scenario B Network Improvements

The potential roadway improvements included in Scenario B are presented below in Table 11.

Table 11 - 2030 Scenario B Network Changes

Map ID	Roadway	Improvement	Project Termini
6	Trenton Rd	Remove the E+C widening and return to 2 lanes	Wilma Rudolph Blvd to Tiny Town Rd
7	Trenton Rd	Remove the E+C reclassification and return to Minor Arterial	Wilma Rudolph Blvd to Tiny Town Rd
8	I-24 Ramps at Trenton	Widen from 1 lanes to 2 lanes	All ramps
20	Needmore Rd	Widen from 2 lanes to 4 lanes	Wilma Rudolph Blvd to Tiny Town Rd
21	Wilma Rudolph Blvd	Widen from 4 lanes to 6 lanes	101st Airborne Pkwy to Kraft St
22	Dunlop Ln	Widen from 2 lanes to 4 lanes	Ted Crozier Blvd to International Blvd
23	Dunlop Ln	Reclassify from Collector to Minor Arterial	Wilma Rudolph Blvd to Rossview Rd
24	Oakland Rd/Merriweather Rd	Widen from 2 lanes to 4 lanes	Wilma Rudolph Blvd to Trenton Rd
25	Dunlop Ln	Widen from 2 lanes to 4 lanes	International Blvd to Hampton Station Rd
26	Dunlop Ln	Roadway extension - 4 lanes	Hampton Station Rd to Rossview Rd

The 2030 Scenario B network is shown in Figure 14, and the Study Area network changes are highlighted in Figure 15.

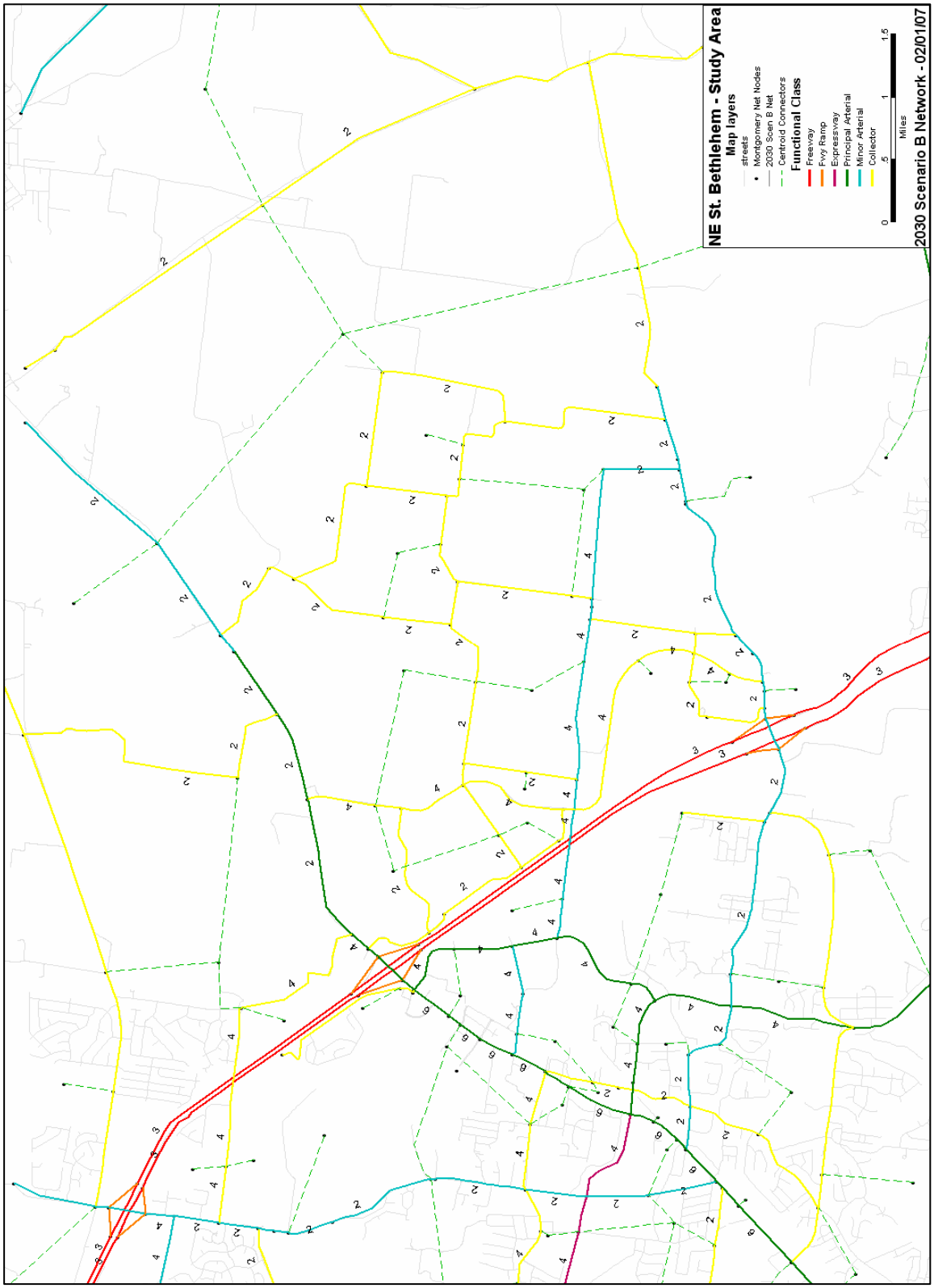


Figure 14 – 2030 Scenario B Network with Total Lanes

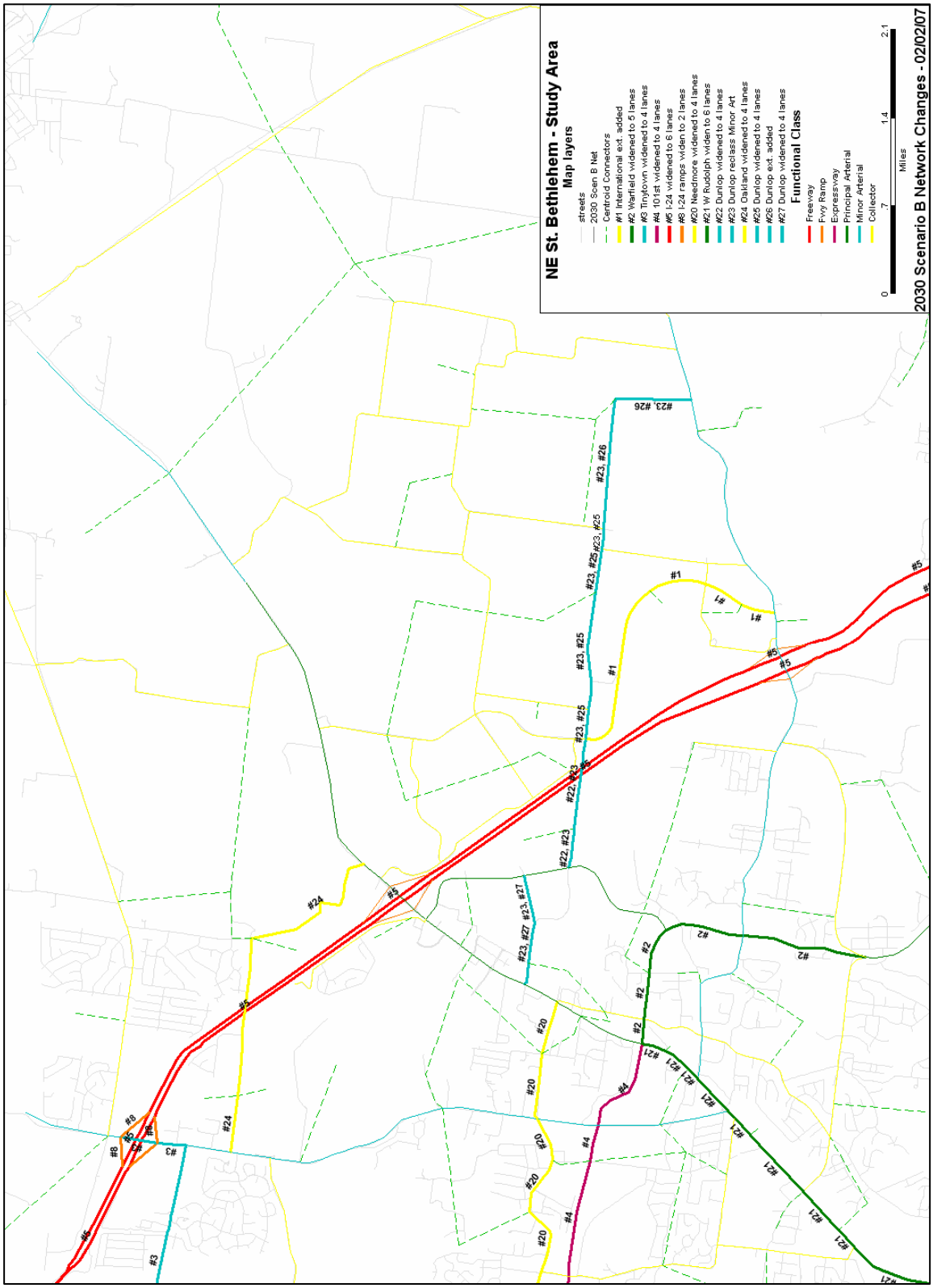


Figure 15 – 2030 Scenario B Network Changes

Scenario B Results

The Study Area roadways that are predicted to operate at LOS D or worse under scenario B are presented in Table 12, and the Study Area roadway LOS is shown in Figure 16.

Table 12 – 2030 Scenario B Roadway Operational Deficiencies

Level of Service	Roadway	Termini
D	I-24	North of Rossview Rd
	I-24 Ramps at Trenton	WB Off-ramp and EB On-ramp
	Tiny Town Rd	West of Trenton Rd
	Trenton Rd	Tiny Town Rd to I-24
	101st Airborne Pkwy	Wilma Rudolph Blvd to centroid connector west of Trenton Rd
	Trenton Rd	Wilma Rudolph Blvd north to first centroid connector
	Wilma Rudolph Blvd	Trenton Rd to Old Trenton Rd
	Wilma Rudolph Blvd	101st Airborne Pkwy to Oakland Rd
	Guthrie Hwy	East of Jim Johnson Rd
	Oakland Rd	Wilma Rudolph Blvd to Merriweather Rd
	Rossview Rd	Wilma Rudolph Blvd to Old Russellville Pk
	Rossview Rd	Warfield Blvd east to first centroid connector
	Rossview Rd	Cardinal Ln to I-24
	Dunlop Ln	Hospital entrance (centroid connector) to Ted Crozier Blvd
E	Trenton Rd	Tiny Town Rd to Merriweather Rd
	Guthrie Hwy	Oakland Rd to International Blvd
	Rossview Rd	Between the I-24 Ramps
	I-24	South of Rossview Rd
F	I-24 Ramps at Wilma Rudolph	All ramps
	I-24 Ramps at Rossview	NB Off-ramp and SB On-ramp
	Rossview Rd	I-24 to International Blvd

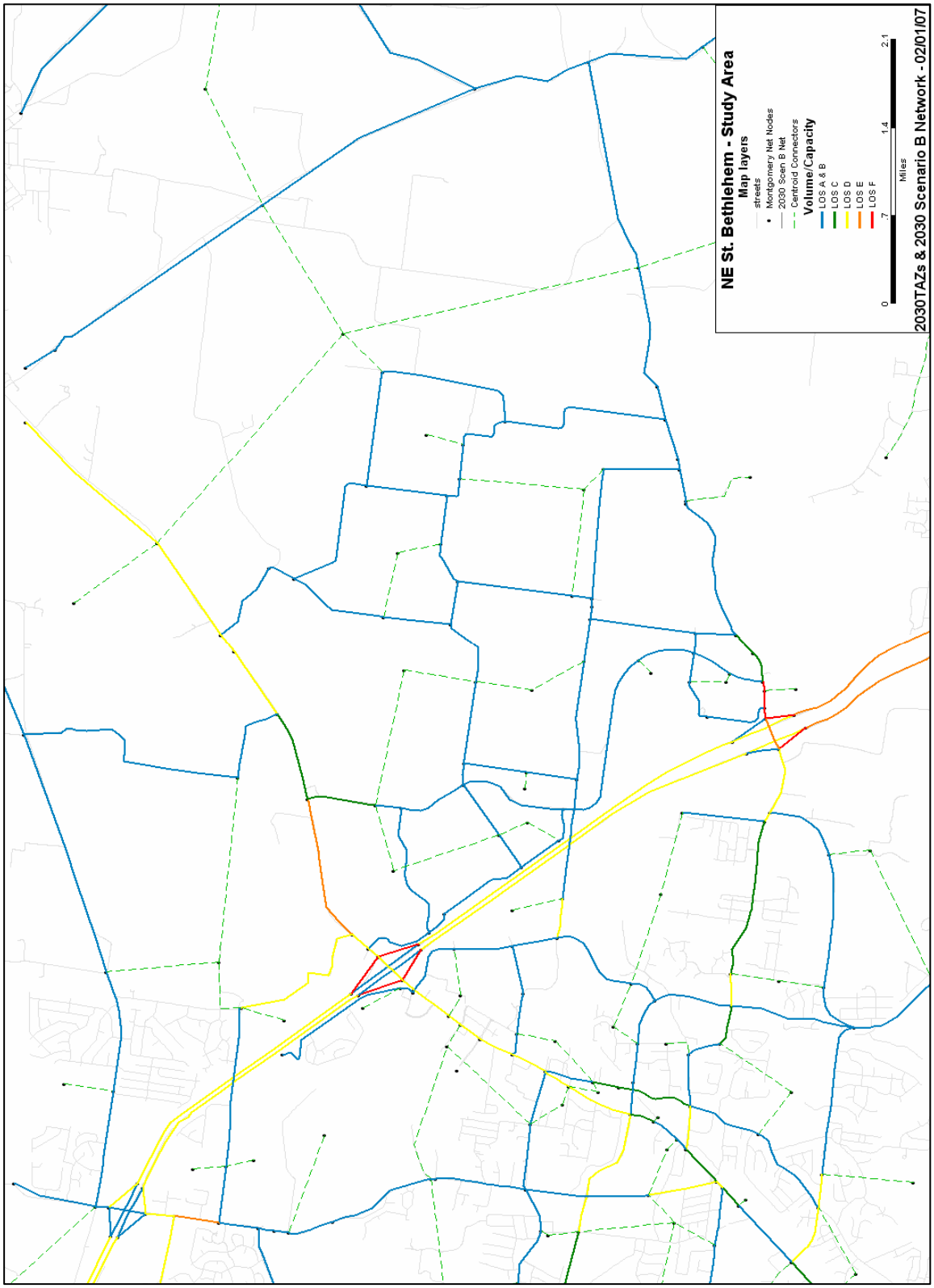


Figure 16 – 2030 Scenario B Network LOS

ALTERNATIVE SCENARIO CONCLUSIONS

The traffic assignment results from 2030 E+C, 2030 Scenario A, and 2030 Scenario B were compared to see which potential improvements best served to relieve the transportation deficiencies in the Study Area. The results and recommendations were discussed with the City of Clarksville in order to determine a final set of recommended improvements in the Study Area.

#1 - #5 – the E+C Improvements (except Trenton Road)

These improvements were all carried through to the final set of recommended improvements, and the estimated volumes for 2030 on the facilities indicate that the projects are all necessary.

#6, #7 – Trenton Rd

The northern end of Trenton Road (approaching I-24) and the southern end (approaching Wilma Rudolph Boulevard) are expected to have sufficient traffic volumes to support widening Trenton Road to four lanes. Although the middle portion could be preserved at two lanes, it was decided to maintain the widening through the entire corridor for continuity and to support future development in the area.

#8 – I-24 Ramps at Trenton Rd

The estimated volumes on the westbound on-ramp and the eastbound off-ramp do not warrant widening, but the widening of the westbound off-ramp and eastbound on-ramp to two lanes was included in the recommended projects.

#9, #18 – Jack Miller Thoroughfare

The Jack Miller thoroughfare from Wilma Rudolph Boulevard to Needmore Road was included in the final set of recommended improvements due to the high volumes estimated it is expected to carry and the relief it offers to Oakland Road/Merriweather Road, Tiny Town Road, and 101st Airborne Parkway. However, the volumes do not warrant the Jack Miller extension west of Needmore Road. Nevertheless, future development activity on the Jack Miller extension west of Needmore Road may warrant the eventual construction of this facility. Therefore, right-of-way should be preserved for this facility west of Needmore Road, and developers may be asked to participate in the construction of this facility in addition to the dedication of right-of-way.

#10, #11, #14, #19 – Rossview Rd

The widening and reclassification of Rossview Road from Warfield Boulevard to Kirkwood Road were included in the final set of recommended improvements due to the expected volumes on Rossview Road. However, widening Rossview Road between Wilma Rudolph Boulevard and Warfield Boulevard was not recommended due to the high volumes that would be attracted to this winding roadway through a residential area. This last section of Rossview Road was also not reclassified to a principal arterial in the final recommendations.

#12 – I-24 Ramps at Rossview Rd

The proposed widening of the northbound off-ramp and southbound on-ramp were included in the final set of recommended improvements due to the expected volumes on the ramp.

#13 – Professional Park Drive

Although this roadway was not predicted by the model to carry a large volume, it was included in the final set of recommended improvements to provide greater access to the hospital site from Rossview Road and to provide a continuous access road adjacent to I-24 from Rossview Road to Dunlop Lane to accommodate future development

#15 – I-24 Ramps at Wilma Rudolph Blvd

The proposed widening of all ramps at this interchange was included in the final set of recommended improvements due to the expected future volumes.

#16, #17, #21 – Wilma Rudolph Blvd

The traffic volumes on Wilma Rudolph Boulevard are expected to be high in 2030 and so all the proposed widening projects on Wilma Rudolph were included in the final set of recommended improvements.

#20 – Needmore Rd

This potential improvement was dropped from the final set of recommended improvements because the expected future volumes did not warrant widening Needmore Road.

#22, #23, #25, #26 – Dunlop Ln

The proposed hospital entrance would be accessed via Dunlop Lane. For this reason it was considered important to include the Dunlop Lane extension to Rossview Road in the the final set of recommended improvements. However, the expected future volumes on Dunlop Lane between International Boulevard and Rossview Road do not warrant widening to a two-lane road. Therefore, the extension would be included in the final recommendations, but as a two-lane road. The expected volumes on Dunlop Lane between International Boulevard and Ted Crozier Boulevard are high enough to warrant widening to a four-lane road.

#24 – Oakland Rd/Merriweather Rd

This potential improvement was not included in the final list of recommended improvements for two reasons. First, the volumes were not expected to be very high in Scenario A, which included the Trenton Road widening and Jack Miller thoroughfare projects, both of which were recommended for inclusion in the final list of improvements, making a general widening of Oakland Road and Merriweather Road unnecessary. Secondly, widening Merriweather Road would also require widening its bridge over I-24, which would be a very costly project. Finally, this roadway is abutted by residential uses and the roadway alignment is winding. Given the relatively low

benefits that could be achieved from widening Merriweather Road, the funds required for widening the bridge would best be used on other improvements in the Study Area.

2030 Final Network Results

The refined-area model was run to test how the final recommended improvements would interact with each other.

2030 FINAL RECOMMENDED NETWORK

The roadway improvements included in the recommended roadway network are presented below in Table 13.

The 2030 recommended network is shown in Figure 17, and the Study Area network changes are highlighted in Figure 18.

Table 13 - 2030 Recommended Network Changes

Map ID	Roadway	Improvement	Project Termini
1	International Blvd	Roadway extension - 4 lanes	Dunlop Ln to Rossview Rd
2	Warfield Blvd	Widen from 2 lanes to 4 lanes	Stokes Rd to Dunbar Cave Rd
3	Tiny Town Rd	Widen from 2 lanes to 4 lanes	Peacher's Mill Rd to Trenton Rd; Trenton Rd north to I-24
4	101st Airborne Pkwy	Widen from 2 lanes to 4 lanes	Wilma Rudolph Blvd to Ft. Campbell Blvd
5	I-24	Widen from 4 lanes to 6 lanes	South of SR 76 to Ft. Campbell Blvd
6	Trenton Rd	Widen from 2 lanes to 4 lanes	Wilma Rudolph Blvd to Tiny Town Rd
7	Trenton Rd	Reclassify from Minor Arterial to Principal Arterial	Wilma Rudolph Blvd to Tiny Town Rd
8	I-24 Ramps at Trenton	Widen from 1 lanes to 2 lanes	WB Off-ramp and EB On-ramp
9	Jack Miller Thoroughfare	New Road - 4 lanes	Wilma Rudolph Blvd to Needmore Rd
10	Rossview Rd	Widen from 2 lanes to 4 lanes	Warfield Blvd to Cardinal Ln
12	I-24 Ramps at Rossview	Widen from 1 lanes to 2 lanes	NB Off-ramp and SB On-ramp
13	Professional Park Dr	New Road - 2 lanes	Cardinal Ln to Dunlop Ln
14	Rossview Rd	Widen from 2 lanes to 4 lanes	Cardinal Ln to Kirkwood Rd
15	I-24 Ramps at Wilma Rudolph	Widen from 1 lanes to 2 lanes	All ramps
16	Wilma Rudolph Blvd	Widen from 4 lanes to 6 lanes	I-24 to Oakland Rd
17	Wilma Rudolph Blvd	Widen from 2 lanes to 4 lanes	Oakland Rd to International Blvd
19	Rossview Rd	Reclassify from Minor Arterial to Princicpal Arterial	Warfield Blvd to Kirkwood Rd
21	Wilma Rudolph Blvd	Widen from 4 lanes to 6 lanes	101st Airborne Pkwy to Kraft St
22	Dunlop Ln	Widen from 2 lanes to 4 lanes	Ted Crozier Blvd to International Blvd
23	Dunlop Ln	Reclassify from Collector to Minor Arterial	Wilma Rudolph Blvd to Rossview Rd
26	Dunlop Ln	Roadway extension - 2 lanes	Hampton Station Rd to Rossview Rd

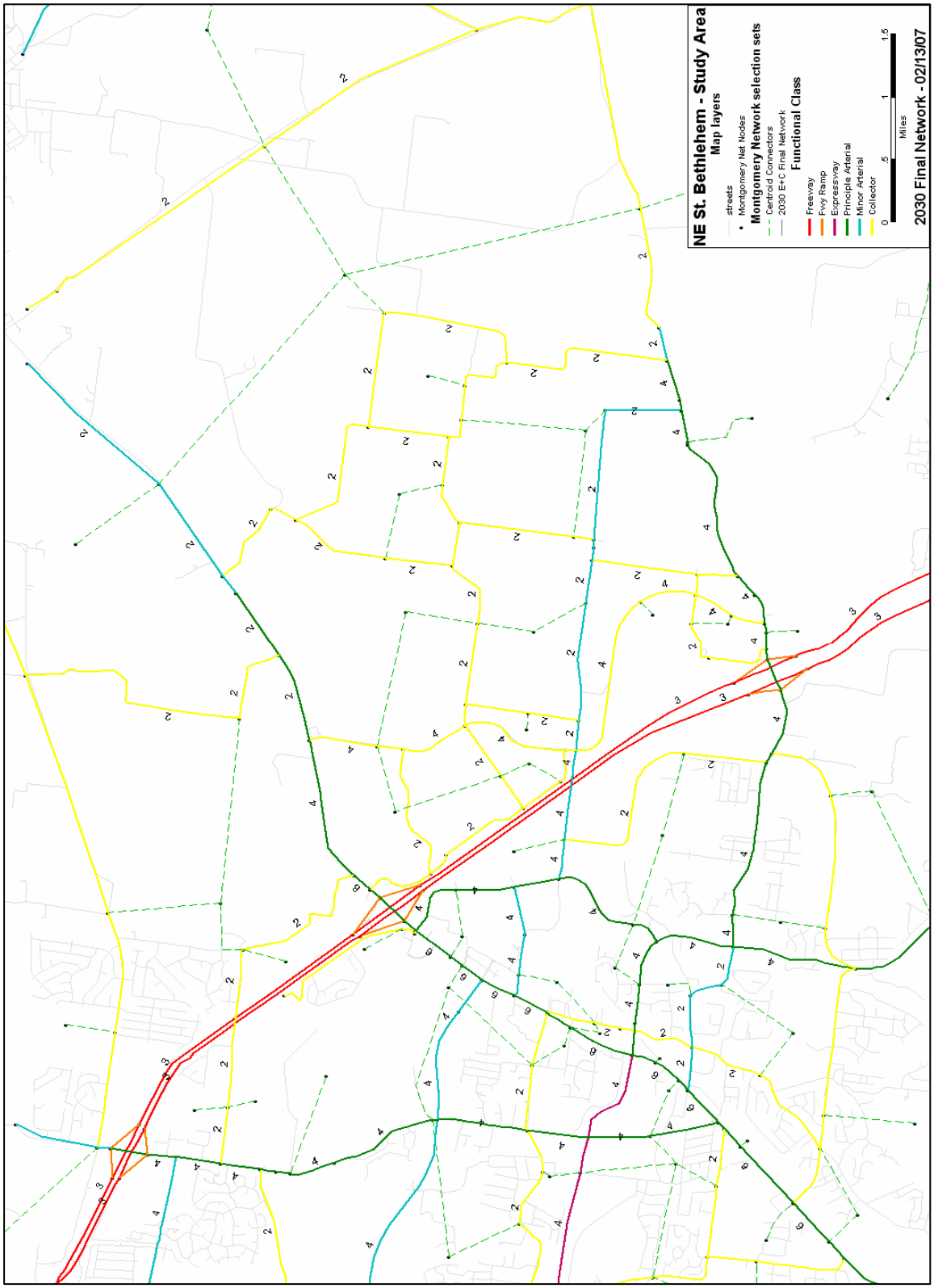


Figure 17 – 2030 Final Recommended Network with Total Lanes

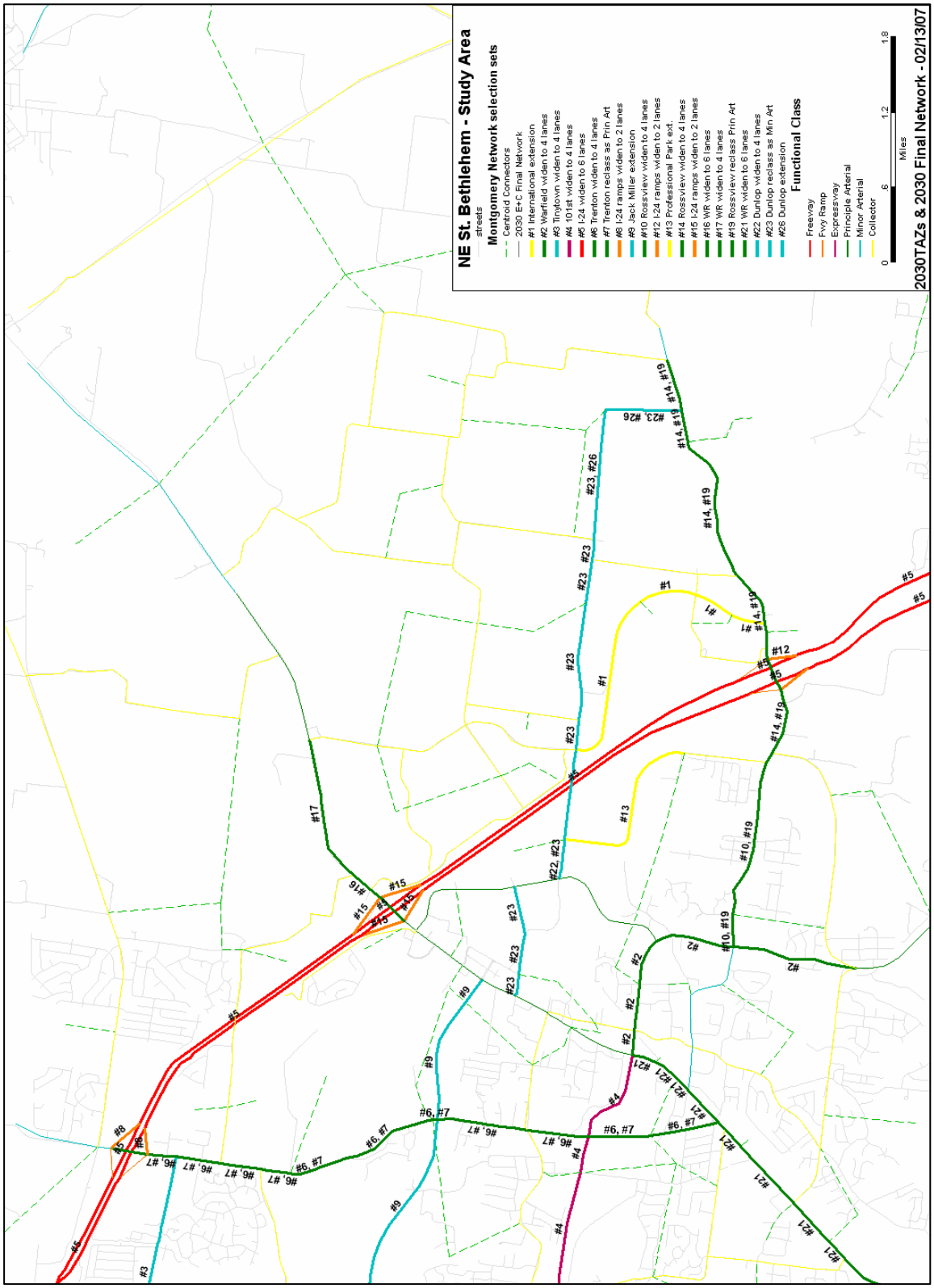


Figure 18 – 2030 Final Recommended Network Changes

2030 FINAL RECOMMENDED NETWORK RESULTS

The Study Area roadways that are still predicted to operate at LOS D or worse under the final recommended network are presented in Table 14, and the Study Area roadway LOS is shown in Figure 19.

Table 14 – 2030 Final Recommended Network Roadway Operational Deficiencies

Level of Service	Roadway	Termini
D	I-24	North of Wilma Rudolph Blvd
	I-24	Southbound from Wilma Rudolph Blvd to Rossview Rd
	I-24 Ramps at Trenton	WB Off-ramp
	I-24 Ramps at Wilma Rudolph	NB On-ramp and SB Off-ramp
	Tiny Town Rd	West of Trenton Rd
	Merriweather Rd	East of Trenton Rd to centroid connectors
	Oakland Rd	Wilma Rudolph Blvd to Merriweather Rd
	101st Airborne Pkwy	Wilma Rudolph Blvd to first centroid connector west of Trenton Rd
	Wilma Rudolph Blvd	Old Trenton Rd to Rossview Rd
	Wilma Rudolph Blvd	Dunlop Ln to I-24
	Guthrie Hwy	East of Jim Johnson Rd
	Dunlop Ln	Ted Crozier Blvd to Hospital entrance (centroid connector)
	Rossview Rd	Wilma Rudolph Blvd to Warfield Blvd
	Rossview Rd	I-24 to International Blvd
E	I-24 Ramps at Trenton	EB On-ramp
	I-24	South of Rossview Rd
F	I-24 Ramps at Rossview	NB Off-ramp and SB On-ramp

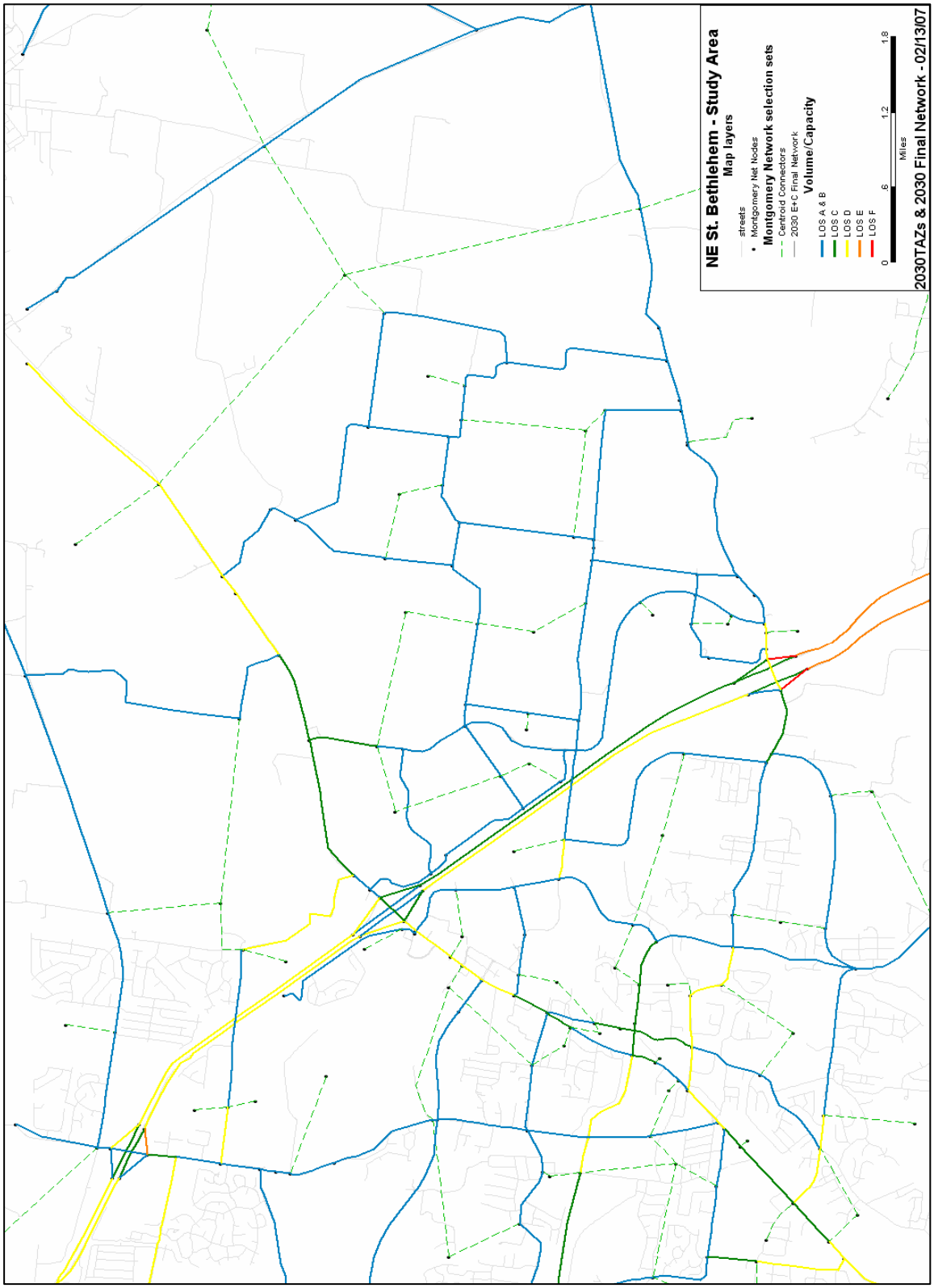


Figure 19 – 2030 Final Recommended Network LOS

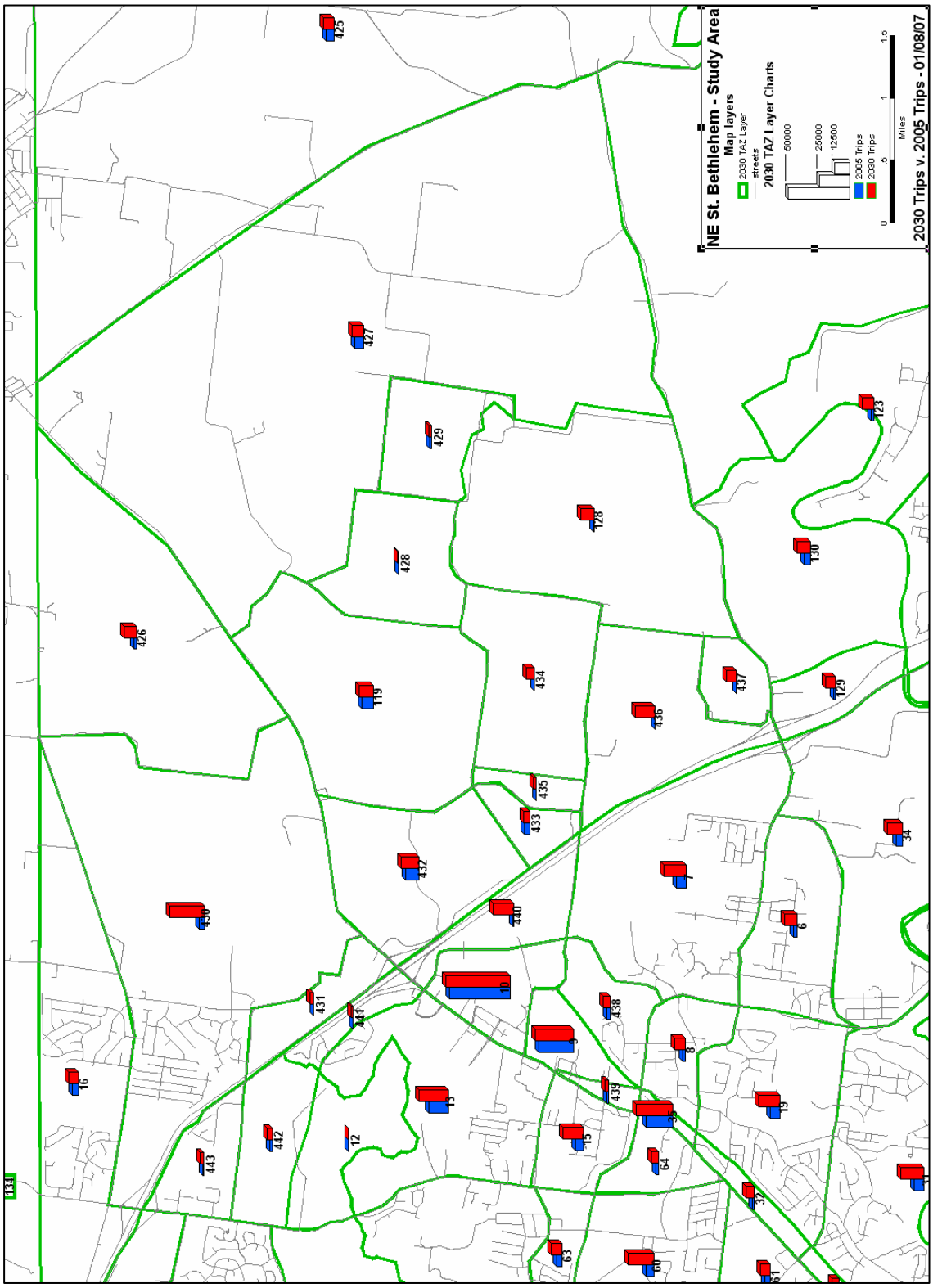
FINAL CONCLUSIONS

The final recommended network includes only three locations in the Study Area with significant operational deficiencies: the I-24 eastbound on-ramp at Trenton Rd (LOS E), I-24 south of Rossview Road (LOS E), and the I-24 northbound off-ramp and southbound on-ramp at Rossview Road (LOS F). No further widening of these facilities is recommended because the recommended improvements have taken them to their currently feasible width. The interstate ramps, in particular, would not benefit from being widened to three lanes because of the difficulty of creating a three-lane diverge and merge onto the interstate which is unorthodox for freeway design. Rather, the other projects that could most benefit the I-24 ramps would be the intersection designs on Rossview Road and Trenton Road and the ramp treatments approaching or departing these intersections.

The intended effect was achieved by not widening Rossview Road between Wilma Rudolph Boulevard and Warfield Boulevard. Namely, the volumes were not as high through this residential section of Rossview Road. Instead, traffic diverts to a four-lane Warfield Boulevard in order to access Wilma Rudolph Boulevard. This also leads to a travel emphasis on 101st Airborne Parkway (connecting to Wilma Rudolph Boulevard across from Warfield Boulevard), which makes sense from a network standpoint because 101st Airborne Parkway, as an expressway, is designed to handle a higher volume of traffic than other streets.

The Jack Miller thoroughfare was included in the final recommended network as a four-lane facility. However, the volumes expected on Jack Miller west of Trenton Road do not support the need for a four-lane facility. This section of Jack Miller could be built as a two-lane roadway. On the other hand, if the area around Jack Miller would be expected to be intensely developed, a four-lane facility might still be desirable to provide quality access to the side streets and driveways.

Appendix A – Refined-Area Model Trip Generation



Appendix B – Model TAZ Housing and Employment

County TAZs

Montgomery County (TN)

			2002	2002 based on permits	2005	Old from Original Model				new
TAZ	**1990 HU**	**2000 HU**	**2002 HU**	**2000 HU + 2000-2001 Permits**	**2000 HU + 2000-2004 Permits**	**2010 HU**	**2016 HU**	**2020 HU**	**2030 HU**	**2030 HU**
3	518	643	671	666	710	791	896	972	1197	1197
4	21	31	32	33	33	37	42	46	56	56
5	161	172	179	172	172	210	238	259	318	318
6	273	308	322	315	346	383	437	478	597	597
7	185	494	516	665	809	615	704	767	957	1863
8	94	240	250	240	241	298	341	373	464	464
9	26	131	143	131	131	171	196	213	267	267
10	2	3	3	3	3	3	4	4	5	3
11	15	7	7	7	7	9	12	13	20	20
12	34	90	96	90	94	130	164	190	279	293
13	139	300	323	560	638	437	548	638	933	933
14	93	321	345	373	544	468	587	683	998	1583
15	396	556	581	558	559	786	986	1148	1676	1676
16	11	211	227	365	688	307	386	449	655	655
17	2	2	2	2	2	2	2	3	3	2
18	11	723	664	1030	1358	899	1128	1313	1918	1918
19	429	723	755	764	802	900	1028	1123	1402	1402
20	201	124	179	124	124	183	187	189	195	195
21	947	1005	1010	1012	1026	1034	1052	1064	1096	1096
22	185	291	309	296	306	400	485	551	760	760
23	92	90	91	90	90	97	102	106	116	116
24	494	557	566	559	562	607	640	663	724	724
25	1299	1480	1488	1484	1489	1523	1550	1568	1614	1614
26	78	93	98	95	96	127	155	175	242	242
27	94	97	93	99	99	99	105	108	118	118
28	739	1260	1372	1373	1636	1772	2149	2443	3367	3367
29	308	517	551	556	631	711	863	981	1352	1352
30	587	818	832	826	872	892	940	974	1063	1063
31	518	883	923	894	909	1100	1256	1373	1712	1712
32	64	51	54	51	51	73	92	108	157	157
33	0	0	0	0	0	0	0	0	0	0
34	241	261	273	262	263	324	371	405	506	506
35	2	2	3	2	2	4	5	6	9	9
36	315	318	331	326	336	390	441	480	590	590
37	300	333	329	345	358	387	439	476	587	587
38	1133	1618	1655	1757	1901	1813	1943	2035	2282	2282
39	301	622	659	678	883	833	995	1119	1502	1502
40	1562	1872	1914	1990	2006	2093	2238	2340	2618	2618

41	987	995	1018	1029	1050	1115	1194	1250	1403	1403
42	1458	2401	2456	2455	2532	2691	2884	3020	3386	3386
43	290	472	483	488	518	528	566	592	665	665
44	1003	1000	1022	1004	1026	1117	1194	1250	1397	1397
45	946	1262	1290	1303	1326	1410	1508	1577	1765	1765
46	483	662	714	686	775	966	1211	1411	2060	2060
47	512	612	617	618	618	641	660	673	707	707
48	1167	1300	1378	1345	1354	1743	2079	2339	3138	3138
49	169	531	584	609	755	739	882	992	1331	1331
50	144	34	34	44	45	37	40	42	47	47
51	751	1125	1204	1175	1210	1582	1944	2228	3139	3139
52	264	362	387	367	381	508	625	716	1008	1008
53	263	286	292	287	287	320	343	359	402	402
54	473	651	690	700	732	872	1040	1171	1571	1571
56	157	782	828	867	1023	1048	1250	1407	1888	1888
57	499	1140	1143	1211	1259	1251	1338	1399	1565	1565
58	408	917	982	964	985	1290	1584	1817	2558	2558
59	5	79	84	150	312	115	143	167	244	244
60	448	700	770	703	706	1043	1309	1523	2224	2224
61	15	15	16	15	15	21	26	31	46	46
62	229	234	232	251	251	224	219	217	209	209
63	27	156	152	170	195	204	257	300	437	437
64	36	67	81	67	67	109	137	160	235	235
65	827	857	891	859	864	1043	1175	1272	1551	1551
67	76	76	76	76	77	76	76	76	76	76
68	273	285	297	297	329	350	396	430	529	529
69	53	50	49	51	52	47	46	46	43	43
70	0	0	9	0	0	9	9	9	8	8
71	201	274	217	279	281	210	206	202	196	196
72	0	0	0	0	0	0	0	0	0	0
73	106	117	117	118	122	119	121	123	126	126
74	489	587	758	591	596	776	790	800	824	824
75	509	508	510	509	515	522	532	537	554	554
76	42	43	42	43	43	43	44	44	45	45
77	390	545	558	566	608	615	662	696	788	788
78	549	766	613	781	793	675	727	763	864	864
79	509	504	506	504	504	518	528	533	549	549
80	11	14	19	14	14	21	22	23	26	26
81	0	0	0	0	0	0	0	0	0	0
82	193	300	301	300	300	308	313	317	326	326
83	113	112	110	112	112	107	104	103	99	99
84	60	51	50	51	51	49	47	47	45	45
85	247	265	263	271	277	255	248	246	237	237
86	542	495	497	496	497	509	518	524	540	540
87	209	216	216	216	218	221	225	228	234	234
88	0	0	0	0	0	0	0	0	0	0

89	4	2	0	2	2	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0
91	5	5	5	5	5	3	3	3	3	3
92	56	54	54	54	54	55	56	56	58	58
93	307	288	286	288	289	277	270	267	258	258
94	40	37	36	37	38	34	34	33	33	33
95	214	213	213	215	216	218	221	225	231	231
96	7	11	11	11	11	9	9	9	9	9
97	74	76	81	76	76	107	133	153	219	219
98	200	232	233	232	232	238	242	245	253	253
99	27	18	18	18	18	18	18	18	18	18
100	65	62	62	62	62	63	64	65	67	67
101	238	258	259	258	258	264	269	273	281	281
102	64	65	68	65	66	91	113	130	186	186
103	47	25	25	25	25	34	43	50	72	72
104	19	24	25	24	24	33	41	48	68	68
105	35	34	34	34	34	42	51	68	93	93
106	19	12	12	12	12	16	20	24	33	33
107	46	47	49	47	47	64	80	94	134	134
108	55	25	26	25	25	34	43	50	71	71
109	28	18	18	18	18	24	30	36	51	51
110	110	104	111	104	104	147	182	210	300	300
111	24	10	10	10	10	12	17	20	28	28
112	62	93	93	93	94	95	97	98	101	101
113	15	653	704	733	1142	952	1195	1391	2031	2031
114	20	307	325	334	518	410	490	552	740	740
115	24	119	128	142	146	173	217	252	369	369
116	12	79	84	126	363	114	143	167	245	245
117	358	524	565	613	842	764	959	1116	1630	1630
118	143	111	117	115	214	147	177	199	266	266
119	28	64	66	67	72	79	90	98	123	123
120	6	7	7	7	7	9	12	14	19	19
121	89	395	420	431	439	543	659	749	1033	1033
122	124	305	327	339	502	422	512	582	802	802
123	1	124	124	137	147	160	195	221	305	305
124	673	1316	1403	1468	1868	1812	2197	2498	3444	3444
128	50	41	42	42	42	50	57	63	78	1089
129	0	5	5	5	6	5	7	7	9	9
130	0	22	22	24	24	26	30	33	41	41
131	238	238	236	238	238	228	224	220	213	213
401	89	46	48	47	47	83	90	94	94	94
402	236	327	348	335	343	593	650	675	675	675
403	120	177	169	181	186	289	316	328	328	328
404	6	14	13	16	17	24	26	27	27	27
405	74	126	133	128	136	228	250	259	259	259
406	102	342	361	349	363	617	675	700	701	701

407	22	33	14	33	33	24	26	28	28	28
408	43	79	83	87	90	143	156	162	162	162
409	106	124	130	132	141	223	244	253	253	253
410	61	86	86	89	99	146	160	167	167	167
411	66	88	91	97	107	155	169	177	177	177
412	384	458	467	490	533	796	871	904	904	904
413	472	542	561	560	586	955	1046	1086	1086	1086
414	14	29	29	30	32	48	53	56	56	56
415	26	40	39	41	43	66	71	74	74	74
416	192	234	237	250	262	405	443	461	461	461
417	361	437	452	454	483	770	843	876	876	876
418	293	386	399	407	428	680	745	773	773	773
419	499	683	711	743	809	1210	1326	1376	1376	1376
420	391	502	532	528	558	907	992	1030	1030	1030
421	404	498	541	540	606	921	1008	1047	1047	1047
422	27	38	39	40	45	67	73	77	77	77
423	126	117	124	124	131	211	231	240	240	240
424	78	126	127	132	141	217	236	246	246	246
425	169	181	188	198	216	320	351	365	365	365
426	157	168	175	183	213	299	326	337	339	425
Model Montgomery County Total	36048	50999	52803	54185	59390	65124	73506	79651	97176	103075
Portion of Montgomery County Not in Model	1185	1168	3574	2192	1756	1288	1284	1294	1370	1370
Census Montgomery County Total	37233	52167	56377	56377	61146	66412	74790	80945	98546	104445
Study Area	**716**	**1614**	**1711**	**2116**	**2548**	**2254**	**2678**	**2996**	**3982**	**6581**
Study Area/Model	0.020	0.032	0.032	0.039	0.043	0.035	0.036	0.038	0.041	0.064
Model/County	0.968	0.978	0.937	0.961	0.971	0.981	0.983	0.984	0.986	0.987
				Christian County (KY)						
1	54	170	155		163	166	176	184	205	205
2	73	148	149		156	159	169	178	197	197
55	733	1140	1157		1213	1237	1313	1373	1523	1523
66	138	1038	1053		1104	1126	1196	1251	1387	1387
125	21	31	18		19	18	20	21	23	23
126	52	60	53		56	56	60	63	70	70
127	481	619	628		659	671	713	745	827	827

Montgomery Model Portion of Christian County Total	1552	3206	3213		3370	3433	3647	3815	4232	4232
Portion of Christian County Not in Montgonery Model	21877	23976	24660		25184	26661	28139	28992	30690	30690
Census Christian County Total	23429	27182	27873		28554	30094	31786	32807	34922	34922
Model/County	0.066	0.118	0.115		0.118	0.114	0.115	0.116	0.121	0.121

Study Area TAZs

Montgomery County (TN)

Old TAZ	Revised* 2002 Emp	New 2005 Emp	Old 2010 Emp	Old 2016 Emp	Old 2020 Emp	Old 2030 Emp	New 2030 Emp
3	66	76	81	137	163	225	261
4	17	27	32	88	114	176	204
5	26	36	41	97	123	185	215
6	5	69	102	243	329	535	620
7	253	272	3953	4094	4180	4386	847
8	85	149	182	323	409	615	713
9	3856	3973	350	491	577	783	4223
10	4633	5098	4730	4871	4957	5163	7019
11	93	96	98	105	108	120	139
12	8	290	67	134	181	288	573
13	1190	1315	1249	1316	1362	1470	2065
14	24	63	83	150	196	304	2105
15	317	356	376	443	489	597	692
16	11	50	70	137	183	291	337
17	492	1930	589	730	816	1022	2443
18	9	48	68	135	181	289	335
19	272	336	369	510	596	802	930
20	161	183	194	302	354	476	552
21	1611	1633	1644	1752	1804	1926	2233
22	765	861	911	1046	1149	1392	1614
23	85	140	169	169	200	273	317
24	635	690	719	719	750	823	954
25	1715	1737	1748	1856	1908	2030	2354
26	14	110	160	295	398	641	743
27	217	313	363	498	601	844	979
28	649	745	795	930	1033	1276	1480
29	351	447	497	632	735	978	1134
30	373	428	457	457	488	561	651
31	40	104	137	278	364	570	661
32	127	191	224	365	451	657	762
33	81	145	178	319	405	611	708
34	308	372	405	546	632	838	972
35	2589	2653	2686	2827	2913	3119	3617
36	68	78	83	139	165	227	263
37	192	202	207	263	289	351	407
38	714	731	740	785	811	873	1012
39	53	78	91	113	136	187	217
40	503	524	535	588	619	692	802
41	859	876	885	930	956	1018	1180
42	188	205	214	259	285	347	402
43	22	39	48	93	119	181	210
44	693	714	725	778	809	882	1023

45	535	556	567	620	651	724	840
46	1760	1799	1819	1886	1932	2040	2366
47	649	715	749	750	787	875	1015
48	360	385	398	420	443	494	573
49	353	378	391	413	436	487	565
50	9	26	35	80	106	168	195
51	1251	1294	1316	1357	1396	1488	1725
52	45	88	110	151	190	282	327
53	59	76	85	130	156	218	253
54	41	66	79	101	124	175	203
56	60	85	98	120	143	194	225
57	115	136	147	200	231	304	353
58	65	108	130	171	210	302	350
59	48	87	107	174	220	328	380
60	132	171	191	258	304	412	478
61	391	430	450	517	563	671	778
62	300	307	310	310	313	322	373
63	232	271	291	358	404	512	594
64	205	244	264	331	377	485	562
65	533	638	692	1124	1337	1846	2141
67	5	48	70	111	150	242	281
68	435	445	450	506	532	594	689
69	211	214	216	223	226	238	276
70	316	323	326	326	329	338	392
71	246	253	256	256	259	268	311
72	506	513	516	516	519	528	612
73	128	131	133	133	135	141	163
74	246	249	251	251	253	259	300
75	726	729	731	731	733	739	857
76	16	19	21	21	23	29	34
77	121	143	154	153	166	195	226
78	205	227	238	237	250	279	324
79	222	277	306	306	337	410	475
80	173	176	178	178	180	186	216
81	238	241	243	243	245	251	291
82	192	195	197	197	199	205	238
83	1067	1074	1077	1077	1080	1089	1263
84	870	877	880	880	883	892	1034
85	685	692	695	695	698	707	820
86	384	387	389	389	391	397	460
87	92	95	97	97	99	105	122
88	189	211	222	221	234	263	305
89	354	361	364	364	367	376	436
90	1327	1334	1337	1337	1340	1349	1564
91	63	66	68	75	78	90	104
92	117	172	201	201	232	305	354

93	1	0	0	111	113	119	138
94	155	158	160	167	170	182	211
95	97	100	102	102	104	110	128
96	188	191	193	200	203	215	249
97	63	66	68	75	78	90	104
98	39	42	44	44	46	52	60
99	97	100	102	102	104	110	128
100	49	52	54	54	56	62	72
101	184	187	189	189	191	197	228
102	186	189	191	198	201	213	247
103	249	252	254	261	264	276	320
104	125	128	130	137	140	152	176
105	125	128	130	137	140	152	176
106	186	189	191	198	201	213	247
107	280	283	285	292	295	307	356
108	186	189	191	198	201	213	247
109	372	375	377	384	387	399	463
110	2694	2697	2699	2706	2709	2721	3155
111	280	283	285	292	295	307	356
112	135	138	140	140	142	148	172
113	13	52	72	139	185	293	340
114	121	142	153	206	237	310	359
115	5	30	43	65	88	139	161
116	7	46	66	133	179	287	333
117	70	109	129	196	242	350	406
118	53	78	91	113	136	187	217
119	1171	1221	1268	1409	1495	1701	2377
120	93	96	98	105	108	120	139
121	106	202	252	387	490	733	850
122	5	101	151	286	389	632	733
123	33	129	179	314	417	660	765
124	149	245	295	430	533	776	900
128	1355	50	1453	1592	1679	1884	2941
129	133	197	230	371	457	663	769
130	632	696	729	870	956	1162	1347
131	1163	1170	1173	1173	1176	1185	1374
401	13	13	13	13	13	13	15
402	8	8	8	8	8	8	9
403	6	6	6	6	6	6	7
404	8	8	8	8	8	8	9
405	8	8	8	8	8	8	9
406	8	8	8	8	8	8	9
407	12	12	12	12	12	12	14
408	11	11	11	11	11	11	13
409	20	20	20	20	21	21	24
410	25	25	25	25	26	26	30

411	0	0	0	0	0	0	0
412	43	43	43	44	45	46	53
413	45	45	45	46	47	48	56
414	15	15	15	15	15	16	19
415	15	15	15	15	15	16	19
416	48	48	48	49	50	51	59
417	47	47	47	48	49	50	58
418	46	46	46	47	48	49	57
419	45	45	45	46	47	48	56
420	40	40	40	41	42	43	50
421	100	101	101	103	105	106	123
422	35	35	35	35	36	37	43
423	90	91	91	93	94	97	112
424	55	55	55	56	57	58	67
425	667	676	680	694	707	719	835
426	1371	1371	1399	1428	1454	1478	2018
Model Montgomery County Total	54228	58804	60091	66793	71338	82129	100419
Portion of Montgomery County Not in Model	2042	2196					
Woods & Poole Montgomery County Total Non-Farm	56270	61000	70240	81020	88000	104170	104170
Study Area	**14353**	**15583**	**15141**	**16215**	**16897**	**18479**	**26611**
Study Area/Model	0.265	0.265	0.252	0.243	0.237	0.225	0.265
Model/County	0.964	0.964	0.856	0.824	0.811	0.788	0.964

* TAZ employment for 7 and 9 flipped

Christian County (KY)

1	52	55	59	72	71	86	86
2	21	22	24	30	30	35	35
55	950	1008	1098	1364	1315	1793	1793
66	111	117	127	158	152	183	183
125	154	163	177	215	213	256	256
126	52	55	60	67	74	89	89
127	1402	1487	1621	1993	1947	2125	2125
Montgomery Model Portion of Christian County Total	2742	2907	3166	3899	3802	4567	4567

Portion of Christian County Not in Montgomery Model	57058	59153					
Woods & Poole Montgomery County Total Non-Farm	59800	62060	64160	66460	67890	71010	71010
Model/County	0.0459	0.0468	0.0493	0.0587	0.0560	0.0643	0.0643

Appendix B

- Typical Sections for Recommended Roadway Improvements

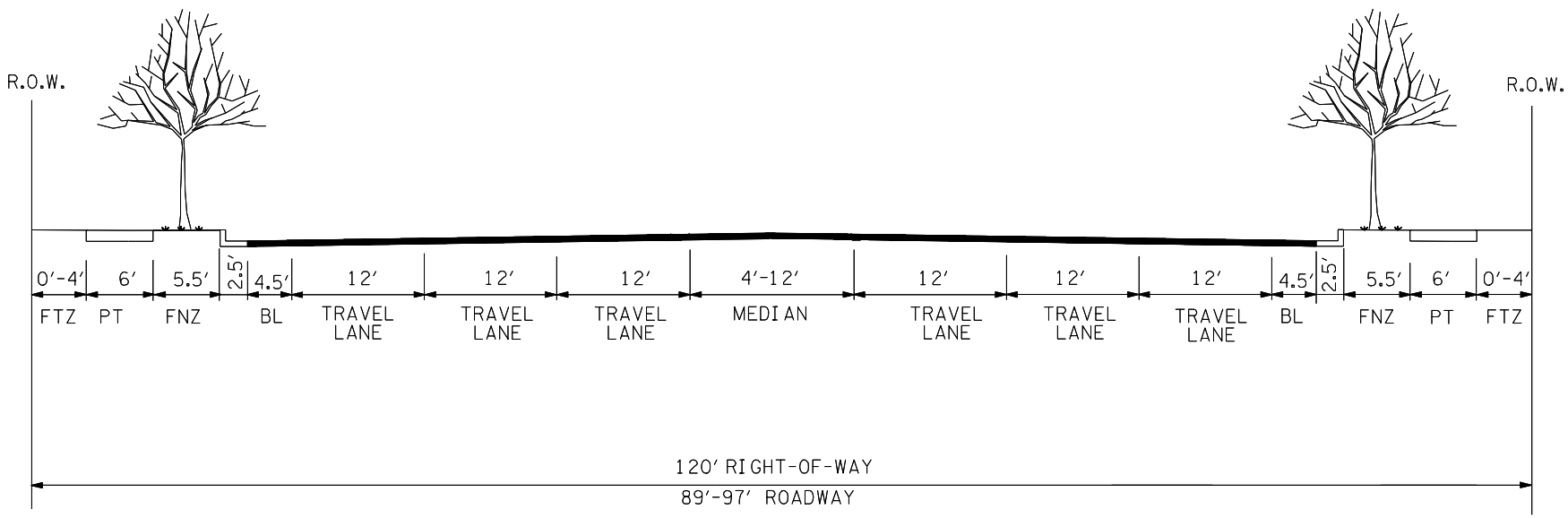
Typical Section Reference Number	Roadway	From	To	Type of Typical Section	Bike Lanes	Sidewalks	Multi-Use Paths	Functional Classification	
								Existing	Proposed
2	Dunlop Ln	Ted Crozier Blvd	International Blvd	Arterial Blvd: 4 lanes with median	X	X		Minor Arterial	Arterial Blvd
3	Dunlop Ln	International Blvd	Rossview Rd	Minor Arterial: 2 lanes	X	X		Collector	Minor Arterial
1A	Wilma Rudolph/Guthrie Hwy	I-24	Oakland Rd/Meriwether Rd	Principal Arterial: 6 lanes with median	X	X		Principal Arterial	Principal Arterial
1B	Wilma Rudolph/Guthrie Hwy	Oakland Rd/Meriwether Rd	International Blvd	Principal Arterial: 4 lanes no median				Principal	Principal Arterial
4	Professional Park Drive	Dunlop Lane	Cardinal Lane	Collector: 2 lanes with center turn lane	X	X		N/A	Collector
1C	Trenton Rd	Wilma Rudolph Blvd	Tiny Town Rd	Principal Arterial: 4 lanes no median			X	Minor Arterial	Principal Arterial
1C	Rossview Rd	Warfield Blvd	Kirkwood Rd	Principal Arterial: 4 lanes no median			X	Minor Arterial	Principal Arterial
2	Jack Miller Thoroughfare	Wilma Rudolph Blvd	Needmore Rd	Arterial Blvd: 4 lanes with median	X	X		N/A	Arterial Blvd
5A	I-24	South of SR 76	Fort Campbell Blvd/US41	Interstate: 6 lanes with median				Freeway	Freeway

Typical Section Reference Number	Interchange	Ramp (Direction)	Function of Ramp	Number of Lanes	
				Existing	Proposed
5B	I-24@Wilma Rudolph/Guthrie	All 4 On/Off Ramps		1	2
5B	I-24@Rossview	WB	Off	1	2
5B		EB	On	1	2
5B	I-24@Trenton	EB	On	1	2
5B		WB	Off	1	2

TYPICAL SECTION 1A

TYPICAL CROSS SECTIONS
NORTHEAST ST. BETHLEHEM TRANSPORTATION STUDY
CLARKSVILLE-MONTGOMERY COUNTY

PRINCIPAL ARTERIAL
(6 LANES)
(120' R.O.W.)

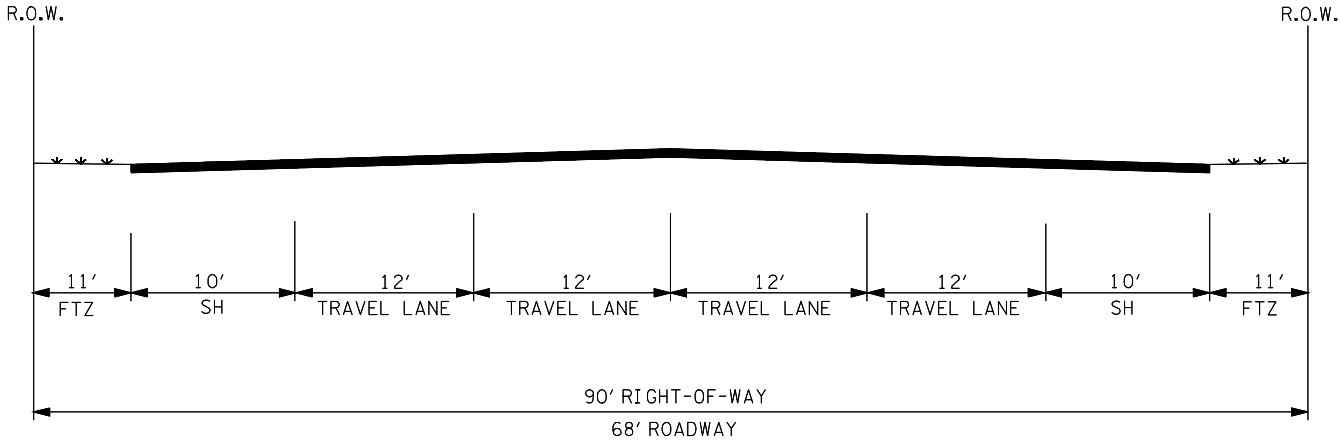


NOTES :
1) ALL UTILITIES LOCATED OUTSIDE ROW IF FEASIBLE
2) FURNISHINGS ZONE MAY BE USED FOR WIDER PEDESTRIAN TRAVELWAY AS APPROPRIATE
3) PT = PEDESTRIAN TRAVEL WAY
4) FTZ = FRONTAGE ZONE/ UTILITIES
5) FNZ = FURNISHINGS ZONE
6) BL = BIKE LANE

TYPICAL SECTION 1B

TYPICAL CROSS SECTIONS
NORTHEAST ST. BETHLEHEM TRANSPORTATION STUDY
CLARKSVILLE-MONTGOMERY COUNTY

PRINCIPAL ARTERIAL
(4 LANES)
(90' R.O.W.)

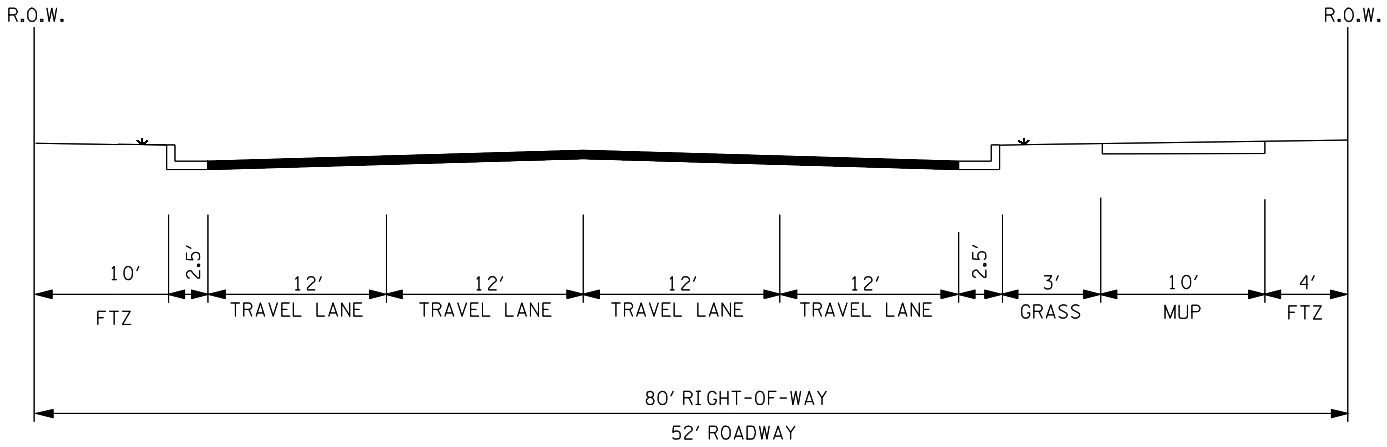


NOTES :
1) ALL UTILITIES LOCATED OUTSIDE ROW IF FEASIBLE
2) FTZ = FRONTAGE ZONE/ UTILITIES
3) SH = SHOULDER

TYPICAL SECTION 1C

TYPICAL CROSS SECTIONS
NORTHEAST ST. BETHLEHEM TRANSPORTATION STUDY
CLARKSVILLE-MONTGOMERY COUNTY

PRINCIPAL ARTERIAL
(4 LANES WITH MULTI USE PATHS)
(80' R.O.W.)

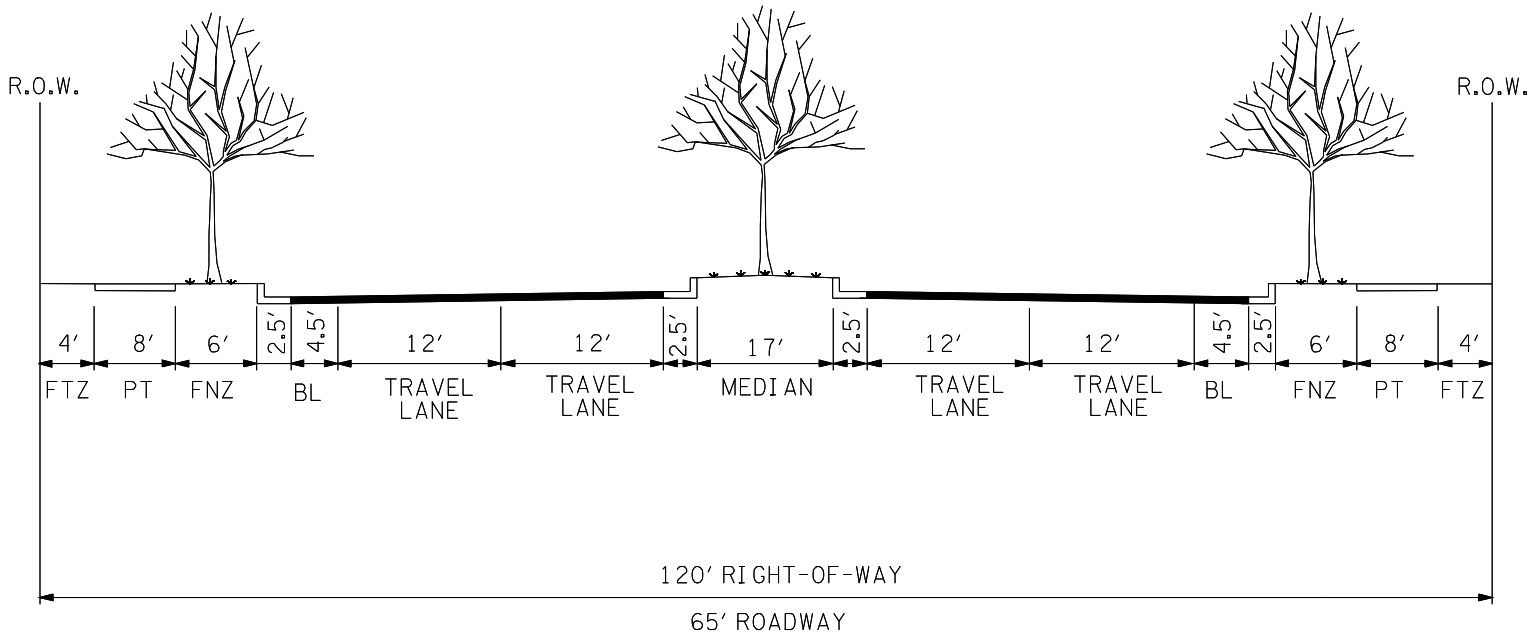


NOTES :
1) ALL UTILITIES LOCATED OUTSIDE ROW IF FEASIBLE
2) MUP = MULTI-USE PATH
3) FTZ = FRONTAGE ZONE/ UTLITIES

TYPICAL SECTION 2

TYPICAL CROSS SECTIONS
NORTHEAST ST. BETHLEHEM TRANSPORTATION STUDY
CLARKSVILLE-MONTGOMERY COUNTY

ARTERIAL BOULEVARD
(4 LANES WITH MEDIAN)
(120' R.O.W.)

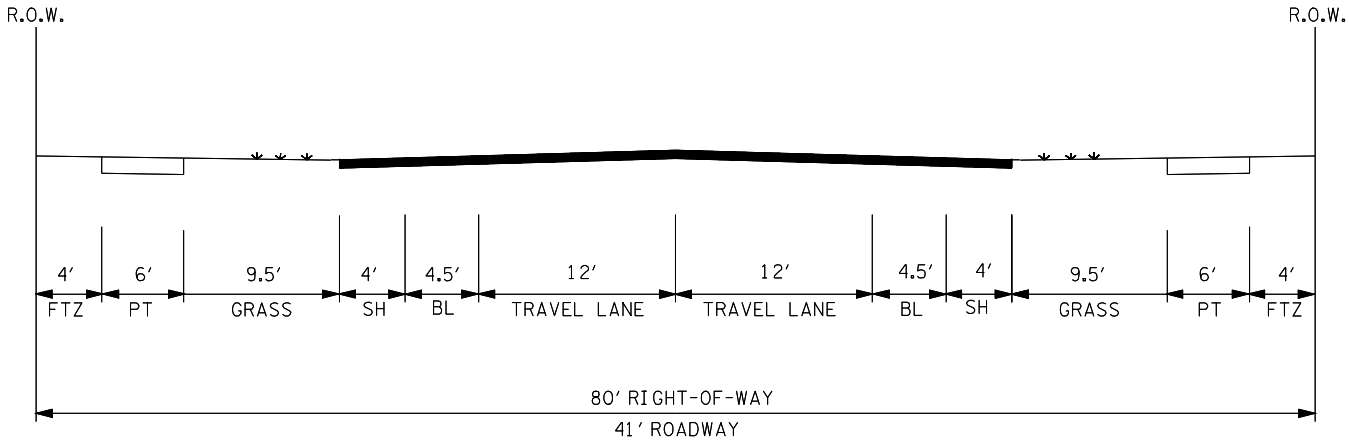


NOTES : 1) ALL UTILITIES LOCATED OUTSIDE ROW IF FEASIBLE
2) PT = PEDESTRIAN TRAVELWAY
3) FNZ = FURNISHINGS ZONE
4) FTZ = FRONTAGE ZONE/UTILITIES
5) BL = BIKE LANE

TYPICAL SECTION 3

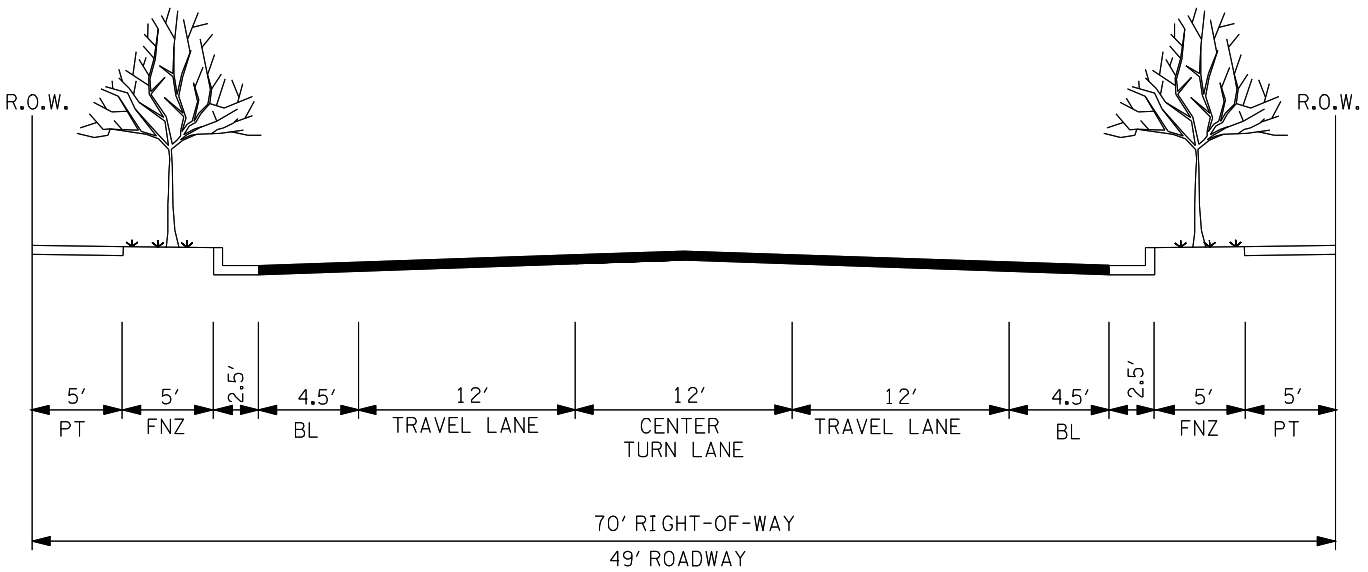
TYPICAL CROSS SECTIONS
NORTHEAST ST. BETHLEHEM TRANSPORTATION STUDY
CLARKSVILLE-MONTGOMERY COUNTY

MINOR ARTERIAL
(2 LANES)
(80' R.O.W.)



NOTES :
1) ALL UTILITIES LOCATED OUTSIDE ROW IF FEASIBLE
2) PT = PEDESTRIAN TRAVELWAY
3) FTZ = FRONTAGE ZONE/ UTILITIES
4) BL = BIKE LANE
5) SH = SHOULDER

COLLECTOR
(2 LANES WITH CENTER TURN LANE)
(70' R.O.W.)



NOTES :
1) ALL UTILITIES LOCATED OUTSIDE ROW IF FEASIBLE
2) FURNISHING ZONE MAY BE USED FOR WIDER PEDESTRIAN TRAVEL WAY AS APPROPRIATE
3) PT = PEDESTRIAN TRAVELWAY
4) FNZ = FURNISHINGS ZONE
5) BL = BIKE LANE

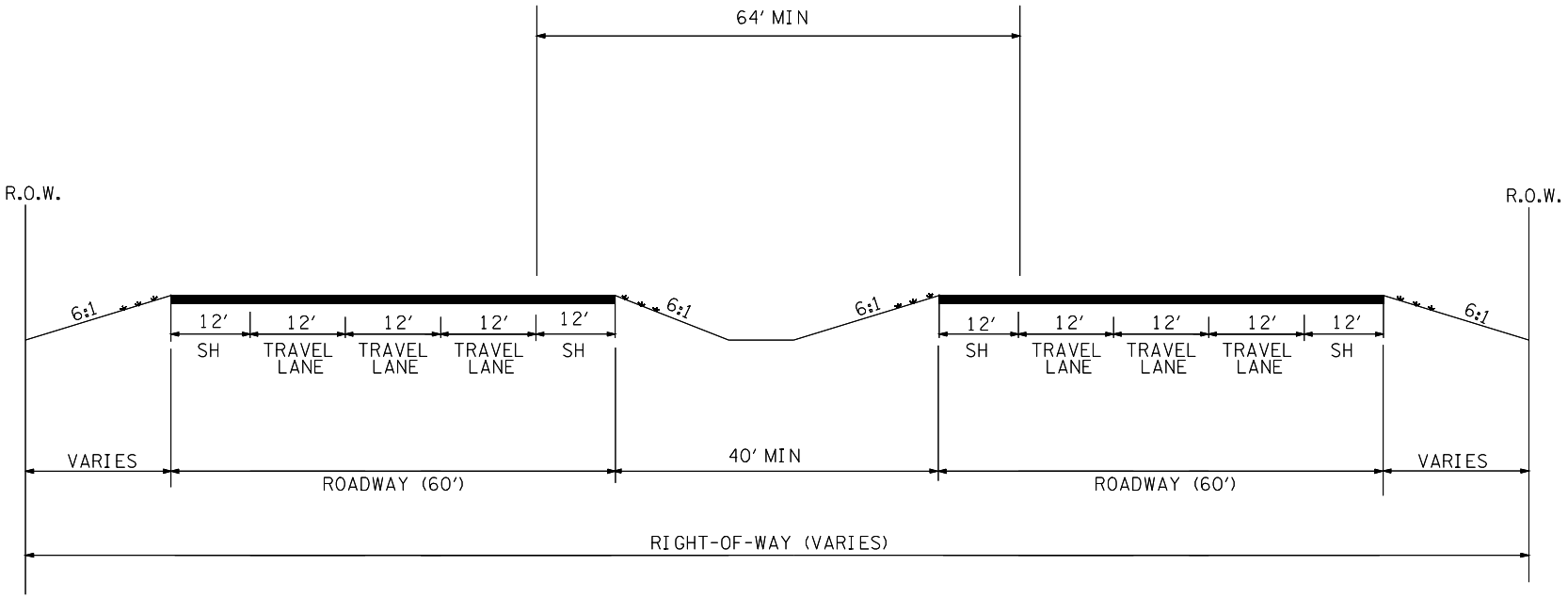
TYPICAL SECTION 4

TYPICAL CROSS SECTIONS
NORTHEAST ST. BETHLEHEM TRANSPORTATION STUDY
CLARKSVILLE-MONTGOMERY COUNTY

TYPICAL SECTION 5A

TYPICAL CROSS SECTIONS
NORTHEAST ST. BETHLEHEM TRANSPORTATION STUDY
CLARKSVILLE-MONTGOMERY COUNTY

ONE-WAY PAIR INTERSTATE
(6 LANES)
(R.O.W. VARIES)

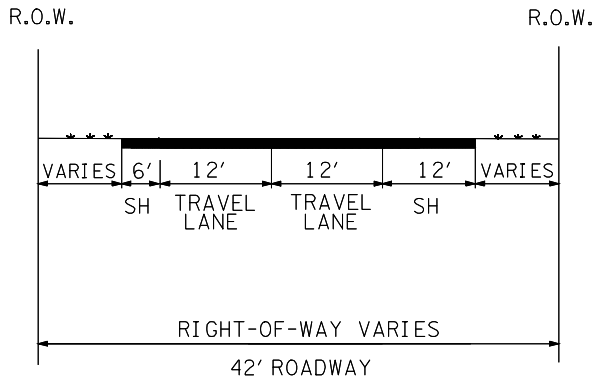


NOTES : 1) ALL UTILITIES LOCATED OUTSIDE ROW IF FEASIBLE
2) SH = SHOULDER

TYPICAL SECTION 5B

TYPICAL CROSS SECTIONS
NORTHEAST ST. BETHLEHEM TRANSPORTATION STUDY
CLARKSVILLE-MONTGOMERY COUNTY

INTERSTATE RAMP
(2 LANES)
(R.O.W. VARIES)



NOTES : 1) ALL UTILITIES LOCATED OUTSIDE ROW IF FEASIBLE
2) SH = SHOULDER

Appendix C

- Access Policies and Guidelines

ACCESS POLICIES AND GUIDELINES

Access management is the practice of controlling the access and roadway geometrics for connections to the local transportation network. The primary goals of Access Management are to improve roadway safety, improve traffic operations, protect taxpayer's investments in roads and create better conditions for pedestrians. Some secondary goals include opportunities to beautify areas and to reduce cut through traffic on residential roads.

Various techniques can be used including restrictive driveways, medians, deceleration and acceleration lanes and connectivity. The use of these features has proven to increase safety and efficiency on the roadways and extend the functionality of the transportation network.

These goals and objectives were recently addressed in the City of Clarksville's Ordinance amending the official code relative to driveway access (Ordinance 107-2006-06). This document provides additional considerations for roadway classification guidelines, connectivity considerations, interchange access spacing and median treatment guidelines.

Benefits of Access Management

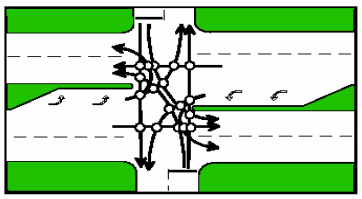
Access Management has been shown to increase safety and efficiency on roads. One of the most noticeable improvements associated with controlled access is the reduction in conflict points, which increases safety and efficiency. Often access management is thought of as median openings; however, access management extends much further to include driveways, land planning and transportation facility planning.

Figure 1 shows the conflict points associated with the various types of median openings. The more controlled the median opening is, the less probability there is for severe crashes. For example, with a full median opening, there are 18 major crashes that could occur because drivers are allowed to maneuver their cars freely. With a closed median, conflict points are reduced to 2 minor conflicts per driveway. These crashes would generally be minor rear end or sideswipe conflicts. Access management allows drivers sufficient sight distance and reaction time to recognize and react to potential hazards creating a safer environment for pedestrians and drivers.

Transportation engineering practice has shown that the efficiency of through traffic is greatly increased when access is controlled. As Figure 1 illustrates, there are less conflict points and therefore less stop-and-go traffic when access management is in place.

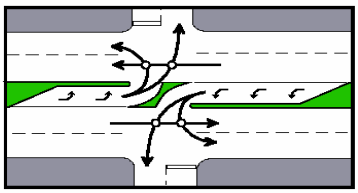
Because vehicles at some drives do not have sufficient gaps to cross high volume roads, channelizing traffic to signals reduces the delay at the side streets and driveways. The greater efficiency creates increased and preserved capacity of the road. This in turn preserves the investment of the roadway system by delaying the need to add more lanes.

Figure 1: Conflict Points Associated with Controlled Access



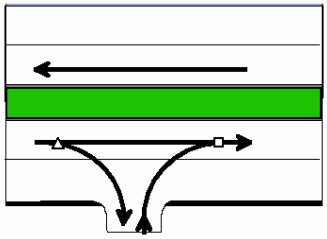
18
MAJOR
Conflicts

Full Median



4
MAJOR
Conflicts

Directional Median Opening



0
MAJOR
Conflicts

2
MINOR
Conflicts

3 Way Intersection / Closed Median

Raised medians and better-spaced driveways can also improve the aesthetics of a community. Landscaping can be included in raised medians and buffer areas; however, if it is improperly designed or maintained, the vegetation may become a safety hazard as sight distance is diminished. The regulated spacing of driveways also reduces the visual clutter of a road (i.e., consolidation of commercial signs and driveways).

All of these factors, plus the comfort level felt by the drivers and pedestrians, increases the appeal of a community. Everyone benefits by cooperative effort to provide good access design, including:

- The public safety and investment in the roadways is protected by the application of access management techniques.
- Property values remain stable or may increase along roadways, which carry significant traffic volumes so long as the traffic can flow smoothly with a minimum of congestion and conflicting movement.
- Each driver is rewarded with lower vehicle operating costs due to the smoother operations and less delay and with greater safety and comfort due to fewer conflicting traffic movements.

It is essential to have regulations in place that address issues of compatibility and function. Access management plans and regulations help to preserve the safety and efficiency of the transportation network as development occurs. Effective access management requires a combination of techniques involving land use planning, zoning, subdivision regulation, signage, access management and intergovernmental coordination.

A concern that often arises at the local level is that access controls could impede economic development. It is understandable that local governments are interested in

increasing their tax base through development. What is often not understood is that not managing access can have long-term adverse impacts on both the transportation function and economic development potential of an area. Access management plans and requirements can also help to discourage the division of roadway frontage into small lots with constrained development potential, and help to preserve larger parcels for higher quality development with good internal circulation and access design.

Table 1 outlines recommended access management guidelines by functional classification.

Table 1: Recommended Roadway Classification Guidelines

			Collectors		Local	
Design Criteria	**Freeway**	**Arterial**	**Major**	**Minor**	**Residential**	**Frontage**
Volume Range (vehicle trips/day)	******	>10,000	4,500 to 10,000	1,000 to 4,500	<1,000	n/a
Right-of-way Width (min. feet)	240	80-120*	80*	60	50	40
Number of Lanes (minimum)	4	5**	3**	2	2	2
Design Speed	55+	50	40	30	30	n/a
Interchange Spacing (miles)	1.0 *** 2.0 **** 3.0 *****	n/a	n/a	n/a	n/a	n/a
Interchange Spacing, > 45 mph (min. feet)	n/a	660	440	440	125	125
Interchange Spacing, < 45 mph (min. feet)	n/a	440	245	245	125	125
Median Spacing, directional (min. feet)	n/a	1,320	660	660	n/a	n/a
Median Spacing, full (min. feet)	n/a	2,640	2,640	1,320	n/a	n/a
Signal Spacing (min. feet)	n/a	2,640	2,640	1,320	1,000	1,000

Notes:

* Medians and/or Shoulders and Ditches may increase needed Right-of-Way Width.

** Two way left turn lanes may be replaced with medians and dedicated turn lanes.

*** CBD or CBD Fringe in Cities in Urbanized Area

**** Existing Urbanized Areas Other Than CBD or CBD Fringe

***** Transitioning Urbanized Areas and Urban Areas Other than CBD, CBD Fringe or Existing Urbanized Area

****** Typical threshold volumes for Expressways = 25,000 and Freeways = 35,000

Table 2 shows additional guidelines for separation distances from interchange exit ramps and Figure 3 illustrates the components of access separation distances.

Table 2: Separation Distances from Interchange Exit Ramps

Roadway Segment	Distance Recommendation
Weaving – moving across through lanes	800 feet on two lane arterials 1200 feet on four lane arterials 1600 feet on six lane arterials
Transition – moving into turn lane(s)	150 – 200 feet
Perception-reaction distance	100 – 150 feet
Storage	Adequate for volume without overflow into through lane (typical 200 – 300 feet depending on demand).
Distance to centerline of intersection	40 – 50 feet

Figure 2: Components of Access Separation Distances

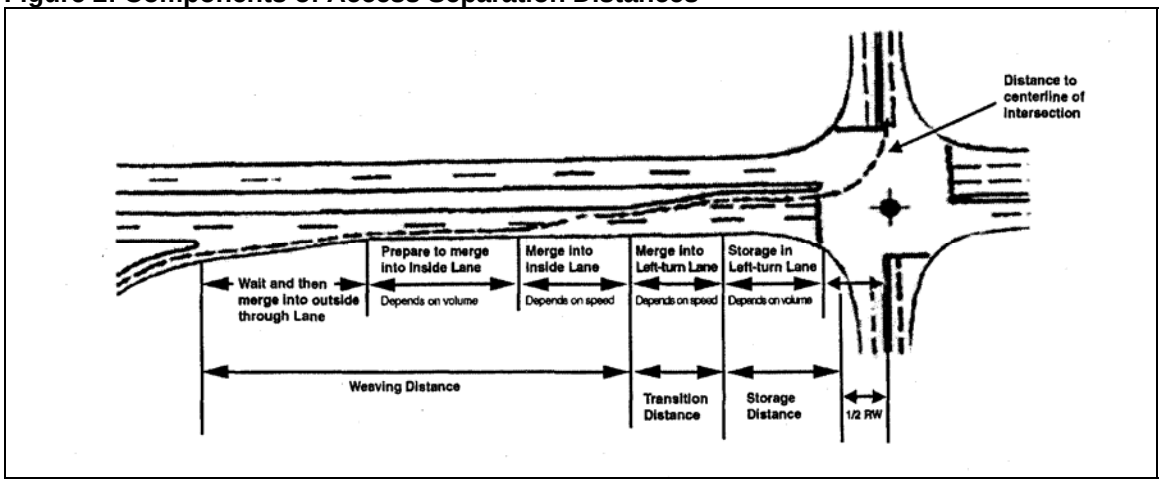


Table 3 shows minimum access spacing standards for four lane cross routes at interchanges.

Table 3: Four Lane Cross Routes

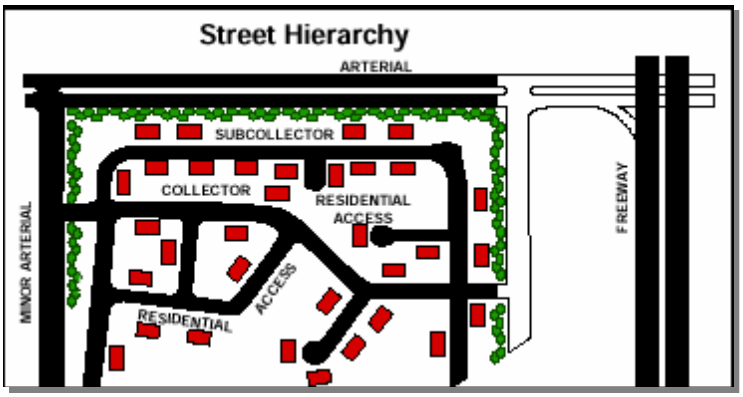
	Area Type		
Access Type	**Fully Developed Urban (45 mph)**	**Suburban (45 mph)**	**Rural (55 mph)**
First Access From Off Ramp	750 feet	990 feet	1320 feet
First Median	990 feet	1320 feet	1320 feet
First Access Before On Ramp	990 feet	1320 feet	1320 feet
First Major Signalized Intersection	2630 feet	2640 feet	2640 feet

Connectivity Considerations

Connectivity can also be thought of as having more than one point of access to a side road for a large development or having cross access within and between developments (i.e., connecting more than one driveway by a frontage road or connecting one driveway to more than one development). Connectivity allows trips to be distributed between the internal transportation systems and the hierarchy of the roadway structure (see Figure 4).

A variety of street types should be included in development plans to help interconnectivity and reduce volumes on major roadways. A common access management tool used to promote connectivity within developments is the use of frontage roads. These roads allow the traffic that would utilize the main road to access business to use an alternate parallel road (the frontage road) to make their turns. Connectivity also allows for pedestrian routes, which encourage walking between destinations and removes internal trips from the adjacent road network.

Figure 3: Street Hierarchy



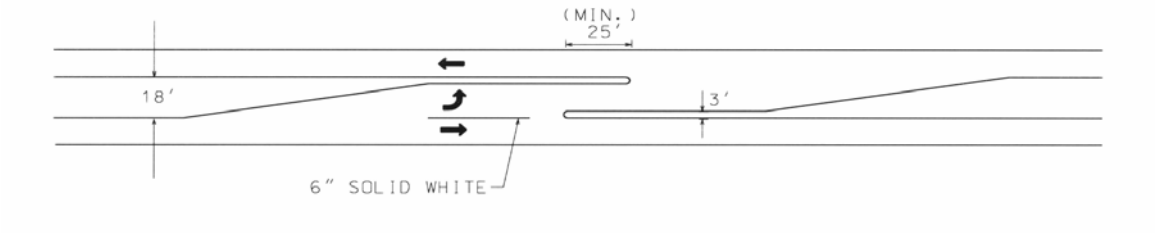
Median Treatment Guidelines

a. Medians should be included or planned to be included on all arterial roads, where there is enough right of way to be obtained. On major collector roads, medians should be seriously considered for inclusion for future projects. For minor collector and local roads, medians should be included where their benefits are greater than their costs or for aesthetic purposes.

b. Some typical design flaws of medians include multiple median openings very closely spaced, narrow medians where cars cannot safely store within them, no left turn lanes, or median openings that are too wide, etc. These medians can often reduce the safety and efficiency of a road.

Raised or painted median openings may be designed at a signalized intersection, a full unsignalized opening or a directional median opening. With a signalized intersection a traffic signal permits movements and most movements are controlled by the signal indicators. Unsignalized full median openings permit left turns to and from the main road and the intersecting road or driveway. Generally, the traffic on the main road has the right of way while traffic on the secondary road or driveway connection is regulated by stop or yield signs. Directional median openings (see Figure 5) allow for left turns from the major road but preclude left turns from the intersecting road or driveway. Other directional median openings allow for left turns into an intersecting road or driveway and/or out from the driveway.

Figure 4: Design of Directional Median Opening



a. A Two Way Left Turn Lane (TWLTL) is defined as a center lane of a road which is striped to allow left turns from virtually any place along the road. This effectively creates a situation with a high number of conflict points, since every driveway functions as a full median opening; however, the design of TWLTLs are encouraged on low volume roads with a high proportion of left turning vehicles (>20%) and a low density of driveways (<12 driveways per traffic direction per mile) in commercial areas. The traffic volumes should be below 28,000 ADT for a five lane typical section and below 17,500 ADT for a three lane typical section. TWLTLs should not be incorporated into 6 lane roadways. Where there are high pedestrian volumes, pedestrian refuge islands should be considered. These create a visual and concrete area for a pedestrian to wait if they cannot cross the entire street at one time; however, care should be taken if these islands are landscaped that the landscaping does not hide the pedestrians.

b. Median spacing helps preserve the efficiency of the traffic and the future capacity of the road. The priority of full median openings should be at existing or future signal locations. Typically, full median opening spacing should not be less than ¼ mile (1320 feet). This ensures optimal efficiency for signals. From the existing/future signal locations, corridors should be reviewed for the inclusion of other full or directional median openings. Generally, municipalities grant full median openings at public streets or the highest trip generator. Some exceptions to this philosophy are at locations of high heavy truck volumes and high schools due to their specialized needs including truck turning radius and available area to do u-turns and high school peak hour traffic and inexperienced drivers. The median opening locations should also be reviewed to ensure an adequate left turn deceleration lane could be incorporated with the median opening. If there is nothing to generate left turns from one side of a median opening, it may be reviewed to omit a left turn lane for that direction. Some factors to consider are the number of u-turns that will be using that location and including the proper sign design to prohibit turns. Due to safety considerations, full median openings with little opportunity to become signalized should not be included on six lane roadways. Vehicles tend to become trapped in the median opening with difficulty seeing the three approaching lanes.

c. Wide median opening widths should be avoided to help control traffic within median openings. The median width is measured from the opposing median noses. This width should vary between 65 feet and 100 feet with an average of 75 feet. The wider the side road or driveway, the wider the median opening width will need to be. If side roads or driveways are offset, they should be reviewed for median opening widths and conflicting turning movements.

d. Access management corridor plans are beneficial by planning development along a corridor so that all parties know what the access will be, signal spacing can be controlled and future construction costs can be offset by the donation of right of way and/or developers including part of the ultimate typical section in their plans.

a. Sight Distance should be reviewed at each median opening. Some of the different types of sight distance associated with median openings are intersection sight distance, U-turn sight distance and sight distances for left and right turns.

Appendix D

- TDM County & Study Area Graphics
  - 2030 Network by Functional Classification and Number of Lanes (Study Area)
  - 2030 Network by Functional Classification and Number of Lanes (County)
  - 2030 Level of Service (Study Area)
  - 2030 Level of Service (County)

Appendix E

- CD Containing Report, Graphics and Field Review Data