Blacksburg/Christiansburg/Montgomery Area

2030 Transportation Plan TECHNICAL REPORT

Developed by the
Blacksburg-Christiansburg-Montgomery
Area Metropolitan Planning Organization

in cooperation with
the Virginia Department of Transportation,
the Virginia Department of Rail and Public Transportation,
the Federal Highway Administration, and
the Federal Transit Administration

November 2005

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Executive Summary

The *Blacksburg/Christiansburg/Montgomery Area 2030 Transportation Plan* (the Plan) describes a comprehensive set of transportation improvements for the Towns of Blacksburg and Christiansburg and the surrounding urbanized portions of Montgomery County. These improvements seek to meet current travel demands, as well as projected travel demands to the year 2030. The Plan is the first for the newly formed Blacksburg-Christiansburg-Montgomery Area Metropolitan Planning Organization (BCM-MPO) and was developed in accordance with federal, state, and local requirements for an MPO Plan. These included early and ongoing public involvement, extensive coordination with local governments to ensure that local goals and objectives were reflected in the Plan recommendations, a 20-plus horizon year for Plan recommendations, consideration of anticipated transportation funding, and consideration of federal planning factors. Because anticipated needs exceeded funding projections to the year 2030, the Plan includes projects within a Financially Constrained Plan as well as a Vision Plan. Should funding projections increase prior to the usual five-year update cycle of the Plan, priority projects in the Vision Plan can be incorporated into the Financially Constrained Plan through an amendment to this document.

The development of the Plan included data collection, assessment of the existing transportation system, the development of a regional computerized transportation model, and public meetings at key milestones to solicit input. Each of these is described within this document. Plan recommendations were based on technical analyses, public input, and consideration of local planning, mobility, safety, and economic development initiatives.

The Financially Constrained Plan comprises two elements: 1) those projects currently programmed for funding in the Virginia Department of Transportation (VDOT) Six-Year Improvement Program, which covers fiscal years 2006 through 2011; and 2) projects that could be implemented based on anticipated funding streams between 2012 and 2030. Projects in the Financially Constrained Plan are shown in Exhibit E1. Note that some projects in Exhibit E-1 could not be fully funded based on the anticipated funding stream to 2030. Based on current fiscal estimates, funding for these projects would extend beyond 2030.

Exhibit E-1
Projects in the Financially Constrained Plan

Project Location	Description	Project in VDOT Six-Year Program
I-81 at Route 11/460 interchange	Install lighting	Yes
I-81 at Route 177/600 interchange	Modify grade at interchange	Yes
I-81 Improvements Environmental Document; statewide project that includes I-81 through the MPO area	Study to assess improvements, including consideration of rail improvements, highway widening, and other system improvements	Yes
"Smart Highway"	Construct roadway	Yes

Exhibit E-1

Projects in the Financially Constrained Plan

Project Location	Description	Project in VDOT Six-Year Program
Route 460 Bypass from Route 460 Business in Christiansburg to Route 460 Business in Blacksburg	Construct 4-lane roadway; project complete, included in program for final financing	Yes
Peppers Ferry Road from Christiansburg corporate limits to Route 460	Widen to four lanes	Yes
Peppers Ferry Connector from Peppers Ferry west of New River Mall to North Franklin Street north of Ellett Road	Construct 4-lane connecter with median, bicycle lanes, and sidewalks	Yes
Route 460 at Toms Creek Road	Construct interchange; project is previously funded, construction to begin in fiscal year 2006	Yes
North Main Street from College Drive to Prices Fork Road	Reconstruct, includes improvements to Prices Ford Road Intersection	Yes
North Main Street from Giles Road to Mount Tabor Road	Widen to four lanes with landscaped median, bicycle lanes, and sidewalks	Yes
Prices Fork Road at Toms Creek/Stanger Road	Improve intersection to improve traffic safety and pedestrian flow	Yes
Prices Fork Road at University City Boulevard	Traffic signal modification to improve traffic flow and pedestrian safety	Yes
South Main Street at Ellett Road; and Prices Fork Road at West Campus Drive and at TomsCreek/Stanger Road	Add turn lanes	Yes
Progress Street Extension from north of Cherokee Drive to Givens Lane; Givens Lane from Ashford Court to North Main Street	Construct Progress Street Extension, improve Givens Lane; in Six-Year Program for preliminary engineering only	Yes
Huckleberry Trail from Prices Fork Road to Glade Road	Construct bicycle trail	Yes
Peppers Ferry Road at New River and Norfolk Southern railroad tracks	Replace bridges	Yes
West Main Street at I-81	Improve interchange for operations	No
Route 460 Bypass at Route 460 Business	Add ramp for southbound Route 460 to westbound Route 460 Business	No
Smart Road from I-81 to Route 460 Bypass	Connection to Route 460 Bypass; includes paving 2-lane roadway	No
Intersection of Riner (Rt 8) and Smith Creek Rd (Rt 675)	Add turn lanes	No
Intersection of Peppers Ferry (Rt 114) and Rolling Hills (Rt 1286)	Add turn lanes	No
Intersection of Riner (Rt 8) and Fairview Church (Rt 669)	Add turn lanes	No
Riner Road (Rt 8) from South Study Area Boundary to Route 669 (Community of Riner)	Reconstruct to current 2-lane standards	No
Peppers Ferry Road from Radford Arsenal main entrance to the Christiansbug West Corporate Limits	Widen road to 4-lanes divided with bicycle lanes (partial funding)	No

Exhibit E-1

Projects in the Financially Constrained Plan

Project Location	Description	Project in VDOT Six-Year Program
Jenelle Road from Route 460 Business to Route 603	Reconstruct road to current 2-lane standards (partial funding)	No
South Main Street at Country Club Road	Improve intersection for operations and safety	No
North Main Street at Turner Street	Traffic signal upgrade to current equipment and standards	No
North Main Street at Progress Street	Traffic signal upgrade to current equipment and standards	No
Heather Drive at Prices Fork Road	Traffic signal upgrade to current equipment and standards	No
Toms Creek Road at Patrick Henry Drive	Upgrade intersection (this project would tie into the project to construct an interchange at Toms Creek Road and Route 460)	No
Marlington Street at South Main Street	Intersection improvements at the intersection of Marlington Street and South Main Street	No
Commerce Street from Trade Street to Jennelle Road	Construct extension of Commerce Street as two-lane roadway	No
Glade Road from Boxwood Drive to Linwood Lane	Reconstruct as 2-lane roadway with bicycle lanes, trail, and sidewalks	No
Shadow Lake Road from Basil Street to Lakewood Drive	Straighten and realign curves	No
Progress Street at Giles Road	Traffic signal upgrade to current equipment and standards	No
Washington Street at Draper Road	Traffic signal upgrade to current equipment and standards	No
Progress Street at Turner Street	Traffic signal upgrade to current equipment and standards	No
460 Bypass at Southgate Drive	Construct interchange (partial funding)	No
Peppers Ferry Road from west corporate limits to Route 460	Widen to four lanes, preliminary engineering and right-of-way acquisition included in Six-Year Program (partial funding)	No
Tech Center Drive south of Duck Pond Drive	Relocate to align with Duck Pond Drive; shift allows for airport runway extension (funded through Federal Aviation Administration)	No

Projects in the Vision Plan were prioritized, creating a Tier 1 list of projects that could be shifted into the Financially Constrained Plan (through amendment of the Plan by the MPO). These Tier 1 Vision Plan projects are summarized in Exhibit E-2.

Exhibit E-2

Tier 1 Vision Plan Projects

Project Location	Description
Smart Road from I-81 to Route 460 Bypass	Connection to Route 460 Bypass; includes paving 2-lane roadway
Peppers Ferry Road from Radford Arsenal main entrance to the Christiansburg West Corporate Limits	Widen road to 4-lanes divided with bicycle lanes
Jenelle Road from Route 460 Business to Route 603	Reconstruct road to current 2-lane standards
460 Bypass at Southgate Drive	Construct interchange
Peppers Ferry Road from west corporate limits to Route 460	Widen to four lanes, PE and ROW included in Six-Year Program
Route 460 Bypass from South Main to Prices Fork Road	Widen to 6 lanes
Southgate Drive Extension from Merrimac Road (Route 657) to Radford Arsenal	Construct as four-lane parkway
Riner Road (Rt 8) from Route 669 to Christiansburg South Corporate limits	Widen road to current standards
Peppers Ferry Road Extension from Route 460 Bypass to Ellett Roud (Route 723)	Construct 2-lane roadway
Merrimac Road from North Franklin Street (Route 460) to Prices Fork Road (Route 685)	Reconstruct road to current 2-lane standards
High Top Road from Merrimac Road to South Main Street (Route 460)	Reconstruct road to current 2-lane standards
Ramble Road from Industrial Park Drive to the Corporate Research Center	Reconstruct as 2-lane urban roadway plus transit pull-offs and bicycle lanes
Farmview Drive/Mabry Lane from Hightop Road to Huckleberry Lane	Reconstruct as 2-lane roadway with bicycle lanes and sidewalks
Progress Street at Patrick Henry Drive	Traffic signal and safety upgrades
Mount Tabor Road from North Main Street to Bishop Road	Reconstruct road to current 2-lane standards with sidewalks and bicycle lanes, and bus pull-offs; align with Givens Lane at North Main Street
Ellett Road from South Main Street to Cedar Hill Drive	Widen road to 4 lanes with bicycle lanes or separate multi-use trail; improve intersection of Ellet and S. Main
Southgate Drive from Merrimac Road to 460 Bypass	Extend Southgate drive as a 4-lane road with median, bicycle lands, and sidewalk
North Main Street from Mount Tabor Road to Route 460 Bypass	Widen road to 4 -lanes divided, with bicycle lanes and sidewalk
Country Club Drive Extension from Airport Road to Hubbard Street Extension	Construct extension of Country Club Drive; include bicycle lanes and trails.
Hubbard Street Extension from Airport Road to Southgate Drive	Construct extension of Hubbard Street as two-lane roadway; includes bicycle lanes and grade-separated crossing for the Huckleberry Trail
Heather Drive Extension from Prices Fork Road to Glade Road	Construct as two-lane roadway with bicycle lanes and sidewalks
Progress Street Extension from Givens Lane to North Main Street	Extension from Givens Lane through Northside Park to North Main Street
West Main Street (Route 8) at Phlegar Street/Radford Street	Improve intersection for operations and safety: shift Phlegar Street to align with Radford Street and create single intersection

Exhibit E-2

Tier 1 Vision Plan Projects

Project Location	Description
Radford Road and Radford Street from Silver Lake Road (western intersection) to Main Street	Widen road to four lanes with a center bi-directional turn lane, bicycle lanes, and sidewalks
North Franklin Street at Peppers Ferry Road	Improve intersection for operations; add additional approach lanes on Peppers Ferry Road to improve capacity
Parkway Drive Extension from existing Parkway Drive at Technology Drive to South Franklin Street	Extend road as 2-lane roadway on 4-lanes of right-of-way

Transportation via transit, bicycle, walking, air, and intercity bus is an integral part of the region's transportation system and the Plan recommends expanding the role that these modes of travel provide in the region. In addition to the provision for bicycles and pedestrians that are included in many of the roadway projects, the Plan recommends expansion to transit in the region, park-and-ride lots, bikeways and walkways, and intercity transportation by rail, air, and bus. Details of transit improvements are currently being developed as part of a Transit Development Plan (TDP) being developed by Blacksburg Transit. In addition, the Virginia Tech/Montgomery Executive Airport is also beginning the development of its Master Plan Update, with anticipated completion by the end of 2006.

The *Blacksburg/Christiansburg/Montgomery Area 2030 Transportation Plan* was adopted by the Blacksburg-Christiansburg-Montgomery Area Metropolitan Planning Organization on October 6, 2005.

Chapter 1: Introduction

The *Blacksburg/Christiansburg/Montgomery Area 2030 Transportation Plan* (the Plan) was developed to provide the Towns of Blacksburg and Christiansburg and the surrounding urbanized portions of Montgomery County with a comprehensive set of transportation improvements that will meet current travel demands, as well as projected travel demands to the year 2030. These improvements encompass all modes of travel, including roadway, transit, rail, air, bicycle, and pedestrian. The primary component of the Plan is the Financially Constrained Long-Range Plan (FCLRP), which consists of projects that can be funded based on anticipated funding streams to the year 2030. Regional transportation needs that are beyond those that could be funded based on current funding estimates are included in the Vision Plan component of this document.

1.1 Scope of the Transportation Plan

The 2030 Transportation Plan was developed to meet federal requirements for metropolitan area transportation planning. While individual jurisdictions often prepare local transportation plans, projects that receive any federal transportation funds must be included in a regionally adopted Transportation Plan that meets federal regulations. These regulations apply to both the content of the Plan and the way in which it is developed. Key requirements include:

- Early, proactive, and ongoing public involvement process
- Coordinated planning across local, state, and federal agencies
- Reflect local transportation, land use, and economic goals and objectives
- Consideration of all modes of travel, with specific emphasis on identifying pedestrian walkway and bicycle transportation facilities
- Include strategies to increase the use of new technologies for transportation, including Intelligent Transportation Systems (ITS)
- Assess needs and develop improvements that address transportation needs for a minimum horizon of 20 years
- Consideration of the social, environmental, and economic impacts of transportation recommendations
- Recommended projects must be able to be funded based on reasonable estimates of transportation funding between today and 2030 (financially constrained)

Federal regulations also require that the Transportation Plan and the recommendations contained within the Plan address seven planning factors. These factors are listed below and specifically addressed in Appendix A. The Transportation Plan should:

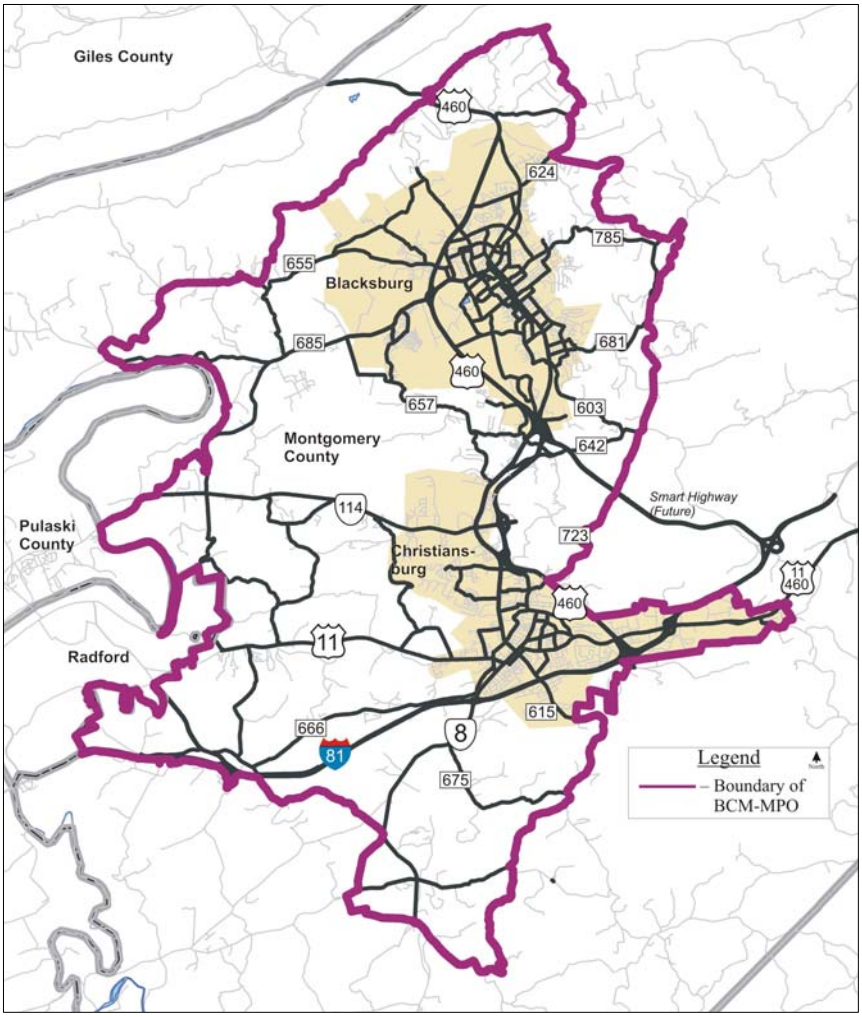
- Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;
- Increase the safety and security of the transportation system for motorized and non-motorized users;
- Increase the accessibility and mobility options available to people and for freight;
- Protect and enhance the environment, promote energy conservation, and improve quality of life;

- Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight; Promote efficient system management and operation; and
- Emphasize the preservation of the existing transportation system.

1.2 Study Area

This Technical Report describes the methodologies used in developing transportation recommendations within the boundaries of the Blacksburg/Christiansburg/ Montgomery Area Metropolitan Planning Organization (BCM-MPO), as well as the projects themselves. The BCM-MPO area includes the Towns of Blacksburg and Christiansburg, as well as the adjacent urbanized portions of Montgomery County. Urbanized areas are defined by the U.S. Census based on total population: encompassing at least one population center with at least 50,000 persons, and including contiguous areas that meet population density thresholds. The Blacksburg/Christiansburg/Montgomery region met these thresholds after the 2000 US Census. The boundaries of the BCM-MPO area are shown in Exhibit 1.

Exhibit 1
Study Area (MPO Boundary)



1.3 Demographic Overview

The BCM-MPO study area is currently home to just under 75,000 persons, as shown in Exhibit 2 below. Through the 1990's, the region's population grew by 13 to 14 percent. The rate of population growth in the 1990's is expected to continue, resulting in an estimated population within the MPO of 101,800 persons in 2030. The population forecasts shown in Exhibit 2 were developed as a cooperative effort by the MPO's Technical Advisory Committee and were adopted by the MPO. The forecasts also reflect generalized estimates as developed by the Virginia Employment Commission (VEC) and the official state-endorsed forecasts from the Tayloe-Murphy Center..

Exhibit 2
Existing and Forecast Population

Area	1990	2003	Percent Increase (1990 to 2003)	2030 (Forecast)	Percent Increase (2003 to 2030)
Blacksburg	34,590	39,573	14.4%	52,704	33.2%
Christiansburg	15,004	16,947	12.9%	24,873	46.8%
Montgomery County	73,913	83,629	13.1%	NA **	NA **
MPO	NA	74,650 *	NA	101,839	36.4%

** -- 2003 estimate including the Towns of Blacksburg and Christiansburg, Virginia Tech, and the urbanized portions of Montgomery County. This is not a total of the lines above, because not all of Montgomery County is in the MPO.*
*** -- Forecasts developed for this study (based on detailed zone-by-zone assessments of growth) were for the MPO area which is included in the area covered by the transportation model. Forecasts were not developed for Montgomery County as a whole.*
Sources: US Census, Blacksburg/Christiansburg/Montgomery MPO

Exhibit 3 below summarizes the existing and 2030 employment for the BCM-MPO area. These forecasts were also developed as a cooperative effort by the MPO and were initially based on a database of all employers in the region provided by the VEC. This data was checked and validated by local jurisdictions. Employment forecasts were developed based on local land use plans, current development patterns, employment trends, and generalized estimates by the VEC. As with the population forecasts, the employment forecasts were adopted by the MPO.

Exhibit 3
Existing and Forecast Employment

Area	2003	2030 (Forecast)	Percent Increase (2003 to 2030)
Blacksburg	20,760	26,764	28.9%
Christiansburg	12,427	15,779	27.0%
Montgomery County	3,188 *	5,406 *	69.6%
MPO	36,375	47,949	31.8%

** -- Portion of Montgomery County within the MPO.*
Sources: Virginia Employment Commission, Blacksburg/ Christiansburg/Montgomery MPO

Future transportation needs in the region were identified using a computerized regional travel demand model that was updated and validated using 2003 as a base year. Increases in population and employment are the primary inputs into the travel forecasting process. The travel demand model is described more fully in Appendix C of this document. Appendix C also includes additional information on the demographic data summarized above.

Chapter 2: Existing Transportation System

The study area is served by a network of roads, sidewalks, and bicycle trails and lanes. Pedestrian travel is served by sidewalks within the downtowns and on local and thoroughfare roads elsewhere. In general, bicycle travel is permitted on existing roads. On-street parking is permitted in Blacksburg and Christiansburg unless restrictions are posted. Transportation needs are also served by Blacksburg Transit (fixed route and paratransit service), SmartWay bus service between Blacksburg/Christiansburg and Salem/Roanoke, taxi service, and the Virginia Tech/Montgomery Executive Airport. Commercial air travel is provided out of Roanoke Airport (approximately 35 miles to the east), while the closest location for intercity passenger train service (Amtrak) is either Clifton Forge, about 60 miles to the north, or Lynchburg, about 80 miles to the northeast.

2.1 Roadway Network

The focus of the Plan is the functionally classified urban thoroughfare system. The urban thoroughfare system is a subset of the area's overall road network that is designated by VDOT, the Federal Highway Administration, and the Towns of Blacksburg and Christiansburg. The thoroughfare system includes roads that are functionally classified as arterials or collectors, and comprises approximately 130 roadway miles (360 lane-miles) within the BCM-MPO study area. Arterial roads serve as the major traffic-carrying facilities in the area, and carry through traffic. Collector roads carry a lesser volume of traffic and feed traffic to the arterial roadways. Since these roadways make use of federal and state funds for construction and maintenance, they must be included in the Plan.

Blacksburg and Christiansburg lie at the convergence of several major north-south and east-west routes. Interstate 81 lies along the east edge of Christiansburg, providing a connection with the upper Shenandoah Valley and the Mid-Atlantic states to the north, and southwest Virginia and Tennessee to the south. US Route 11 parallels I-81 in a north-south direction, and traverses the central business district of Christiansburg. This road is designated as Roanoke Street, Main Street and Radford Street at various locations. US Route 460 travels in an east-west direction in the Blacksburg/Christiansburg area and provides a connection between the two towns. The road is designated Franklin Street in Christiansburg and Main Street in Blacksburg. Each town has a Route 460 Bypass that provides a route around its downtown area, and a new bypass that relieves the congested portions of Route 460 between the two towns was completed in the summer of 2002.

The area is also served by three Virginia primary routes. These are Route 8 and Route 111 in Christiansburg, designated as Riner Road and Depot Street, respectively. Route 114 ties into US Route 460 between Christiansburg and Blacksburg, and is designated as Pepper's Ferry Road.

Existing (year 2003) daily traffic volumes on study area roads are shown in Exhibits 4 and 5.

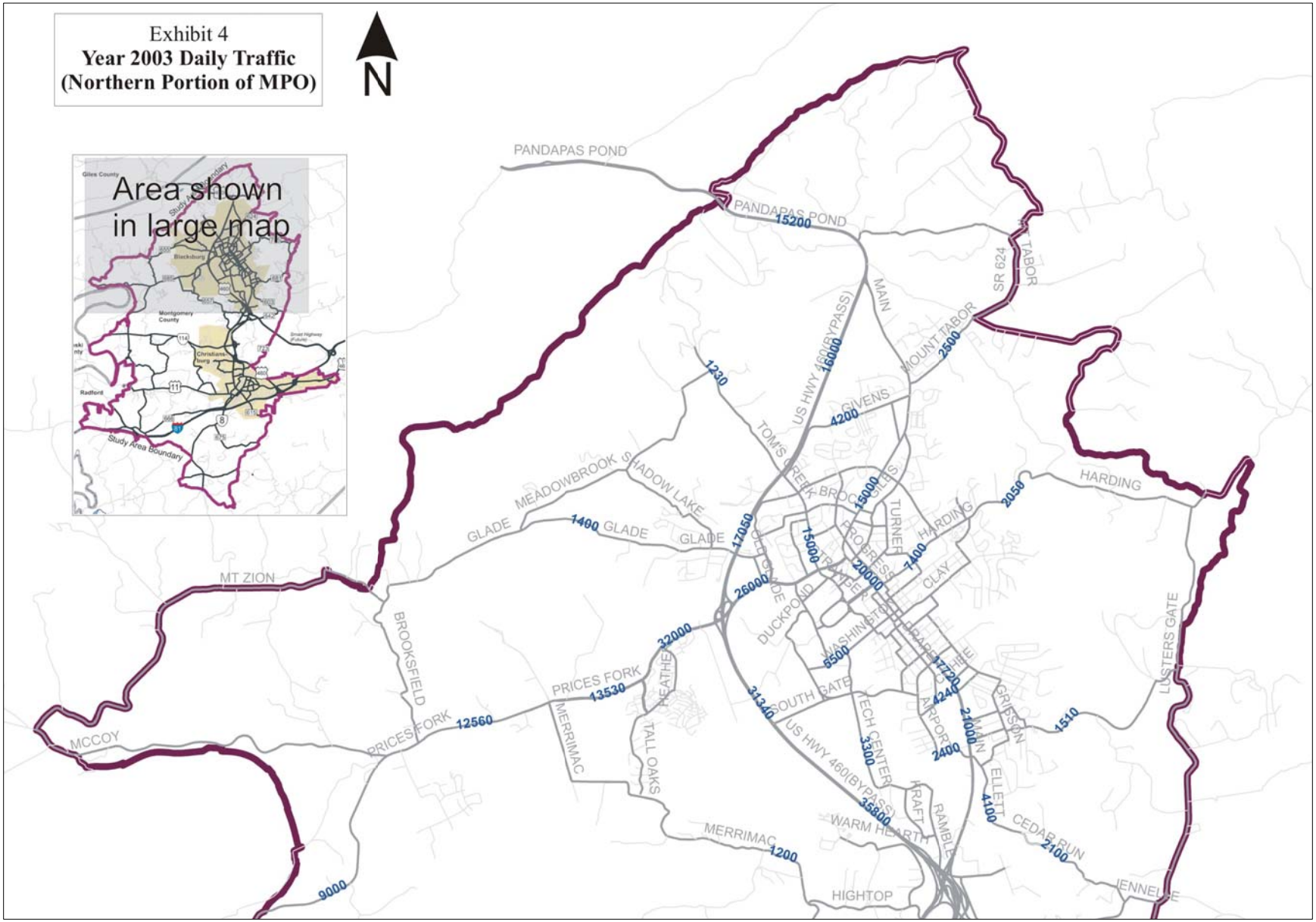


Exhibit 4
Year 2003 Daily Traffic
(Northern Portion of MPO)
N
Area shown in large map
Study Area Boundary
PANDAPAS POND
PANDAPAS POND
15200
SR 624
MOUNT TABOR
MOUNT TABOR
2500
MAIN
US HWY 460(BYPASS)
16000
1230
GIVENS
4200
TOMS CREEK
MEADOWBROOK
SHADOW LAKE
GLADE
1400
GLADE
GLADE
17050
15000
15000
HARDING
2050
HARDING
7400
CLAY
20000
26000
DUCKPOND
MT ZION
BROOKSFIELD
32000
PRICES FORK
13530
PRICES FORK
12560
MCCOY
9000
MERRIMAC
TALL OAKS
MERRIMAC
1200
HEATHER
5500
SOUTH GATE
31340
US HWY 460(BYPASS)
35800
WARM HEARTH
HIGHTOP
3300
17720
4240
21000
2400
4100
2100
1510
LUSTERS GATE
CEDAR RUN
ELLETT
KRAFT
RAMBLE

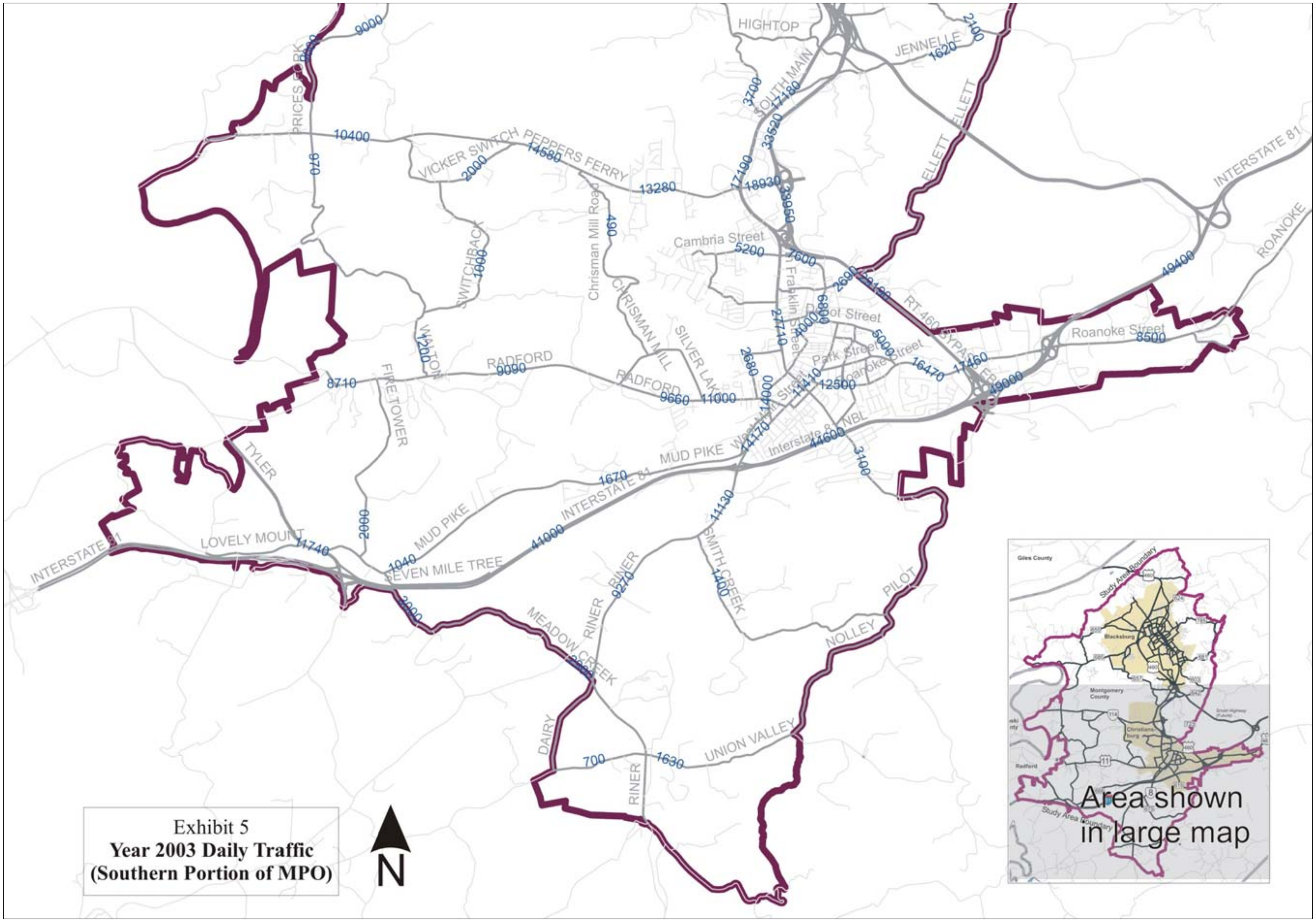


Exhibit 5
Year 2003 Daily Traffic
(Southern Portion of MPO)

2.2 Bicycle and Pedestrian Network

The Town of Blacksburg has about 14 miles of roadway with bicycle lanes (with most major streets having bicycle lanes), and 17 miles of separate paved trails. There are currently no bicycle lanes in Christiansburg, although travel lanes on some streets have been narrowed to make travel easier for bicyclists. The region's major off-road bicycle facility, the Huckleberry Trail, lies along the old Huckleberry Line railroad bed that runs from the New River Valley Mall in Christiansburg to trails in Blacksburg link to the downtown. Christiansburg's ultimate goals are to extend the Huckleberry Trail into its downtown.

In addition to the walking amenities that off-road trails such as the Huckleberry Trail provide, the downtowns of both Blacksburg and Christiansburg are well served by sidewalks. Blacksburg estimates that over 25 miles of road within the Town have sidewalks on at least one side. Since the late 1980's, Blacksburg has also had an ordinance requiring sidewalks in front of all existing and future development. For commercial land uses, sidewalks are required on both sides of the road; for residential land uses, they are required on one side. Christiansburg also requires all new development in commercial districts to have sidewalks. All three jurisdictions within the BCM MPO are actively seeking an expanded network of sidewalks and trails – Montgomery County is seeking these pedestrian amenities as part of its village planning in the communities of Prices Fork, Riner, Plum Creek, and Belview.

2.3 Transit Service

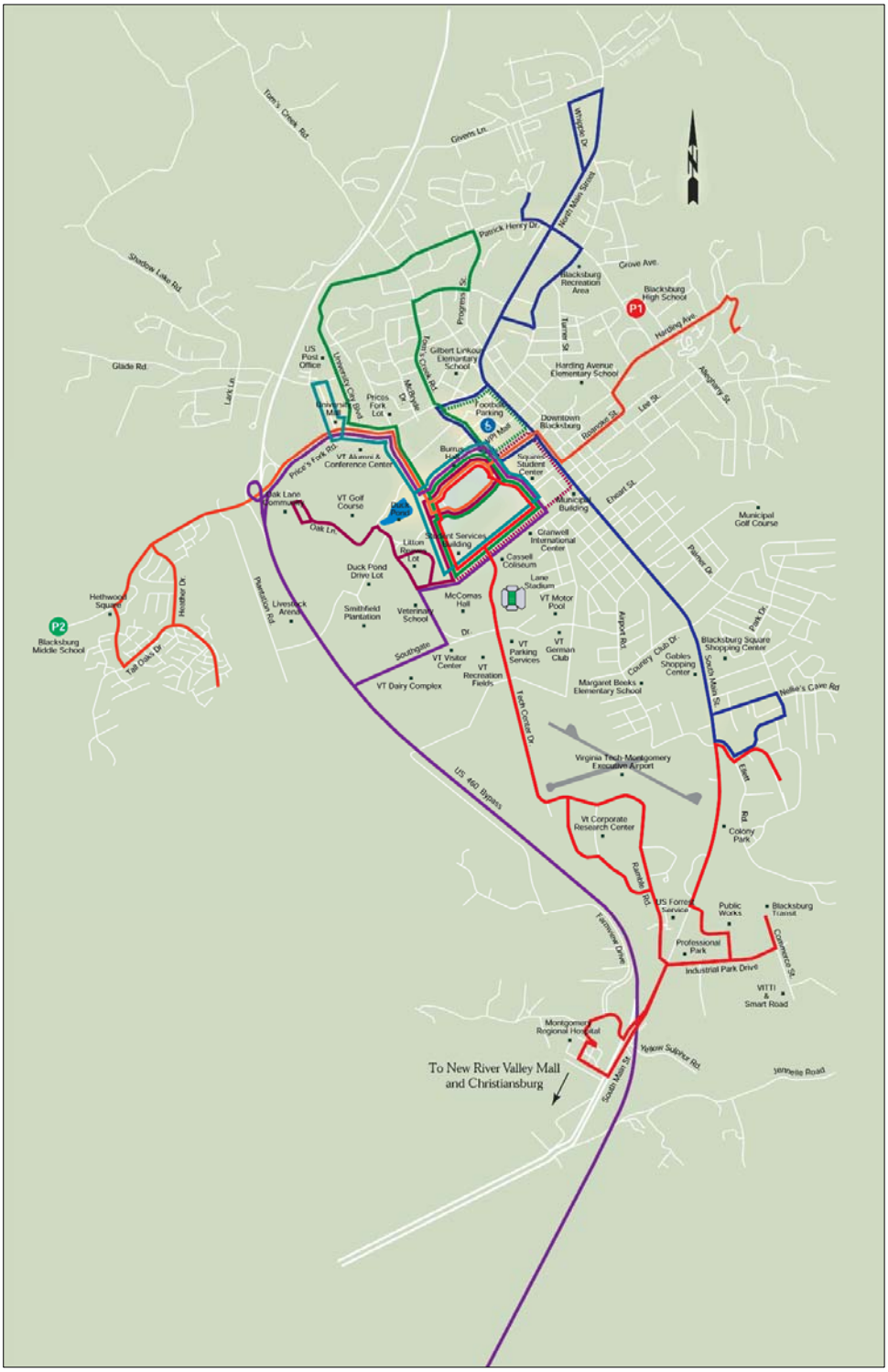
Transit service within the MPO is provided by Blacksburg Transit (BT). BT's primary service area is the Town of Blacksburg and Virginia Tech. Service outside of the Blacksburg is provided to the Montgomery Regional Hospital; Two-Town Trolley service is also provided in the Town of Christiansburg. BT was originally formed by an agreement between the Town and Virginia Tech in 1983. Service started with six buses; by the late 1980s, the service was running with 22 buses. Today, BT runs fixed route and paratransit service with a fleet of 31 buses and 11 vans.

BT operates eight routes within the town limits of Blacksburg (see route map in Exhibit 6), and one route to Christiansburg. Generally, buses run every 15 minutes during the week, with hourly service on the weekends. Buses run on arterial and connector streets throughout Blacksburg, and serve many high-density residential areas and commercial centers in the town. The Two Town Trolley, the express route to Christiansburg, runs hourly from downtown Blacksburg to downtown Christiansburg. A few additional stops are made along the route, including the New River Valley Mall.

Ninety-five percent of the 1.9 annual million trips on BT are made by Virginia Tech students, faculty and staff. University students, faculty and staff do not pay a fare to ride; the cost of the service is paid for in advance by a student transit fee and revenue generated from university parking permit fees. Local residents pay a fare of 50 cents to ride the bus and have several options to purchase passes at a reduced cost.

Exhibit 6

Blacksburg Transit Route Map



Source: Blacksburg Transit

Transit service in Christiansburg is currently limited to a route that connects the retail corridor at Route 114 to the downtown area. This service is provided as part of the Two Town Trolley route operated by the Town of Blacksburg under a cost-sharing agreement with Christiansburg to cover the subsidy for non-university affiliated riders.

BT also operates a paratransit service that transports persons with disabilities to all areas within Blacksburg's corporate limits, as well as one-half mile past the Town limits on Nellies Cave Road and three-quarters of a mile past Montgomery Regional Hospital.

Transit service is also provided from the BCM-MPO area to Roanoke and Salem via the Smartway Bus. Smartway is operated by Valley Metro out of Roanoke. Buses run 12 times a day Monday through Friday and nine times on Saturday, with one additional evening run on Fridays and Saturdays.

2.4 Park-and-Ride and Rideshare

There are currently no rideshare programs within the BCM-MPO area. Formal and informal park-and-ride facilities in the BCM-MPO area include one at the interchange of Route 460 and I-81 (Exit 118), at Route 8 and I-81 (Exit 114), the New River Valley Mall, the K-Mart at North Franklin Street near Peppers Ferry Road, and several other small lots.

2.5 Intercity Rail, Bus, and Air Service

The BCM-MPO area is not currently served by intercity passenger rail (Amtrak) service. The closest locations with train service are Clifton Forge (60 miles to the north) or Lynchburg (80 miles to the northeast). There are currently no intercity bus stops in the BCM-MPO area; service is provided out of Roanoke. Recent cutbacks in Greyhound service have decreased intercity bus service throughout the country.

The closest location to the BCM-MPO area for commercial air service is Roanoke, approximately 35 miles east of the MPO. In addition to driving or taking a taxi, travel to the Roanoke Airport can be made using the Smartway Bus service. General aviation service within the MPO is provided by the Virginia Tech/Montgomery Executive Airport, located adjacent to the Virginia Tech campus and approximately three miles south of the center of Blacksburg. The single asphalt runway is 4,550 feet long. The airport has a parallel taxiway, ten hangers, and a terminal. There are 35 aircraft based at the airport. The airport has about 1,450 operations (one take-off and landing) per month, with substantially more during the fall tourist season. The airport also has a flight school, which is operated by an independent contractor.

Chapter 3: Existing and Future Transportation Needs

Transportation needs in the Blacksburg/Christiansburg/Montgomery Area Metropolitan Planning Organization (BCM-MPO) were identified through a process that included interviews with transportation providers, agency and local government input, public involvement, and transportation planning and traffic engineering analysis. Interviews included staff from each of the Towns as well as Montgomery County, the Virginia Department of Transportation, Blacksburg Transit, and several major local industries. Details on public input, as well as the planning and engineering analyses, are described below. Note that transportation needs were identified for both existing conditions and for the Plan's horizon year of 2030.

3.1 Public Involvement Process

Public input into the Plan was sought prior to the beginning of the plan development process and at key milestones. Before the plan development process began, displays on the purpose and development of the Plan were available at the region's annual transportation public meeting which was held on March 17, 2004. Project staff were available to answer questions and take comments from the public on a wide range of transportation issues in the region. A plan development outline was also presented. Public input at this meeting was generally related to the need for expanded transit service and expanded regional bicycle facilities.

Planning efforts in 2004 and early 2005 were primarily focused on the development of the computerized regional transportation model and assessment of existing conditions based on traffic engineering analysis and other modes assessments. Input on existing transportation conditions was sought at the March 16, 2005 regional transportation public meeting. At this meeting, information on the regional transportation model and preliminary traffic engineering analysis was presented for public review. Preliminary funding estimates for the Plan were also presented for review. Input on projects that should be considered in the 2030 Plan was sought. Input received at the meeting included consideration of extending Southgate Drive west towards Radford and into Pulaski County and consideration of constructing a new roadway between Routes 674 and 640 in Montgomery County. The first proposed project includes sections within the BCM-MPO area as well as sections in Pulaski County. The second project cited for consideration is located outside of the MPO boundary but was noted for consideration in other planning efforts.

A public meeting to review projects under consideration in the 2030 Plan was held on July 20, 2005. Information was presented at this meeting on:

- the existing transportation system for all modes;
- projected 2030 traffic volumes and anticipated deficiencies;
- preliminary projects for all modes proposed for inclusion in the 2030 Plan;
- the plan development process and schedule;
- the financial constraint process and proposed priorities

Public input was sought with respect to the proposed projects and priorities, as well as other projects that meeting participants believed should be considered as part of the Plan. Twenty-five people attended this meeting and 10 comment sheets were returned. The major areas addressed in the comments include:

- Support for east-west connector from Route 460 Bypass at Southgate Drive through Montgomery and Pulaski Counties to I-81 at exit 94 (portion in the BCM-MPO area is included in the Plan);
- Overall need for more emphasis in the region on bicycle routes/lanes and sidewalks (including a goal to have sidewalks on all residential streets, and better pedestrian connections to and within the New River Mall area);
- Need to expand transit service (to Warm Hearth), promote roadway improvements that support transit, and maintain the SmartWay bus service;
- Comments both in support of and against proposed improvements to Marlington Street and Nellies Cave Road (Blacksburg);
- Comments indicating that improvements on North Main Street, Ellett Road, Toms Creek Road, and Marlington Street (all in Blacksburg) should be a priority ;
- Need for intersection improvements at Marlington and Main Streets (Blacksburg);
- Need for a direct connection from Route 460 Bypass to the Virginia Tech Corporate Research Center;
- Expand the MPO area to include Radford, Pulaski County, and Giles County

A final public hearing on the draft Plan was held on September 14, 2005. Eleven citizens attended this meeting. Most of the comments received related to either bicycle or transit projects, indicating that these need to be a priority within the BCM-MPO area. Comments received include:

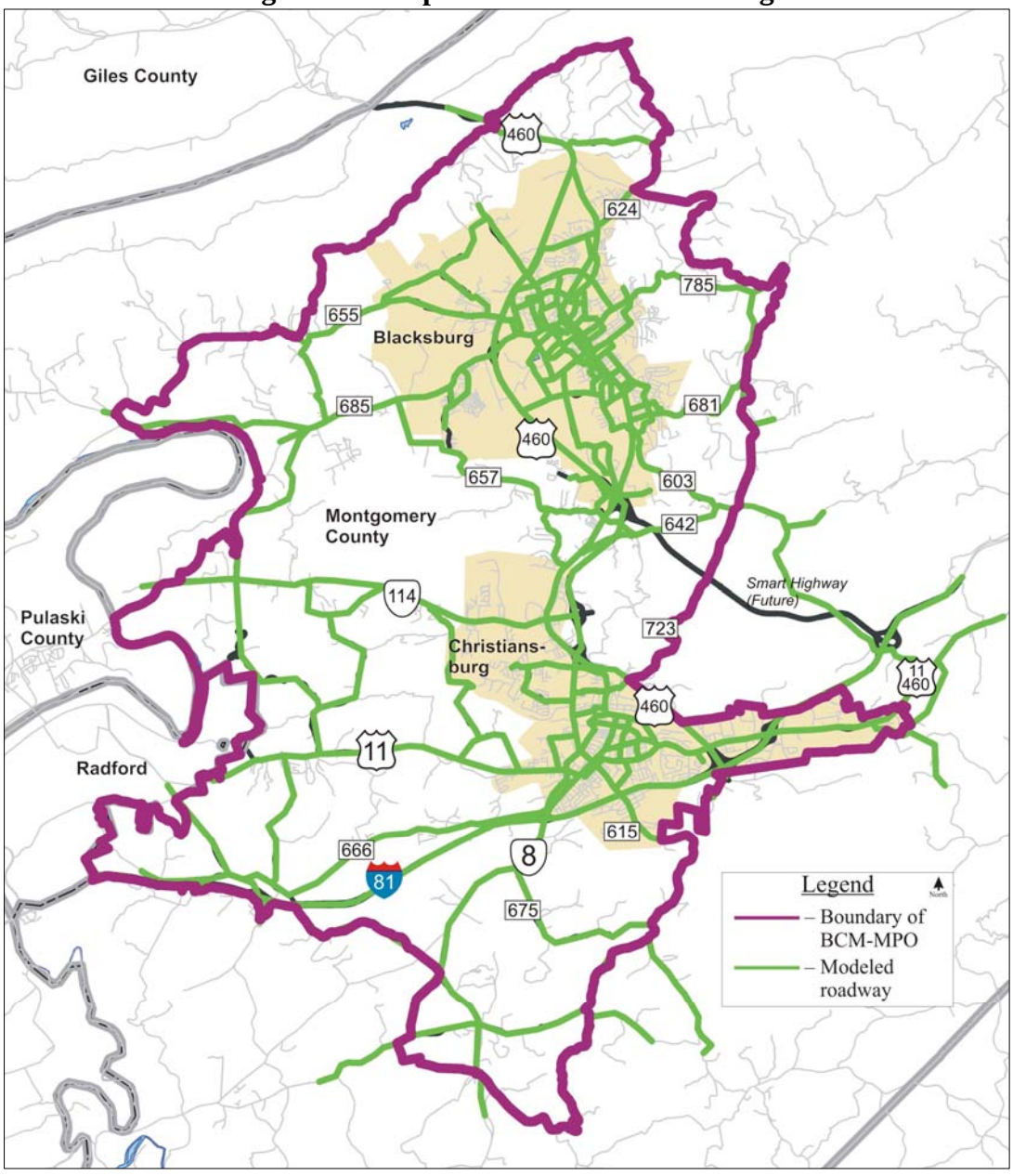
- The widening of Harding Avenue (Route 785), North Main Street (Route 460 Business) and Peppers Ferry Road (Route 114) should include paved shoulders or bicycle lanes;
- Ensure that the interchange of Route 460 at Toms Creek Road safely accommodates bicycles;
- Allow bicycles on the Route 460 Bypass;
- Continue the SmartWay bus service, add a stop on Route 460 in eastern Montgomery County, and consider feeder bus service to tie into the proposed TransDominion Express intercity passenger rail service;
- Overall, develop a wider range of transportation options, particularly on I-81;
- Seek to expand funding for bicycle improvements;
- Reduce the extent of work proposed on Marlington Street;
- Develop disaster preparedness plan.

3.2 Travel Demand Forecasting

Through the use of a computerized regional transportation model, travel demand forecasts for the year 2030 were developed. The transportation model, developed using industry-standard TP+ modeling software, includes all of the roadways in the region's

thoroughfare system as well as some limited amount of coverage outside of the BCM-MPO area (shown in Exhibit 7).

Exhibit 7
Regional Transportation Network Coverage



Traffic forecasts are primarily a function of expected increases in population and employment, and the particular areas where traffic grows at the highest levels is based on where this anticipated growth is expected to occur. Base year population and employment data was determined for geographic areas in the region called transportation

analysis zones (TAZs). In consultation with local planners, future growth in population and employment for each TAZ was also determined, with overall growth estimates guided by regional control totals. Exhibits 8 and 9 show the expected growth in population and employment by TAZ between 2003 and 2030. Note that both the computer network and TAZ boundaries extend beyond the BCM-MPO boundary.

Exhibit 8

Anticipated Growth in Population (2003 to 2030)

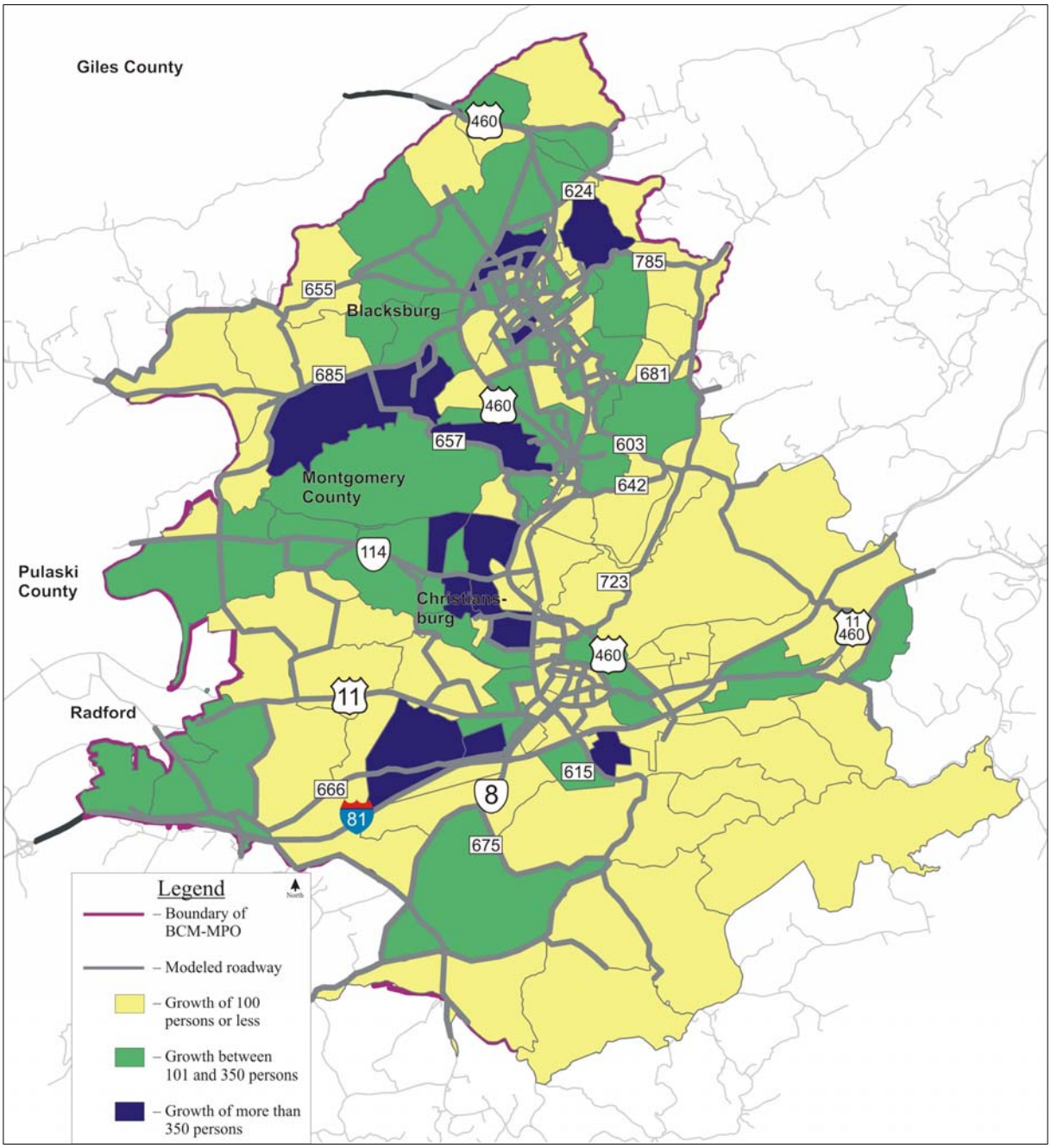
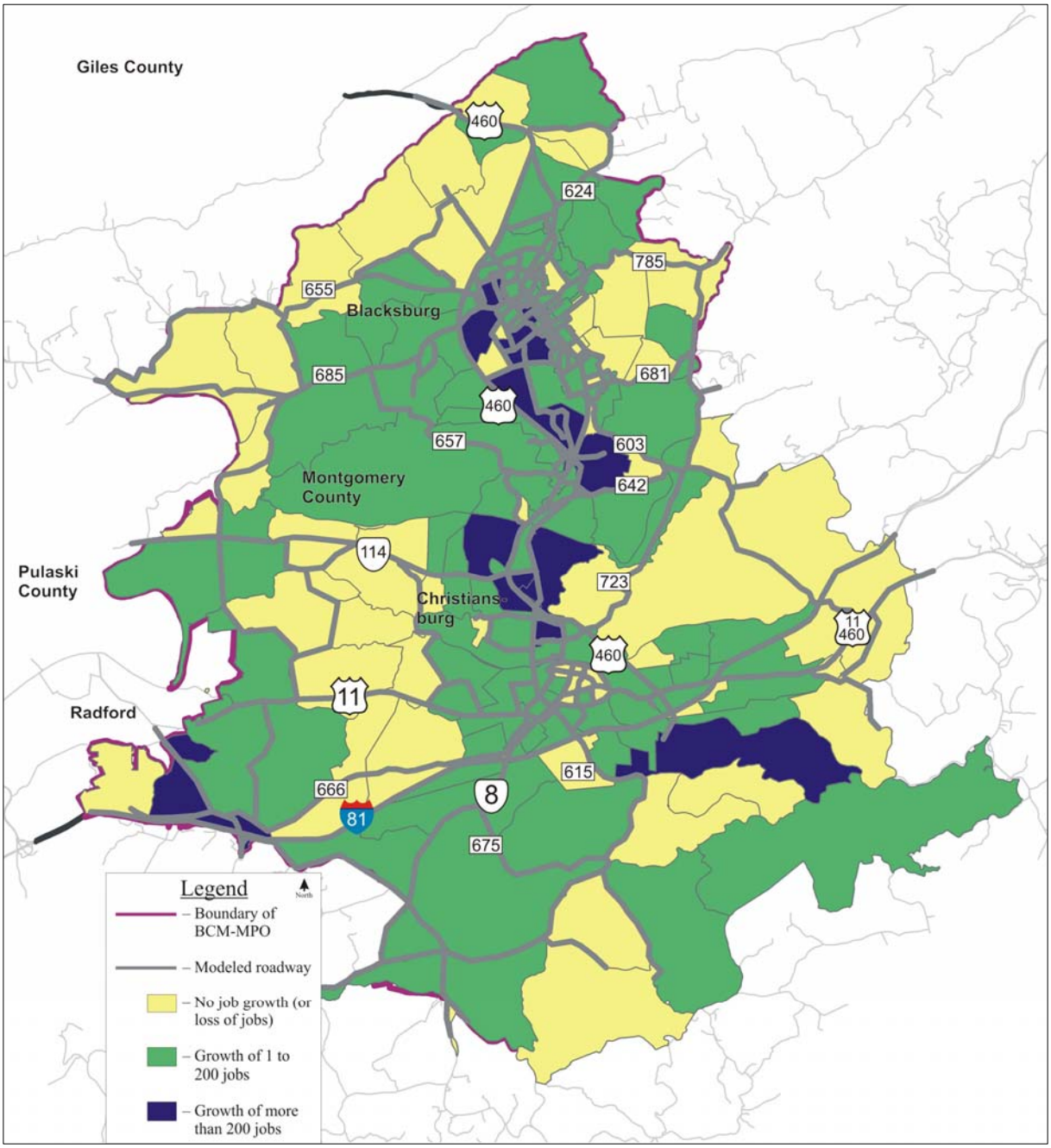


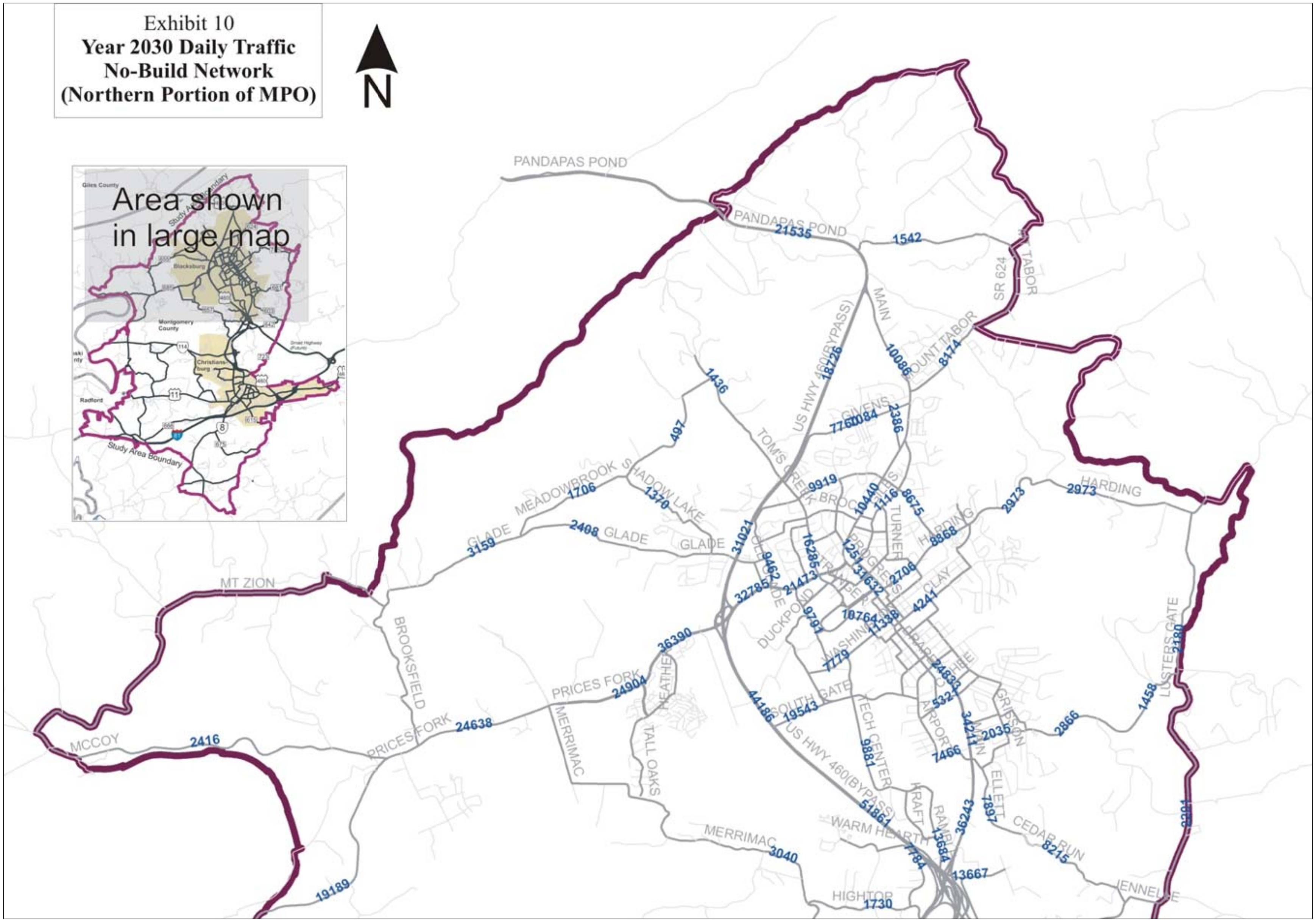
Exhibit 9

Anticipated Growth in Employment (2003 to 2030)



Forecast traffic volumes in 2030 that are anticipated based on the expected growth in population and employment are shown in Exhibit 10 and 11. These are the year 2030 volumes on BCM-MPO "No-Build" network. The "No-Build" network assumes that only those roadway projects that currently have funding allocated for construction would be built. Generally, these are projects that have construction funding in the current

Exhibit 10
Year 2030 Daily Traffic
No-Build Network
(Northern Portion of MPO)



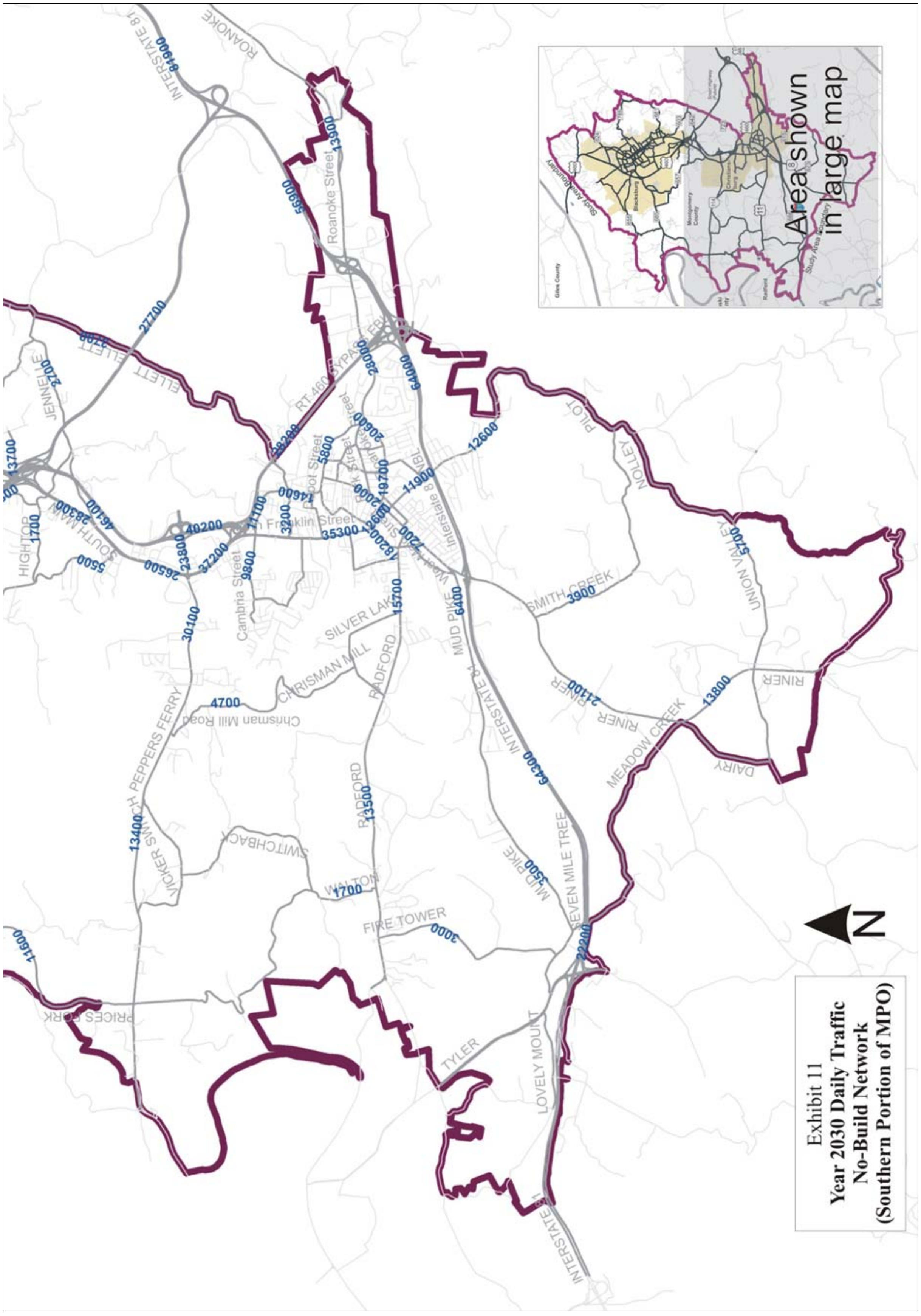


Exhibit 11
Year 2030 Daily Traffic
No-Build Network
(Southern Portion of MPO)

Virginia Department of Transportation Six-Year Improvement Program (Fiscal Years 2006 through 2011). Projects in the No-Build network include:

- Construct, as a four-lane facility, the Peppers Ferry Connector from Peppers Ferry west of New River Mall to North Franklin Street north of Ellett Road
- Construct the interchange at Route 460 Bypass and Toms Creek Road.
- Reconstruct North Main Street from College Drive to Prices Fork Road
- Widen North Main Street to four lanes from Giles Road to Mount Tabor Road
- Construct the Progress Street Extension from north of Cherokee Drive to Givens Lane, and improve Givens Lane from Ashford Court to North Main Street
- Improve intersections along Prices Fork Road (at Toms Creek/Stanger Road, University City Boulevard, and West Campus Drive), and at South Main Street at Ellett Road

The No-Build also includes the construction of the Smart Road between I-81 and Route 460 on the south side of the Town of Blacksburg. This improvement is expected to provide substantial diversion of traffic from Route 460 and Route 460 Business between I-81 and the Town of Blacksburg.

Complete information on the model development process and demographic estimates is included in Appendix C.

3.3 Traffic Operations Analysis and Capacity Needs

Traffic operations analysis provides a primary method for identifying transportation needs. Traffic engineers quantify the operations of a roadway using a measure called Level of Service. Level of Service provides a comparative measure of the traffic performance of roads and intersections through a grading system of A to F. Level of Service A represents excellent traffic operations with minimal delays, while Level of Service F represents breakdown conditions and substantial delays. Roadways and intersections in the region were analyzed using planning-level methodologies based on estimating the ratio of traffic volume to overall capacity (volume to capacity, or v/c ratios). These techniques are described more fully in Appendix D.

The traffic operations analysis was used in the development of the 2030 Transportation Plan to identify existing and future capacity deficiencies on the roadway system. VDOT has developed Level of Service criteria to be used in the analysis of roadway and intersection operations for areas such as the Blacksburg-Christiansburg-Montgomery region. Intersections or roadway segments operating at Level of Service C or better as determined by the planning methodology are defined as operating at under-capacity, or acceptable operations. Intersections or roadway segments operating at Levels of Service D, E, or F are defined as operating at over-capacity, or unacceptable operations.

Exhibit 12 summarizes the operations at major intersections within the MPO region based on the methodologies described in Appendix D. Operations are indicated as either under

capacity or over capacity. For unsignalized intersections, Exhibit 12 also shows the Level of Service that could be expected if the intersection were to be signalized. It is important to note that deficient Level of Service does not provide sufficient warrants to install a traffic signal; this information is provided to assess the potential benefits of installing a traffic signal should such an installation be supported based on an in-depth warrant study.

As Exhibit 12 indicates, all but 6 of the 30 intersections analyzed are expected to operate at over-capacity conditions by the year 2030. This finding is typical when assessing intersection operations 20 or more years in the future when traffic volumes on the overall network are generally expected to increase by 40 to 60 percent. Most of these intersection deficiencies can be corrected by providing additional turn lanes at the intersection itself without the need for major roadway widening to increase capacity. Broader, long-term corridor-level needs that can pinpoint the need for additional capacity and/or travel demand management were identified through the use of the regional model. Exhibit 13 depicts the corridors within the region that could be operating at either near- or over-capacity conditions by the year 2030. The near-capacity roadways include portions of the following roads:

- Depot Street (Christiansburg)
- Duck Pond Drive (Virginia Tech)
- Franklin Street (Christiansburg)
- Interstate 81 (Christiansburg and Montgomery County)
- Kent Street (Blacksburg)
- Main Street (Blacksburg and Christiansburg)
- Meadow Creek Road (Route 658, Montgomery County)
- Nolley Road (Route 679, Montgomery County)
- Roanoke Street (Blacksburg and Christiansburg)
- Peppers Ferry Road (Route 114, Montgomery County)
- Mud Pike (Route 666, Montgomery County)
- Riner Road (Route 8, Montgomery County)
- Tech Center Drive (Virginia Tech, Blacksburg)
- Tyler Road (Route 177, Montgomery County)
- Radford Road (Route 11, Montgomery County)
- Roanoke Road (Route 11/460, Montgomery County)
- Washington Street (Blacksburg)
- West Campus Drive (Blacksburg)

Roadways that are anticipated to be operating at over-capacity conditions by the year 2030 include:

- Cambria Street (Christiansburg)
- Depot Street (Christiansburg)
- Duck Pond Drive (Virginia Tech)
- Franklin Street (Christiansburg)
- Glade Road (Blacksburg)

Exhibit 12

Summary of Base Year and Year 2030 No-Build Intersection Operations

Location	Control[1]	Base Year (2004)						Year 2030 No-Build					
		AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak	
		Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]
Blacksburg													
North Main Street at Prices Fork Road	Sig	54%	U	60%	U	87%	O	123%	O	120%	O	124%	O
Toms Creek Road at Prices Fork Road	Sig	39%	U	76%	O	88%	O	103%	O	93%	O	97%	O
West Campus Drive at Prices Fork Road	Sig	73%	O	83%	O	103%	O	118%	O	89%	O	99%	O
University City Boulevard at Prices Fork Road	Sig	54%	U	74%	O	97%	O	79%	O	79%	O	90%	O
Heather Drive at Prices Fork Road	Sig	40%	U	43%	U	55%	U	83%	O	67%	U	69%	U
Route 460 Bypass at Southgate Drive	Sig	63%	U	47%	U	61%	U	95%	O	91%	O	98%	O
Toms Creek Road at Patrick Henry Drive	Sig	41%	U	78%	O	68%	U	98%	O	88%	O	89%	O
South Main Street at Airport Road/Graves Street	Sig	44%	U	41%	U	63%	U	71%	U	67%	U	70%	U
South Main Street at Country Club Road	Sig	44%	U	50%	U	51%	U	106%	O	112%	O	113%	O
South Main Street at Ellett Street/Hubbard Road	Sig	48%	U	60%	U	75%	O	82%	O	90%	O	91%	O
South Main Street at Industrial Park Road	Sig	34%	U	56%	U	64%	U	121%	O	127%	O	155%	O
North Main Street at Patrick Henry Drive	Sig	48%	U	46%	U	61%	U	94%	O	80%	O	78%	O
Route 460 Bypass at North Main Street (460 Bus)	Uns	37%	U/U	31%	U/U	50%	U/U	57%	O/U	70%	O/U	74%	O/O
Turner Street at Lucas Drive	Uns	13%	U/U	13%	U/U	13%	U/U	13%	U/U	15%	U/U	14%	U/U
Tech Center Drive at Southgate Drive	Uns	45%	O/U	53%	O/U	52%	O/U	86%	O/O	96%	O/O	101%	O/O
Christiansburg													
Depot Street at Roanoke Street	Sig	34%	U	39%	U	62%	U	52%	U	55%	U	51%	U
Route 8 at Mud Pike/Moose Drive	Sig	58%	U	32%	U	54%	U	105%	O	104%	O	119%	O

Exhibit 12

Summary of Base Year and Year 2030 No-Build Intersection Operations

Location	Control[1]	Base Year (2004)						Year 2030 No-Build					
		AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak	
		Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]
North Franklin Street at Depot Street	Sig	77%	O	47%	U	74%	O	119%	O	119%	O	119%	O
East Main Street at Roanoke Street	Sig	34%	U	37%	U	42%	U	66%	U	61%	U	67%	U
Franklin Street at Main Street	Sig	57%	U	61%	U	70%	U	116%	O	110%	O	107%	O
North Franklin Street at Peppers Ferry Road	Sig	101%	O	78%	O	99%	O	89%	O	98%	O	88%	O
West Main Street at Depot Street	Sig	59%	U	49%	U	62%	U	97%	O	81%	O	79%	O
East Main Street at Depot Street	Uns	23%	U/U	26%	U/U	33%	O/U	79%	O/O	83%	O/O	82%	O/O
Cambria Street at Ellett Road	Uns	41%	U/U	30%	U/U	62%	O/U	91%	O/O	92%	O/O	92%	O/O
Depot Street at North Franklin Street	Sig	56%	U	44%	U	62%	U	67%	U	61%	U	61%	U
Depot Street at Radford Street	Sig	58%	U	59%	U	79%	O	84%	O	87%	O	89%	O
Route 8 at I-81 Eastbound Ramp	Uns	58%	O/U	41%	O/U	61%	O/U	164%	O/O	160%	O/O	153%	O/O
Route 8 at I-81 Westbound Ramp	Uns	44%	O/U	36%	O/U	51%	O/U	149%	O/O	144%	O/O	154%	O/O
Montgomery County													
Route 600/177 at Route 658	Uns	52%	U/U	40%	U/U	54%	U/U	162%	O/O	162%	O/O	162%	O/O
Route 600 at Route 627	Uns	41%	U/U	28%	U/U	32%	U/U	64%	U/U	64%	U/U	60%	U/U

Notes:

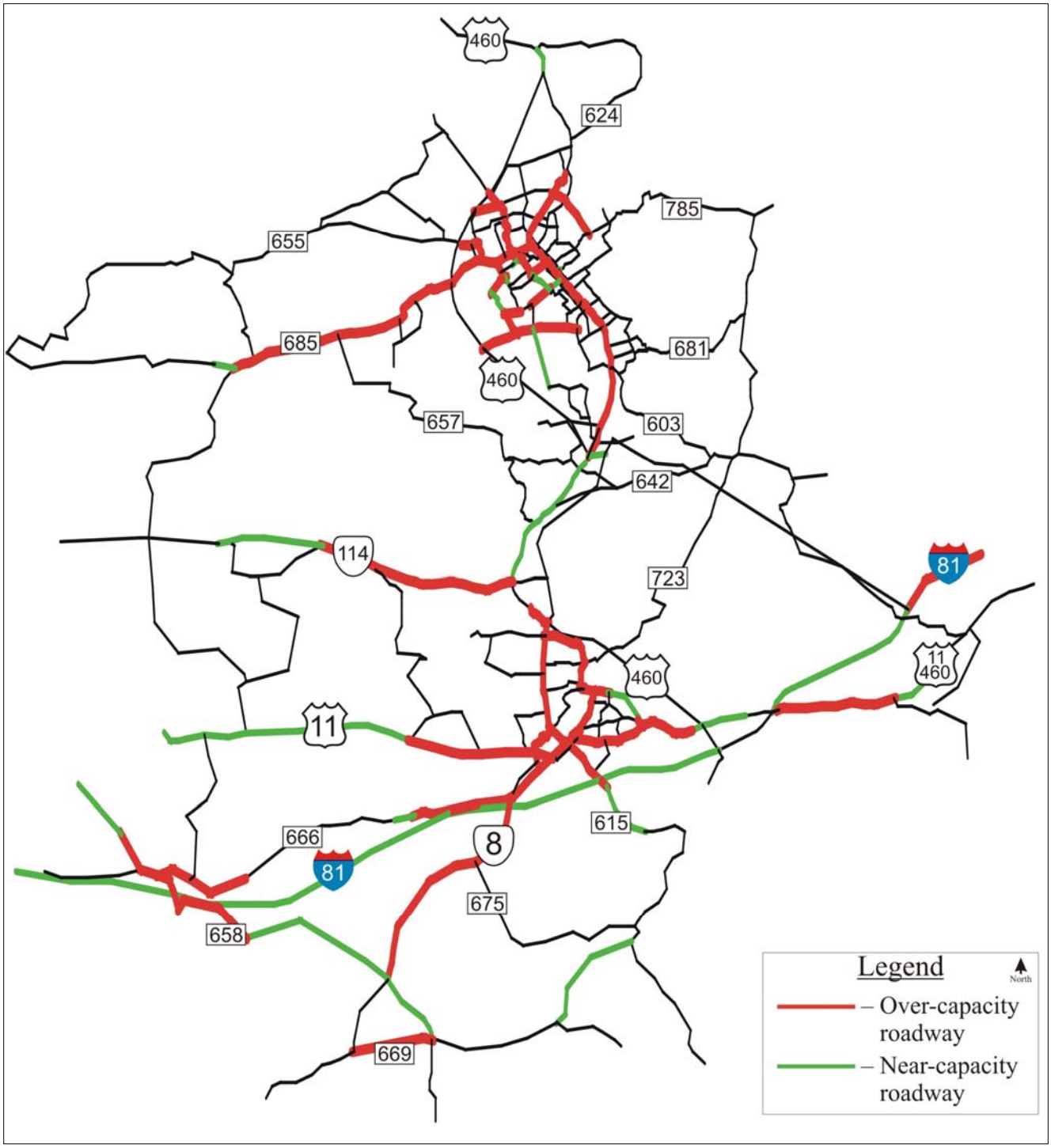
1 – Indicates traffic control at intersection: Sig=signalized intersection, UNS=unsignalized intersection.

2 – Intersection capacity utilization, indicates the percent of the intersection capacity being utilized by the traffic load.

3 – Traffic operations at intersection: U=under capacity, O=over capacity. For unsignalized intersections, the first value shown indicates the operations as an unsignalized intersection; the second value shown indicates operations if a traffic signal is installed. Note that the determination with respect to installation of a traffic signal is based on detailed studies to determine if a signal is warranted; traffic operations are only one of many factors involved in such determinations.

Exhibit 13

Potential Year 2030 Roadway Corridor Deficiencies



- Main Street (Blacksburg and Christiansburg)
- Meadow Creek Road (Route 658, Montgomery County)
- Mud Pike (Route 666, Montgomery County)
- Patrick Henry Drive (Blacksburg)
- Peppers Ferry Road (Christiansburg) – this roadway is planned to be widened, but is currently only programmed for preliminary engineering and right-of-way acquisition
- Prices Fork Road (Blacksburg and Montgomery County)
- Radford Road (Route 11, Montgomery County)
- Roanoke Street (Christiansburg)
- Fairview Church Road (Route 669, Montgomery County)
- Southgate Drive (Virginia Tech, Blacksburg)
- Stanger Street (Virginia Tech, Blacksburg)
- Riner Road (Route 8, Montgomery County)
- Toms Creek Road (Blacksburg)
- Tyler Road (Route 177, Montgomery County)
- University City Boulevard (Blacksburg)
- Washington Street (Blacksburg)
- West Campus Drive (Virginia Tech, Blacksburg)

Chapter 4 – Financially Constrained Transportation Plan Improvements

Federal regulations that guide the development of transportation plans for metropolitan planning areas require that the projects included in the plans allow for implementation based on reasonably expected public and private funding sources. For metropolitan areas in Virginia, the Virginia Department of Transportation (VDOT) has provided estimates of transportation funding levels to the year 2030. Those projects that can be funded based on these estimates comprise the Financially Constrained Long-Range Transportation Plan which is described in this chapter. Regulations also allow Transportation Plans to include additional projects that would be included in the long-range plan if additional resources were to become available. These projects comprise the Vision Plan, which is described in the next chapter.

4.1 Funding Constraints

The complete set of transportation projects that was developed as part of the transportation planning process exceeded the estimates of available transportation funding to the year 2030. The bulk of the projects are roadway or roadway-related, therefore, the focus of the financial constraint process is on the roadway system. VDOT estimates that are used to financially constrain the Plan are provided by roadway program: National Highway System (NHS) interstate highways, non-interstate NHS roads, other primary roads, urban roads in each of the two towns, and secondary roads in Montgomery County. The current VDOT Six-Year Improvement Program covers the years 2006 through 2011, and the Plan assumes that these projects and associated funding will remain as they currently stand. Estimated funding for projects beyond the timeframe of the current Six-Year Program are for 2012 through 2030, and are as follows:

- NHS interstate highways: $8.1 million
- Non-interstate NHS roadways: $1.6 million
- Other primary roads: $3.8 million
- Urban roads in the Town of Blacksburg: $16.49 million
- Urban roads in the Town of Christiansburg: $3.9 million
- Secondary roads in Montgomery County: $2.2 million

Transit system funding comes from a variety of federal, state, and local sources. Blacksburg Transit is in the process of developing a detailed Transit Development Plan (TDP), which will be adopted as an amendment into this 2030 Transportation Plan once complete. The TDP will include a detailed funding program based on realistic estimates of public transit funds, including contributions from the Towns of Blacksburg and Christiansburg, and Virginia Tech. For the 2030 Transportation Plan, funding projections have been developed by Blacksburg Transit and the Town of Blacksburg Finance Department, with assistance from the Virginia Department of Rail and Public Transportation. The projections are based on historical funding levels and future inflation predictions, and include both operating and capital costs. The projections are shown in Exhibit 14. Note that Exhibit 14 combines

information from both the Six-Year Capital Improvement Program and estimates for the years between 2012 and 2030.

Exhibit 14
Projected Transit Operating and Capital Funding
(Fiscal Years 2007 through 2030)

Year	Operating Funding	Purchase Replacement Rolling Stock	Purchase Expansion Rolling Stock	All Other Capital Projects	Construction of Facilities	Total Capital Expenditures [1]
2007	$4.68	$0.18	$1.30	$0.47	$0.30	$2.26
2008	$5.15	$1.94	$1.01	$0.25	$0.00	$3.21
2009	$5.66	$2.06	$1.06	$0.21	$0.00	$3.33
2010	$6.23	$1.99	$1.16	$0.18	$0.00	$3.32
2011	$6.85	$1.00	$1.11	$0.26	$0.00	$2.37
2012	$7.53	$2.72	$0.82	$0.30	$10.00	$13.83
Subtotals - Six Year Capital Program (FY'07-FY'12) [2]		$9.88	$6.46	$1.68	$10.30	$28.32
2013	$7.84	$2.68	$0.79	$0.31	$0.00	$3.78
2014	$8.15	$1.86	$0.78	$0.32	$0.00	$2.96
2015	$8.48	$0.14	$0.83	$0.33	$0.00	$1.30
2016	$8.81	$0.28	$0.90	$0.34	$0.00	$1.52
2017	$9.17	$0.44	$0.87	$0.35	$0.00	$1.65
2018	$9.53	$0.30	$0.86	$0.36	$0.00	$1.52
2019	$9.92	$0.31	$1.00	$0.37	$0.00	$1.67
2020	$10.31	$2.54	$2.30	$0.38	$5.00	$10.22
2021	$10.72	$2.77	$2.48	$0.39	$0.00	$5.64
2022	$11.15	$2.94	$2.38	$0.40	$0.00	$5.73
2023	$11.60	$1.41	$2.60	$0.42	$0.00	$4.43
2024	$12.06	$3.51	$2.13	$0.43	$0.00	$6.08
2025	$12.55	$3.29	$2.09	$0.44	$0.00	$5.82
2026	$13.05	$2.60	$2.24	$0.45	$0.00	$5.30
2027	$13.57	$0.56	$2.30	$0.47	$0.00	$3.32
2028	$14.11	$0.38	$2.25	$0.48	$0.00	$3.11
2029	$14.68	$0.39	$2.31	$0.50	$0.00	$3.19
2030	$15.26	$0.20	$2.47	$0.51	$2.00	$5.19
TOTALS [3]	**$237.05**	**$36.49**	**$38.05**	**$8.91**	**$17.30**	**$100.75**

Notes:
[1] – Total of capital costs, including purchase of replacement rolling stock, purchase of expanded rolling stock, other capital projects, and construction of facilities. Operating costs are not included in these totals.
[2] – Six-year subtotals for capital cost categories only.
[3] – Sum of costs for 2007 to 2030.

The operating and capital funding levels shown in Exhibit 14 were estimated separately. In the first six years of projections for the operating costs (Fiscal Years 2007 to 2012), annual increases of 10 percent were assumed as part of an overall restructuring of the system. For the remaining 18 years covered by this Plan (Fiscal Years 2013 to 2030), annual increases in operating costs of 4 percent were assumed.

The capital projects cost projections are based on information from the Town of Blacksburg Capital Improvement Program administered by the Town of Blacksburg Finance Department

and both the Capital Improvement Program and the Program of Projects administered by the Virginia Department of Rail and Public Transportation. These include funds from a combination of federal formula, flexible and earmarked funds. As indicated previously, detailed funding streams are currently being estimated as part of the development of the TDP, and the 2030 Transportation Plan will be amended, as required, based on the results of the TDP.

With the TDP process still ongoing, the transit funding stream reflects only a modest increase in operations from year-to-year. These projections for future operating and capital funding for Blacksburg Transit have been made with the realization that public transit funds have traditionally only slightly increased from year to year, some years not even matching inflation. Blacksburg Transit has received local match funding, both operating and capital, from Town of Blacksburg, Town of Christiansburg, and Virginia Tech; the projections shown in Exhibit 14 are based on the continued support from these entities.

Additional anticipated funding for transportation projects in the region include funds for extending the runway at the Virginia Tech/Montgomery Executive Airport. These costs are being developed as part of the airport's Master Plan update; however, funding for both the runway extension, and the relocation of Tech Center Drive to support this extension, are anticipated to be provided by the Federal Aviation Administration. These projects are included in the 2030 Transportation Plan based on the expectation that such funding is forthcoming.

4.2 Financially Constrained Plan Projects

The Financially Constrained Plan includes two elements: (1) projects that are included in the Virginia Department of Transportation's Six-Year Improvement Program covering fiscal years 2006 through 2011, and (2) projects that can be funded with the estimated funds for the years 2012 through 2030. Projects in the current VDOT Six-Year Improvement Program are shown in Exhibits 15, 17A, and 17B. It is important to note that the Six-Year Improvement Program is a capital funding plan: it serves to allocate funds to projects on a year-by-year basis. Construction on some projects begins prior to allocation of full funding; in these instances, funding continues to be allocated to projects even if they have been completed. Exhibit 15 also includes line items for improvements that are not project-specific but will be allocated for rail safety, traffic operations and safety, transportation enhancements, and roadway maintenance.

Exhibit 15
Projects in the Current VDOT Six-Year Improvement Program (Fiscal Years 2006 through 2011)

Map ID [1]	VDOT ID	Route	Project Location	Description	Programmed Funds [2]	Funding Source
1	52453	81	I-81 at Route 11/460 interchange	Install lighting	$936,000	Interstate

Exhibit 15

Projects in the Current VDOT Six-Year Improvement Program (Fiscal Years 2006 through 2011)

Map ID [1]	VDOT ID	Route	Project Location	Description	Programmed Funds [2]	Funding Source
2	63705	81	I-81 at Route 177/600 interchange	Modify grade at interchange	$78,000	Interstate
--	67588	81	I-81 Improvements Environmental Document; statewide project that includes I-81 through the MPO area	Study to assess improvements, including consideration of rail improvements, highway widening, and other system improvements	$3,619,000	Interstate
3	14826, 16931, 17345		"Smart Highway"	Construct roadway	$24,653,000	Primary
4	18152, 18156	460	Route 460 Bypass from Route 460 Business in Christiansburg to Route 460 Business in Blacksburg	Construct 4-lane roadway; project complete, included in program for final financing	$10,290,000	Primary
5	8746, 71586	114	Peppers Ferry Road from Christiansburg corporate limits to Route 460	Widen to four lanes	$5,288,000	Christians-burg Urban
6	70594		Peppers Ferry Connector from Peppers Ferry west of New River Mall to North Franklin Street north of Ellett Road	Construct 4-lane connecter with median, bicycle lanes, and sidewalks	$283,000	Christians-burg Urban
7	17682	460	Route 460 at Toms Creek Road	Construct interchange; project is previously funded, construction to begin in fiscal year 2006	--	Blacksburg Urban
8	67974	460 Bus	North Main Street from College Drive to Prices Fork Road	Reconstruct, includes improvements to Prices Ford Road Intersection	$5,992,000	Blacksburg Urban
9	67976	460 Bus	North Main Street from Giles Road to Mount Tabor Road	Widen to four lanes with landscaped median, bicycle lanes, and sidewalks	$3,067,000	Blacksburg Urban
10	67745	412	Prices Fork Road at Toms Creek/Stanger Road	Improve intersection to improve traffic safety and pedestrian flow	$7,000	Blacksburg Urban

Exhibit 15

Projects in the Current VDOT Six-Year Improvement Program (Fiscal Years 2006 through 2011)

Map ID [1]	VDOT ID	Route	Project Location	Description	Programmed Funds [2]	Funding Source
11	72525	412	Prices Fork Road at University City Boulevard	Traffic signal modification to improve traffic flow and pedestrian safety	$305,000	Blacksburg Urban
12,13, 10	67975		South Main Street at Ellett Road; and Prices Fork Road at West Campus Drive and at TomsCreek/Stanger Road	Add turn lanes	$1,651,000	Blacksburg Urban
14	72527		Progress Street Extension from north of Cherokee Drive to Givens Lane; Givens Lane from Ashford Court to North Main Street	Construct Progress Street Extension, improve Givens Lane; in Six-Year Program for preliminary engineering only	$616,000	Blacksburg Urban
15	72526		Huckleberry Trail from Prices Fork Road to Glade Road	Construct bicycle trail	$1,005,000	Blacksburg Urban
16	50030, 50561, 18856	114	Peppers Ferry Road at New River and Norfolk Southern railroad tracks	Replace bridges	$8,024,000	Primary
--			MPO-Wide	Improvements for safety, traffic operations, TSM	Determined on an annual basis [3]	--
--			MPO-Wide	Transportation enhancements	Determined on an annual basis [3]	--
--			MPO-Wide	Rail crossing safety improvements	Determined on an annual basis [3]	--
--			MPO-Wide	Maintenance	Determined on an annual basis [4]	--

Notes:

[1] Corresponds to the key numbers on map in Exhibit 16.

[2] Amount included in for fiscal years 2006 through 2011; many projects have funds accrued in years prior to 2006.

[3] Funding for these categories are allocated statewide and awarded to individual projects on a competitive basis.

[4] Funding for these categories is allocated to each of the VDOT Construction Districts. Further allocations to the MPO area (which is part of the VDOT Salem Construction District) are determined annually, based on need.

Recommendations included in the Financially Constrained Plan that are not in the VDOT Six-Year Improvement Program are those that were judged by the study team and local government officials, with public input considered, to be a relatively high priority. These

recommendations are shown in Exhibits 16, 17A, and 17B. As described previously, projects that were judged to be of a lesser priority, as well as those that may have an implementation timetable beyond the 2030 horizon, are included in the region's "Transportation Vision Plan". Vision Plan projects are those that could be constructed should additional funding become available. Vision Plan projects are described in Chapter 5 of this document.

Exhibit 16

Financially Constrained Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Funded Amount in Constrained Plan [3]	Locality/Funding Source
17	81	West Main Street at I-81	Improve interchange for operations	$3,000,000	$3,000,000	Montgomery-Christiansburg/ Interstate
NA	81	MPO Wide	Safety/operations/ widening improvements to be identified	To Be Determined	$5,100,000	Montgomery-Christiansburg/ Interstate
18	460	Route 460 Bypass at Route 460 Business	Add ramp for southbound Route 460 to westbound Route 460 Business	$340,000	$340,000	Montgomery/NHS
3		Smart Road from I-81 to Route 460 Bypass	Connection to Route 460 Bypass; includes paving 2-lane roadway	$7,400,000	$1,300,000	Montgomery/NHS
19	8	Intersection of Riner (Rt 8) and Smith Creek Rd (Rt 675)	Add turn lanes	$250,000	$250,000	Montgomery/ Primary
20	114	Intersection of Peppers Ferry (Rt 114) and Rolling Hills (Rt 1286)	Add turn lanes	$250,000	$250,000	Montgomery/ Primary
21	8	Intersection of Riner (Rt 8) and Fairview Church (Rt 669)	Add turn lanes	$250,000	$250,000	Montgomery/ Primary
22	8	Riner Road (Rt 8) from South Study Area Boundary to Route 669 (Community of Riner)	Reconstruct to current 2-lane standards	$1,909,000	$1,909,000	Montgomery/ Primary
23	114	Peppers Ferry Road from Radford Arsenal main entrance to the Christiansbug West Corporate Limits	Widen road to 4-lanes divided with bicycle lanes	$33,299,000	$1,100,000	Montgomery/ Primary
24	642	Jenelle Road from Route 460 Business to Route 603	Reconstruct road to current 2-lane standards	$4,154,000	$2,200,000	Montgomery/ Secondary

Exhibit 16

Financially Constrained Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Funded Amount in Constrained Plan [3]	Locality/Funding Source
25	460 Bus	South Main Street at Country Club Road	Improve intersection for operations and safety	$500,000	$500,000	Blacksburg/ Urban
26	460 Bus	North Main Street at Turner Street	Traffic signal upgrade to current equipment and standards	$104,000	$104,000	Blacksburg/ Urban
27	460 Bus	North Main Street at Progress Street	Traffic signal upgrade to current equipment and standards	$104,000	$104,000	Blacksburg/ Urban
28		Heather Drive at Prices Fork Road	Traffic signal upgrade to current equipment and standards	$104,000	$104,000	Blacksburg/ Urban
29		Toms Creek Road at Patrick Henry Drive	Upgrade intersection (this project would tie into the project to construct an interchange at Toms Creek Road and Route 460)	$1,332,000	$1,332,000	Blacksburg/ Urban
30		Marlington Street at South Main Street	Intersection improvements at the intersection of Marlington Street and South Main Street	$250,000	$250,000	Blacksburg/ Urban
31		Commerce Street from Trade Street to Jennelle Road	Construct extension of Commerce Street as two-lane roadway	$1,630,000	$1,630,000	Blacksburg/ Urban
32		Glade Road from Boxwood Drive to Linwood Lane	Reconstruct as 2-lane roadway with bicycle lanes, trail, and sidewalks	$1,720,000	$1,720,000	Blacksburg/ Urban
33		Shadow Lake Road from Basil Street to Lakewood Drive	Straighten and realign curves	$1,500,000	$1,500,000	Blacksburg/ Urban
34		Progress Street at Giles Road	Traffic signal upgrade to current equipment and standards	$104,000	$104,000	Blacksburg/ Urban
35		Washington Street at Draper Road	Traffic signal upgrade to current equipment and standards	$104,000	$104,000	Blacksburg/ Urban

Exhibit 16

Financially Constrained Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Funded Amount in Constrained Plan [3]	Locality/Funding Source
36		Progress Street at Turner Street	Traffic signal upgrade to current equipment and standards	$104,000	$104,000	Blacksburg/ Urban
37	460	460 Bypass at Southgate Drive	Construct interchange	$16,000,000	$8,956,000	Montgomery/NHS, Primary Blacksburg/Urban
5	114	Peppers Ferry Road from west corporate limits to Route 460	Widen to four lanes, PE and ROW included in Six-Year Program	$12,301,000	$3,900,000	Christiansburg/ Urban
38		Tech Center Drive south of Duck Pond Drive	Relocate to align with Duck Pond Drive; shift allows for airport runway extension	$1,962,000	$1,962,000	Blacksburg/ Urban (project to be funded by FAA)
--		MPO-Wide	Improvements for safety, traffic operations, TSM	--	Determined on an annual basis [4]	--
--		MPO-Wide	Transportation enhancements	--	Determined on an annual basis [4]	--
--		MPO-Wide	Rail crossing safety improvements	--	Determined on an annual basis [4]	--
--		MPO-Wide	Maintenance	--	Determined on an annual basis [5]	--

Notes:

[1] Corresponds to the key numbers on map in Exhibit 16.

[2] Estimated costs are planning-level estimates based on average or typical projects for each cross-section type. Costs are for year 2005 and include both construction and rights-of-way.

[3] Project costs that are not covered by the amounts shown in this column are anticipated to be covered by funding from 2030 and beyond. It is anticipated that these projects would be the first to be fully funded should additional transportation funds be identified in the next few years.

[4] Funding for these categories is allocated to each of the VDOT Construction Districts by roadway system. Further distribution within the MPO area (which is part of the VDOT Salem Construction District) is based on need, and determined on an annual basis.

[5] Funding for these categories is allocated to each of the VDOT Construction Districts. Further allocations to the MPO area (which is part of the VDOT Salem Construction District) are determined annually, based on need.

Exhibit 17A

Map of Financially Constrained Plan Transportation Recommendations

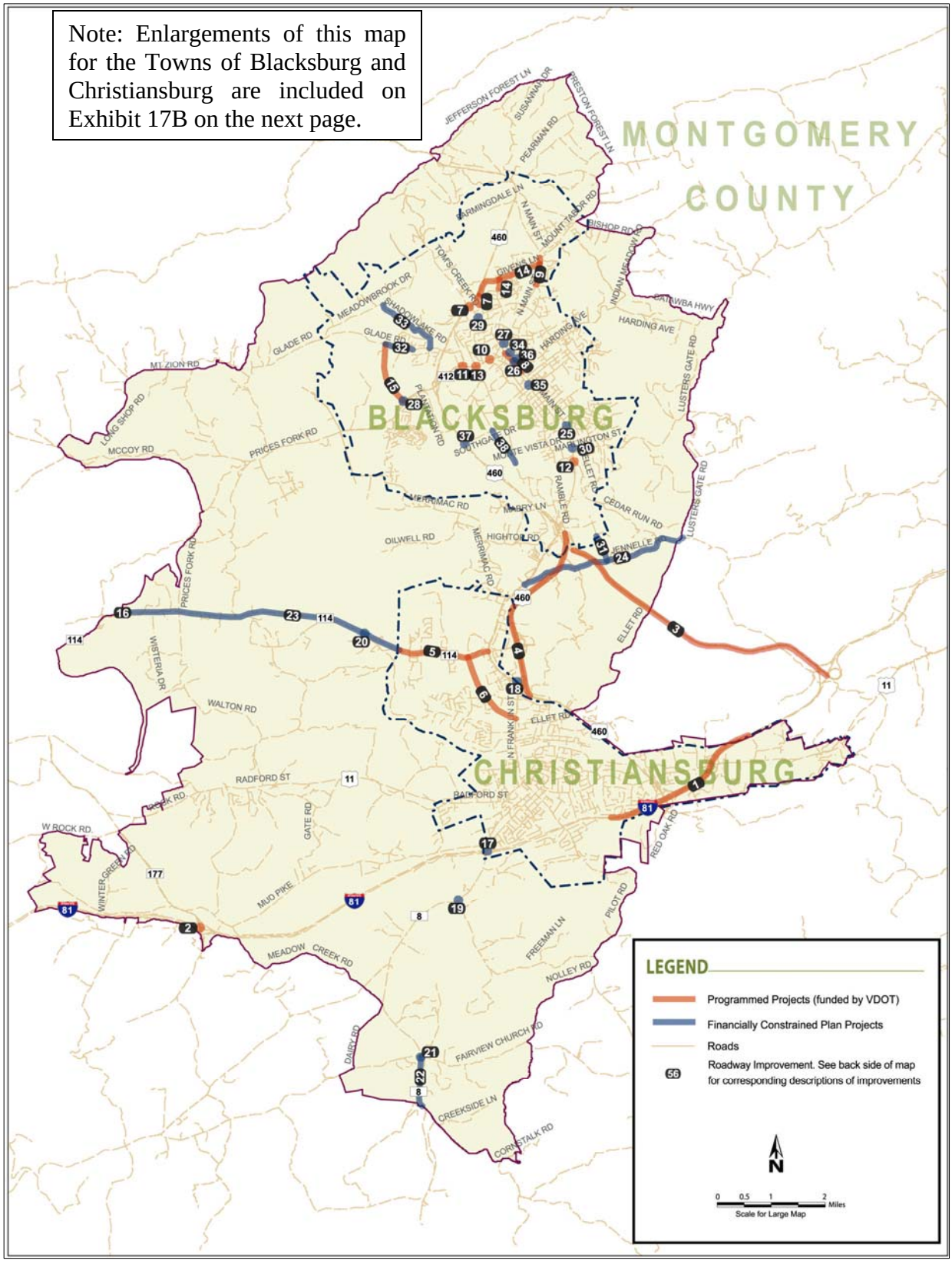
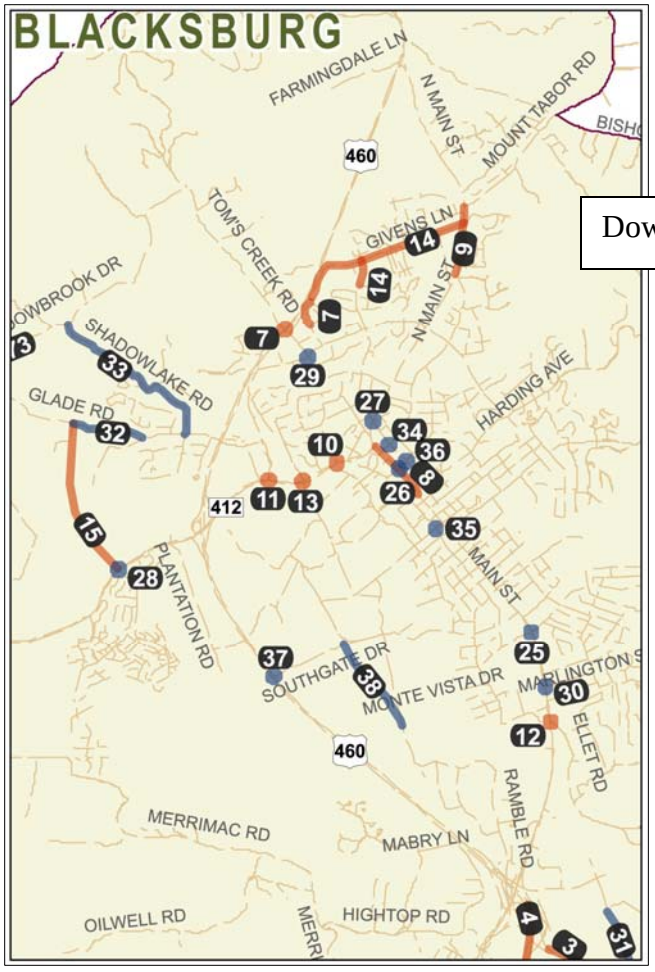


Exhibit 17B

Map of Financially Constrained Plan Transportation Recommendations (Town Insets)



Downtown Blacksburg Inset

Downtown Christiansburg Inset

4.3 Environmental Overview

An environmental overview was conducted for recommendations in the Financially Constrained Plan as well as the Tier 1 Vision Plan. This overview included the following:

- potential residential and business displacements;
- environmental justice group (low-income and minority) impacts;
- community disruptions;
- community service impacts;
- land use/zoning conflicts;
- hazardous materials sites;
- impacts on historic sites and districts;
- impacts to wildlife refuges, critical habitats, and known locations of threatened and endangered species;
- proximity to wild and scenic rivers;
- encroachment on critical soil types (prime farmlands, erosive soils);
- proximity to managed forest lands, scenic routes, and parks/recreation areas;
- air quality impacts; impacts to noise sensitive receptors; and
- impacts to water quality, floodplains, and wetlands.

Potential impacts were identified using aerial photography and other existing mapping and data sources. These various sources are identified in Appendix B.

Exhibit 18 summarizes the potential impacts of the recommendations in the Financially Constrained Plan (these are shown in Exhibit 16), as well as the Tier 1 Vision Plan recommendations (which are discussed in the next chapter and summarized in Exhibit 19). It is important to note that this analysis identified potential impacts for general planning purposes; determination of actual impacts would be based on follow-on, detailed environmental analyses. The reader should also be aware that, as projects were identified and considered for the 2030 Transportation Plan, environmental impacts were also considered. The final recommendations, shown in Exhibit 18, are expected to result in various levels of impact on the natural and man-made environment. As these projects proceed in the project development process, refinements in design will seek to minimize and/or mitigate these impacts. Overall, this environmental overview did not identify any impacts that would categorically preclude the implementation of any of the recommendations.

4.4 Other Considerations

Other considerations for the 2030 Transportation Plan, including specific considerations for environmental justice populations as well as policies implementing increased operations management, Intelligent Transportation Systems (ITS), and freight planning are described in Appendix A.

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
West Main Street at I-81	Improve interchange for operations				X		X											X					
Route 460 Bypass at Route 460 Business	Add ramp for southbound Route 460 to westbound Route 460 Business																					X	
Smart Road from I-81 to Route 460 Bypass	Connection to Route 460 Bypass; includes paving 2-lane roadway																					X	
Intersection of Riner (Rt 8) and Smith Creek Rd (Rt 675)	Add turn lanes																					X	
Intersection of Peppers Ferry (Rt 114) and Rolling Hills (Rt 1286)	Add turn lanes																					X	
Intersection of Riner (Rt 8) and Fairview Church (Rt 669)	Add turn lanes	1																					
Riner Road (Rt 8) from South Study Area Boundary to Route 669 (Community of Riner)	Reconstruct to current 2-lane standards				X		X											X					

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
Peppers Ferry Road from Radford Arsenal main entrance to the Christiansbug West Corporate Limits	Widen road to 4-lanes divided with bicycle lanes	15	X	X														X	X				
Jenelle Road from Route 460 Business to Route 603	Reconstruct road to current 2-lane standards	3																					
South Main Street at Country Club Road	Improve intersection for operations and safety																					X	
North Main Street at Turner Street	Traffic signal upgrade to current equipment and standards																					X	
North Main Street at Progress Street	Traffic signal upgrade to current equipment and standards																					X	
Heather Drive at Prices Fork Road	Traffic signal upgrade to current equipment and standards																					X	

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
Toms Creek Road at Patrick Henry Drive	Upgrade intersection (this project would tie into the project to construct an interchange at Toms Creek Road and Route 460)																					X	
Marlington Street at South Main Street	Intersection improvements at the intersection of Marlington Street and South Main Street	1																					
Commerce Street from Trade Street to Jennelle Road	Construct extension of Commerce Street as two-lane roadway					X													X	X	X		
Glade Road from Boxwood Drive to Linwood Lane	Reconstruct as 2-lane roadway with bicycle lanes, trail, and sidewalks	2																					
Shadow Lake Road from Basil Street to Lakewood Drive	Straighten and realign curves	3																					
Progress Street at Giles Road	Traffic signal upgrade to current equipment and standards																					X	

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
Washington Street at Draper Road	Traffic signal upgrade to current equipment and standards																					X	
Progress Street at Turner Street	Traffic signal upgrade to current equipment and standards																					X	
460 Bypass at Southgate Drive	Construct interchange			X	X													X					
Peppers Ferry Road from west corporate limits to Route 460	Widen to four lanes, PE and ROW included in Six-Year Program	5		X	X															X			
Tech Center Drive south of Duck Pond Drive	Relocate to align with Duck Pond Drive; shift allows for airport runway extension																					X	
Smart Road from I-81 to Route 460 Bypass	Connection to Route 460 Bypass; includes paving 2-lane roadway																					X	
Peppers Ferry Road from Radford Arsenal main entrance to the Christiansburg West Corporate Limits	Widen road to 4-lanes divided with bicycle lanes																						

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
Route 460 Bypass from South Main to Prices Fork Road	Widen to 6 lanes														X							X	
Southgate Drive Extension from Merrimac Road (Route 657) to Radford Arsenal	Construct as four-lane parkway	5	X				X																
Riner Road (Rt 8) from Route 669 to Christiansburg South Corporate limits	Widen road to current standards	18		X	X		X	X															
Peppers Ferry Road Extension from Route 460 Bypass to Ellett Roud (Route 723)	Construct 2-lane roadway																			X	X		
Merrimac Road from North Franklin Street (Route 460) to Prices Fork Road (Route 685)	Reconstruct road to current 2-lane standards	5			X										X								

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
High Top Road from Merrimac Road to South Main Street (Route 460)	Reconstruct road to current 2-lane standards																					X	
Ramble Road from Industrial Park Drive to the Corporate Research Center (north of Merrimac Road)	Reconstruct as 2-lane urban roadway plus transit pull-offs and bicycle lanes																					X	
Farmview Drive/Mabry Lane from Hightop Road to Huckleberry Lane	Reconstruct as 2-lane roadway with bicycle lanes and sidewalks																					X	
Progress Street at Patrick Henry Drive	Traffic signal and safety upgrades																					X	
Mount Tabor Road from North Main Street to Bishop Road	Reconstruct road to current 2-lane standards with sidewalks and bicycle lanes, and bus pull-offs; align with Givens Lane at North Main Street	3																					

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
Ellett Road from South Main Street to Cedar Hill Drive	Widen road to 4 lanes with bicycle lanes or separate multi-use trail; improve intersection of Ellet and S. Main	5	X	X	X		X											X					
Southgate Drive from Merrimac Road to 460 Bypass	Extend Southgate drive as a 4-lane road with median, bicycle lands, and sidewalk	5	X				X																
North Main Street from Mount Tabor Road to Route 460 Bypass	Widen road to 4 -lanes divided, with bicycle lanes and sidewalk	3		X	X													X					
Country Club Drive Extension from Airport Road to Hubbard Street Extension	Construct extension of Country Club Drive; include bicycle lanes and trails.			X														X					
Hubbard Street Extension from Airport Road to Southgate Drive	Construct extension of Hubbard Street as two-lane roadway; includes bicycle lanes and grade-separated crossing for the Huckleberry Trail			X														X					

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
Heather Drive Extension from Prices Fork Road to Glade Road	Construct as two-lane roadway with bicycle lanes and sidewalks																			X	X		
Progress Street Extension from Givens Lane to North Main Street	Extension from Givens Lane through Northside Park to North Main Street	3																					
West Main Street (Rt 8) at Phlegar Street/Radford Street	Improve intersection for operations and safety: shift Phlegar Street to align with Radford Street and create single intersection	4																					
Radford Road and Radford Street from Silver Lake Road (western intersection) to Main Street	Widen road to four lanes with a center bi-directional turn lane, bicycle lanes, and sidewalks	10	X	X	X	X									X			X					

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
North Franklin Street at Peppers Ferry Road	Improve intersection for operations; add additional approach lanes on Peppers Ferry Road to improve capacity																					X	
Parkway Drive Extension from existing Parkway Drive at Technology Drive to South Franklin Street	Extend road as 2-lane roadway on 4-lanes of right-of-way																		X	X			

Chapter 5 – Transportation Vision Plan

Because the total estimated costs for the transportation improvements that were identified as part of the Plan development process exceed the estimated funding to the year 2030, the MPO and local governments prioritized the proposed improvements in order to identify those to be included in the Financially Constrained Transportation Plan. Recommendations with a lesser priority that could not be funded based on the expected funding stream are included in the region's Transportation Vision Plan.

It is anticipated that some projects may be able to be advanced within the next few years should additional funding become available. For this reason, two tiers have been established for Vision Plan projects. Tier 1 Vision Plan projects (shown in Exhibits 19 and 21) are those that were judged to be of a higher priority and should be advanced first should additional funding become available. Tier 2 Vision Plan projects (shown in Exhibits 20 and 21) are those that were judged to be longer-term and of a lesser priority.

Exhibit 19

Tier 1 Vision Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Locality/Funding Source
3		Smart Road from I-81 to Route 460 Bypass	Connection to Route 460 Bypass; includes paving 2-lane roadway	$6,100,000 ** (see note 2)	Montgomery/NHS
23	114	Peppers Ferry Road from Radford Arsenal main entrance to the Christiansburg West Corporate Limits	Widen road to 4-lanes divided with bicycle lanes	$32,199,000 ** (see note 2)	Montgomery/ Primary
24	642	Jenelle Road from Route 460 Business to Route 603	Reconstruct road to current 2-lane standards	$1,954,000 ** (see note 2)	Montgomery/ Secondary
37	460	460 Bypass at Southgate Drive	Construct interchange	$8,663,000 ** (see note 2)	Montgomery/NHS, Primary Blacksburg/Urban
5	114	Peppers Ferry Road from west corporate limits to Route 460	Widen to four lanes, PE and ROW included in Six-Year Program	$8,401,000 ** (see note 2)	Christiansburg/ Urban
39	460	Route 460 Bypass from South Main to Prices Fork Road	Widen to 6 lanes	$27,083,000	Montgomery-Blacksburg/NHS
40		Southgate Drive Extension from Merrimac Road (Route 657) to Radford Arsenal	Construct as four-lane parkway	$16,561,000	Montgomery/ Primary

Exhibit 19

Tier 1 Vision Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Locality/Funding Source
41	8	Riner Road (Rt 8) from Route 669 to Christiansburg South Corporate limits	Widen road to current standards	$26,741,000	Montgomery/ Primary
42	114	Peppers Ferry Road Extension from Route 460 Bypass to Ellett Roud (Route 723)	Construct 2-lane roadway	$2,294,000	Montgomery/ Primary
43	657	Merrimac Road from North Franklin Street (Route 460) to Prices Fork Road (Route 685)	Reconstruct road to current 2-lane standards	$7,044,000	Montgomery/ Secondary
44	808	High Top Road from Merrimac Road to South Main Street (Route 460)	Reconstruct road to current 2-lane standards	$2,018,000	Montgomery/ Secondary
45		Ramble Road from Industrial Park Drive to the Corporate Research Center (north of Merrimac Road)	Reconstruct as 2-lane urban roadway plus transit pull-offs and bicycle lanes	$2,892,000	Blacksburg/ Urban
46		Farmview Drive/Mabry Lane from Hightop Road to Huckleberry Lane	Reconstruct as 2-lane roadway with bicycle lanes and sidewalks	$3,439,000	Blacksburg/ Urban
47		Progress Street at Patrick Henry Drive	Traffic signal and safety upgrades	$1,000,000	Blacksburg/ Urban
48		Mount Tabor Road from North Main Street to Bishop Road	Reconstruct road to current 2-lane standards with sidewalks and bicycle lanes, and bus pull-offs; align with Givens Lane at North Main Street	$3,941,000	Blacksburg/ Urban
49		Ellett Road from South Main Street to Cedar Hill Drive	Widen road to 4 lanes with bicycle lanes or separate multi-use trail; improve intersection of Ellet and S. Main	$5,923,000	Blacksburg/ Urban
50		Southgate Drive from Merrimac Road to 460 Bypass	Extend Southgate drive as a 4-lane road with median, bicycle lands, and sidewalk	$10,467,000	Blacksburg/ Urban
51	460 Bus	North Main Street from Mount Tabor Road to Route 460 Bypass	Widen road to 4 -lanes divided, with bicycle lanes and sidewalk	$10,559,000	Blacksburg/ Urban

Exhibit 19

Tier 1 Vision Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Locality/Funding Source
52		Country Club Drive Extension from Airport Road to Hubbard Street Extension	Construct extension of Country Club Drive; include bicycle lanes and trails.	$1,122,000	Blacksburg/ Urban
53		Hubbard Street Extension from Airport Road to Southgate Drive	Construct extension of Hubbard Street as two-lane roadway; includes bicycle lanes and grade-separated crossing for the Huckleberry Trail	$6,296,000	Blacksburg/ Urban
54		Heather Drive Extension from Prices Fork Road to Glade Road	Construct as two-lane roadway with bicycle lanes and sidewalks	$3,888,000	Blacksburg/ Urban
55		Progress Street Extension from Givens Lane to North Main Street	Extension from Givens Lane through Northside Park to North Main Street	$3,659,000	Blacksburg/ Urban
56	8	West Main Street (Rt 8) at Phlegar Street/Radford Street	Improve intersection for operations and safety: shift Phlegar Street to align with Radford Street and create single intersection	$862,000	Christiansburg/ Urban
57	11	Radford Road and Radford Street from Silver Lake Road (western intersection) to Main Street	Widen road to four lanes with a center bi-directional turn lane, bicycle lanes, and sidewalks	$18,585,000	Christiansburg/ Urban
58		North Franklin Street at Peppers Ferry Road	Improve intersection for operations; add additional approach lanes on Peppers Ferry Road to improve capacity	$1,074,000	Christiansburg/ Urban
59		Parkway Drive Extension from existing Parkway Drive at Technology Drive to South Franklin Street	Extend road as 2-lane roadway on 4-lanes of right-of-way	$2,668,000	Christiansburg/ Urban

Notes:

[1] Corresponds to the key numbers on map in Exhibit 19.

*[2] Estimated costs are planning-level estimates based on average or typical projects for each cross-section type. Costs are for year 2005 and include both construction and rights-of-way. The amount shown for those projects marked with ** is the remaining cost to construct these projects which are only partially funded in the Financially Constrained Plan. The total estimated cost for these projects shown with ** are included in the Exhibit 2 Financially Constrained Plan.*

Exhibit 20

Tier 2 Vision Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Locality/Funding Source
60	460	460 Bypass at North Main Street	Construct interchange	$22,000,000	Montgomery-Blacksburg/NHS
61		Radford Road from West Study Area Boundary to western intersection of Silver Lake Road	Widen to 4-lanes with median (rural cross-section); 5-lane cross-section in Plum Creek area	$26,805,000	Montgomery/ Primary
62		Ellett Road/Cedar Run Road from Cedar Hill Drive to Route 723 (Ellett Road)	Upgrade road to current 2-lane standards; sidewalks and bicycle lanes or trail in Town portion	$5,852,000	Montgomery/ Secondary
63		Harding Avenue and Harding Road from Progress Street to Lusters Gate Road	Reconstruct road to current 2-lane standards; sidewalks and bicycle lanes, and bus pull-offs in Town portion	$10,569,000	Montgomery/ Secondary
64	658/627	Meadow Creek/Barn Road from Riner Road (Route 8) to Tyler Road (Route 600)	Reconstruct road to current 2-lane standards	$11,290,000	Montgomery/ Secondary
65	669	Fairview Church Road from West Study Area Boundary to Riner Road	Reconstruct road to current 2-lane standards	$1,624,000	Montgomery/ Secondary
66	669	Union Valley Road from Riner Road (Route 8) to East Study Area Boundary	Reconstruct road to current 2-lane standards	$2,674,000	Montgomery/ Secondary
67	723	Ellett Road from Christiansburg Corporate Limits to Route 603	Reconstruct road to current 2-lane standards	$5,376,000	Montgomery/ Secondary
68		Turner Street from Prices Fork Road to North Main Street	Reconstruct as 2-lane urban roadway including turn lanes at the Creative Arts Center and a bicycle lane	$1,421,000	Blacksburg/ Urban
69		Old Glade Road from Prices Fork Road to Glade Road	Construct 2-lane roadway with bicycle lanes and sidewalk	$1,308,000	Blacksburg/ Urban
70		Giles Road Extension from North Main Street to Turner Street	Construct/reconstruct as 2-lane roadway to improve access in the Barger Street area	$580,000	Blacksburg/ Urban

Exhibit 20

Tier 2 Vision Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Locality/Funding Source
71		Toms Creek Road from Meadowbrook Road to Route 460	Reconstruct as two-lane roadway with bicycle lanes and sidewalks	$4,299,000	Blacksburg/ Urban
72		Connector from 460 Bypass to Toms Creek	Construct as 2-lane road	$3,102,000	Blacksburg/ Urban
73		Meadowbrook Road from Glade Road to Toms Creek Road	Reconstruct as 2-lane roadway with bicycle lanes, trail, and sidewalks	$9,309,000	Blacksburg/ Urban
74		Parkway Drive extension from Radford Road to South Franklin Street	Extend Parkway Drive as a 2-lane facility	$14,128,000	Christiansburg-Montgomery/ Urban-Secondary
75		Mill Lane from existing terminus to North Franklin Street	Construct as two-lane roadway	$290,000	Christiansburg/ Urban
76		Cambria Street at Ellet Road	Improve intersection for operations; install signal pending warrants	$207,000	Christiansburg/ Urban

Notes:

[1] Corresponds to the key numbers on map in Exhibit 19.

[2] Estimated costs are planning-level estimates based on average or typical projects for each cross-section type. Costs are for year 2005 and include both construction and rights-of-way.

Exhibit 21A

Map of Vision Plan Transportation Recommendations

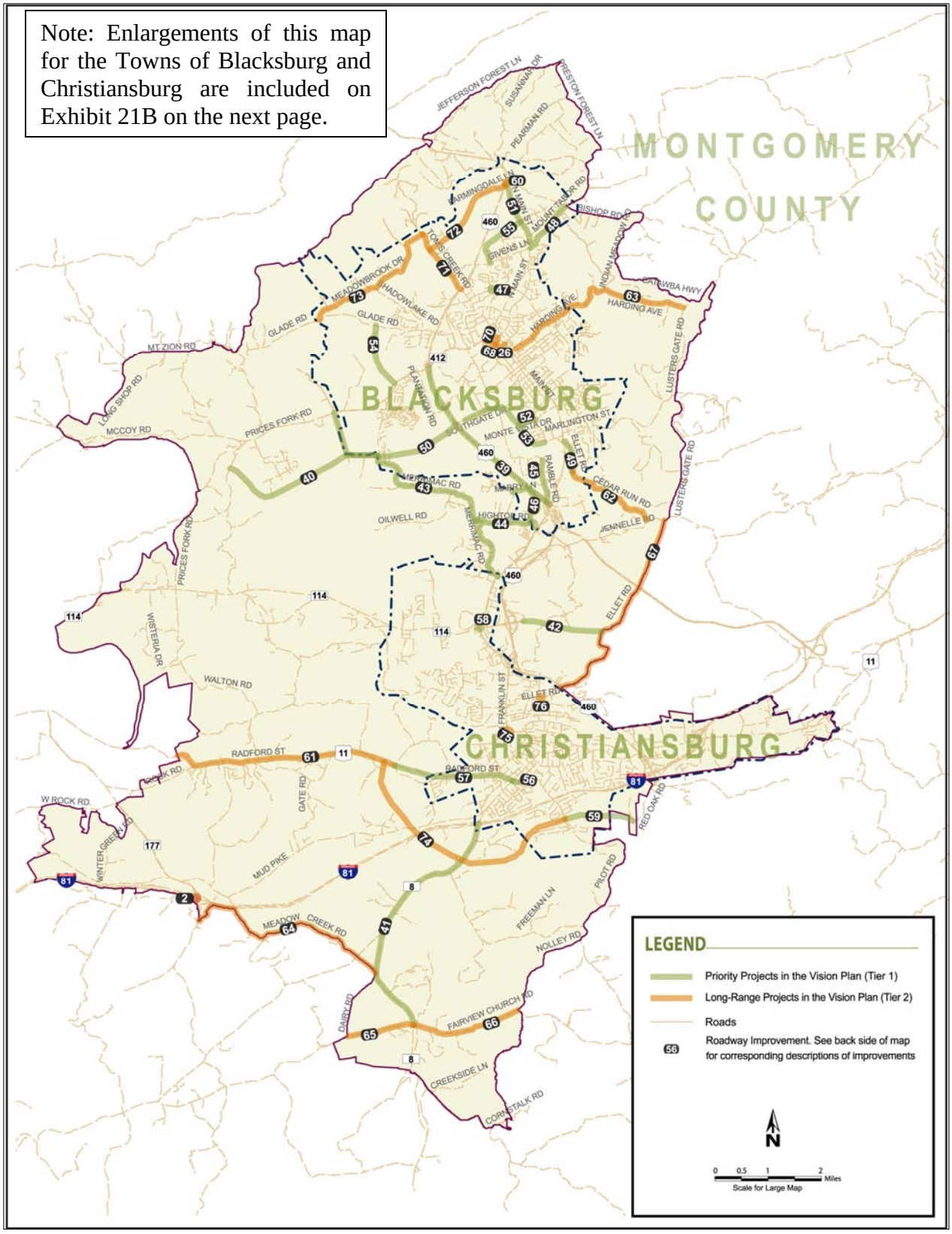
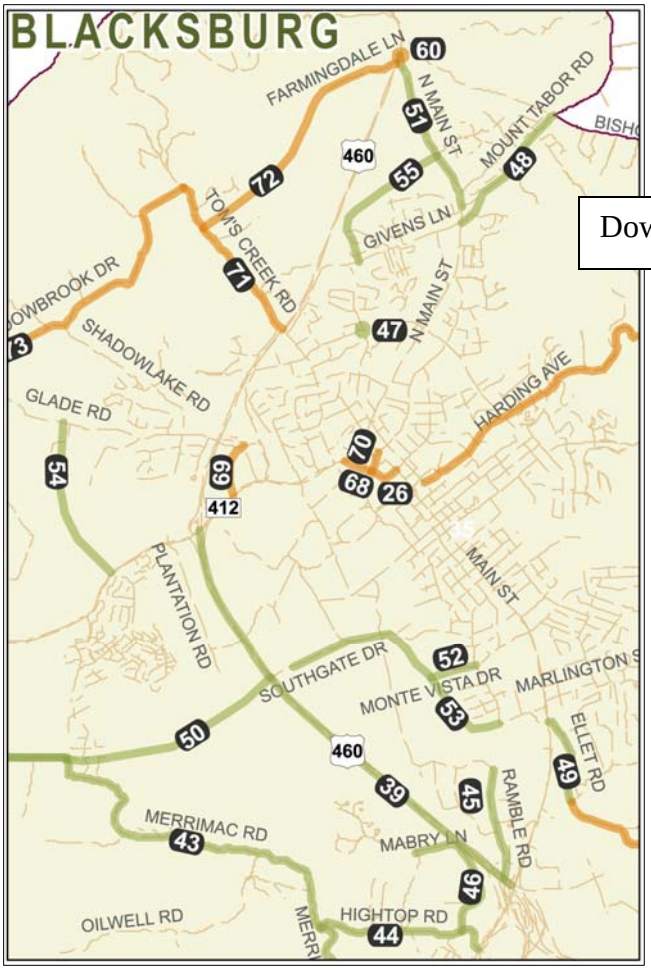


Exhibit 21B

Map of Vision Plan Transportation Recommendations (Town Insets)



Downtown Blacksburg Inset

Downtown Christiansburg Inset

Chapter 6 – Alternative Transportation Modes

Transportation via transit, bicycle, walking, air, and intercity bus is an integral part of the region's transportation system and the Plan recommends substantial expansion of the role that these modes of travel serve. Many of the roadway projects described in Chapters 4 and 5 include provisions for bicycle and pedestrian amenities, with a goal towards developing a comprehensive network of trails and sidewalks. Carefully designed roadway improvements also serve transit vehicles and such needs should be taken into consideration in the design of all new and reconstructed roadways. Other initiatives to support non-automotive travel are described in this section. As indicated previously, Blacksburg Transit is in the process of developing a detailed Transit Development Plan (TDP) that will provide details on expansion of transit service in the region. Upon completion of this document, it will be adopted by amendment into the BCM-MPO 2030 Transportation Plan.

Blacksburg Transit has grown steadily over the past two decades, carrying 2.2 million passengers in Fiscal Year 2004-2005. Public input, including input received at meetings associated with the development of this Plan, is calling for increased service throughout the BCM MPO area and the New River Valley. To meet this demand, Blacksburg Transit is planning to expand service within the New River Valley in the next decade and is using the TDP process to help plan for funding these possible services.

The Virginia Tech/Montgomery Executive Airport is also beginning the development of its Master Plan Update. The Master Plan Update is anticipated to be complete by the end of 2006.

As the major activity center in the region, improvements on the campus of Virginia Tech have significant impacts on overall transportation. The Virginia Tech Master Plan describes roadway improvements, parking facilities, transportation policies, and the location of new academic and residential facilities – all of which affect regional transportation. The Virginia Tech Master Plan was considered in the development of the Plan. The Master Plan document is in the process of being updated, however, with final recommendations due shortly.

<u>Mass Transit Improvements</u>

- Construct Multi-Modal Transportation Center to include a parking garage and a bus transfer facility that will connect the off-campus route system to the on-campus circulation system.
- Expand Blacksburg Transit service into the Blacksburg/ Christiansburg/Montgomery MPO area and adjacent jurisdictions with service along main arterial streets, making stops at large commercial areas, at local and county facilities, and at high-density residential areas.
- Provide transit service from the Blacksburg/Christiansburg/Montgomery MPO area and adjacent jurisdictions to the Christiansburg train station to accommodate riders of the proposed TransDominion rail service.

Rideshare/Park-and-Ride Improvements

- Provide park and ride lots at Route 460 Bypass and South Main Street, Southgate Drive, Tom's Creek Road, North Main Street and Price's Fork Road; Route 460 and Peppers Ferry Road; and at Interstate 81 and Route 8. Provide shuttle bus service to link these lots to the transfer facility in the Multi-Modal Transportation Center.
- Construct additional regional park-and-ride lots to serve Radford, Roanoke, and Giles County commuters, along with shuttle service and/or a rideshare program.
- Implement regional rideshare programs.

Bikeway/Walkway Improvements

- Construct extension of Huckleberry Trail from Prices Fork Road to Glade Road (Six-Year Program project).
- Extend the Huckleberry Trail to the downtowns of both Blacksburg and Christiansburg, as well as to the Blacksburg Recreation Center. Construct bridge for trail over Norfolk Southern railroad tracks.
- Implement other elements of the bicycle plans for each jurisdiction.
- Widen sidewalks in downtown Christiansburg and continue with the Downtown Improvement project.
- Widen sidewalks within downtown Blacksburg to 10 feet.
- Construct sidewalks with new commercial development in villages and towns within the region.
- Revitalize downtown Cambria through an improvement program including sidewalks, pedestrian lighting, and other streetscape enhancements.
- Construct bikeways and walkways in the communities of Prices Fork, Riner, Plum Creek, and Belview.
- Construct sidewalks and/or bicycle trails with most planned roadway projects.

Intercity Transportation Improvements

- Re-establish Greyhound inter-city bus service within the MPO.
- Support implementation of the proposed TransDominion train service.
- Develop Christiansburg train station and rail infrastructure to accommodate a stop for the proposed TransDominion rail service.

Exhibit E-1

Projects in the Financially Constrained Plan

Project Location	Description	Project in VDOT Six-Year Program
Route 460 Bypass from Route 460 Business in Christiansburg to Route 460 Business in Blacksburg	Construct 4-lane roadway; project complete, included in program for final financing	Yes
Peppers Ferry Road from Christiansburg corporate limits to Route 460	Widen to four lanes	Yes
Peppers Ferry Connector from Peppers Ferry west of New River Mall to North Franklin Street north of Ellett Road	Construct 4-lane connecter with median, bicycle lanes, and sidewalks	Yes
Route 460 at Toms Creek Road	Construct interchange; project is previously funded, construction to begin in fiscal year 2006	Yes
North Main Street from College Drive to Prices Fork Road	Reconstruct, includes improvements to Prices Ford Road Intersection	Yes
North Main Street from Giles Road to Mount Tabor Road	Widen to four lanes with landscaped median, bicycle lanes, and sidewalks	Yes
Prices Fork Road at Toms Creek/Stanger Road	Improve intersection to improve traffic safety and pedestrian flow	Yes
Prices Fork Road at University City Boulevard	Traffic signal modification to improve traffic flow and pedestrian safety	Yes
South Main Street at Ellett Road; and Prices Fork Road at West Campus Drive and at TomsCreek/Stanger Road	Add turn lanes	Yes
Progress Street Extension from north of Cherokee Drive to Givens Lane; Givens Lane from Ashford Court to North Main Street	Construct Progress Street Extension, improve Givens Lane; in Six-Year Program for preliminary engineering only	Yes
Huckleberry Trail from Prices Fork Road to Glade Road	Construct bicycle trail	Yes
Peppers Ferry Road at New River and Norfolk Southern railroad tracks	Replace bridges	Yes
West Main Street at I-81	Improve interchange for operations	No
Route 460 Bypass at Route 460 Business	Add ramp for southbound Route 460 to westbound Route 460 Business	No
Smart Road from I-81 to Route 460 Bypass	Connection to Route 460 Bypass; includes paving 2-lane roadway	No
Intersection of Riner (Rt 8) and Smith Creek Rd (Rt 675)	Add turn lanes	No
Intersection of Peppers Ferry (Rt 114) and Rolling Hills (Rt 1286)	Add turn lanes	No
Intersection of Riner (Rt 8) and Fairview Church (Rt 669)	Add turn lanes	No
Riner Road (Rt 8) from South Study Area Boundary to Route 669 (Community of Riner)	Reconstruct to current 2-lane standards	No
Peppers Ferry Road from Radford Arsenal main entrance to the Christiansbug West Corporate Limits	Widen road to 4-lanes divided with bicycle lanes (partial funding)	No

Exhibit E-1

Projects in the Financially Constrained Plan

Project Location	Description	Project in VDOT Six-Year Program
Jenelle Road from Route 460 Business to Route 603	Reconstruct road to current 2-lane standards (partial funding)	No
South Main Street at Country Club Road	Improve intersection for operations and safety	No
North Main Street at Turner Street	Traffic signal upgrade to current equipment and standards	No
North Main Street at Progress Street	Traffic signal upgrade to current equipment and standards	No
Heather Drive at Prices Fork Road	Traffic signal upgrade to current equipment and standards	No
Toms Creek Road at Patrick Henry Drive	Upgrade intersection (this project would tie into the project to construct an interchange at Toms Creek Road and Route 460)	No
Marlington Street at South Main Street	Intersection improvements at the intersection of Marlington Street and South Main Street	No
Commerce Street from Trade Street to Jennelle Road	Construct extension of Commerce Street as two-lane roadway	No
Glade Road from Boxwood Drive to Linwood Lane	Reconstruct as 2-lane roadway with bicycle lanes, trail, and sidewalks	No
Shadow Lake Road from Basil Street to Lakewood Drive	Straighten and realign curves	No
Progress Street at Giles Road	Traffic signal upgrade to current equipment and standards	No
Washington Street at Draper Road	Traffic signal upgrade to current equipment and standards	No
Progress Street at Turner Street	Traffic signal upgrade to current equipment and standards	No
460 Bypass at Southgate Drive	Construct interchange (partial funding)	No
Peppers Ferry Road from west corporate limits to Route 460	Widen to four lanes, preliminary engineering and right-of-way acquisition included in Six-Year Program (partial funding)	No
Tech Center Drive south of Duck Pond Drive	Relocate to align with Duck Pond Drive; shift allows for airport runway extension (funded through Federal Aviation Administration)	No

Projects in the Vision Plan were prioritized, creating a Tier 1 list of projects that could be shifted into the Financially Constrained Plan (through amendment of the Plan by the MPO). These Tier 1 Vision Plan projects are summarized in Exhibit E-2.

Exhibit E-2

Tier 1 Vision Plan Projects

Project Location	Description
Smart Road from I-81 to Route 460 Bypass	Connection to Route 460 Bypass; includes paving 2-lane roadway
Peppers Ferry Road from Radford Arsenal main entrance to the Christiansburg West Corporate Limits	Widen road to 4-lanes divided with bicycle lanes
Jenelle Road from Route 460 Business to Route 603	Reconstruct road to current 2-lane standards
460 Bypass at Southgate Drive	Construct interchange
Peppers Ferry Road from west corporate limits to Route 460	Widen to four lanes, PE and ROW included in Six-Year Program
Route 460 Bypass from South Main to Prices Fork Road	Widen to 6 lanes
Southgate Drive Extension from Merrimac Road (Route 657) to Radford Arsenal	Construct as four-lane parkway
Riner Road (Rt 8) from Route 669 to Christiansburg South Corporate limits	Widen road to current standards
Peppers Ferry Road Extension from Route 460 Bypass to Ellett Roud (Route 723)	Construct 2-lane roadway
Merrimac Road from North Franklin Street (Route 460) to Prices Fork Road (Route 685)	Reconstruct road to current 2-lane standards
High Top Road from Merrimac Road to South Main Street (Route 460)	Reconstruct road to current 2-lane standards
Ramble Road from Industrial Park Drive to the Corporate Research Center	Reconstruct as 2-lane urban roadway plus transit pull-offs and bicycle lanes
Farmview Drive/Mabry Lane from Hightop Road to Huckleberry Lane	Reconstruct as 2-lane roadway with bicycle lanes and sidewalks
Progress Street at Patrick Henry Drive	Traffic signal and safety upgrades
Mount Tabor Road from North Main Street to Bishop Road	Reconstruct road to current 2-lane standards with sidewalks and bicycle lanes, and bus pull-offs; align with Givens Lane at North Main Street
Ellett Road from South Main Street to Cedar Hill Drive	Widen road to 4 lanes with bicycle lanes or separate multi-use trail; improve intersection of Ellet and S. Main
Southgate Drive from Merrimac Road to 460 Bypass	Extend Southgate drive as a 4-lane road with median, bicycle lands, and sidewalk
North Main Street from Mount Tabor Road to Route 460 Bypass	Widen road to 4 -lanes divided, with bicycle lanes and sidewalk
Country Club Drive Extension from Airport Road to Hubbard Street Extension	Construct extension of Country Club Drive; include bicycle lanes and trails.
Hubbard Street Extension from Airport Road to Southgate Drive	Construct extension of Hubbard Street as two-lane roadway; includes bicycle lanes and grade-separated crossing for the Huckleberry Trail
Heather Drive Extension from Prices Fork Road to Glade Road	Construct as two-lane roadway with bicycle lanes and sidewalks
Progress Street Extension from Givens Lane to North Main Street	Extension from Givens Lane through Northside Park to North Main Street
West Main Street (Route 8) at Phlegar Street/Radford Street	Improve intersection for operations and safety: shift Phlegar Street to align with Radford Street and create single intersection

Exhibit E-2

Tier 1 Vision Plan Projects

Project Location	Description
Radford Road and Radford Street from Silver Lake Road (western intersection) to Main Street	Widen road to four lanes with a center bi-directional turn lane, bicycle lanes, and sidewalks
North Franklin Street at Peppers Ferry Road	Improve intersection for operations; add additional approach lanes on Peppers Ferry Road to improve capacity
Parkway Drive Extension from existing Parkway Drive at Technology Drive to South Franklin Street	Extend road as 2-lane roadway on 4-lanes of right-of-way

Transportation via transit, bicycle, walking, air, and intercity bus is an integral part of the region's transportation system and the Plan recommends expanding the role that these modes of travel provide in the region. In addition to the provision for bicycles and pedestrians that are included in many of the roadway projects, the Plan recommends expansion to transit in the region, park-and-ride lots, bikeways and walkways, and intercity transportation by rail, air, and bus. Details of transit improvements are currently being developed as part of a Transit Development Plan (TDP) being developed by Blacksburg Transit. In addition, the Virginia Tech/Montgomery Executive Airport is also beginning the development of its Master Plan Update, with anticipated completion by the end of 2006.

The *Blacksburg/Christiansburg/Montgomery 2030 Transportation Plan* was adopted by the Blacksburg-Christiansburg-Montgomery Metropolitan Planning Organization on October 6, 2005.

Chapter 1: Introduction

The *Blacksburg/Christiansburg/Montgomery Area 2030 Transportation Plan* (the Plan) was developed to provide the Towns of Blacksburg and Christiansburg and the surrounding urbanized portions of Montgomery County with a comprehensive set of transportation improvements that will meet current travel demands, as well as projected travel demands to the year 2030. These improvements encompass all modes of travel, including roadway, transit, rail, air, bicycle, and pedestrian. The primary component of the Plan is the Financially Constrained Long-Range Plan (FCLRP), which consists of projects that can be funded based on anticipated funding streams to the year 2030. Regional transportation needs that are beyond those that could be funded based on current funding estimates are included in the Vision Plan component of this document.

1.1 Scope of the Transportation Plan

The 2030 Transportation Plan was developed to meet federal requirements for metropolitan area transportation planning. While individual jurisdictions often prepare local transportation plans, projects that receive any federal transportation funds must be included in a regionally adopted Transportation Plan that meets federal regulations. These regulations apply to both the content of the Plan and the way in which it is developed. Key requirements include:

- Early, proactive, and ongoing public involvement process
- Coordinated planning across local, state, and federal agencies
- Reflect local transportation, land use, and economic goals and objectives
- Consideration of all modes of travel, with specific emphasis on identifying pedestrian walkway and bicycle transportation facilities
- Include strategies to increase the use of new technologies for transportation, including Intelligent Transportation Systems (ITS)
- Assess needs and develop improvements that address transportation needs for a minimum horizon of 20 years
- Consideration of the social, environmental, and economic impacts of transportation recommendations
- Recommended projects must be able to be funded based on reasonable estimates of transportation funding between today and 2030 (financially constrained)

Federal regulations also require that the Transportation Plan and the recommendations contained within the Plan address seven planning factors. These factors are listed below and specifically addressed in Appendix A. The Transportation Plan should:

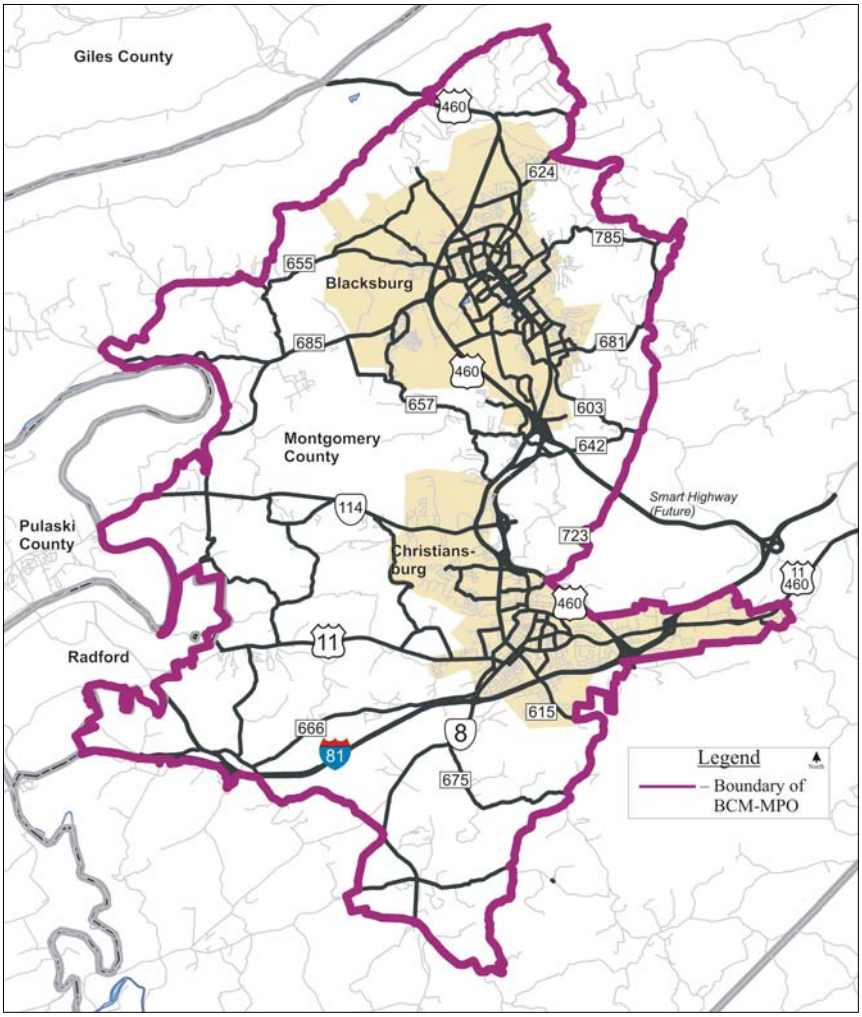
- Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;
- Increase the safety and security of the transportation system for motorized and non-motorized users;
- Increase the accessibility and mobility options available to people and for freight;
- Protect and enhance the environment, promote energy conservation, and improve quality of life;

- Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight; Promote efficient system management and operation; and
- Emphasize the preservation of the existing transportation system.

1.2 Study Area

This Technical Report describes the methodologies used in developing transportation recommendations within the boundaries of the Blacksburg/Christiansburg/ Montgomery Area Metropolitan Planning Organization (BCM-MPO), as well as the projects themselves. The BCM-MPO area includes the Towns of Blacksburg and Christiansburg, as well as the adjacent urbanized portions of Montgomery County. Urbanized areas are defined by the U.S. Census based on total population: encompassing at least one population center with at least 50,000 persons, and including contiguous areas that meet population density thresholds. The Blacksburg/Christiansburg/Montgomery region met these thresholds after the 2000 US Census. The boundaries of the BCM-MPO area are shown in Exhibit 1.

Exhibit 1
Study Area (MPO Boundary)



1.3 Demographic Overview

The BCM-MPO study area is currently home to just under 75,000 persons, as shown in Exhibit 2 below. Through the 1990's, the region's population grew by 13 to 14 percent. The rate of population growth in the 1990's is expected to continue, resulting in an estimated population within the MPO of 101,800 persons in 2030. The population forecasts shown in Exhibit 2 were developed as a cooperative effort by the MPO's Technical Advisory Committee and were adopted by the MPO. The forecasts also reflect generalized estimates as developed by the Virginia Employment Commission (VEC) and the official state-endorsed forecasts from the Tayloe-Murphy Center..

Exhibit 2
Existing and Forecast Population

Area	1990	2003	Percent Increase (1990 to 2003)	2030 (Forecast)	Percent Increase (2003 to 2030)
Blacksburg	34,590	39,573	14.4%	52,704	33.2%
Christiansburg	15,004	16,947	12.9%	24,873	46.8%
Montgomery County	73,913	83,629	13.1%	NA **	NA **
MPO	NA	74,650 *	NA	101,839	36.4%

** -- 2003 estimate including the Towns of Blacksburg and Christiansburg, Virginia Tech, and the urbanized portions of Montgomery County. This is not a total of the lines above, because not all of Montgomery County is in the MPO.*
*** -- Forecasts developed for this study (based on detailed zone-by-zone assessments of growth) were for the MPO area which is included in the area covered by the transportation model. Forecasts were not developed for Montgomery County as a whole.*
Sources: US Census, Blacksburg/Christiansburg/Montgomery MPO

Exhibit 3 below summarizes the existing and 2030 employment for the BCM-MPO area. These forecasts were also developed as a cooperative effort by the MPO and were initially based on a database of all employers in the region provided by the VEC. This data was checked and validated by local jurisdictions. Employment forecasts were developed based on local land use plans, current development patterns, employment trends, and generalized estimates by the VEC. As with the population forecasts, the employment forecasts were adopted by the MPO.

Exhibit 3
Existing and Forecast Employment

Area	2003	2030 (Forecast)	Percent Increase (2003 to 2030)
Blacksburg	20,760	26,764	28.9%
Christiansburg	12,427	15,779	27.0%
Montgomery County	3,188 *	5,406 *	69.6%
MPO	36,375	47,949	31.8%

** -- Portion of Montgomery County within the MPO.*
Sources: Virginia Employment Commission, Blacksburg/ Christiansburg/Montgomery MPO

Future transportation needs in the region were identified using a computerized regional travel demand model that was updated and validated using 2003 as a base year. Increases in population and employment are the primary inputs into the travel forecasting process. The travel demand model is described more fully in Appendix C of this document. Appendix C also includes additional information on the demographic data summarized above.

Chapter 2: Existing Transportation System

The study area is served by a network of roads, sidewalks, and bicycle trails and lanes. Pedestrian travel is served by sidewalks within the downtowns and on local and thoroughfare roads elsewhere. In general, bicycle travel is permitted on existing roads. On-street parking is permitted in Blacksburg and Christiansburg unless restrictions are posted. Transportation needs are also served by Blacksburg Transit (fixed route and paratransit service), SmartWay bus service between Blacksburg/Christiansburg and Salem/Roanoke, taxi service, and the Virginia Tech/Montgomery Executive Airport. Commercial air travel is provided out of Roanoke Airport (approximately 35 miles to the east), while the closest location for intercity passenger train service (Amtrak) is either Clifton Forge, about 60 miles to the north, or Lynchburg, about 80 miles to the northeast.

2.1 Roadway Network

The focus of the Plan is the functionally classified urban thoroughfare system. The urban thoroughfare system is a subset of the area's overall road network that is designated by VDOT, the Federal Highway Administration, and the Towns of Blacksburg and Christiansburg. The thoroughfare system includes roads that are functionally classified as arterials or collectors, and comprises approximately 130 roadway miles (360 lane-miles) within the BCM-MPO study area. Arterial roads serve as the major traffic-carrying facilities in the area, and carry through traffic. Collector roads carry a lesser volume of traffic and feed traffic to the arterial roadways. Since these roadways make use of federal and state funds for construction and maintenance, they must be included in the Plan.

Blacksburg and Christiansburg lie at the convergence of several major north-south and east-west routes. Interstate 81 lies along the east edge of Christiansburg, providing a connection with the upper Shenandoah Valley and the Mid-Atlantic states to the north, and southwest Virginia and Tennessee to the south. US Route 11 parallels I-81 in a north-south direction, and traverses the central business district of Christiansburg. This road is designated as Roanoke Street, Main Street and Radford Street at various locations. US Route 460 travels in an east-west direction in the Blacksburg/Christiansburg area and provides a connection between the two towns. The road is designated Franklin Street in Christiansburg and Main Street in Blacksburg. Each town has a Route 460 Bypass that provides a route around its downtown area, and a new bypass that relieves the congested portions of Route 460 between the two towns was completed in the summer of 2002.

The area is also served by three Virginia primary routes. These are Route 8 and Route 111 in Christiansburg, designated as Riner Road and Depot Street, respectively. Route 114 ties into US Route 460 between Christiansburg and Blacksburg, and is designated as Pepper's Ferry Road.

Existing (year 2003) daily traffic volumes on study area roads are shown in Exhibits 4 and 5.

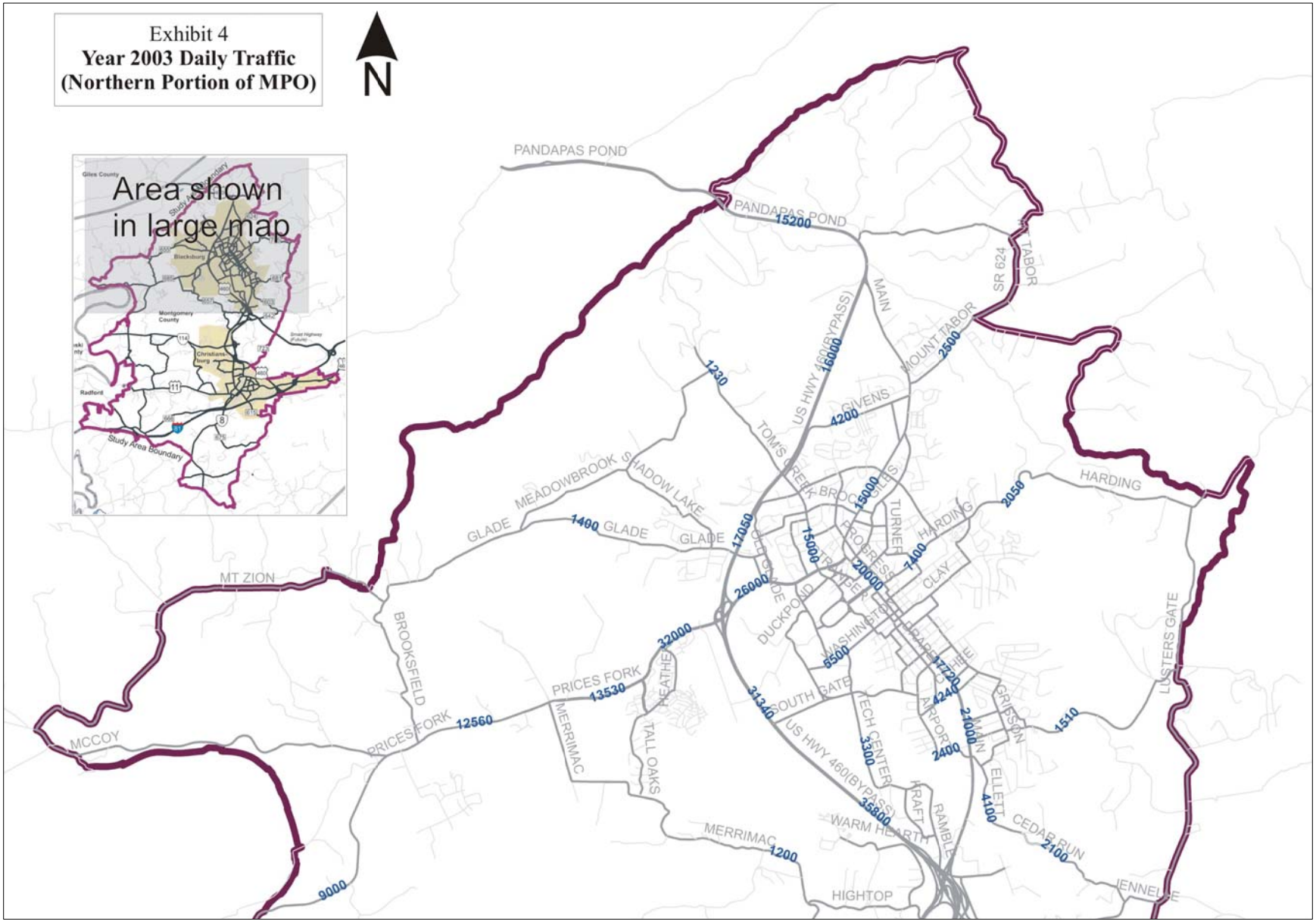


Exhibit 4
Year 2003 Daily Traffic
(Northern Portion of MPO)
N
Area shown in large map
Study Area Boundary
PANDAPAS POND
PANDAPAS POND
15200
SR 624
MOUNT TABOR
MOUNT TABOR
2500
MAIN
US HWY 460(BYPASS)
16000
1230
GIVENS
4200
TOMS CREEK
MEADOWBROOK
SHADOW LAKE
GLADE
1400
GLADE
GLADE
17050
15000
15000
HARDING
2050
HARDING
7400
CLAY
20000
26000
DUCKPOND
MT ZION
BROOKSFIELD
32000
PRICES FORK
13530
PRICES FORK
12560
MCCOY
9000
MERRIMAC
TALL OAKS
MERRIMAC
1200
HEATHER
5500
SOUTH GATE
31340
US HWY 460(BYPASS)
35800
WARM HEARTH
HIGHTOP
3300
17720
4240
21000
2400
4100
2100
1510
LUSTERS GATE
CEDAR RUN
ELLETT
KRAFT
RAMBLE

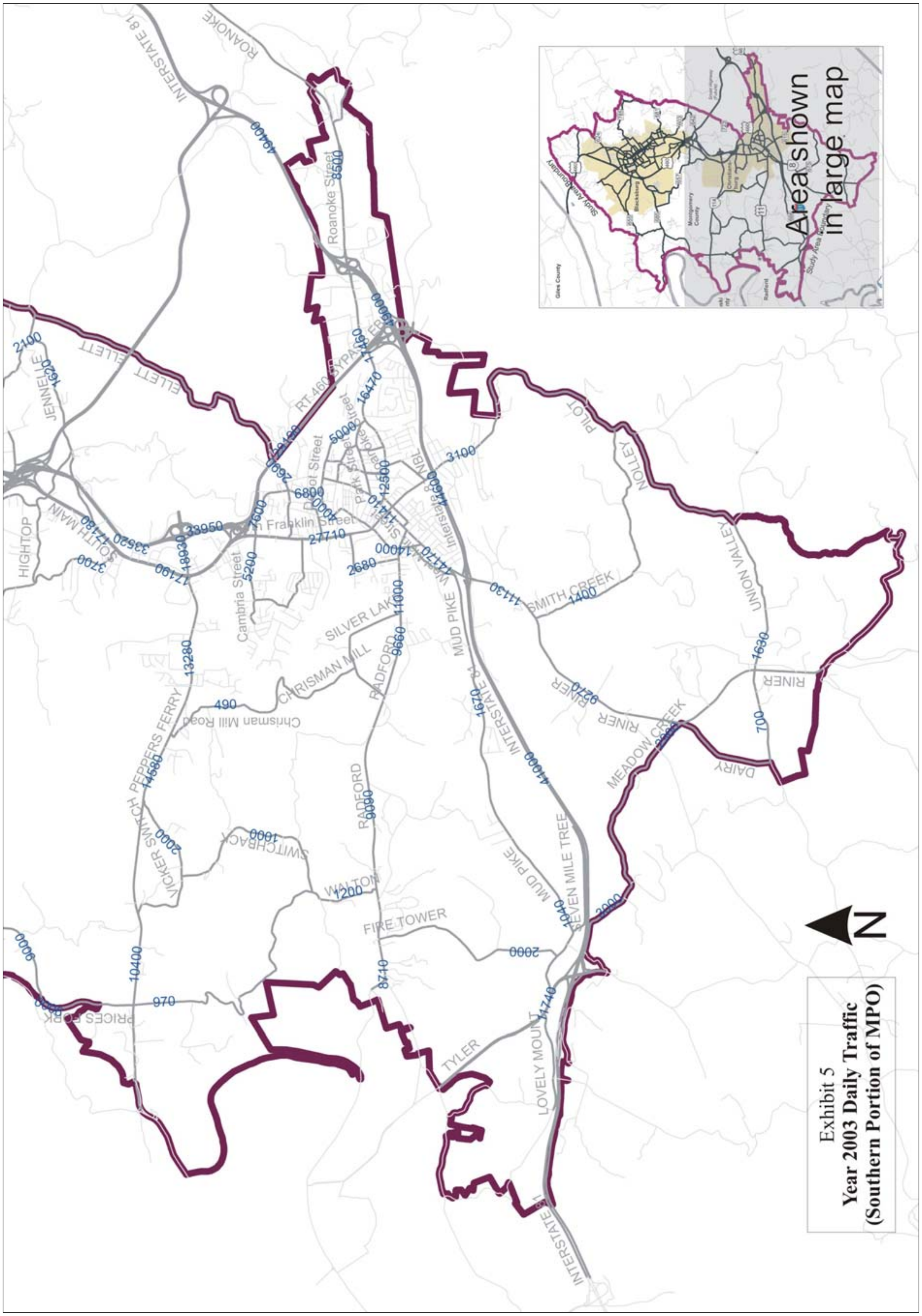


Exhibit 5
Year 2003 Daily Traffic
(Southern Portion of MPO)

2.2 Bicycle and Pedestrian Network

The Town of Blacksburg has about 14 miles of roadway with bicycle lanes (with most major streets having bicycle lanes), and 17 miles of separate paved trails. There are currently no bicycle lanes in Christiansburg, although travel lanes on some streets have been narrowed to make travel easier for bicyclists. The region's major off-road bicycle facility, the Huckleberry Trail, lies along the old Huckleberry Line railroad bed that runs from the New River Valley Mall in Christiansburg to trails in Blacksburg link to the downtown. Christiansburg's ultimate goals are to extend the Huckleberry Trail into its downtown.

In addition to the walking amenities that off-road trails such as the Huckleberry Trail provide, the downtowns of both Blacksburg and Christiansburg are well served by sidewalks. Blacksburg estimates that over 25 miles of road within the Town have sidewalks on at least one side. Since the late 1980's, Blacksburg has also had an ordinance requiring sidewalks in front of all existing and future development. For commercial land uses, sidewalks are required on both sides of the road; for residential land uses, they are required on one side. Christiansburg also requires all new development in commercial districts to have sidewalks. All three jurisdictions within the BCM MPO are actively seeking an expanded network of sidewalks and trails – Montgomery County is seeking these pedestrian amenities as part of its village planning in the communities of Prices Fork, Riner, Plum Creek, and Belview.

2.3 Transit Service

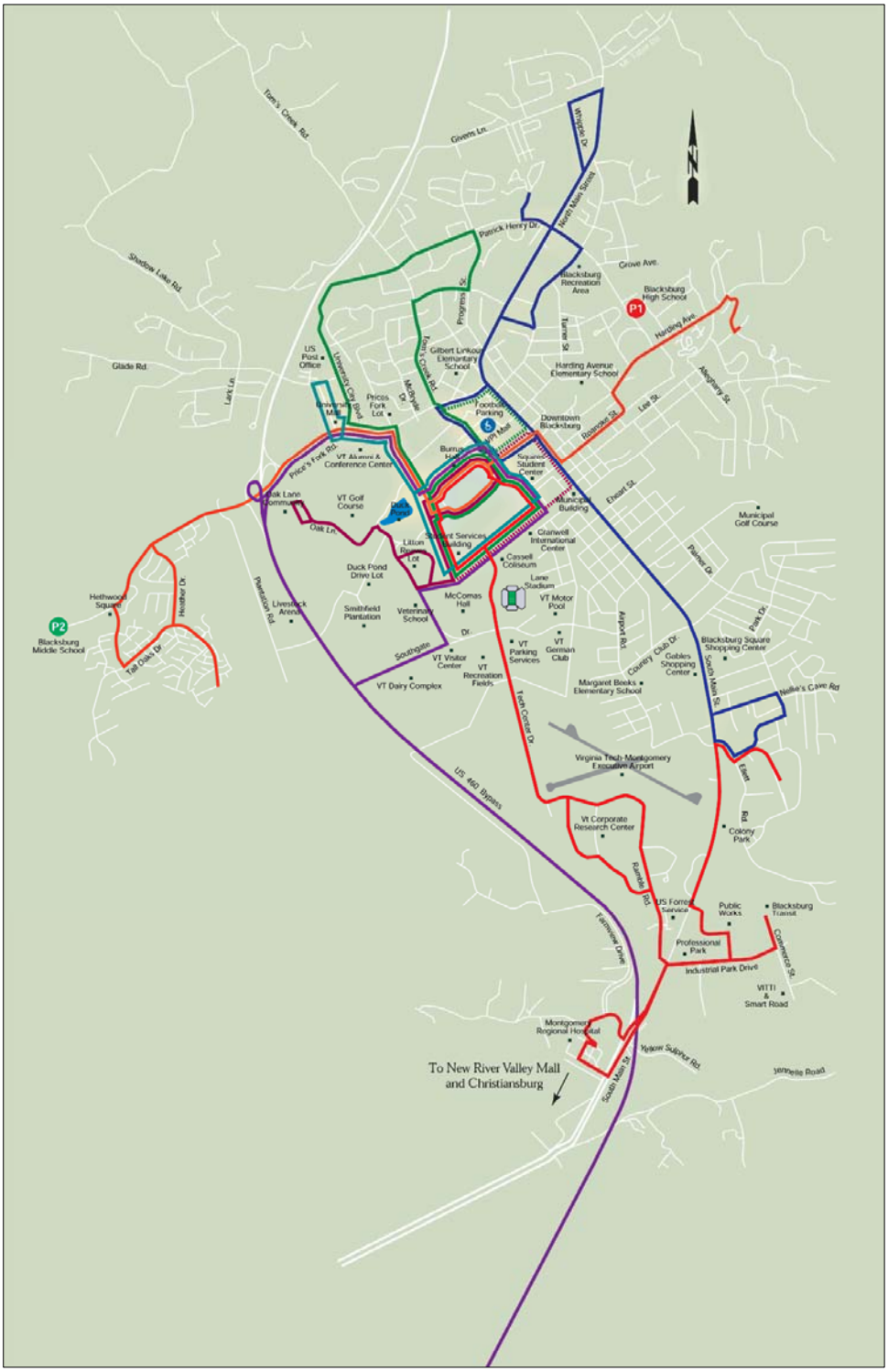
Transit service within the MPO is provided by Blacksburg Transit (BT). BT's primary service area is the Town of Blacksburg and Virginia Tech. Service outside of the Blacksburg is provided to the Montgomery Regional Hospital; Two-Town Trolley service is also provided in the Town of Christiansburg. BT was originally formed by an agreement between the Town and Virginia Tech in 1983. Service started with six buses; by the late 1980s, the service was running with 22 buses. Today, BT runs fixed route and paratransit service with a fleet of 31 buses and 11 vans.

BT operates eight routes within the town limits of Blacksburg (see route map in Exhibit 6), and one route to Christiansburg. Generally, buses run every 15 minutes during the week, with hourly service on the weekends. Buses run on arterial and connector streets throughout Blacksburg, and serve many high-density residential areas and commercial centers in the town. The Two Town Trolley, the express route to Christiansburg, runs hourly from downtown Blacksburg to downtown Christiansburg. A few additional stops are made along the route, including the New River Valley Mall.

Ninety-five percent of the 1.9 annual million trips on BT are made by Virginia Tech students, faculty and staff. University students, faculty and staff do not pay a fare to ride; the cost of the service is paid for in advance by a student transit fee and revenue generated from university parking permit fees. Local residents pay a fare of 50 cents to ride the bus and have several options to purchase passes at a reduced cost.

Exhibit 6

Blacksburg Transit Route Map



Source: Blacksburg Transit

Transit service in Christiansburg is currently limited to a route that connects the retail corridor at Route 114 to the downtown area. This service is provided as part of the Two Town Trolley route operated by the Town of Blacksburg under a cost-sharing agreement with Christiansburg to cover the subsidy for non-university affiliated riders.

BT also operates a paratransit service that transports persons with disabilities to all areas within Blacksburg's corporate limits, as well as one-half mile past the Town limits on Nellies Cave Road and three-quarters of a mile past Montgomery Regional Hospital.

Transit service is also provided from the BCM-MPO area to Roanoke and Salem via the Smartway Bus. Smartway is operated by Valley Metro out of Roanoke. Buses run 12 times a day Monday through Friday and nine times on Saturday, with one additional evening run on Fridays and Saturdays.

2.4 Park-and-Ride and Rideshare

There are currently no rideshare programs within the BCM-MPO area. Formal and informal park-and-ride facilities in the BCM-MPO area include one at the interchange of Route 460 and I-81 (Exit 118), at Route 8 and I-81 (Exit 114), the New River Valley Mall, the K-Mart at North Franklin Street near Peppers Ferry Road, and several other small lots.

2.5 Intercity Rail, Bus, and Air Service

The BCM-MPO area is not currently served by intercity passenger rail (Amtrak) service. The closest locations with train service are Clifton Forge (60 miles to the north) or Lynchburg (80 miles to the northeast). There are currently no intercity bus stops in the BCM-MPO area; service is provided out of Roanoke. Recent cutbacks in Greyhound service have decreased intercity bus service throughout the country.

The closest location to the BCM-MPO area for commercial air service is Roanoke, approximately 35 miles east of the MPO. In addition to driving or taking a taxi, travel to the Roanoke Airport can be made using the Smartway Bus service. General aviation service within the MPO is provided by the Virginia Tech/Montgomery Executive Airport, located adjacent to the Virginia Tech campus and approximately three miles south of the center of Blacksburg. The single asphalt runway is 4,550 feet long. The airport has a parallel taxiway, ten hangers, and a terminal. There are 35 aircraft based at the airport. The airport has about 1,450 operations (one take-off and landing) per month, with substantially more during the fall tourist season. The airport also has a flight school, which is operated by an independent contractor.

Chapter 3: Existing and Future Transportation Needs

Transportation needs in the Blacksburg/Christiansburg/Montgomery Area Metropolitan Planning Organization (BCM-MPO) were identified through a process that included interviews with transportation providers, agency and local government input, public involvement, and transportation planning and traffic engineering analysis. Interviews included staff from each of the Towns as well as Montgomery County, the Virginia Department of Transportation, Blacksburg Transit, and several major local industries. Details on public input, as well as the planning and engineering analyses, are described below. Note that transportation needs were identified for both existing conditions and for the Plan's horizon year of 2030.

3.1 Public Involvement Process

Public input into the Plan was sought prior to the beginning of the plan development process and at key milestones. Before the plan development process began, displays on the purpose and development of the Plan were available at the region's annual transportation public meeting which was held on March 17, 2004. Project staff were available to answer questions and take comments from the public on a wide range of transportation issues in the region. A plan development outline was also presented. Public input at this meeting was generally related to the need for expanded transit service and expanded regional bicycle facilities.

Planning efforts in 2004 and early 2005 were primarily focused on the development of the computerized regional transportation model and assessment of existing conditions based on traffic engineering analysis and other modes assessments. Input on existing transportation conditions was sought at the March 16, 2005 regional transportation public meeting. At this meeting, information on the regional transportation model and preliminary traffic engineering analysis was presented for public review. Preliminary funding estimates for the Plan were also presented for review. Input on projects that should be considered in the 2030 Plan was sought. Input received at the meeting included consideration of extending Southgate Drive west towards Radford and into Pulaski County and consideration of constructing a new roadway between Routes 674 and 640 in Montgomery County. The first proposed project includes sections within the BCM-MPO area as well as sections in Pulaski County. The second project cited for consideration is located outside of the MPO boundary but was noted for consideration in other planning efforts.

A public meeting to review projects under consideration in the 2030 Plan was held on July 20, 2005. Information was presented at this meeting on:

- the existing transportation system for all modes;
- projected 2030 traffic volumes and anticipated deficiencies;
- preliminary projects for all modes proposed for inclusion in the 2030 Plan;
- the plan development process and schedule;
- the financial constraint process and proposed priorities

Public input was sought with respect to the proposed projects and priorities, as well as other projects that meeting participants believed should be considered as part of the Plan. Twenty-five people attended this meeting and 10 comment sheets were returned. The major areas addressed in the comments include:

- Support for east-west connector from Route 460 Bypass at Southgate Drive through Montgomery and Pulaski Counties to I-81 at exit 94 (portion in the BCM-MPO area is included in the Plan);
- Overall need for more emphasis in the region on bicycle routes/lanes and sidewalks (including a goal to have sidewalks on all residential streets, and better pedestrian connections to and within the New River Mall area);
- Need to expand transit service (to Warm Hearth), promote roadway improvements that support transit, and maintain the SmartWay bus service;
- Comments both in support of and against proposed improvements to Marlington Street and Nellies Cave Road (Blacksburg);
- Comments indicating that improvements on North Main Street, Ellett Road, Toms Creek Road, and Marlington Street (all in Blacksburg) should be a priority ;
- Need for intersection improvements at Marlington and Main Streets (Blacksburg);
- Need for a direct connection from Route 460 Bypass to the Virginia Tech Corporate Research Center;
- Expand the MPO area to include Radford, Pulaski County, and Giles County

A final public hearing on the draft Plan was held on September 14, 2005. Eleven citizens attended this meeting. Most of the comments received related to either bicycle or transit projects, indicating that these need to be a priority within the BCM-MPO area. Comments received include:

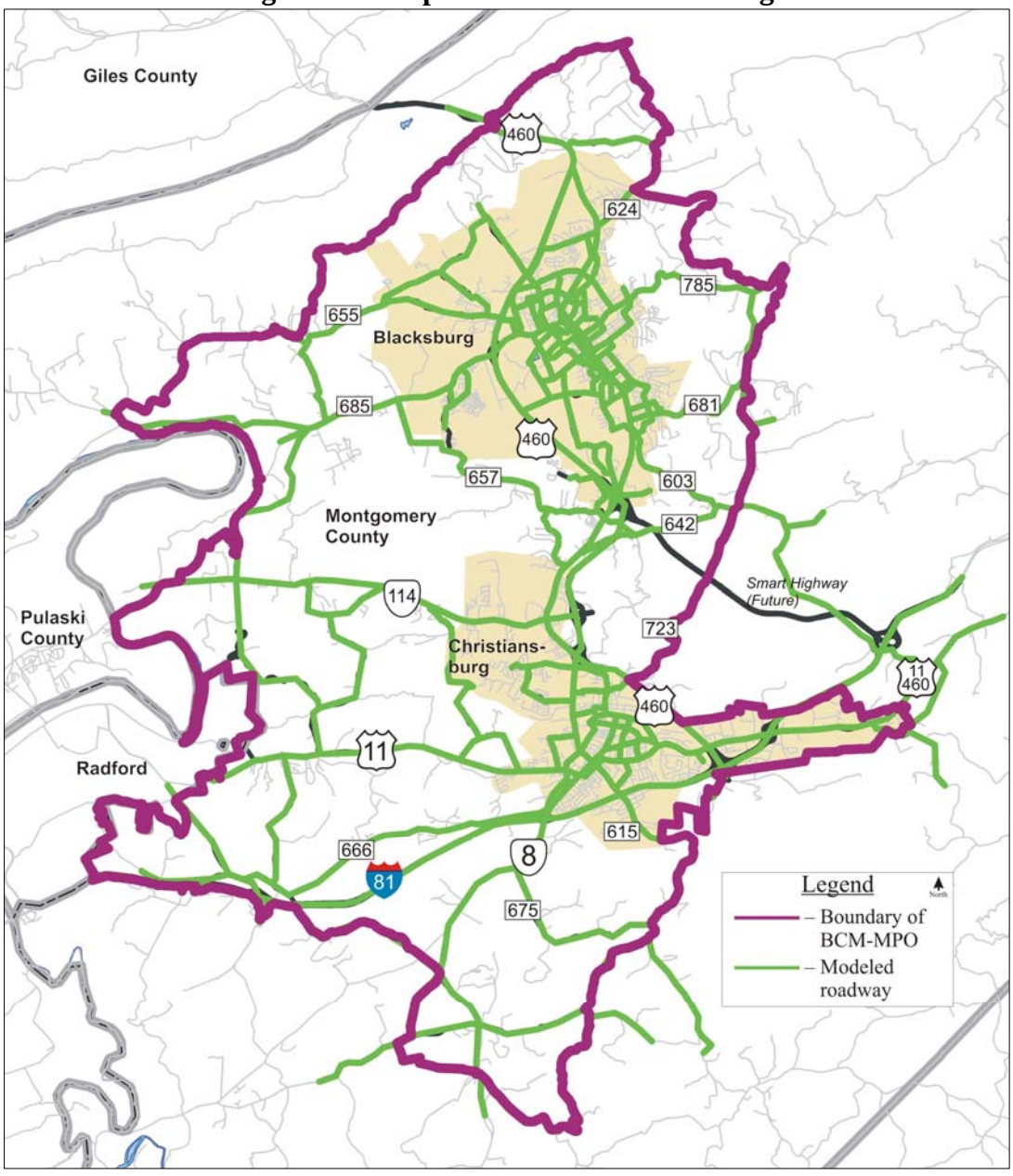
- The widening of Harding Avenue (Route 785), North Main Street (Route 460 Business) and Peppers Ferry Road (Route 114) should include paved shoulders or bicycle lanes;
- Ensure that the interchange of Route 460 at Toms Creek Road safely accommodates bicycles;
- Allow bicycles on the Route 460 Bypass;
- Continue the SmartWay bus service, add a stop on Route 460 in eastern Montgomery County, and consider feeder bus service to tie into the proposed TransDominion Express intercity passenger rail service;
- Overall, develop a wider range of transportation options, particularly on I-81;
- Seek to expand funding for bicycle improvements;
- Reduce the extent of work proposed on Marlington Street;
- Develop disaster preparedness plan.

3.2 Travel Demand Forecasting

Through the use of a computerized regional transportation model, travel demand forecasts for the year 2030 were developed. The transportation model, developed using industry-standard TP+ modeling software, includes all of the roadways in the region's

thoroughfare system as well as some limited amount of coverage outside of the BCM-MPO area (shown in Exhibit 7).

Exhibit 7
Regional Transportation Network Coverage



Traffic forecasts are primarily a function of expected increases in population and employment, and the particular areas where traffic grows at the highest levels is based on where this anticipated growth is expected to occur. Base year population and employment data was determined for geographic areas in the region called transportation

analysis zones (TAZs). In consultation with local planners, future growth in population and employment for each TAZ was also determined, with overall growth estimates guided by regional control totals. Exhibits 8 and 9 show the expected growth in population and employment by TAZ between 2003 and 2030. Note that both the computer network and TAZ boundaries extend beyond the BCM-MPO boundary.

Exhibit 8

Anticipated Growth in Population (2003 to 2030)

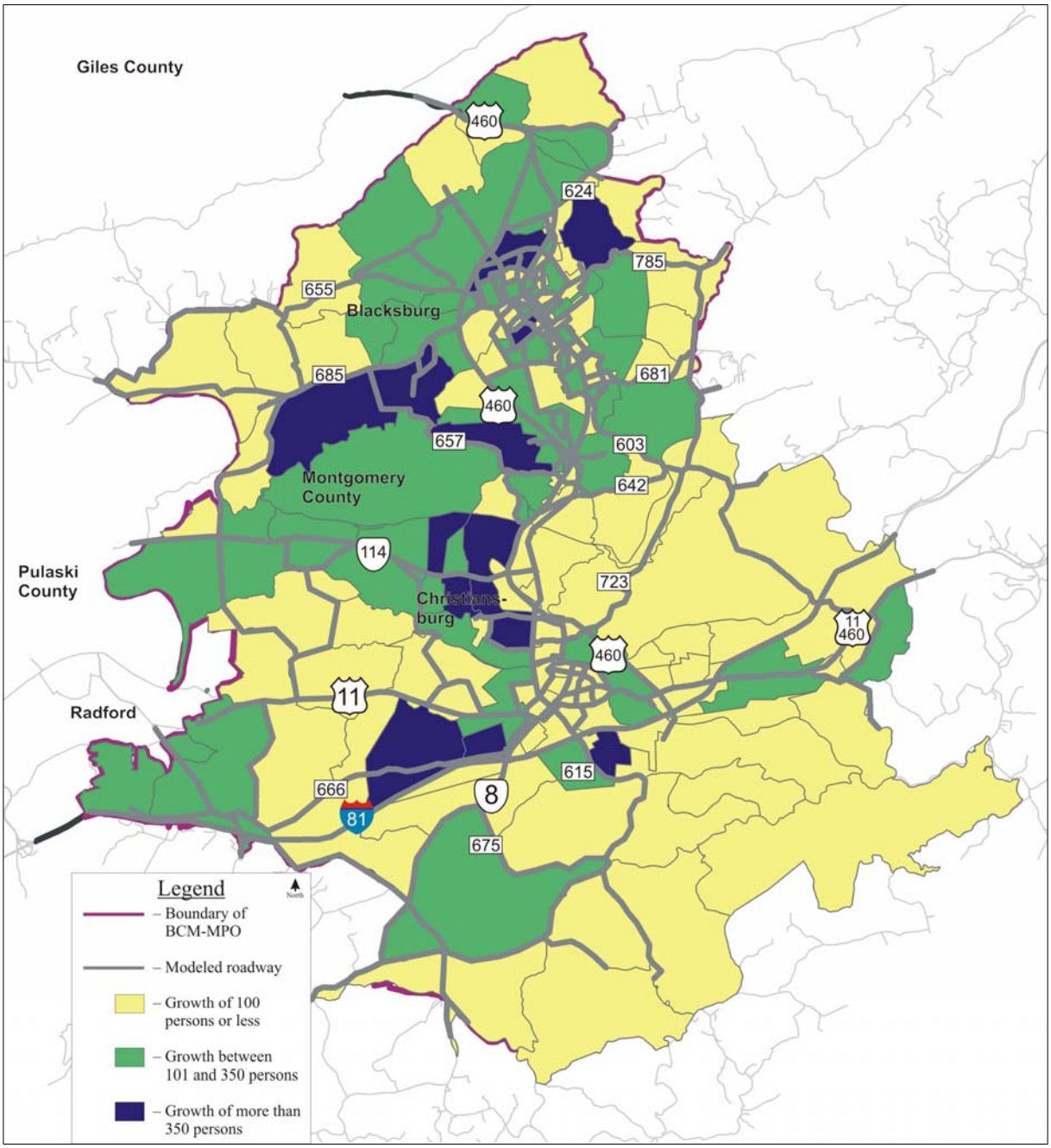
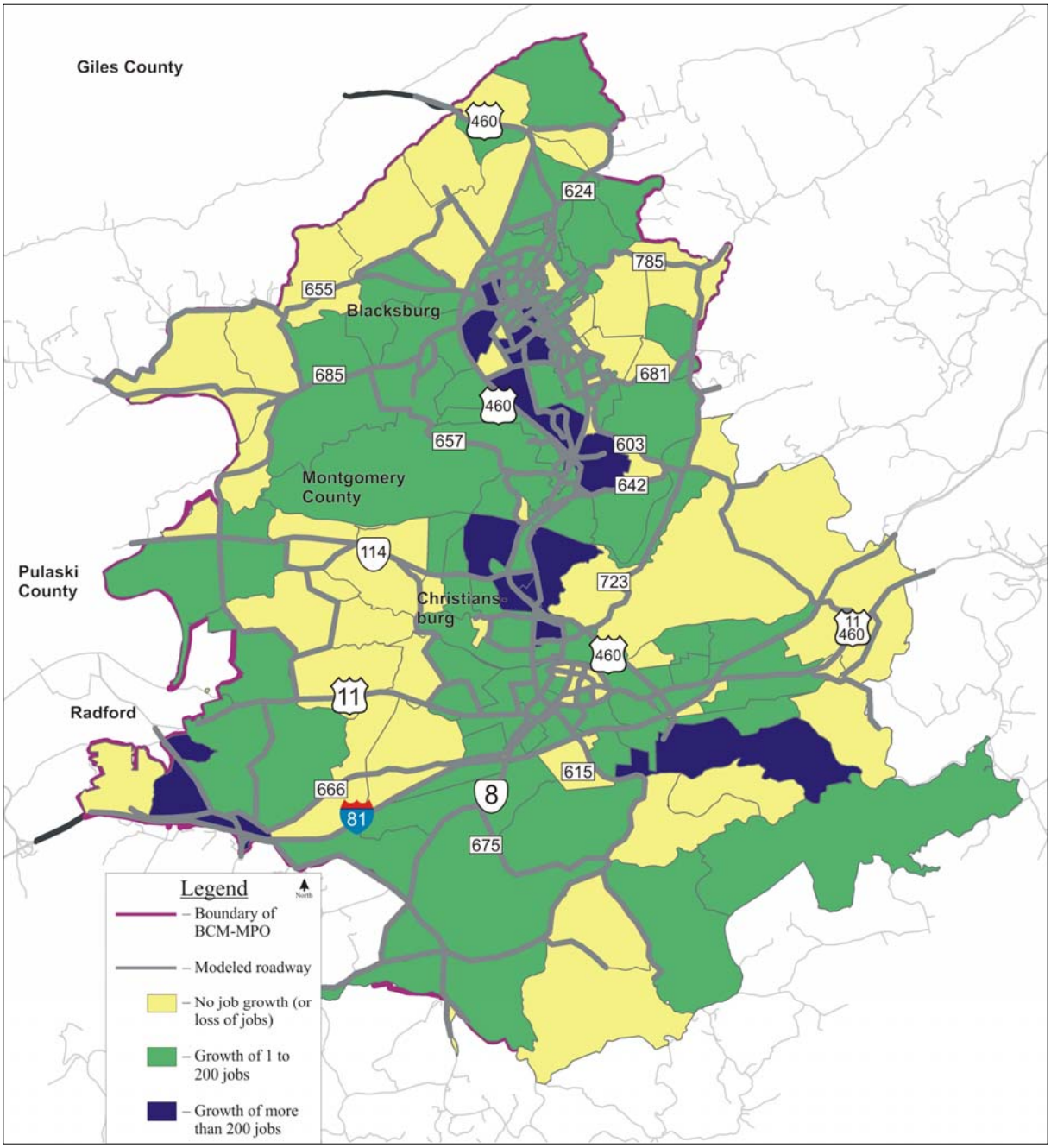


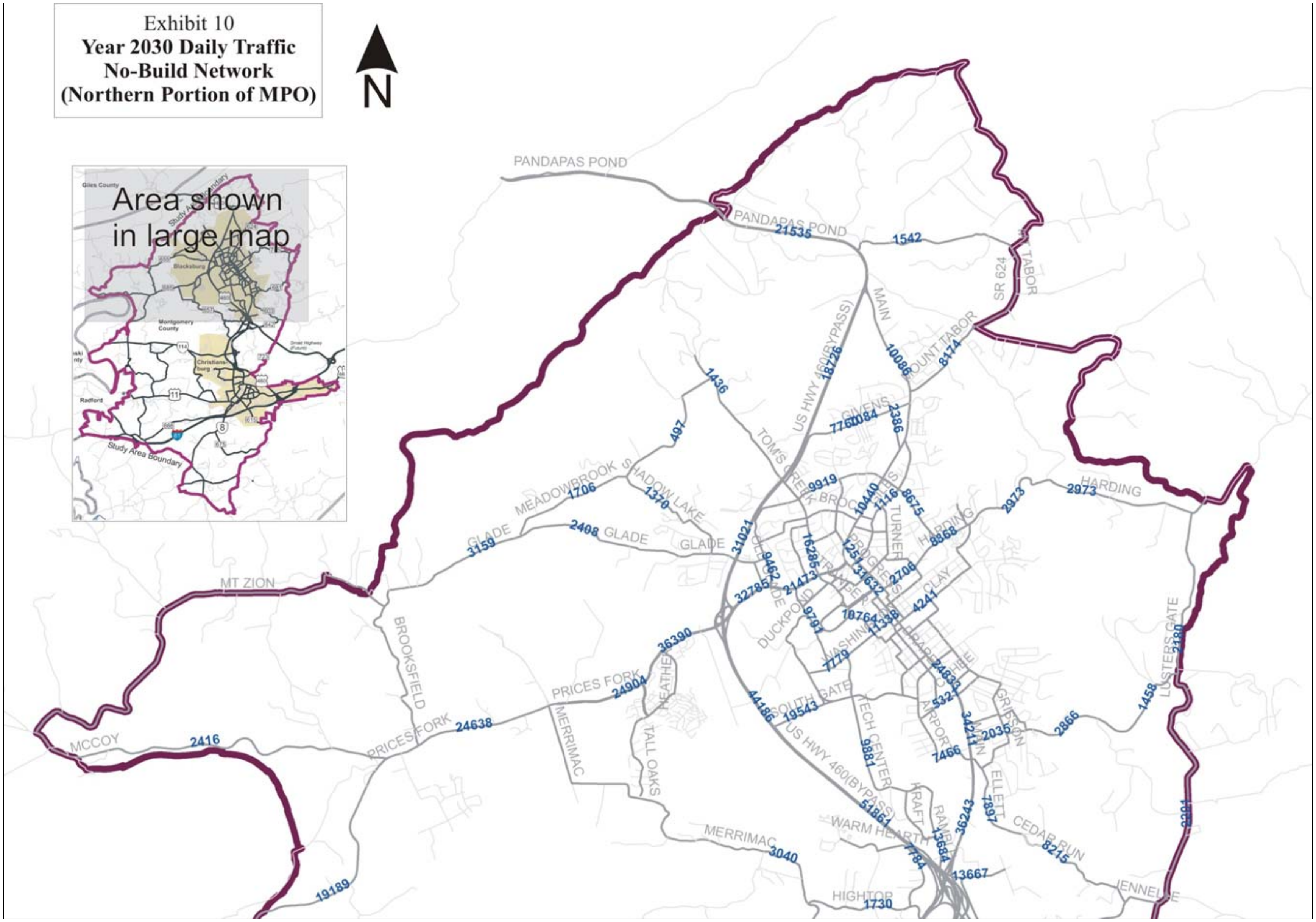
Exhibit 9

Anticipated Growth in Employment (2003 to 2030)



Forecast traffic volumes in 2030 that are anticipated based on the expected growth in population and employment are shown in Exhibit 10 and 11. These are the year 2030 volumes on BCM-MPO "No-Build" network. The "No-Build" network assumes that only those roadway projects that currently have funding allocated for construction would be built. Generally, these are projects that have construction funding in the current

Exhibit 10
Year 2030 Daily Traffic
No-Build Network
(Northern Portion of MPO)



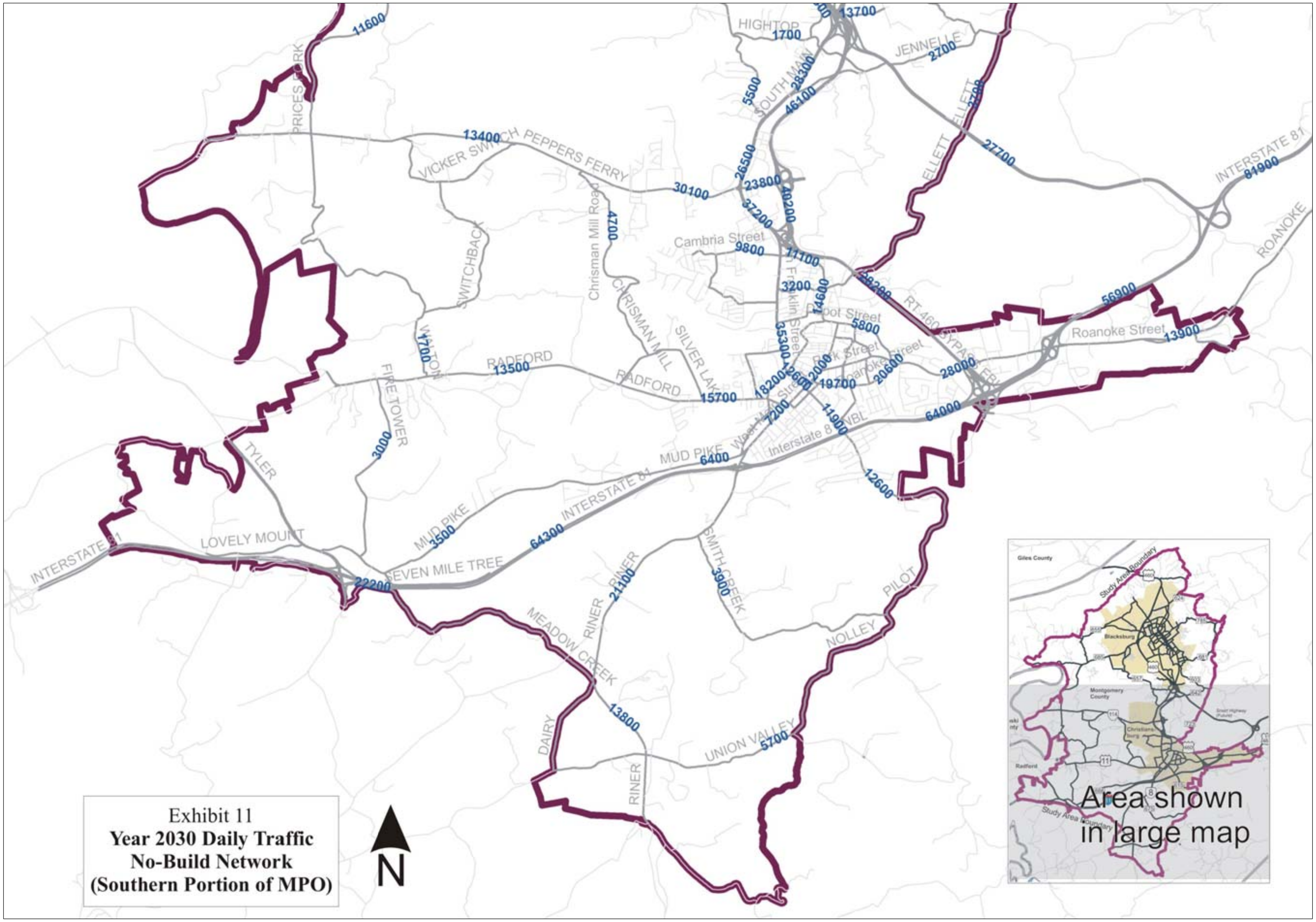


Exhibit 11
Year 2030 Daily Traffic
No-Build Network
(Southern Portion of MPO)

Virginia Department of Transportation Six-Year Improvement Program (Fiscal Years 2006 through 2011). Projects in the No-Build network include:

- Construct, as a four-lane facility, the Peppers Ferry Connector from Peppers Ferry west of New River Mall to North Franklin Street north of Ellett Road
- Construct the interchange at Route 460 Bypass and Toms Creek Road.
- Reconstruct North Main Street from College Drive to Prices Fork Road
- Widen North Main Street to four lanes from Giles Road to Mount Tabor Road
- Construct the Progress Street Extension from north of Cherokee Drive to Givens Lane, and improve Givens Lane from Ashford Court to North Main Street
- Improve intersections along Prices Fork Road (at Toms Creek/Stanger Road, University City Boulevard, and West Campus Drive), and at South Main Street at Ellett Road

The No-Build also includes the construction of the Smart Road between I-81 and Route 460 on the south side of the Town of Blacksburg. This improvement is expected to provide substantial diversion of traffic from Route 460 and Route 460 Business between I-81 and the Town of Blacksburg.

Complete information on the model development process and demographic estimates is included in Appendix C.

3.3 Traffic Operations Analysis and Capacity Needs

Traffic operations analysis provides a primary method for identifying transportation needs. Traffic engineers quantify the operations of a roadway using a measure called Level of Service. Level of Service provides a comparative measure of the traffic performance of roads and intersections through a grading system of A to F. Level of Service A represents excellent traffic operations with minimal delays, while Level of Service F represents breakdown conditions and substantial delays. Roadways and intersections in the region were analyzed using planning-level methodologies based on estimating the ratio of traffic volume to overall capacity (volume to capacity, or v/c ratios). These techniques are described more fully in Appendix D.

The traffic operations analysis was used in the development of the 2030 Transportation Plan to identify existing and future capacity deficiencies on the roadway system. VDOT has developed Level of Service criteria to be used in the analysis of roadway and intersection operations for areas such as the Blacksburg-Christiansburg-Montgomery region. Intersections or roadway segments operating at Level of Service C or better as determined by the planning methodology are defined as operating at under-capacity, or acceptable operations. Intersections or roadway segments operating at Levels of Service D, E, or F are defined as operating at over-capacity, or unacceptable operations.

Exhibit 12 summarizes the operations at major intersections within the MPO region based on the methodologies described in Appendix D. Operations are indicated as either under

capacity or over capacity. For unsignalized intersections, Exhibit 12 also shows the Level of Service that could be expected if the intersection were to be signalized. It is important to note that deficient Level of Service does not provide sufficient warrants to install a traffic signal; this information is provided to assess the potential benefits of installing a traffic signal should such an installation be supported based on an in-depth warrant study.

As Exhibit 12 indicates, all but 6 of the 30 intersections analyzed are expected to operate at over-capacity conditions by the year 2030. This finding is typical when assessing intersection operations 20 or more years in the future when traffic volumes on the overall network are generally expected to increase by 40 to 60 percent. Most of these intersection deficiencies can be corrected by providing additional turn lanes at the intersection itself without the need for major roadway widening to increase capacity. Broader, long-term corridor-level needs that can pinpoint the need for additional capacity and/or travel demand management were identified through the use of the regional model. Exhibit 13 depicts the corridors within the region that could be operating at either near- or over-capacity conditions by the year 2030. The near-capacity roadways include portions of the following roads:

- Depot Street (Christiansburg)
- Duck Pond Drive (Virginia Tech)
- Franklin Street (Christiansburg)
- Interstate 81 (Christiansburg and Montgomery County)
- Kent Street (Blacksburg)
- Main Street (Blacksburg and Christiansburg)
- Meadow Creek Road (Route 658, Montgomery County)
- Nolley Road (Route 679, Montgomery County)
- Roanoke Street (Blacksburg and Christiansburg)
- Peppers Ferry Road (Route 114, Montgomery County)
- Mud Pike (Route 666, Montgomery County)
- Riner Road (Route 8, Montgomery County)
- Tech Center Drive (Virginia Tech, Blacksburg)
- Tyler Road (Route 177, Montgomery County)
- Radford Road (Route 11, Montgomery County)
- Roanoke Road (Route 11/460, Montgomery County)
- Washington Street (Blacksburg)
- West Campus Drive (Blacksburg)

Roadways that are anticipated to be operating at over-capacity conditions by the year 2030 include:

- Cambria Street (Christiansburg)
- Depot Street (Christiansburg)
- Duck Pond Drive (Virginia Tech)
- Franklin Street (Christiansburg)
- Glade Road (Blacksburg)

Exhibit 12

Summary of Base Year and Year 2030 No-Build Intersection Operations

Location	Control[1]	Base Year (2004)						Year 2030 No-Build					
		AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak	
		Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]
Blacksburg													
North Main Street at Prices Fork Road	Sig	54%	U	60%	U	87%	O	123%	O	120%	O	124%	O
Toms Creek Road at Prices Fork Road	Sig	39%	U	76%	O	88%	O	103%	O	93%	O	97%	O
West Campus Drive at Prices Fork Road	Sig	73%	O	83%	O	103%	O	118%	O	89%	O	99%	O
University City Boulevard at Prices Fork Road	Sig	54%	U	74%	O	97%	O	79%	O	79%	O	90%	O
Heather Drive at Prices Fork Road	Sig	40%	U	43%	U	55%	U	83%	O	67%	U	69%	U
Route 460 Bypass at Southgate Drive	Sig	63%	U	47%	U	61%	U	95%	O	91%	O	98%	O
Toms Creek Road at Patrick Henry Drive	Sig	41%	U	78%	O	68%	U	98%	O	88%	O	89%	O
South Main Street at Airport Road/Graves Street	Sig	44%	U	41%	U	63%	U	71%	U	67%	U	70%	U
South Main Street at Country Club Road	Sig	44%	U	50%	U	51%	U	106%	O	112%	O	113%	O
South Main Street at Ellett Street/Hubbard Road	Sig	48%	U	60%	U	75%	O	82%	O	90%	O	91%	O
South Main Street at Industrial Park Road	Sig	34%	U	56%	U	64%	U	121%	O	127%	O	155%	O
North Main Street at Patrick Henry Drive	Sig	48%	U	46%	U	61%	U	94%	O	80%	O	78%	O
Route 460 Bypass at North Main Street (460 Bus)	Uns	37%	U/U	31%	U/U	50%	U/U	57%	O/U	70%	O/U	74%	O/O
Turner Street at Lucas Drive	Uns	13%	U/U	13%	U/U	13%	U/U	13%	U/U	15%	U/U	14%	U/U
Tech Center Drive at Southgate Drive	Uns	45%	O/U	53%	O/U	52%	O/U	86%	O/O	96%	O/O	101%	O/O
Christiansburg													
Depot Street at Roanoke Street	Sig	34%	U	39%	U	62%	U	52%	U	55%	U	51%	U
Route 8 at Mud Pike/Moose Drive	Sig	58%	U	32%	U	54%	U	105%	O	104%	O	119%	O

Exhibit 12

Summary of Base Year and Year 2030 No-Build Intersection Operations

Location	Control[1]	Base Year (2004)						Year 2030 No-Build					
		AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak	
		Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]	Util[2]	Op[3]
North Franklin Street at Depot Street	Sig	77%	O	47%	U	74%	O	119%	O	119%	O	119%	O
East Main Street at Roanoke Street	Sig	34%	U	37%	U	42%	U	66%	U	61%	U	67%	U
Franklin Street at Main Street	Sig	57%	U	61%	U	70%	U	116%	O	110%	O	107%	O
North Franklin Street at Peppers Ferry Road	Sig	101%	O	78%	O	99%	O	89%	O	98%	O	88%	O
West Main Street at Depot Street	Sig	59%	U	49%	U	62%	U	97%	O	81%	O	79%	O
East Main Street at Depot Street	Uns	23%	U/U	26%	U/U	33%	O/U	79%	O/O	83%	O/O	82%	O/O
Cambria Street at Ellett Road	Uns	41%	U/U	30%	U/U	62%	O/U	91%	O/O	92%	O/O	92%	O/O
Depot Street at North Franklin Street	Sig	56%	U	44%	U	62%	U	67%	U	61%	U	61%	U
Depot Street at Radford Street	Sig	58%	U	59%	U	79%	O	84%	O	87%	O	89%	O
Route 8 at I-81 Eastbound Ramp	Uns	58%	O/U	41%	O/U	61%	O/U	164%	O/O	160%	O/O	153%	O/O
Route 8 at I-81 Westbound Ramp	Uns	44%	O/U	36%	O/U	51%	O/U	149%	O/O	144%	O/O	154%	O/O
Montgomery County													
Route 600/177 at Route 658	Uns	52%	U/U	40%	U/U	54%	U/U	162%	O/O	162%	O/O	162%	O/O
Route 600 at Route 627	Uns	41%	U/U	28%	U/U	32%	U/U	64%	U/U	64%	U/U	60%	U/U

Notes:

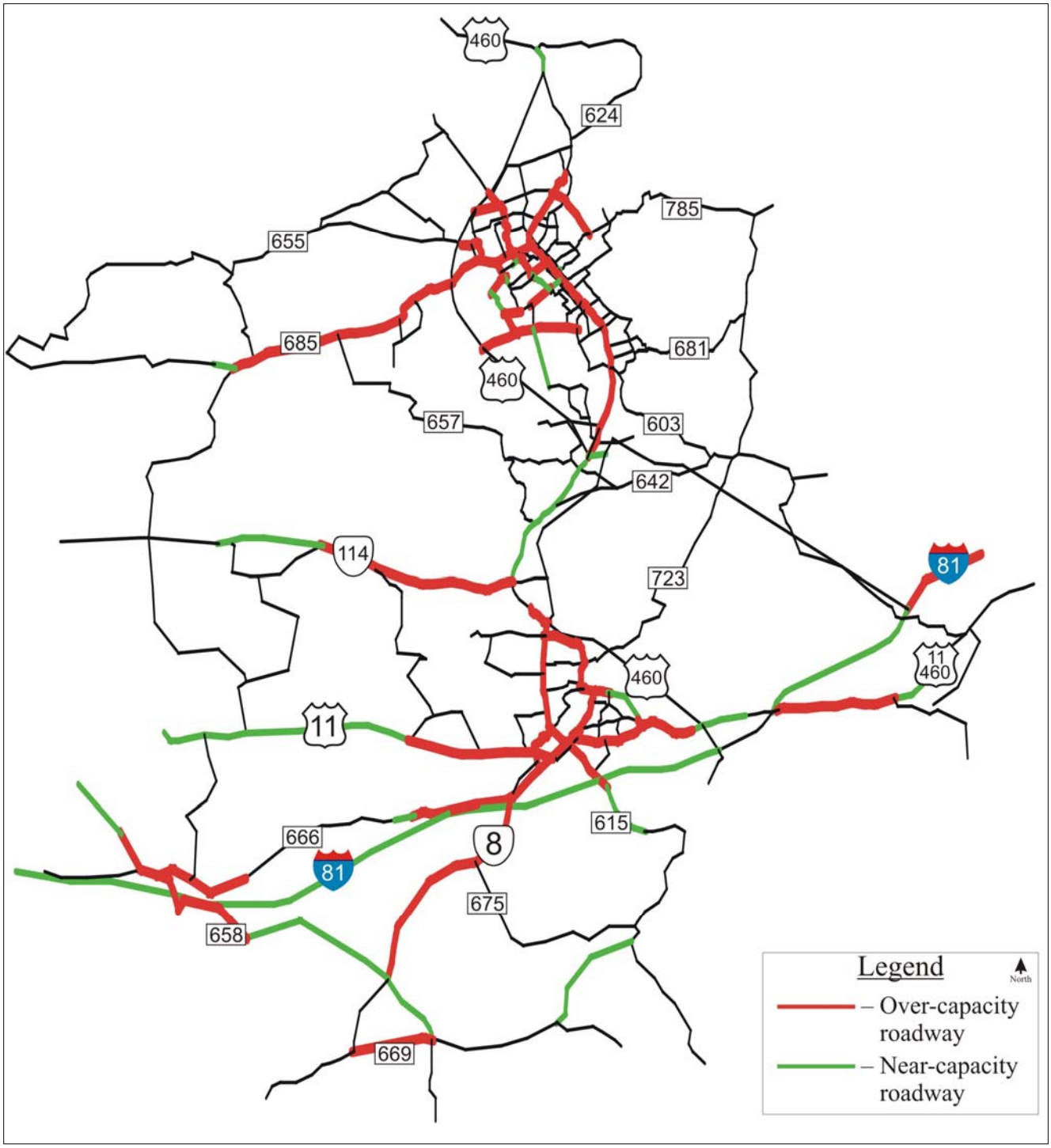
1 – Indicates traffic control at intersection: Sig=signalized intersection, UNS=unsignalized intersection.

2 – Intersection capacity utilization, indicates the percent of the intersection capacity being utilized by the traffic load.

3 – Traffic operations at intersection: U=under capacity, O=over capacity. For unsignalized intersections, the first value shown indicates the operations as an unsignalized intersection; the second value shown indicates operations if a traffic signal is installed. Note that the determination with respect to installation of a traffic signal is based on detailed studies to determine if a signal is warranted; traffic operations are only one of many factors involved in such determinations.

Exhibit 13

Potential Year 2030 Roadway Corridor Deficiencies



- Main Street (Blacksburg and Christiansburg)
- Meadow Creek Road (Route 658, Montgomery County)
- Mud Pike (Route 666, Montgomery County)
- Patrick Henry Drive (Blacksburg)
- Peppers Ferry Road (Christiansburg) – this roadway is planned to be widened, but is currently only programmed for preliminary engineering and right-of-way acquisition
- Prices Fork Road (Blacksburg and Montgomery County)
- Radford Road (Route 11, Montgomery County)
- Roanoke Street (Christiansburg)
- Fairview Church Road (Route 669, Montgomery County)
- Southgate Drive (Virginia Tech, Blacksburg)
- Stanger Street (Virginia Tech, Blacksburg)
- Riner Road (Route 8, Montgomery County)
- Toms Creek Road (Blacksburg)
- Tyler Road (Route 177, Montgomery County)
- University City Boulevard (Blacksburg)
- Washington Street (Blacksburg)
- West Campus Drive (Virginia Tech, Blacksburg)

Chapter 4 – Financially Constrained Transportation Plan Improvements

Federal regulations that guide the development of transportation plans for metropolitan planning areas require that the projects included in the plans allow for implementation based on reasonably expected public and private funding sources. For metropolitan areas in Virginia, the Virginia Department of Transportation (VDOT) has provided estimates of transportation funding levels to the year 2030. Those projects that can be funded based on these estimates comprise the Financially Constrained Long-Range Transportation Plan which is described in this chapter. Regulations also allow Transportation Plans to include additional projects that would be included in the long-range plan if additional resources were to become available. These projects comprise the Vision Plan, which is described in the next chapter.

4.1 Funding Constraints

The complete set of transportation projects that was developed as part of the transportation planning process exceeded the estimates of available transportation funding to the year 2030. The bulk of the projects are roadway or roadway-related, therefore, the focus of the financial constraint process is on the roadway system. VDOT estimates that are used to financially constrain the Plan are provided by roadway program: National Highway System (NHS) interstate highways, non-interstate NHS roads, other primary roads, urban roads in each of the two towns, and secondary roads in Montgomery County. The current VDOT Six-Year Improvement Program covers the years 2006 through 2011, and the Plan assumes that these projects and associated funding will remain as they currently stand. Estimated funding for projects beyond the timeframe of the current Six-Year Program are for 2012 through 2030, and are as follows:

- NHS interstate highways: $8.1 million
- Non-interstate NHS roadways: $1.6 million
- Other primary roads: $3.8 million
- Urban roads in the Town of Blacksburg: $16.49 million
- Urban roads in the Town of Christiansburg: $3.9 million
- Secondary roads in Montgomery County: $2.2 million

Transit system funding comes from a variety of federal, state, and local sources. Blacksburg Transit is in the process of developing a detailed Transit Development Plan (TDP), which will be adopted as an amendment into this 2030 Transportation Plan once complete. The TDP will include a detailed funding program based on realistic estimates of public transit funds, including contributions from the Towns of Blacksburg and Christiansburg, and Virginia Tech. For the 2030 Transportation Plan, funding projections have been developed by Blacksburg Transit and the Town of Blacksburg Finance Department, with assistance from the Virginia Department of Rail and Public Transportation. The projections are based on historical funding levels and future inflation predictions, and include both operating and capital costs. The projections are shown in Exhibit 14. Note that Exhibit 14 combines

information from both the Six-Year Capital Improvement Program and estimates for the years between 2012 and 2030.

Exhibit 14
Projected Transit Operating and Capital Funding
(Fiscal Years 2007 through 2030)

Year	Operating Funding	Purchase Replacement Rolling Stock	Purchase Expansion Rolling Stock	All Other Capital Projects	Construction of Facilities	Total Capital Expenditures [1]
2007	$4.68	$0.18	$1.30	$0.47	$0.30	$2.26
2008	$5.15	$1.94	$1.01	$0.25	$0.00	$3.21
2009	$5.66	$2.06	$1.06	$0.21	$0.00	$3.33
2010	$6.23	$1.99	$1.16	$0.18	$0.00	$3.32
2011	$6.85	$1.00	$1.11	$0.26	$0.00	$2.37
2012	$7.53	$2.72	$0.82	$0.30	$10.00	$13.83
Subtotals - Six Year Capital Program (FY'07-FY'12) [2]		$9.88	$6.46	$1.68	$10.30	$28.32
2013	$7.84	$2.68	$0.79	$0.31	$0.00	$3.78
2014	$8.15	$1.86	$0.78	$0.32	$0.00	$2.96
2015	$8.48	$0.14	$0.83	$0.33	$0.00	$1.30
2016	$8.81	$0.28	$0.90	$0.34	$0.00	$1.52
2017	$9.17	$0.44	$0.87	$0.35	$0.00	$1.65
2018	$9.53	$0.30	$0.86	$0.36	$0.00	$1.52
2019	$9.92	$0.31	$1.00	$0.37	$0.00	$1.67
2020	$10.31	$2.54	$2.30	$0.38	$5.00	$10.22
2021	$10.72	$2.77	$2.48	$0.39	$0.00	$5.64
2022	$11.15	$2.94	$2.38	$0.40	$0.00	$5.73
2023	$11.60	$1.41	$2.60	$0.42	$0.00	$4.43
2024	$12.06	$3.51	$2.13	$0.43	$0.00	$6.08
2025	$12.55	$3.29	$2.09	$0.44	$0.00	$5.82
2026	$13.05	$2.60	$2.24	$0.45	$0.00	$5.30
2027	$13.57	$0.56	$2.30	$0.47	$0.00	$3.32
2028	$14.11	$0.38	$2.25	$0.48	$0.00	$3.11
2029	$14.68	$0.39	$2.31	$0.50	$0.00	$3.19
2030	$15.26	$0.20	$2.47	$0.51	$2.00	$5.19
TOTALS [3]	**$237.05**	**$36.49**	**$38.05**	**$8.91**	**$17.30**	**$100.75**

Notes:
[1] – Total of capital costs, including purchase of replacement rolling stock, purchase of expanded rolling stock, other capital projects, and construction of facilities. Operating costs are not included in these totals.
[2] – Six-year subtotals for capital cost categories only.
[3] – Sum of costs for 2007 to 2030.

The operating and capital funding levels shown in Exhibit 14 were estimated separately. In the first six years of projections for the operating costs (Fiscal Years 2007 to 2012), annual increases of 10 percent were assumed as part of an overall restructuring of the system. For the remaining 18 years covered by this Plan (Fiscal Years 2013 to 2030), annual increases in operating costs of 4 percent were assumed.

The capital projects cost projections are based on information from the Town of Blacksburg Capital Improvement Program administered by the Town of Blacksburg Finance Department

and both the Capital Improvement Program and the Program of Projects administered by the Virginia Department of Rail and Public Transportation. These include funds from a combination of federal formula, flexible and earmarked funds. As indicated previously, detailed funding streams are currently being estimated as part of the development of the TDP, and the 2030 Transportation Plan will be amended, as required, based on the results of the TDP.

With the TDP process still ongoing, the transit funding stream reflects only a modest increase in operations from year-to-year. These projections for future operating and capital funding for Blacksburg Transit have been made with the realization that public transit funds have traditionally only slightly increased from year to year, some years not even matching inflation. Blacksburg Transit has received local match funding, both operating and capital, from Town of Blacksburg, Town of Christiansburg, and Virginia Tech; the projections shown in Exhibit 14 are based on the continued support from these entities.

Additional anticipated funding for transportation projects in the region include funds for extending the runway at the Virginia Tech/Montgomery Executive Airport. These costs are being developed as part of the airport's Master Plan update; however, funding for both the runway extension, and the relocation of Tech Center Drive to support this extension, are anticipated to be provided by the Federal Aviation Administration. These projects are included in the 2030 Transportation Plan based on the expectation that such funding is forthcoming.

4.2 Financially Constrained Plan Projects

The Financially Constrained Plan includes two elements: (1) projects that are included in the Virginia Department of Transportation's Six-Year Improvement Program covering fiscal years 2006 through 2011, and (2) projects that can be funded with the estimated funds for the years 2012 through 2030. Projects in the current VDOT Six-Year Improvement Program are shown in Exhibits 15, 17A, and 17B. It is important to note that the Six-Year Improvement Program is a capital funding plan: it serves to allocate funds to projects on a year-by-year basis. Construction on some projects begins prior to allocation of full funding; in these instances, funding continues to be allocated to projects even if they have been completed. Exhibit 15 also includes line items for improvements that are not project-specific but will be allocated for rail safety, traffic operations and safety, transportation enhancements, and roadway maintenance.

Exhibit 15
Projects in the Current VDOT Six-Year Improvement Program (Fiscal Years 2006 through 2011)

Map ID [1]	VDOT ID	Route	Project Location	Description	Programmed Funds [2]	Funding Source
1	52453	81	I-81 at Route 11/460 interchange	Install lighting	$936,000	Interstate

Exhibit 15

Projects in the Current VDOT Six-Year Improvement Program (Fiscal Years 2006 through 2011)

Map ID [1]	VDOT ID	Route	Project Location	Description	Programmed Funds [2]	Funding Source
2	63705	81	I-81 at Route 177/600 interchange	Modify grade at interchange	$78,000	Interstate
--	67588	81	I-81 Improvements Environmental Document; statewide project that includes I-81 through the MPO area	Study to assess improvements, including consideration of rail improvements, highway widening, and other system improvements	$3,619,000	Interstate
3	14826, 16931, 17345		"Smart Highway"	Construct roadway	$24,653,000	Primary
4	18152, 18156	460	Route 460 Bypass from Route 460 Business in Christiansburg to Route 460 Business in Blacksburg	Construct 4-lane roadway; project complete, included in program for final financing	$10,290,000	Primary
5	8746, 71586	114	Peppers Ferry Road from Christiansburg corporate limits to Route 460	Widen to four lanes	$5,288,000	Christians-burg Urban
6	70594		Peppers Ferry Connector from Peppers Ferry west of New River Mall to North Franklin Street north of Ellett Road	Construct 4-lane connecter with median, bicycle lanes, and sidewalks	$283,000	Christians-burg Urban
7	17682	460	Route 460 at Toms Creek Road	Construct interchange; project is previously funded, construction to begin in fiscal year 2006	--	Blacksburg Urban
8	67974	460 Bus	North Main Street from College Drive to Prices Fork Road	Reconstruct, includes improvements to Prices Ford Road Intersection	$5,992,000	Blacksburg Urban
9	67976	460 Bus	North Main Street from Giles Road to Mount Tabor Road	Widen to four lanes with landscaped median, bicycle lanes, and sidewalks	$3,067,000	Blacksburg Urban
10	67745	412	Prices Fork Road at Toms Creek/Stanger Road	Improve intersection to improve traffic safety and pedestrian flow	$7,000	Blacksburg Urban

Exhibit 15

Projects in the Current VDOT Six-Year Improvement Program (Fiscal Years 2006 through 2011)

Map ID [1]	VDOT ID	Route	Project Location	Description	Programmed Funds [2]	Funding Source
11	72525	412	Prices Fork Road at University City Boulevard	Traffic signal modification to improve traffic flow and pedestrian safety	$305,000	Blacksburg Urban
12,13, 10	67975		South Main Street at Ellett Road; and Prices Fork Road at West Campus Drive and at TomsCreek/Stanger Road	Add turn lanes	$1,651,000	Blacksburg Urban
14	72527		Progress Street Extension from north of Cherokee Drive to Givens Lane; Givens Lane from Ashford Court to North Main Street	Construct Progress Street Extension, improve Givens Lane; in Six-Year Program for preliminary engineering only	$616,000	Blacksburg Urban
15	72526		Huckleberry Trail from Prices Fork Road to Glade Road	Construct bicycle trail	$1,005,000	Blacksburg Urban
16	50030, 50561, 18856	114	Peppers Ferry Road at New River and Norfolk Southern railroad tracks	Replace bridges	$8,024,000	Primary
--			MPO-Wide	Improvements for safety, traffic operations, TSM	Determined on an annual basis [3]	--
--			MPO-Wide	Transportation enhancements	Determined on an annual basis [3]	--
--			MPO-Wide	Rail crossing safety improvements	Determined on an annual basis [3]	--
--			MPO-Wide	Maintenance	Determined on an annual basis [4]	--

Notes:

[1] Corresponds to the key numbers on map in Exhibit 16.

[2] Amount included in for fiscal years 2006 through 2011; many projects have funds accrued in years prior to 2006.

[3] Funding for these categories are allocated statewide and awarded to individual projects on a competitive basis.

[4] Funding for these categories is allocated to each of the VDOT Construction Districts. Further allocations to the MPO area (which is part of the VDOT Salem Construction District) are determined annually, based on need.

Recommendations included in the Financially Constrained Plan that are not in the VDOT Six-Year Improvement Program are those that were judged by the study team and local government officials, with public input considered, to be a relatively high priority. These

recommendations are shown in Exhibits 16, 17A, and 17B. As described previously, projects that were judged to be of a lesser priority, as well as those that may have an implementation timetable beyond the 2030 horizon, are included in the region's "Transportation Vision Plan". Vision Plan projects are those that could be constructed should additional funding become available. Vision Plan projects are described in Chapter 5 of this document.

Exhibit 16

Financially Constrained Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Funded Amount in Constrained Plan [3]	Locality/Funding Source
17	81	West Main Street at I-81	Improve interchange for operations	$3,000,000	$3,000,000	Montgomery-Christiansburg/ Interstate
NA	81	MPO Wide	Safety/operations/ widening improvements to be identified	To Be Determined	$5,100,000	Montgomery-Christiansburg/ Interstate
18	460	Route 460 Bypass at Route 460 Business	Add ramp for southbound Route 460 to westbound Route 460 Business	$340,000	$340,000	Montgomery/NHS
3		Smart Road from I-81 to Route 460 Bypass	Connection to Route 460 Bypass; includes paving 2-lane roadway	$7,400,000	$1,300,000	Montgomery/NHS
19	8	Intersection of Riner (Rt 8) and Smith Creek Rd (Rt 675)	Add turn lanes	$250,000	$250,000	Montgomery/ Primary
20	114	Intersection of Peppers Ferry (Rt 114) and Rolling Hills (Rt 1286)	Add turn lanes	$250,000	$250,000	Montgomery/ Primary
21	8	Intersection of Riner (Rt 8) and Fairview Church (Rt 669)	Add turn lanes	$250,000	$250,000	Montgomery/ Primary
22	8	Riner Road (Rt 8) from South Study Area Boundary to Route 669 (Community of Riner)	Reconstruct to current 2-lane standards	$1,909,000	$1,909,000	Montgomery/ Primary
23	114	Peppers Ferry Road from Radford Arsenal main entrance to the Christiansbug West Corporate Limits	Widen road to 4-lanes divided with bicycle lanes	$33,299,000	$1,100,000	Montgomery/ Primary
24	642	Jenelle Road from Route 460 Business to Route 603	Reconstruct road to current 2-lane standards	$4,154,000	$2,200,000	Montgomery/ Secondary

Exhibit 16

Financially Constrained Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Funded Amount in Constrained Plan [3]	Locality/Funding Source
25	460 Bus	South Main Street at Country Club Road	Improve intersection for operations and safety	$500,000	$500,000	Blacksburg/ Urban
26	460 Bus	North Main Street at Turner Street	Traffic signal upgrade to current equipment and standards	$104,000	$104,000	Blacksburg/ Urban
27	460 Bus	North Main Street at Progress Street	Traffic signal upgrade to current equipment and standards	$104,000	$104,000	Blacksburg/ Urban
28		Heather Drive at Prices Fork Road	Traffic signal upgrade to current equipment and standards	$104,000	$104,000	Blacksburg/ Urban
29		Toms Creek Road at Patrick Henry Drive	Upgrade intersection (this project would tie into the project to construct an interchange at Toms Creek Road and Route 460)	$1,332,000	$1,332,000	Blacksburg/ Urban
30		Marlington Street at South Main Street	Intersection improvements at the intersection of Marlington Street and South Main Street	$250,000	$250,000	Blacksburg/ Urban
31		Commerce Street from Trade Street to Jennelle Road	Construct extension of Commerce Street as two-lane roadway	$1,630,000	$1,630,000	Blacksburg/ Urban
32		Glade Road from Boxwood Drive to Linwood Lane	Reconstruct as 2-lane roadway with bicycle lanes, trail, and sidewalks	$1,720,000	$1,720,000	Blacksburg/ Urban
33		Shadow Lake Road from Basil Street to Lakewood Drive	Straighten and realign curves	$1,500,000	$1,500,000	Blacksburg/ Urban
34		Progress Street at Giles Road	Traffic signal upgrade to current equipment and standards	$104,000	$104,000	Blacksburg/ Urban
35		Washington Street at Draper Road	Traffic signal upgrade to current equipment and standards	$104,000	$104,000	Blacksburg/ Urban

Exhibit 16

Financially Constrained Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Funded Amount in Constrained Plan [3]	Locality/Funding Source
36		Progress Street at Turner Street	Traffic signal upgrade to current equipment and standards	$104,000	$104,000	Blacksburg/ Urban
37	460	460 Bypass at Southgate Drive	Construct interchange	$16,000,000	$8,956,000	Montgomery/NHS, Primary Blacksburg/Urban
5	114	Peppers Ferry Road from west corporate limits to Route 460	Widen to four lanes, PE and ROW included in Six-Year Program	$12,301,000	$3,900,000	Christiansburg/ Urban
38		Tech Center Drive south of Duck Pond Drive	Relocate to align with Duck Pond Drive; shift allows for airport runway extension	$1,962,000	$1,962,000	Blacksburg/ Urban (project to be funded by FAA)
--		MPO-Wide	Improvements for safety, traffic operations, TSM	--	Determined on an annual basis [4]	--
--		MPO-Wide	Transportation enhancements	--	Determined on an annual basis [4]	--
--		MPO-Wide	Rail crossing safety improvements	--	Determined on an annual basis [4]	--
--		MPO-Wide	Maintenance	--	Determined on an annual basis [5]	--

Notes:

[1] Corresponds to the key numbers on map in Exhibit 16.

[2] Estimated costs are planning-level estimates based on average or typical projects for each cross-section type. Costs are for year 2005 and include both construction and rights-of-way.

[3] Project costs that are not covered by the amounts shown in this column are anticipated to be covered by funding from 2030 and beyond. It is anticipated that these projects would be the first to be fully funded should additional transportation funds be identified in the next few years.

[4] Funding for these categories is allocated to each of the VDOT Construction Districts by roadway system. Further distribution within the MPO area (which is part of the VDOT Salem Construction District) is based on need, and determined on an annual basis.

[5] Funding for these categories is allocated to each of the VDOT Construction Districts. Further allocations to the MPO area (which is part of the VDOT Salem Construction District) are determined annually, based on need.

Exhibit 17A

Map of Financially Constrained Plan Transportation Recommendations

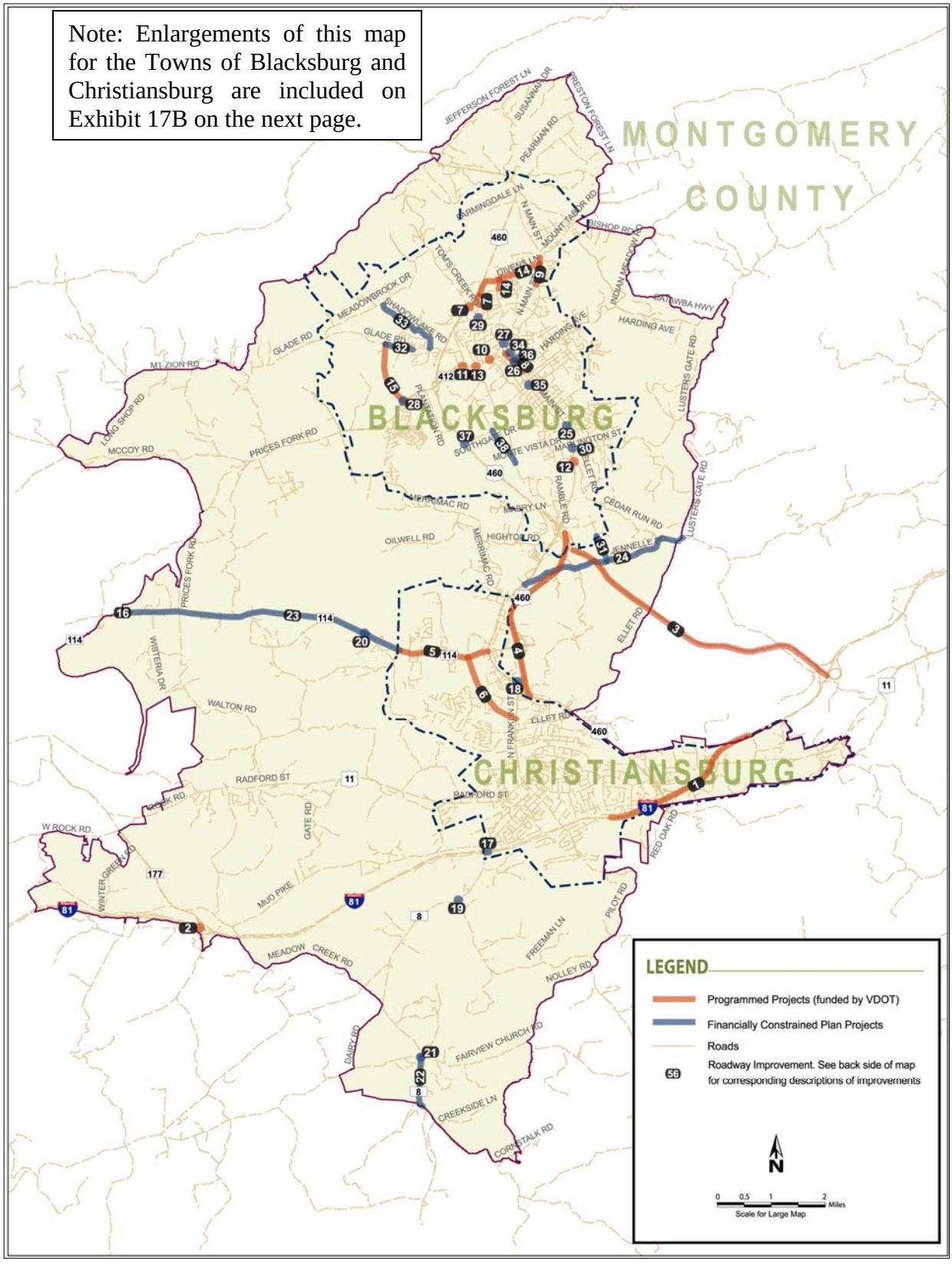
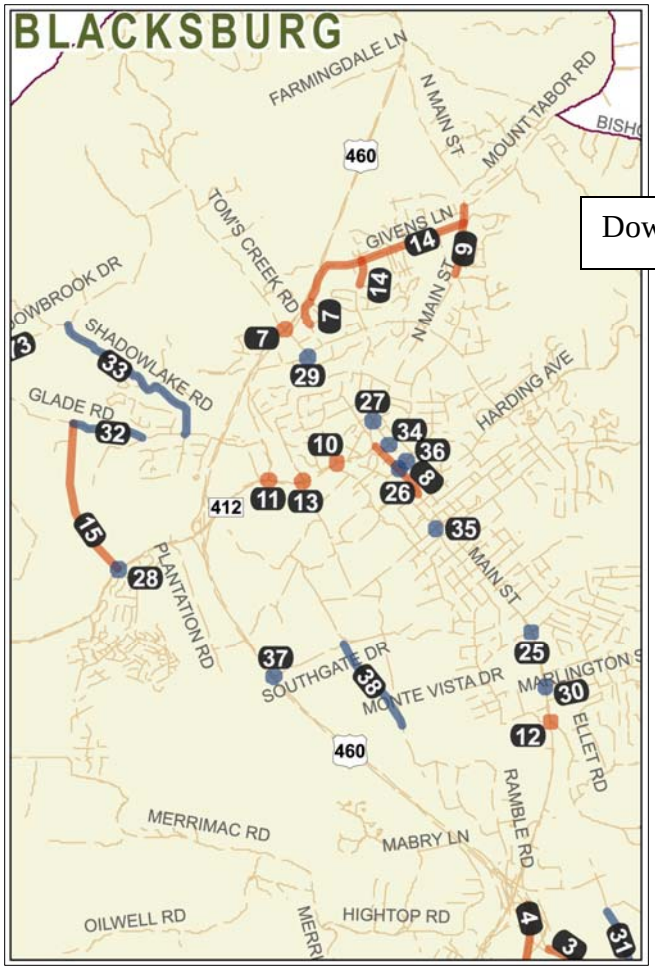


Exhibit 17B

Map of Financially Constrained Plan Transportation Recommendations (Town Insets)



Downtown Blacksburg Inset

Downtown Christiansburg Inset

4.3 Environmental Overview

An environmental overview was conducted for recommendations in the Financially Constrained Plan as well as the Tier 1 Vision Plan. This overview included the following:

- potential residential and business displacements;
- environmental justice group (low-income and minority) impacts;
- community disruptions;
- community service impacts;
- land use/zoning conflicts;
- hazardous materials sites;
- impacts on historic sites and districts;
- impacts to wildlife refuges, critical habitats, and known locations of threatened and endangered species;
- proximity to wild and scenic rivers;
- encroachment on critical soil types (prime farmlands, erosive soils);
- proximity to managed forest lands, scenic routes, and parks/recreation areas;
- air quality impacts; impacts to noise sensitive receptors; and
- impacts to water quality, floodplains, and wetlands.

Potential impacts were identified using aerial photography and other existing mapping and data sources. These various sources are identified in Appendix B.

Exhibit 18 summarizes the potential impacts of the recommendations in the Financially Constrained Plan (these are shown in Exhibit 16), as well as the Tier 1 Vision Plan recommendations (which are discussed in the next chapter and summarized in Exhibit 19). It is important to note that this analysis identified potential impacts for general planning purposes; determination of actual impacts would be based on follow-on, detailed environmental analyses. The reader should also be aware that, as projects were identified and considered for the 2030 Transportation Plan, environmental impacts were also considered. The final recommendations, shown in Exhibit 18, are expected to result in various levels of impact on the natural and man-made environment. As these projects proceed in the project development process, refinements in design will seek to minimize and/or mitigate these impacts. Overall, this environmental overview did not identify any impacts that would categorically preclude the implementation of any of the recommendations.

4.4 Other Considerations

Other considerations for the 2030 Transportation Plan, including specific considerations for environmental justice populations as well as policies implementing increased operations management, Intelligent Transportation Systems (ITS), and freight planning are described in Appendix A.

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
West Main Street at I-81	Improve interchange for operations				X		X											X					
Route 460 Bypass at Route 460 Business	Add ramp for southbound Route 460 to westbound Route 460 Business																					X	
Smart Road from I-81 to Route 460 Bypass	Connection to Route 460 Bypass; includes paving 2-lane roadway																					X	
Intersection of Riner (Rt 8) and Smith Creek Rd (Rt 675)	Add turn lanes																					X	
Intersection of Peppers Ferry (Rt 114) and Rolling Hills (Rt 1286)	Add turn lanes																					X	
Intersection of Riner (Rt 8) and Fairview Church (Rt 669)	Add turn lanes	1																					
Riner Road (Rt 8) from South Study Area Boundary to Route 669 (Community of Riner)	Reconstruct to current 2-lane standards				X		X											X					

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
Peppers Ferry Road from Radford Arsenal main entrance to the Christiansbug West Corporate Limits	Widen road to 4-lanes divided with bicycle lanes	15	X	X														X	X				
Jenelle Road from Route 460 Business to Route 603	Reconstruct road to current 2-lane standards	3																					
South Main Street at Country Club Road	Improve intersection for operations and safety																					X	
North Main Street at Turner Street	Traffic signal upgrade to current equipment and standards																					X	
North Main Street at Progress Street	Traffic signal upgrade to current equipment and standards																					X	
Heather Drive at Prices Fork Road	Traffic signal upgrade to current equipment and standards																					X	

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
Toms Creek Road at Patrick Henry Drive	Upgrade intersection (this project would tie into the project to construct an interchange at Toms Creek Road and Route 460)																					X	
Marlington Street at South Main Street	Intersection improvements at the intersection of Marlington Street and South Main Street	1																					
Commerce Street from Trade Street to Jennelle Road	Construct extension of Commerce Street as two-lane roadway					X													X	X	X		
Glade Road from Boxwood Drive to Linwood Lane	Reconstruct as 2-lane roadway with bicycle lanes, trail, and sidewalks	2																					
Shadow Lake Road from Basil Street to Lakewood Drive	Straighten and realign curves	3																					
Progress Street at Giles Road	Traffic signal upgrade to current equipment and standards																					X	

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
Washington Street at Draper Road	Traffic signal upgrade to current equipment and standards																					X	
Progress Street at Turner Street	Traffic signal upgrade to current equipment and standards																					X	
460 Bypass at Southgate Drive	Construct interchange			X	X													X					
Peppers Ferry Road from west corporate limits to Route 460	Widen to four lanes, PE and ROW included in Six-Year Program	5		X	X															X			
Tech Center Drive south of Duck Pond Drive	Relocate to align with Duck Pond Drive; shift allows for airport runway extension																					X	
Smart Road from I-81 to Route 460 Bypass	Connection to Route 460 Bypass; includes paving 2-lane roadway																					X	
Peppers Ferry Road from Radford Arsenal main entrance to the Christiansburg West Corporate Limits	Widen road to 4-lanes divided with bicycle lanes																						

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
Route 460 Bypass from South Main to Prices Fork Road	Widen to 6 lanes														X							X	
Southgate Drive Extension from Merrimac Road (Route 657) to Radford Arsenal	Construct as four-lane parkway	5	X				X																
Riner Road (Rt 8) from Route 669 to Christiansburg South Corporate limits	Widen road to current standards	18		X	X		X	X															
Peppers Ferry Road Extension from Route 460 Bypass to Ellett Roud (Route 723)	Construct 2-lane roadway																			X	X		
Merrimac Road from North Franklin Street (Route 460) to Prices Fork Road (Route 685)	Reconstruct road to current 2-lane standards	5			X										X								

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
High Top Road from Merrimac Road to South Main Street (Route 460)	Reconstruct road to current 2-lane standards																					X	
Ramble Road from Industrial Park Drive to the Corporate Research Center (north of Merrimac Road)	Reconstruct as 2-lane urban roadway plus transit pull-offs and bicycle lanes																					X	
Farmview Drive/Mabry Lane from Hightop Road to Huckleberry Lane	Reconstruct as 2-lane roadway with bicycle lanes and sidewalks																					X	
Progress Street at Patrick Henry Drive	Traffic signal and safety upgrades																					X	
Mount Tabor Road from North Main Street to Bishop Road	Reconstruct road to current 2-lane standards with sidewalks and bicycle lanes, and bus pull-offs; align with Givens Lane at North Main Street	3																					

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
Ellett Road from South Main Street to Cedar Hill Drive	Widen road to 4 lanes with bicycle lanes or separate multi-use trail; improve intersection of Ellet and S. Main	5	X	X	X		X											X					
Southgate Drive from Merrimac Road to 460 Bypass	Extend Southgate drive as a 4-lane road with median, bicycle lands, and sidewalk	5	X				X																
North Main Street from Mount Tabor Road to Route 460 Bypass	Widen road to 4 -lanes divided, with bicycle lanes and sidewalk	3		X	X													X					
Country Club Drive Extension from Airport Road to Hubbard Street Extension	Construct extension of Country Club Drive; include bicycle lanes and trails.			X														X					
Hubbard Street Extension from Airport Road to Southgate Drive	Construct extension of Hubbard Street as two-lane roadway; includes bicycle lanes and grade-separated crossing for the Huckleberry Trail			X														X					

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
Heather Drive Extension from Prices Fork Road to Glade Road	Construct as two-lane roadway with bicycle lanes and sidewalks																			X	X		
Progress Street Extension from Givens Lane to North Main Street	Extension from Givens Lane through Northside Park to North Main Street	3																					
West Main Street (Rt 8) at Phlegar Street/Radford Street	Improve intersection for operations and safety: shift Phlegar Street to align with Radford Street and create single intersection	4																					
Radford Road and Radford Street from Silver Lake Road (western intersection) to Main Street	Widen road to four lanes with a center bi-directional turn lane, bicycle lanes, and sidewalks	10	X	X	X	X									X			X					

Exhibit 18

Environmental Overview of Financially Constrained Plan and Tier 1 Vision Plan Recommendations

Project Location	Description	Potential Displacements	Minority Groups Affected	Community Disruption	Community Services Affected	Economic Impacts (Tax Base)	Land Use/Zoning Conflicts	Hazardous Materials	Historic/Archeological Impacts	Critical Habitats	Wild and Scenic Rivers	Prime Farmland	Managed Forest Land	Scenic Routes	Public Parks/Recreation Areas	Threatened/Endangered Species	Air Quality Impacts	Noise Sensitive Impacts	Water Quality Impacts	Floodplains	Wetlands	Potentially Erosive Soils	No significant impacts identified based on overview
North Franklin Street at Peppers Ferry Road	Improve intersection for operations; add additional approach lanes on Peppers Ferry Road to improve capacity																					X	
Parkway Drive Extension from existing Parkway Drive at Technology Drive to South Franklin Street	Extend road as 2-lane roadway on 4-lanes of right-of-way																		X	X			

Chapter 5 – Transportation Vision Plan

Because the total estimated costs for the transportation improvements that were identified as part of the Plan development process exceed the estimated funding to the year 2030, the MPO and local governments prioritized the proposed improvements in order to identify those to be included in the Financially Constrained Transportation Plan. Recommendations with a lesser priority that could not be funded based on the expected funding stream are included in the region's Transportation Vision Plan.

It is anticipated that some projects may be able to be advanced within the next few years should additional funding become available. For this reason, two tiers have been established for Vision Plan projects. Tier 1 Vision Plan projects (shown in Exhibits 19 and 21) are those that were judged to be of a higher priority and should be advanced first should additional funding become available. Tier 2 Vision Plan projects (shown in Exhibits 20 and 21) are those that were judged to be longer-term and of a lesser priority.

Exhibit 19

Tier 1 Vision Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Locality/Funding Source
3		Smart Road from I-81 to Route 460 Bypass	Connection to Route 460 Bypass; includes paving 2-lane roadway	$6,100,000 ** (see note 2)	Montgomery/NHS
23	114	Peppers Ferry Road from Radford Arsenal main entrance to the Christiansburg West Corporate Limits	Widen road to 4-lanes divided with bicycle lanes	$32,199,000 ** (see note 2)	Montgomery/ Primary
24	642	Jenelle Road from Route 460 Business to Route 603	Reconstruct road to current 2-lane standards	$1,954,000 ** (see note 2)	Montgomery/ Secondary
37	460	460 Bypass at Southgate Drive	Construct interchange	$8,663,000 ** (see note 2)	Montgomery/NHS, Primary Blacksburg/Urban
5	114	Peppers Ferry Road from west corporate limits to Route 460	Widen to four lanes, PE and ROW included in Six-Year Program	$8,401,000 ** (see note 2)	Christiansburg/ Urban
39	460	Route 460 Bypass from South Main to Prices Fork Road	Widen to 6 lanes	$27,083,000	Montgomery-Blacksburg/NHS
40		Southgate Drive Extension from Merrimac Road (Route 657) to Radford Arsenal	Construct as four-lane parkway	$16,561,000	Montgomery/ Primary

Exhibit 19

Tier 1 Vision Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Locality/Funding Source
41	8	Riner Road (Rt 8) from Route 669 to Christiansburg South Corporate limits	Widen road to current standards	$26,741,000	Montgomery/ Primary
42	114	Peppers Ferry Road Extension from Route 460 Bypass to Ellett Roud (Route 723)	Construct 2-lane roadway	$2,294,000	Montgomery/ Primary
43	657	Merrimac Road from North Franklin Street (Route 460) to Prices Fork Road (Route 685)	Reconstruct road to current 2-lane standards	$7,044,000	Montgomery/ Secondary
44	808	High Top Road from Merrimac Road to South Main Street (Route 460)	Reconstruct road to current 2-lane standards	$2,018,000	Montgomery/ Secondary
45		Ramble Road from Industrial Park Drive to the Corporate Research Center (north of Merrimac Road)	Reconstruct as 2-lane urban roadway plus transit pull-offs and bicycle lanes	$2,892,000	Blacksburg/ Urban
46		Farmview Drive/Mabry Lane from Hightop Road to Huckleberry Lane	Reconstruct as 2-lane roadway with bicycle lanes and sidewalks	$3,439,000	Blacksburg/ Urban
47		Progress Street at Patrick Henry Drive	Traffic signal and safety upgrades	$1,000,000	Blacksburg/ Urban
48		Mount Tabor Road from North Main Street to Bishop Road	Reconstruct road to current 2-lane standards with sidewalks and bicycle lanes, and bus pull-offs; align with Givens Lane at North Main Street	$3,941,000	Blacksburg/ Urban
49		Ellett Road from South Main Street to Cedar Hill Drive	Widen road to 4 lanes with bicycle lanes or separate multi-use trail; improve intersection of Ellet and S. Main	$5,923,000	Blacksburg/ Urban
50		Southgate Drive from Merrimac Road to 460 Bypass	Extend Southgate drive as a 4-lane road with median, bicycle lands, and sidewalk	$10,467,000	Blacksburg/ Urban
51	460 Bus	North Main Street from Mount Tabor Road to Route 460 Bypass	Widen road to 4 -lanes divided, with bicycle lanes and sidewalk	$10,559,000	Blacksburg/ Urban

Exhibit 19

Tier 1 Vision Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Locality/Funding Source
52		Country Club Drive Extension from Airport Road to Hubbard Street Extension	Construct extension of Country Club Drive; include bicycle lanes and trails.	$1,122,000	Blacksburg/ Urban
53		Hubbard Street Extension from Airport Road to Southgate Drive	Construct extension of Hubbard Street as two-lane roadway; includes bicycle lanes and grade-separated crossing for the Huckleberry Trail	$6,296,000	Blacksburg/ Urban
54		Heather Drive Extension from Prices Fork Road to Glade Road	Construct as two-lane roadway with bicycle lanes and sidewalks	$3,888,000	Blacksburg/ Urban
55		Progress Street Extension from Givens Lane to North Main Street	Extension from Givens Lane through Northside Park to North Main Street	$3,659,000	Blacksburg/ Urban
56	8	West Main Street (Rt 8) at Phlegar Street/Radford Street	Improve intersection for operations and safety: shift Phlegar Street to align with Radford Street and create single intersection	$862,000	Christiansburg/ Urban
57	11	Radford Road and Radford Street from Silver Lake Road (western intersection) to Main Street	Widen road to four lanes with a center bi-directional turn lane, bicycle lanes, and sidewalks	$18,585,000	Christiansburg/ Urban
58		North Franklin Street at Peppers Ferry Road	Improve intersection for operations; add additional approach lanes on Peppers Ferry Road to improve capacity	$1,074,000	Christiansburg/ Urban
59		Parkway Drive Extension from existing Parkway Drive at Technology Drive to South Franklin Street	Extend road as 2-lane roadway on 4-lanes of right-of-way	$2,668,000	Christiansburg/ Urban

Notes:

[1] Corresponds to the key numbers on map in Exhibit 19.

*[2] Estimated costs are planning-level estimates based on average or typical projects for each cross-section type. Costs are for year 2005 and include both construction and rights-of-way. The amount shown for those projects marked with ** is the remaining cost to construct these projects which are only partially funded in the Financially Constrained Plan. The total estimated cost for these projects shown with ** are included in the Exhibit 2 Financially Constrained Plan.*

Exhibit 20

Tier 2 Vision Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Locality/Funding Source
60	460	460 Bypass at North Main Street	Construct interchange	$22,000,000	Montgomery-Blacksburg/NHS
61		Radford Road from West Study Area Boundary to western intersection of Silver Lake Road	Widen to 4-lanes with median (rural cross-section); 5-lane cross-section in Plum Creek area	$26,805,000	Montgomery/ Primary
62		Ellett Road/Cedar Run Road from Cedar Hill Drive to Route 723 (Ellett Road)	Upgrade road to current 2-lane standards; sidewalks and bicycle lanes or trail in Town portion	$5,852,000	Montgomery/ Secondary
63		Harding Avenue and Harding Road from Progress Street to Lusters Gate Road	Reconstruct road to current 2-lane standards; sidewalks and bicycle lanes, and bus pull-offs in Town portion	$10,569,000	Montgomery/ Secondary
64	658/627	Meadow Creek/Barn Road from Riner Road (Route 8) to Tyler Road (Route 600)	Reconstruct road to current 2-lane standards	$11,290,000	Montgomery/ Secondary
65	669	Fairview Church Road from West Study Area Boundary to Riner Road	Reconstruct road to current 2-lane standards	$1,624,000	Montgomery/ Secondary
66	669	Union Valley Road from Riner Road (Route 8) to East Study Area Boundary	Reconstruct road to current 2-lane standards	$2,674,000	Montgomery/ Secondary
67	723	Ellett Road from Christiansburg Corporate Limits to Route 603	Reconstruct road to current 2-lane standards	$5,376,000	Montgomery/ Secondary
68		Turner Street from Prices Fork Road to North Main Street	Reconstruct as 2-lane urban roadway including turn lanes at the Creative Arts Center and a bicycle lane	$1,421,000	Blacksburg/ Urban
69		Old Glade Road from Prices Fork Road to Glade Road	Construct 2-lane roadway with bicycle lanes and sidewalk	$1,308,000	Blacksburg/ Urban
70		Giles Road Extension from North Main Street to Turner Street	Construct/reconstruct as 2-lane roadway to improve access in the Barger Street area	$580,000	Blacksburg/ Urban

Exhibit 20

Tier 2 Vision Plan Transportation Recommendations

Map ID [1]	Route	Project Location	Description	Estimated Cost [2]	Locality/Funding Source
71		Toms Creek Road from Meadowbrook Road to Route 460	Reconstruct as two-lane roadway with bicycle lanes and sidewalks	$4,299,000	Blacksburg/ Urban
72		Connector from 460 Bypass to Toms Creek	Construct as 2-lane road	$3,102,000	Blacksburg/ Urban
73		Meadowbrook Road from Glade Road to Toms Creek Road	Reconstruct as 2-lane roadway with bicycle lanes, trail, and sidewalks	$9,309,000	Blacksburg/ Urban
74		Parkway Drive extension from Radford Road to South Franklin Street	Extend Parkway Drive as a 2-lane facility	$14,128,000	Christiansburg-Montgomery/ Urban-Secondary
75		Mill Lane from existing terminus to North Franklin Street	Construct as two-lane roadway	$290,000	Christiansburg/ Urban
76		Cambria Street at Ellet Road	Improve intersection for operations; install signal pending warrants	$207,000	Christiansburg/ Urban

Notes:

[1] Corresponds to the key numbers on map in Exhibit 19.

[2] Estimated costs are planning-level estimates based on average or typical projects for each cross-section type. Costs are for year 2005 and include both construction and rights-of-way.

Exhibit 21A

Map of Vision Plan Transportation Recommendations

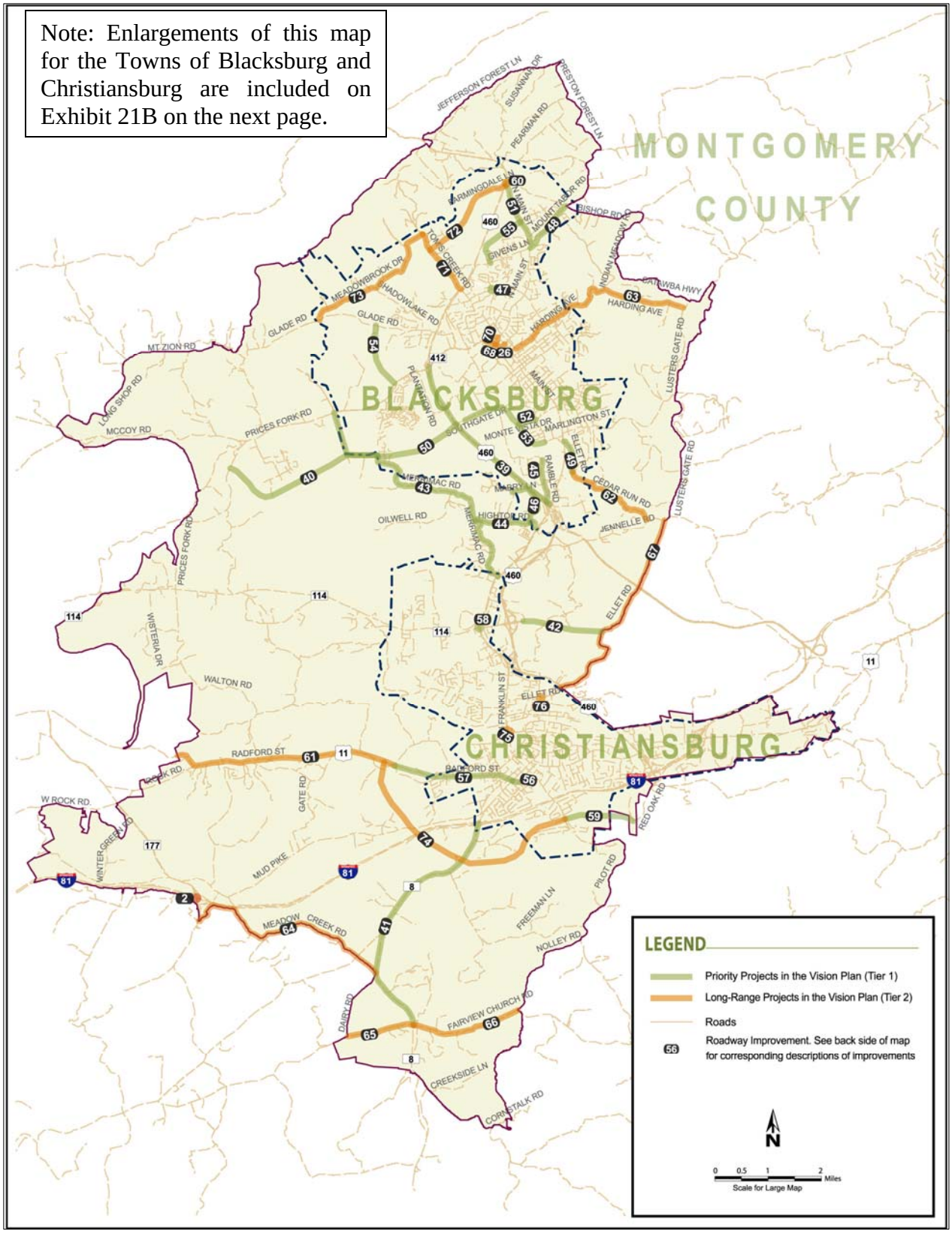
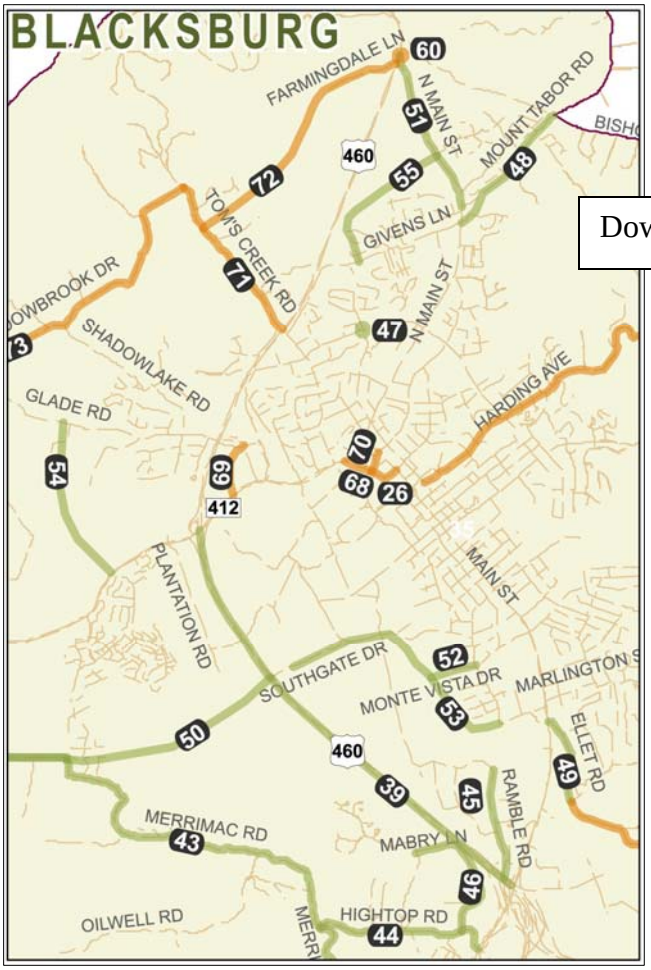


Exhibit 21B

Map of Vision Plan Transportation Recommendations (Town Insets)



Downtown Blacksburg Inset

Downtown Christiansburg Inset

Chapter 6 – Alternative Transportation Modes

Transportation via transit, bicycle, walking, air, and intercity bus is an integral part of the region's transportation system and the Plan recommends substantial expansion of the role that these modes of travel serve. Many of the roadway projects described in Chapters 4 and 5 include provisions for bicycle and pedestrian amenities, with a goal towards developing a comprehensive network of trails and sidewalks. Carefully designed roadway improvements also serve transit vehicles and such needs should be taken into consideration in the design of all new and reconstructed roadways. Other initiatives to support non-automotive travel are described in this section. As indicated previously, Blacksburg Transit is in the process of developing a detailed Transit Development Plan (TDP) that will provide details on expansion of transit service in the region. Upon completion of this document, it will be adopted by amendment into the BCM-MPO 2030 Transportation Plan.

Blacksburg Transit has grown steadily over the past two decades, carrying 2.2 million passengers in Fiscal Year 2004-2005. Public input, including input received at meetings associated with the development of this Plan, is calling for increased service throughout the BCM MPO area and the New River Valley. To meet this demand, Blacksburg Transit is planning to expand service within the New River Valley in the next decade and is using the TDP process to help plan for funding these possible services.

The Virginia Tech/Montgomery Executive Airport is also beginning the development of its Master Plan Update. The Master Plan Update is anticipated to be complete by the end of 2006.

As the major activity center in the region, improvements on the campus of Virginia Tech have significant impacts on overall transportation. The Virginia Tech Master Plan describes roadway improvements, parking facilities, transportation policies, and the location of new academic and residential facilities – all of which affect regional transportation. The Virginia Tech Master Plan was considered in the development of the Plan. The Master Plan document is in the process of being updated, however, with final recommendations due shortly.

<u>Mass Transit Improvements</u>

- Construct Multi-Modal Transportation Center to include a parking garage and a bus transfer facility that will connect the off-campus route system to the on-campus circulation system.
- Expand Blacksburg Transit service into the Blacksburg/ Christiansburg/Montgomery MPO area and adjacent jurisdictions with service along main arterial streets, making stops at large commercial areas, at local and county facilities, and at high-density residential areas.
- Provide transit service from the Blacksburg/Christiansburg/Montgomery MPO area and adjacent jurisdictions to the Christiansburg train station to accommodate riders of the proposed TransDominion rail service.

Rideshare/Park-and-Ride Improvements

- Provide park and ride lots at Route 460 Bypass and South Main Street, Southgate Drive, Tom's Creek Road, North Main Street and Price's Fork Road; Route 460 and Peppers Ferry Road; and at Interstate 81 and Route 8. Provide shuttle bus service to link these lots to the transfer facility in the Multi-Modal Transportation Center.
- Construct additional regional park-and-ride lots to serve Radford, Roanoke, and Giles County commuters, along with shuttle service and/or a rideshare program.
- Implement regional rideshare programs.

Bikeway/Walkway Improvements

- Construct extension of Huckleberry Trail from Prices Fork Road to Glade Road (Six-Year Program project).
- Extend the Huckleberry Trail to the downtowns of both Blacksburg and Christiansburg, as well as to the Blacksburg Recreation Center. Construct bridge for trail over Norfolk Southern railroad tracks.
- Implement other elements of the bicycle plans for each jurisdiction.
- Widen sidewalks in downtown Christiansburg and continue with the Downtown Improvement project.
- Widen sidewalks within downtown Blacksburg to 10 feet.
- Construct sidewalks with new commercial development in villages and towns within the region.
- Revitalize downtown Cambria through an improvement program including sidewalks, pedestrian lighting, and other streetscape enhancements.
- Construct bikeways and walkways in the communities of Prices Fork, Riner, Plum Creek, and Belview.
- Construct sidewalks and/or bicycle trails with most planned roadway projects.

Intercity Transportation Improvements

- Re-establish Greyhound inter-city bus service within the MPO.
- Support implementation of the proposed TransDominion train service.
- Develop Christiansburg train station and rail infrastructure to accommodate a stop for the proposed TransDominion rail service.

Appendix A – Federal Planning Requirements

The Transportation Equity Act for the 21st Century (TEA-21), enacted by the U.S. Congress in June 1998, describes transportation issues that metropolitan area transportation plans should address. One key requirement is that seven specific planning factors be considered in the development of the Plan. The discussion below describes how each factor was considered in the development of the recommendation of the 2030 Transportation Plan.

A.1 Support the Economic Vitality of the Metropolitan Area, Especially by Enabling Global Competitiveness, Productivity, and Efficiency

Recommendations in the Plan seek to address the economic vitality of the Blacksburg/Christiansburg/Montgomery region by enhancing mobility and improving access to Interstate 81 as well as other modes. Some of the specific improvements that address economic vitality include:

- Construction of the Smart Road between Blacksburg and I-81, which will improve accessibility to Blacksburg and Virginia Tech.
- Supporting the implementation of the Dominion Express Railway service which will enhance accessibility by non-roadway modes to the region.
- Widening Peppers Ferry Road to enhance accessibility from Route 460 to this portion of Montgomery County and Christiansburg.
- Lengthen the runway at the Virginia Tech/Montgomery Executive Airport to provide improved service to corporate jets and general aviation traffic.

A.2 Increase the Safety and Security of the Transportation System for Motorized and Non-Motorized Users

Projects in the 2030 Transportation Plan will improve the overall safety of motorists, bicyclists, and pedestrians. Projects such as the Smart Road will divert traffic from arterial roadways that typically experience higher crash rates onto a limited access facility which typically experience one-quarter to one-third of the number of crashes per vehicle-mile. The Plan also includes projects (such as the Glade Road reconstruction) that will bring roadways that do not meet current geometric standards up to current levels, substantially improving the safety of these roads. The Plan also includes a major emphasis on pedestrian and bicycle safety through the construction of sidewalks, bicycle lanes, and bicycle trails (such as the extension of the Huckleberry Trail), as well as intersection improvements that seek to address pedestrian and bicycle safety (i.e., for several intersections along Prices Fork Road).

A.3 Increase the Accessibility and Mobility Options Available to People and for Freight

Accessibility and mobility options will be increased by the multi-modal elements of the Plan. Improved roadway access serves cars, buses, social service transportation, and trucks. Substantial increases in accessibility are provided by several road projects in this

Plan, including the Smart Road connecting to Interstate 81, the widening of Peppers Ferry Road, the construction of an interchange on Route 460 at Toms Creek Road (as well as the longer-term interchange at Southgate Drive). Inter-city mobility will be enhanced by the proposed TransDominion Rail service and improvements to the Virginia Tech/Montgomery Executive Airport. Sidewalk and bikeway improvements, as well as the expansion of transit service, will also serve to enhance the overall mobility of the region's residents.

A.4 Protect and Enhance the Environment, Promote Energy Conservation, and Improve Quality of Life

By alleviating congestion and improving multi-modal transportation service and connections, the Plan will promote energy conservation and improve the quality of life in the Blacksburg/Christiansburg/Montgomery region. Upgraded roadways will reduce congestion, enhance travel safety, and improve access to and use of non-automotive modes of travel. Reduced congestion, along with upgrades to transit service, will reduce fuel consumption and improve air quality.

All of the Transportation Plan projects have been subjected to a planning-level review of social, economic, energy, and environmental impacts. In addition, as part of the development of both the vision and constrained plans, those projects that were judged to have unacceptably high environmental or community impacts were removed from consideration. Prior to construction, all projects will be subjected to more detailed studies with respect to their impacts on the natural and man-made environment.

A.5 Enhance the Integration and Connectivity of the Transportation System, Across and Between Modes, for People and Freight

Recommended improvements in the Plan will enhance the integration and connectivity of the various travel modes in the Blacksburg/Christiansburg/Montgomery region. As discussed previously, many projects will enhance regional connectivity by providing new and/or improved connections such as Smart Road, new interchanges on Route 460, and widened roadways for key connections. Many of the projects also incorporate bicycle and pedestrian facilities. Transit expansion and the construction of a multi Multi-Modal Transportation Center (including a parking garage and a bus transfer facility) will provide for significant increases in regional connectivity for those who cannot or choose not to drive.

A.6 Promote Efficient System Management and Operation

System management in the Plan is addressed through enhancements to the operations of key intersections, provision of enhanced interface between roadway and transit through the Multi-Modal Transportation Center, and the constructing regional park-and-ride facilities (to assist in managing overall travel demand). Blacksburg Transit is developing a detailed Transit Development Plan (TDP) that will seek to improve the operations of the existing system by assessing both routes and overall operations.

A.7 Emphasize the Preservation of the Existing Transportation System

A key feature of the Plan, as well as VDOT funding priorities, is the preservation of the existing transportation system. The number of projects in the Financially Constrained Plan is limited by the need to divert currently limited financial resources to ensure that the existing system is well-maintained. Many of the projects in the Plan also focus on preservation of the existing system as well as safety by reconstructing existing roadways without adding more travel lanes. In addition, both transit and air transportation improvements include funds to both preserve the existing service as well as to enhance its efficiency.

A.8 Environmental Justice

In addition to considering the seven planning factors, this Plan included an emphasis on several other factors, including consideration of disproportionate impacts on minority communities. The Plan was developed as part of a process that takes into account the requirements of Presidential Executive Order 12898 on Environmental Justice. This order was signed in 1994 and augments Title VI of the Civil Rights Act of 1964 by providing additional specifics on prohibiting discrimination based on race, color, and national origin. The Executive Order applies to persons belonging to Black, Hispanic, Asian American, American Indian, Alaskan Native, as well as low-income groups. Environmental justice principles require that all potentially affected communities participate in the decision-making process; minority and low-income populations are not prevented from receiving the benefits of transportation improvements; and disproportionately high and adverse impacts on minority and low-income populations are avoided, minimized, or mitigated.

Throughout the development of the Plan, efforts were made to reach out to minority and low-income groups by holding meetings at locations that were accessible to all citizens by transit, walking, or car.

Executive Order 12898 also requires that transportation planning efforts avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority and low-income populations. Many projects in this Plan, including those suggested by the general public early in the study, were developed to increase accessibility to minority and low-income areas while being sensitive to the potential impacts of these projects. Such projects include those that increase accessibility to the region's downtowns (in both Blacksburg and Christiansburg), as well as proposals to expand transit service. These projects will serve to increase mobility options for low-income and transit-dependent populations.

To the maximum extent possible, projects that were judged, at a planning level, to have disproportionately high impacts on minority and low-income neighborhoods were dropped from consideration, thus avoiding the impacts. As part of the environmental overview process for all Transportation Plan recommendations, the potential impacts of

transportation projects were identified. As these projects are implemented, Environmental Justice principles will be applied throughout the project development and design process to minimize and/or mitigate disproportionately high impacts on minority and low-income groups.

Demographic analysis was performed as part of the development of the Plan to identify the geographic distribution of environmental justice populations, and to guide in the development of projects that will minimize adverse impacts of transportation projects on these populations, as well as identify areas where additional transportation services are needed. Exhibits A-1 through A-3 show the geographic distribution of environmental justice populations.

A.9 Freight Planning/Goods Movement

The most recent surveys with companies that move goods into and out the MPO area (performed as part of the development of the region's draft 2025 Transportation Plan) indicate that these companies report a generally smooth-flowing system for moving goods within and into/out of the region. Reported concerns about the Route 460 corridor between Blacksburg and Christiansburg have been addressed, to a large extent, by the recently completed bypass. Surveyed companies reported little use of rail freight, but some did report using air freight to ship goods out of the Roanoke Regional Airport.

In order to better quantify issues related to freight movement within the MPO area, the BCM-MPO is participating in a VDOT statewide effort to obtain recent data sets that provide information on commodity flows at the zip-code level. Based on analysis of these data sets, the BCM-MPO will be updating regional goods movement plans. These updated plans will be included in amendments to the 2030 Transportation Plan, as appropriate.

A.10 Operations Management and Intelligent Transportation Systems

Intelligent transportation systems (ITS) is the coordination of new technologies, improvements in information and communications systems, and conventional surface transportation infrastructure. ITS improvements have the potential to improve the efficiency and safety of the regional transportation system, sometimes at significantly less cost and/or with fewer negative impacts. ITS recommendations for roadways in the Blacksburg/Christiansburg/Montgomery region include continued implementation of traffic signal improvements such as video-based signal actuation and provision of traffic information to motorists through variable message signing at key locations. Over the medium to long-term, Blacksburg Transit's Transit Development Plan will consider the addition of ITS to transit service. Measures that could be considered include real-time tracking of bus movements to be provided to patrons via information kiosks, cell phones, bus stop signs, and/or through the Internet.

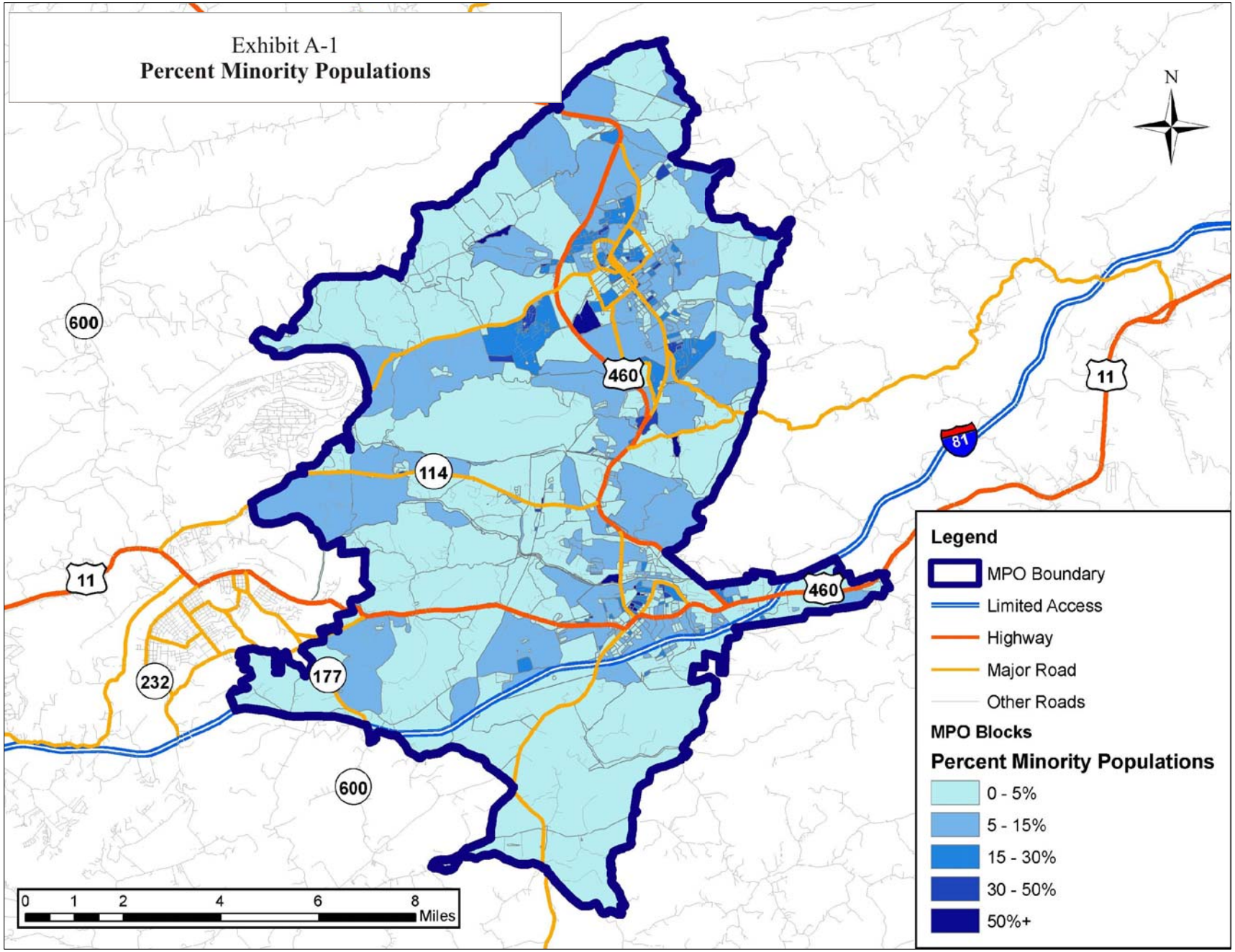


Exhibit A-1
Percent Minority Populations
N
600
460
11
81
114
11
460
232
177
600
0 1 2 4 6 8
Miles
Legend
MPO Boundary
Limited Access
Highway
Major Road
Other Roads
MPO Blocks
Percent Minority Populations
0 - 5%
5 - 15%
15 - 30%
30 - 50%
50%+

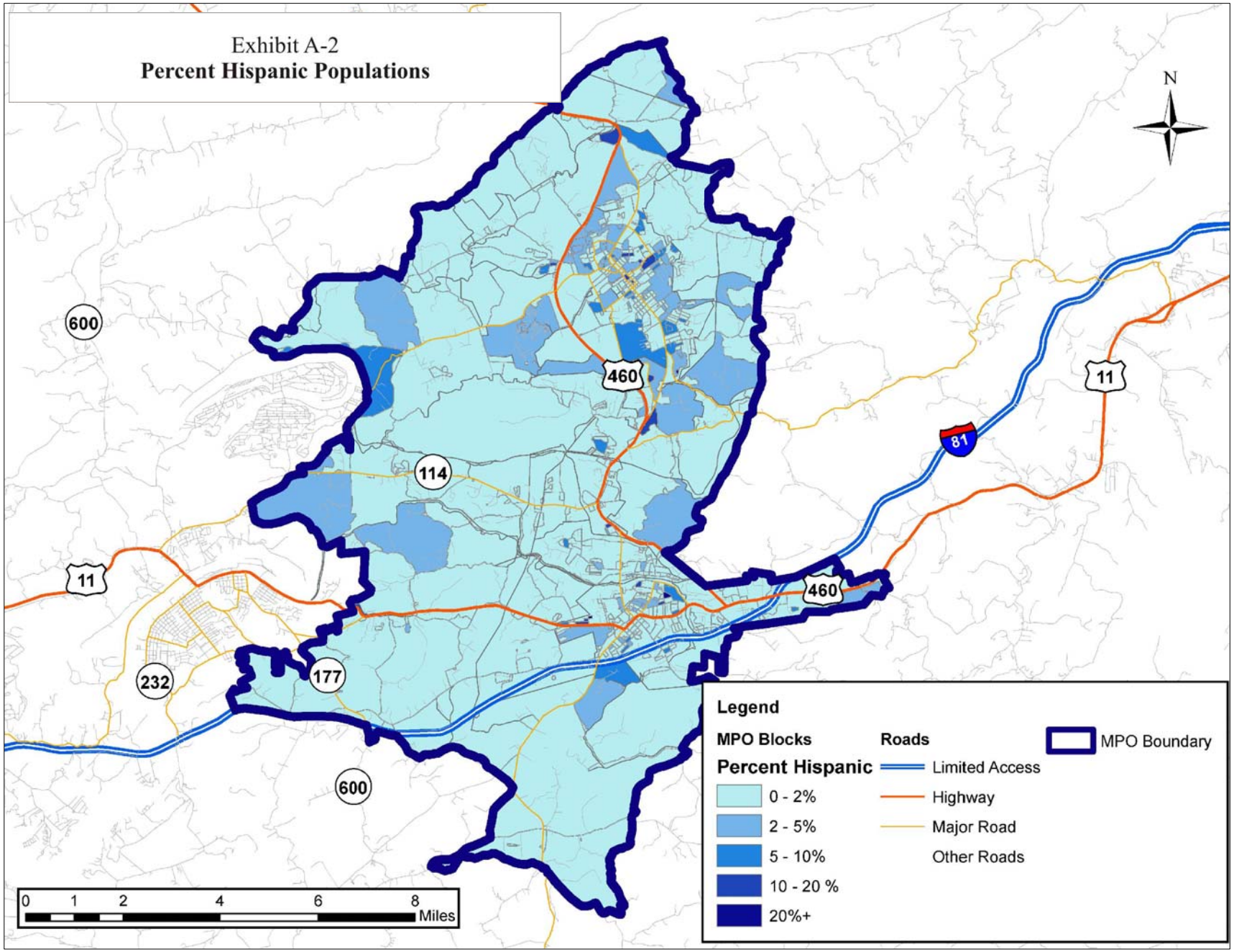


Exhibit A-2
Percent Hispanic Populations
N
600
460
11
81
114
11
460
232
177
600
0 1 2 4 6 8
Miles
Legend
MPO Blocks
Percent Hispanic
0 - 2%
2 - 5%
5 - 10%
10 - 20 %
20%+
Roads
Limited Access
Highway
Major Road
Other Roads
MPO Boundary

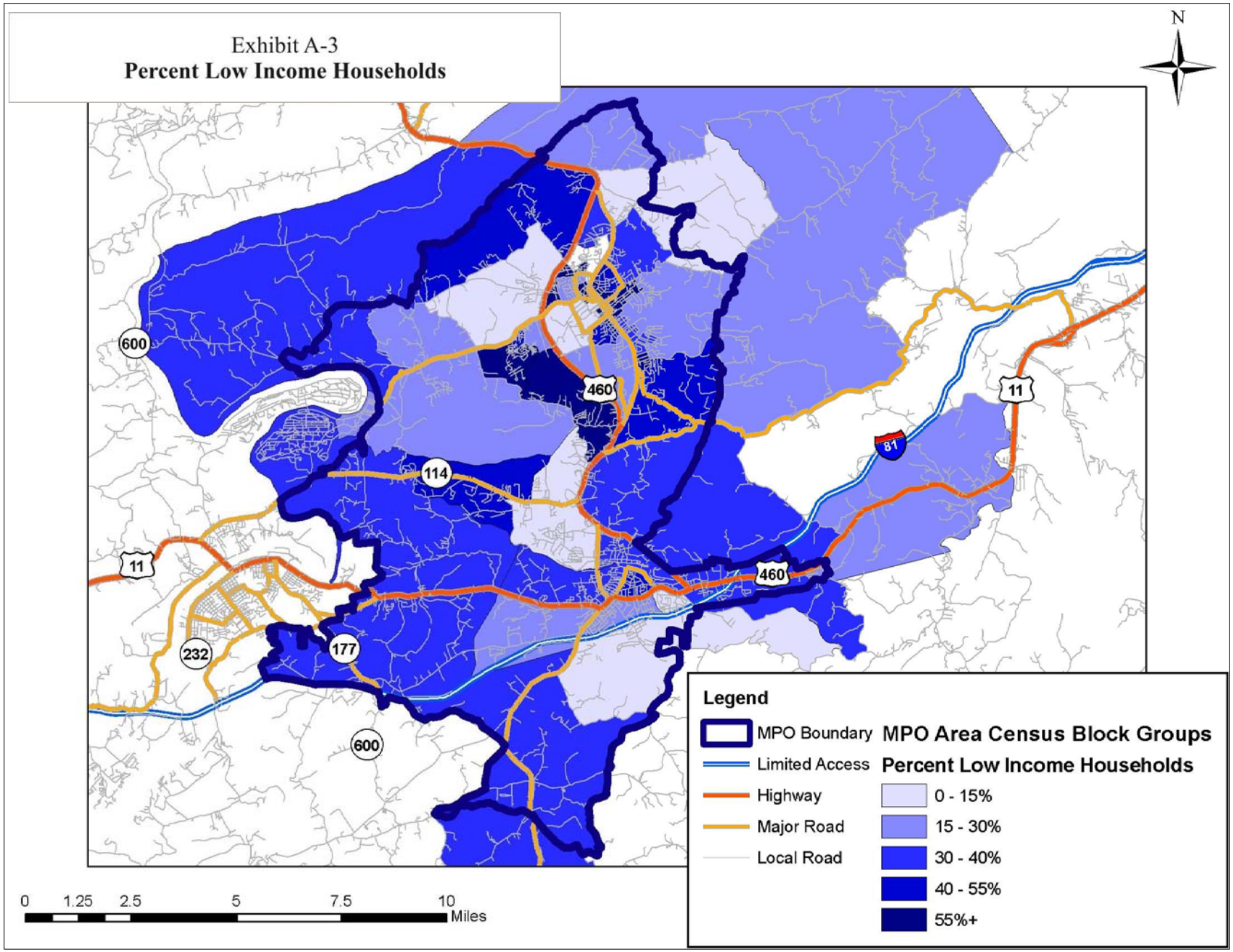


Exhibit A-3
Percent Low Income Households
N
600
460
11
81
114
11
460
232
177
600
0 1.25 2.5 5 7.5 10
Miles
Legend
MPO Boundary
Limited Access
Highway
Major Road
Local Road
MPO Area Census Block Groups
Percent Low Income Households
0 - 15%
15 - 30%
30 - 40%
40 - 55%
55%+

Appendix B – Analysis Methodologies

B.1 ROADWAY INVENTORY

To analyze the thoroughfare roadway system in Blacksburg and Christiansburg, the State Highway Planning Systems (SHiPS) database of roadway conditions was reviewed. The SHiPS database includes all thoroughfare highways in the state, identified by roadway segment. Each segment of the road is defined by major intersecting roadways or by significant changes in the geometry of the roadway segment (number of lanes, pavement width, etc.). The database contains information about both sides of the road, and therefore uses a convention of northbound or eastbound orientation to maintain consistent references to the right and left sides of the road.

Review of the database included field observation in Blacksburg and Christiansburg of every thoroughfare roadway. The fieldwork enabled identification of geometric deficiencies such as limited sight distances, obstructions near the travel way, limited pavement width, and other operational issues. Each variable in the database was compared to actual conditions noted in the field. The SHiPS database variables reviewed included the following.

- Pavement Width – the width of pavement from curb to curb measured in feet (total roadway pavement width)
- Number of Through Lanes – the number of lanes available for through traffic in both directions of permitted travel
- Access Control – the type of access control provided on the road (local streets have no access control, freeways and major divided highways usually have full and limited access control respectively).
- Type of Operation – the type of roadway operation (one or two-way travel)
- Median Type – the type of median the road contains (none, raised, depressed, flush, or center turn lane)
- Median Width – the width of the median, from edge to edge, measured in feet
- Left Shoulder Width – the width of the left shoulder of the road measured from the ditch line to the travel lane edge
- Right Shoulder Width – the width of the right shoulder of the road measured from the ditch line to the travel lane edge
- Curb and Gutters – the presence of curb and gutter along the roadway (none, both sides of the street, left side only, or right side only)
- Sidewalks – the presence of sidewalks along the roadway segment (either none, both sides of the street, left side only, or right side only)
- Number of Traffic Signals – the number of traffic signals located on the road, including the beginning and ending intersections of the road segment
- Posted Speed Limit – the speed limit posted along the road segment

B.2 CAPACITY ANALYSIS

Capacity analysis is used by traffic engineers to determine whether a particular road exceeds or will exceed acceptable thresholds of traffic congestion. The approach used in the capacity analyses for this study was to use planning-level techniques based on volume to capacity ratios and lookup tables for level of service based on various roadway types. Intersections were analyzed using the industry-standard Synchro software (Version 5) which was developed and is distributed by Trafficware, Corporation. In addition to powerful analysis methodologies which parallel the analyses techniques of the *Highway Capacity Manual* (Transportation Research Board, 2000), this software provides a planning-level measure of intersection operations based on percentage of total intersection capacity utilized. The intersection capacity utilization (ICU) methodology provides results independent of such parameters as detailed signal timing plans which are often details that are not developed at as part of planning-level studies. Similar to the critical lane volumes procedure of previous editions of the Highway Capacity Manual, the ICU methodology essentially involves summing the amount of time required to serve all traffic movement demands for a given cycle length. The table below shows the level of service for ranges of ICU. Additional information is available at www.trafficware.com/icu.htm.

Intersection Capacity Utilized	Level of Service
0 to 55 percent	A
55 to 64 percent	B
64 to 73 percent	C
73 to 82 percent	D
82 to 91 percent	E
Greater than 91 percent	F

Source: Intersection Capacity Utilization (Trafficware, 2003)

Roadway segment deficiencies were identified at a planning-level based on output from the regional transportation model. Virginia Department of Transportation (VDOT) guidelines for planning studies indicate that level of service C or better is considered acceptable, while level of service D or worse indicates a potential operational deficiency. The table below summarizes the daily “level of service C” volumes over which roadways would experience level of service D or worse. The lookup values are based on the methodologies of the Highway Capacity Manual (Transportation Research Board, 2000) as well as assumptions developed and applied by the Florida Department of Transportation for planning studies.

Roadway Type	Total number of lanes (both directions)	Maximum Volume for Operations at Level of Service C or Better
Type I arterial (suburban, 0 to 1.99 signalized intersections per mile, free-flow speed of 45 mph)	2	15,400
	4	38,700
	6	58,200
	8	74,000
Type II arterial (suburban, 2.0 to 4.5 signalized intersections per mile, free-flow speed of 40 mph)	2	12,600
	4	29,100
	6	45,200
	8	59,600
Type III arterial (inner suburban, more than 4.5 signalized intersections per mile, free-flow speed of 35 mph)	2	6,000
	4	13,900
	6	21,800
	8	28,800
Type IV arterial (urban, more than 4.5 signalized intersections per mile, free-flow speed of 30 mph)	2	5,800
	4	13,900
	6	21,400
	8	28,800
Freeway (limited access with interchanges)	4	62,900
	6	97,300
	8	131,500
	10	166,000
	12	200,200
Two-lane collector (typically in urban residential areas)	2	10,700
Multi-lane collector	2	24,100
	4	48,400
Two-lane rural	2	5,600

Sources: Highway Capacity Manual (Transportation Research Board, 2000), Florida Department of Transportation (www.dot.state.fl.us/planning/systems/sm/los/pdfs/QLOS2002.pdf), Parsons Transportation Group analyses

B.3 ENVIRONMENTAL OVERVIEW

An environmental overview was performed to document major environmental constraints within the study area. This overview allowed for potential impacts to be identified as projects were first developed and also as they were screened to identify higher priority projects. Potential impacts that were identified included:

- Outdoor Easements (as identified by the Virginia Outdoors Foundation)
- Hazardous Waste Generators (as identified in EPA databases)
- Pollution Releasing Facilities (as identified in EPA databases)
- Scenic Byways (as identified in VDOT Scenic Byways mapping)
- Superfund Sites (as identified by EPA)

B.4 COSTING METHODOLOGY

The development of cost estimates for each proposed recommendation in the Plan was based on unit costs developed by VDOT's Transportation and Mobility Planning Division. These estimates represent the average of a wide range of proposed road, bridge, intersection, and interchange improvements. These costs are for planning purposes only and actual construction and right-of-way costs will vary based on project specifics and local conditions. Further refinement of these cost estimates will occur at each phase of a project's development. The unit costs used for this study are shown in the table on the following pages.

	Improvement Details	Cross Section Code	Additional Improvement Details			2005 Unit Costs
Urban Typical Sections	2 lanes	U2	26'-30' pavement	Reconstruct or new	per mile	$2,415,000
	3 lanes	U3	36'-40' pavement	Reconstruct or new	per mile	$4,600,000
	4 lanes	U4	40'-48' pavement	Reconstruct or new	per mile	$5,520,000
	4 lanes divided	U4D	48' pavement	Reconstruct or new	per mile	$6,095,000
	6 lanes divided	U6D	72' pavement	Reconstruct or new	per mile	$7,935,000
	8 lanes divided	U8D	96' pavement	Reconstruct or new	per mile	$9,890,000
Rural Typical Sections	2 lanes	R2	18' pavement	Reconstruct or new	per mile	$403,000
	2 lanes	R2	20' pavement	Reconstruct or new	per mile	$667,000
	2 lanes	R2	22' pavement	Reconstruct or new	per mile	$794,000
	2 lanes	R2	24' pavement	Reconstruct or new	per mile	$1,150,000
	4 lanes divided	R4D	48' pavement	Reconstruct	per mile	$3,105,000
	4 lanes divided	R4D	48' pavement	New	per mile	$4,715,000
	4 lanes divided	R4D-P	48' pavement	Parallel	per mile	$2,415,000
	4 lanes divided	R4D	48' pavement with 16' R median	Reconstruct or new	per mile	$3,335,000
	6 lanes divided	R6D	72' pavement widen 4-6 lanes	Reconstruct	per mile	$4,370,000
	6 lanes divided	R6D	72' pavement	New	per mile	$5,750,000
	8 lanes divided	R8D	96' pavement widen 6-8 lanes	Reconstruct	per mile	$4,370,000
	8 lanes divided	R8D	96' pavement widen 4-8 lanes	Reconstruct	per mile	$8,625,000
Right and Left Turn Lanes on Four-Lane Road	Right turn lane		100' parallel and 100' taper		each	$85,000
	Left turn lane		200' parallel and 200' taper		each	$104,000
	Crossover				each	$78,000
	Provide new crossover with two right and two left turn lanes				each	$454,000

	Improvement Details	Cross Section Code	Additional Improvement Details			2005 Unit Costs
Right and Center Left Turn Lane on Two-Lane Road	One left turn lane		500' parallel and two 700' taper		each	$631,000
	Two left turn lanes		900' parallel and two 700' taper		each	$719,000
	Right and left turn lane				each	$716,000
	Two right and two left turn lanes				each	$888,000
Bridge Cost	Over 25' to 200' in length			Widen, reconstruct, or new	per sq ft.	$97
	Over 200' in length			Widen, reconstruct, or new	per sq ft.	$121
Other Improvement Cost	Eliminate parking, restripe (Both sides)				per mile	$69,000
	Provide Signal at unsignalized intersection				each	$207,000
	Improve, replace Signal at intersection				each	$104,000
	Improve phasing of system, signalized intersections				each	$138,000
	Provide pedestrian signal phase				each	$28,000
	Provide pedestrian crosswalk				each	$1,000
	Downtown signage				per mile	$21,000
	Close open ditch drainage and provide curb & gutter				per mile	$1,150,000
	Widen radius for truck turning				each	$29,000
	Install railroad warning lights (no gates)				each	$29,000
	Lower railroad bed by 2 ft. for a 1,000 ft.				per mile	$2,300,000
	Provide park & ride facility				per space	$2,000
	Fixed route shuttle service				each	$690,000
	Provide 5' ft. sidewalk				per mile	$74,000
	Provide 8' hike/bike trail off road.				per mile	$116,000
	Improve grade separated interchange				each	$27,600,000

	Improvement Details	Cross Section Code	Additional Improvement Details		2005 Unit Costs
	Provide grade separated interchange			each	$41,400,000
	Provide new grade separated interchange			each	$41,400,000
	Add 5' bikeway rural			per mile	$179,000
	Add 5' bikeway urban			per mile	$397,000
Right of Way & Utilities Cost % of Cost Estimate	Rural				25%
	Residential / Suburban low density				50%
	Outlying business / Suburban high density				60%
	Central business district				100%

Costs include 20% for engineering and contingencies.

APPENDIX C

Transportation Model Development
Technical Report

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Chapter 1
INTRODUCTION

1.1 OVERVIEW

With the release of the 2000 Census data, the Blacksburg Urbanized Area population exceeded 50,000, the threshold necessary for Metropolitan Planning Organization (MPO) designation. As a result, the Blacksburg/Christiansburg/Montgomery Area Metropolitan Planning Organization (MPO) has been designated. MPOs for newly designated urbanized areas are required to establish a planning process that meets all the requirements of 23 CFR 450 and 49 CFR 613, including a long range plan and Transportation Improvement Program (TIP). The region's Transportation Plan must conform to the requirements of 23 CFR §450.322, the FHWA planning requirements for MPO transportation plans, as well as the seven planning factors from TEA-21. Providing the basis for the region's Transportation Plan, travel demand forecasts must reflect the most recent planning assumptions.

The existing travel demand forecasting model was validated for the 1999 conditions, which were prior to the 2000 Census and the construction of several roadways that have effects on regional travel patterns. Validation to the year 2003 is required to provide the region with an effective, updated travel demand forecasting tool.

The objective of this study is to update and validate the current transportation demand model to reflect the most recent planning assumptions so that it can function as an accurate, effective, and expandable tool for long-range transportation planning.

1.2 STUDY AREA

Blacksburg, Christiansburg, and Montgomery County are located along the I-81 corridor, north of the intersection with I-77 in southwestern Virginia. The urbanized area has grown substantially over the past 30 years. Montgomery County was the fastest growing county in Southwest Virginia in the 1980s[1] and 1990s, with populations of 73,913 in 1990 and 83,629 in 2000. In 2000, the Town of Blacksburg, with a population of 39,573, contributed 47% of the total population of Montgomery County, whereas the Town of Christiansburg, with a population of 16,947, contributed 20%. The remaining population resides in the rural part of Montgomery County outside of the two towns. A location map is provided in Figure 1-1, with Montgomery County in red.

[1] Montgomery Regional Economic Development Commission

The modeled area consists of the Town of Blacksburg, the Town of Christiansburg, and portions of Montgomery County surrounding the two towns as shown in Figure 1-2. Covering the MPO and the area beyond the MPO boundary on the southeast side, the modeling domain has an area of 155 square miles. The base year for the model validation is 2003. The model has 207 internal transportation analysis zones (TAZs) and 22 external stations.

1.3 MODEL FEATURES AND UPDATE

The existing model is a traditional travel demand forecast model, without a formal mode choice process. During the last model validation, major model elements were developed as follows:

- The highway network was developed from TIGER/Line files. Arcview GIS was utilized for the development of the highway network and zone structure, as well as for socioeconomic data analysis;
- Trip generation production and attraction rates were based on a 1999 home interview survey;
- Trip distribution was estimated with a standard gravity model;
- Traffic assignment routines estimated daily 24-hour trips.

The major efforts undertaken in this modeling update include:

- Collect traffic counts at key locations in the study area and update other counts to 2003;
- Clean and update the traffic count database in the highway network;
- Adjust the coverage area of the 1999 transportation model to correspond to the newly designated MPO boundary;
- Update the highway network to include new highway improvements and roadways in the new expanded area;
- Develop socioeconomic data for the new base year 2003;
- Convert the existing model from the MINUTP to TP+ platform;
- Check the coding of the transportation demand model for accuracy and validate to the new base year 2003;
- Extend the demographic and traffic forecasts to the horizon year 2030.

Figure 1-1. Location Map

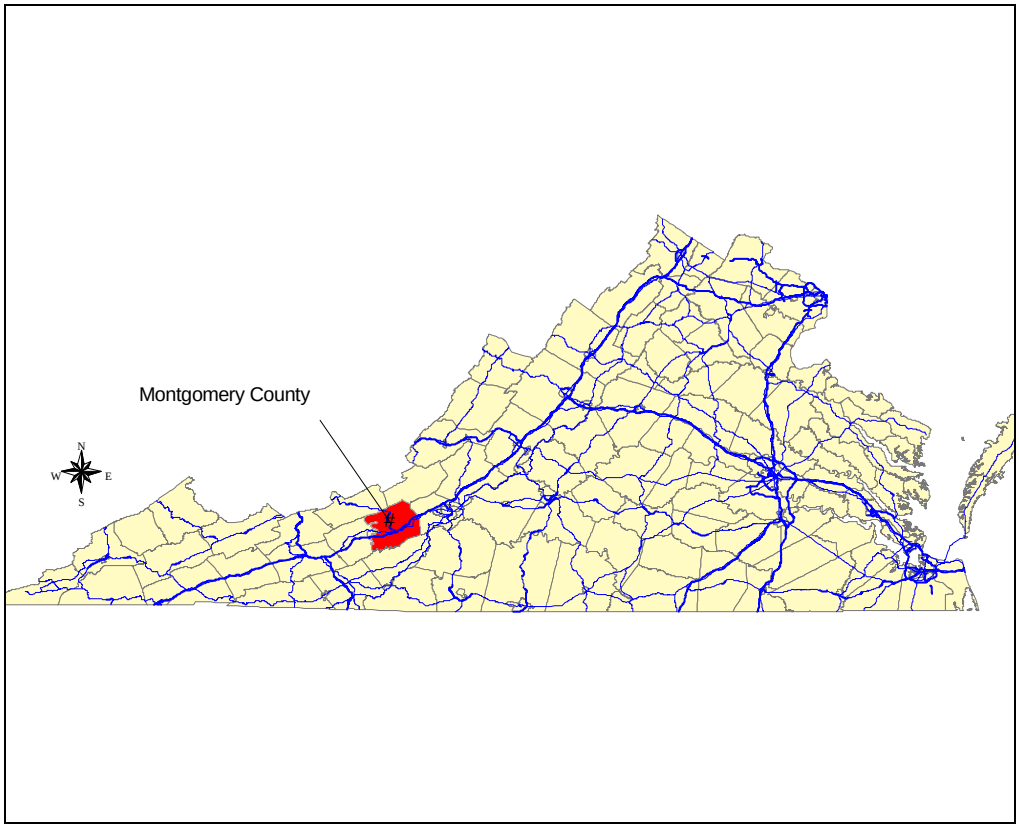
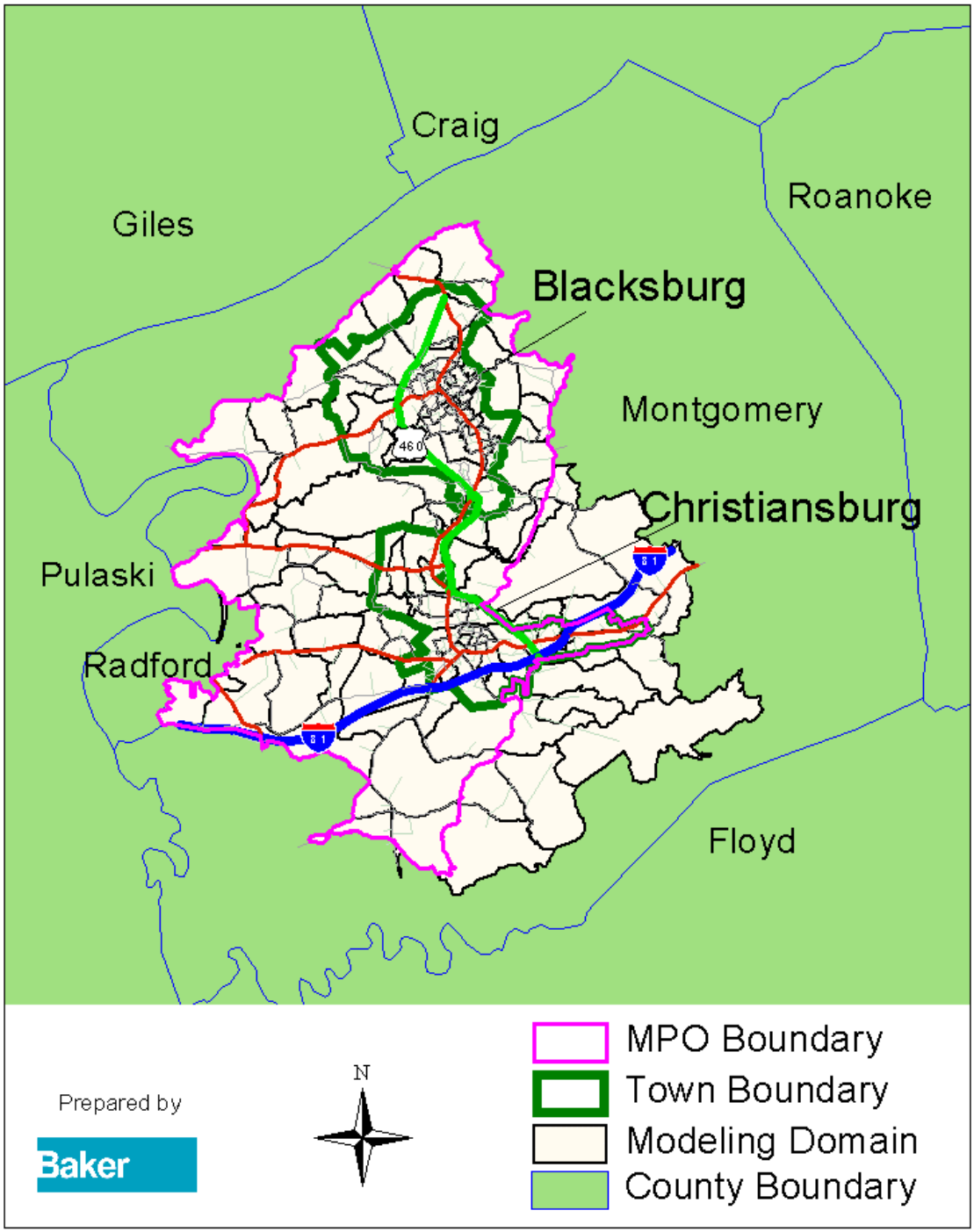


Figure 1-2. Study Area



Chapter 2
ZONE STRUCTURE, SOCIOECONOMIC DATA, AND HIGHWAY NETWORK

2.1 ZONE STRUCTURE

This model update includes a major restructuring of the Transportation Analysis Zones (TAZs) in the study area. This restructuring is based on the 2000 Census, the newly-defined MPO boundary, and local guidance and approval. The existing TAZ structure was developed based on the 1990 Census geography, aerial photos, and old urban boundary.

The new study area is comprised of 207 internal TAZs. Each zone, represented by a single point called a "centroid", can be thought of as a producer and an attractor of trips. A few general guidelines were adhered to when creating the TAZs:

1. The activity within each zone is relatively homogeneous with respect to socioeconomic characteristics that influence trip-making behavior.
2. Census geography is the basic building block for TAZ boundary delineation; Census blocks are the basic geographic unit for further aggregation to TAZ.
3. Zonal boundaries adhere to natural boundaries such as rivers, and to man-made features such as roads and town boundaries, to the greatest extent possible.
4. TAZs should be small enough to adequately represent trip-making; an individual TAZ should generally generate less than 10,000 trips.

The zone boundaries and their respective TAZ numbers, for Montgomery County, the Town of Blacksburg, and the Town of Christiansburg are displayed in Figures 2-1, 2-2, and 2-3.

FIGURE 2-1

Montgomery County Transportation Analysis Zones

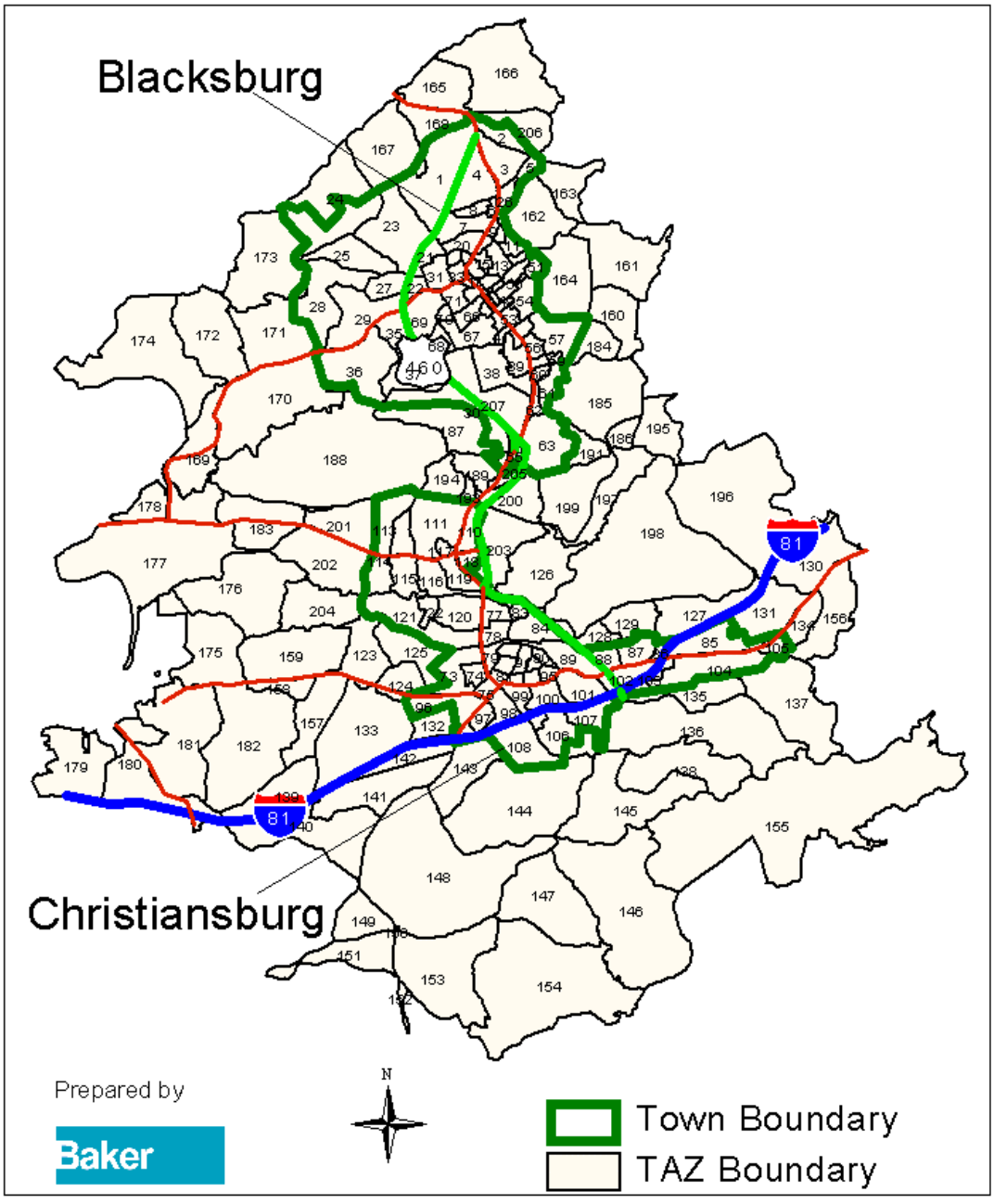


FIGURE 2-2

Town of Blacksburg Transportation Analysis Zones

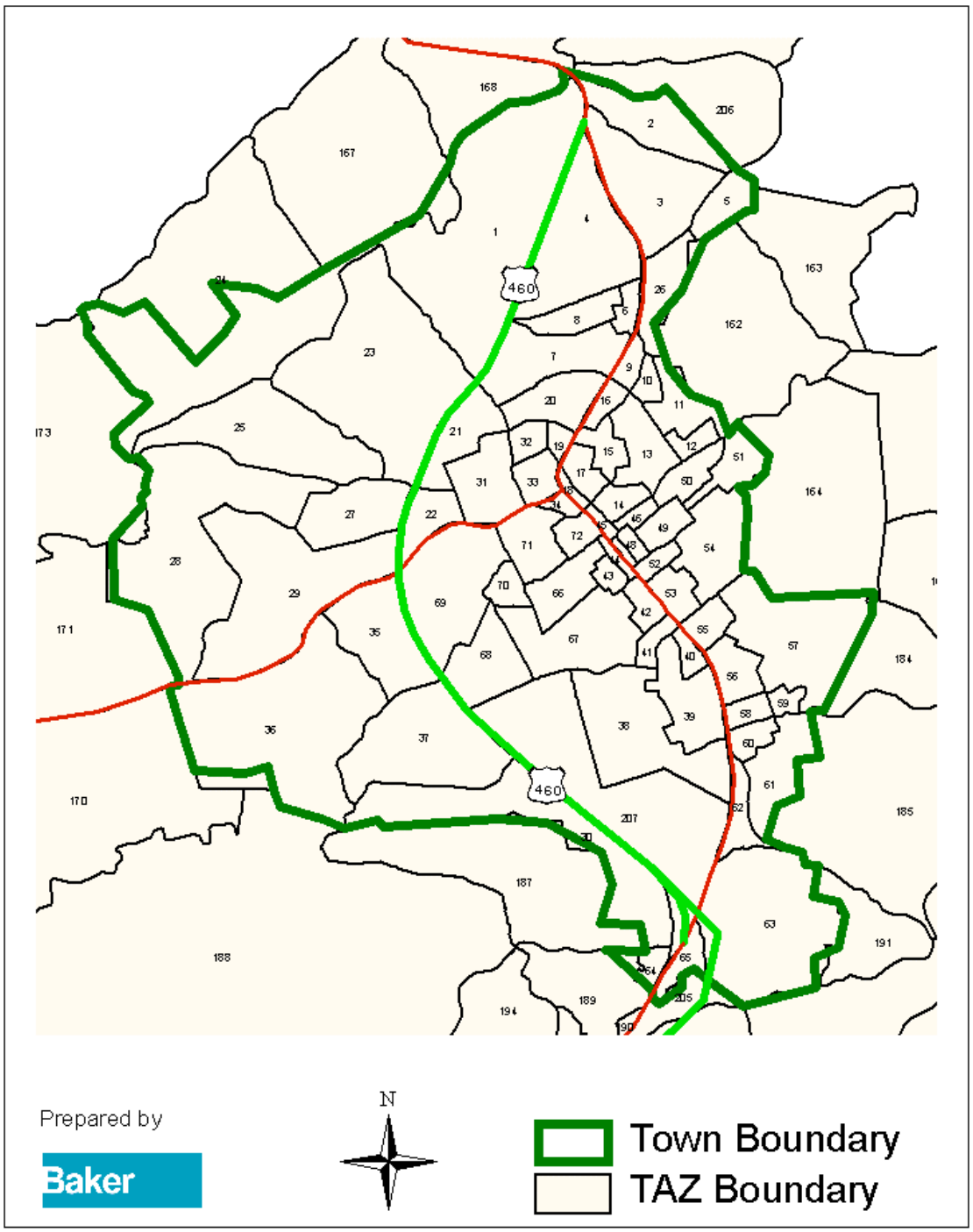
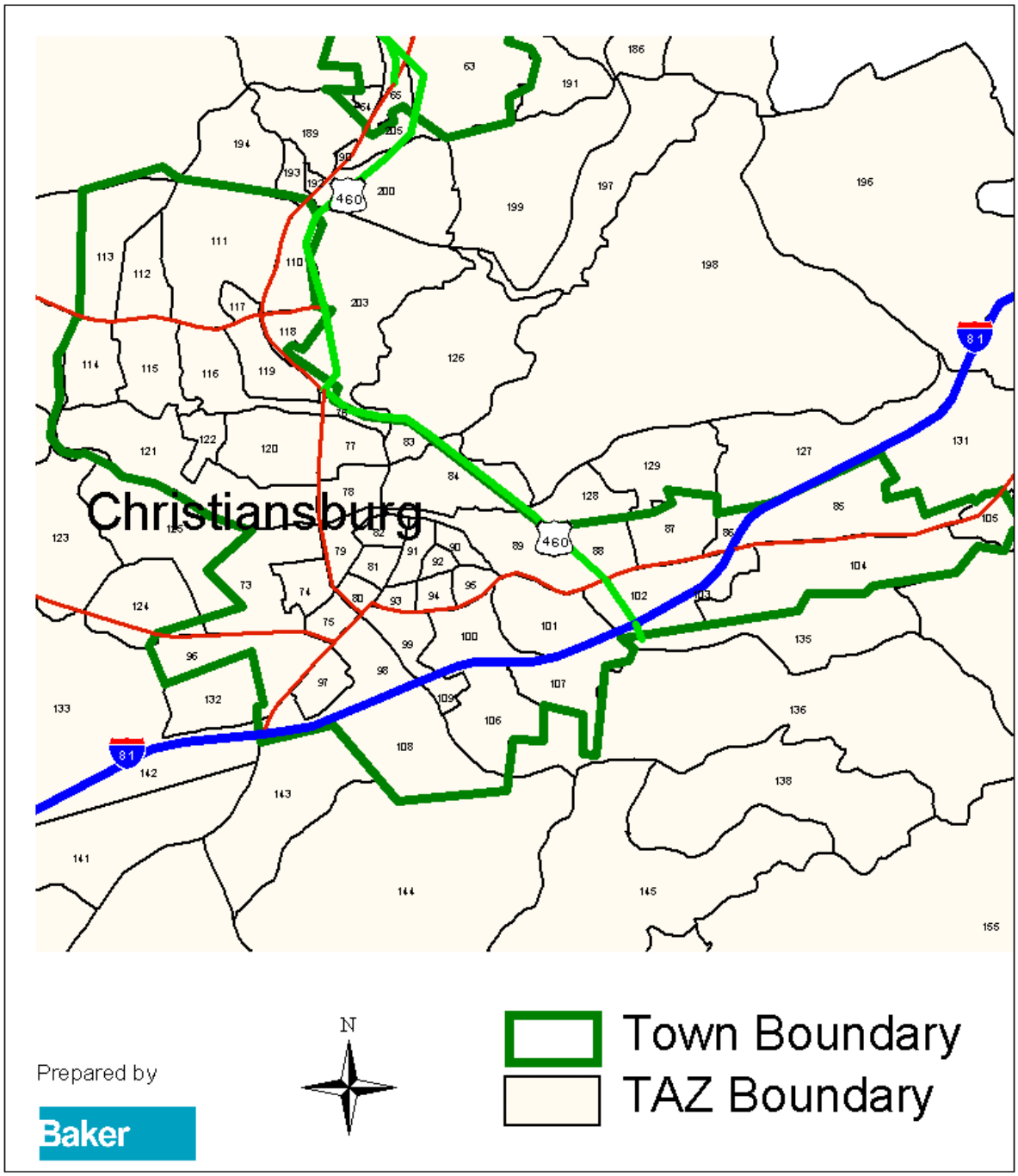


FIGURE 2-3
Town of Christiansburg Transportation Analysis Zones



2.2 SOCIOECONOMIC DATA

Socioeconomic factors are the most important driving force for traffic growth and hence the most critical variables for the transportation demand forecasting model. Land use data were initially developed in 1999 and since then, the 2000 Census was released and provided the most comprehensive and accurate data source for this 2003 model update. Another important data source is employment data from the Virginia Employment Commission. Additional data include 1995-1996 aerial photography from VDOT and data provided by the Town of Blacksburg, the Town of Christiansburg, and Montgomery County.

The first-cut TAZ-level socioeconomic data needed for the transportation demand forecast model were developed based on these data sources. This process includes gecoding and aggregation to the 2003 TAZ structure. These data were subsequently submitted for the MPO review. The MPO conducted an extensive review and revision.

The 2003 travel demand model includes the following socioeconomic variables:

- Population
- Households
- Retail Employment
- Non-Retail Employment
- Total Employment

POPULATION AND HOUSEHOLDS

Both population and households data were developed using 2000 Census statistics at the block level. In most cases, Census Blocks remained intact and were aggregated to the TAZ level. In a few instances, Census Block boundaries needed to be subdivided. Once the 2000 data at the TAZ level were generated, growth factors were applied to different jurisdictions to produce the 2003 data at the TAZ level. Upon review, the MPO made the final adjustments based on local data.

EMPLOYMENT

The Virginia Employment Commission (VEC) provided employment data that consisted of name, address, Standard Industrial Classification code (SIC), and number of employees for all businesses in Montgomery County. Based on the SIC code, the employment data were subdivided into two categories, retail and non-retail, then each employer was assigned to a TAZ using an ArcView's address match

geocoding module. The initial match rate was only 60%. The unmatched addresses were cleaned and standardized. Business establishments and their addresses were also verified through phone directories and Internet search engines. This geocoding process resulted in about 97% matching rate for all establishments. The number of employees working in each TAZ was then tabulated. The VEC data were supplemented by local data sources, for example, employment and student enrolment at Virginia Tech. Again, during the review, the MPO made the final adjustments based on local data.

Table 2-1 shows socioeconomic data summary by jurisdictions. Appendix A shows year 2003 land use data by TAZ.

Table 2-1
Base Year Socioeconomic Data Summary by Jurisdictions

	BASE YEAR -- 2003				
Jurisdiction	**Retail Employment**	**Non-Retail Employment**	**Total Employment**	**Population**	**Households**
Blacksburg	2,589	9,454	12,043	31,637	13,338
Virginia Tech	289	8,428	8,717	9,066	315
Blacksburg plus VA Tech	2,878	17,882	20,760	40,703	13,653
Christiansburg	5,131	7,296	12,427	17,697	7,409
Montgomery County	273	2,915	3,188	16,250	6,593
TOTAL	8,282	28,093	36,375	74,650	27,655

2.3 HIGHWAY NETWORK

The highway network in the travel demand model represents the principal street system as defined by the Virginia Department of Transportation (VDOT) and the Blacksburg/Christiansburg/Montgomery Area MPO. Street sections and their associated intersections are represented in the network as links and nodes respectively. The model contains approximately 1,400 nodes and 3,200 links. These links represent 100 percent of interstate and freeway facilities, principal arterials, and major collectors in the study area. The highway network has only a small portion of local roads, for the purpose of simplicity and compatibility with the TAZ size. Centroid connectors are used to represent local streets and access points within each TAZ. Each link has its own attributes, which are detailed later. As part of the process of updating the highway network, centroids and centroid connectors were modified to represent current conditions. The highway network was transformed and projected to a coordinate system, State Plan NAD 83 meters, which is consistent with the VDOT standard.

Highway Link Attributes

Table 2-2 provides a complete listing of link attributes and their definitions. All links have distances, speed classes, capacity classes, number of lanes, functional classes, area type, and street names. Speeds, distances, capacities, and number of lanes have been reviewed and, in most cases, reflect actual roadway conditions. Some links have traffic count data. Traffic count data sources include 2004 field counts, VDOT count database, estimates based on previous turning movement counts and special studies. The quality of the count data varies widely. Although the count database has been coded, cleaned and verified through multiple sources during the validation process, model users should be aware of the remaining potential uncertainties associated with the count data. Figure 2-3 shows the final highway network.

Table 2-2
Link Attribute Definitions

Attribute	*Definition*
DISTANCE	Link distance (in miles)
SPDCLASS	Free-flow speed class (see Table 2.3 for detailed definition)
CAPCLASS	Capacity class at LOS C (see Table 2.3 for detailed definition)
LANES	The number of directional lanes per link
DIR	Direction indicator—used to denote one-way or two-way facilities
FUNC	Functional class (see Table 2.3 for detailed definition)
AREA	Area type, i.e., urban commercial, suburban residential, etc…
NAME	Street name
CNT2003	24 hour traffic count data for 2003
SCREEN3	Screenline/cutline location numbers for model validation purposes

Highway Speed and Capacity

The 2003 base year network uses a speed/capacity table to assign free-flow speeds and capacities to links in the network based upon the link's functional class and area type (reflected in SPDCLASS and CAPCLASS attributes). Area types were developed from land use and zoning maps, and from field observations. Table 2-3 shows the speed/capacity table. In addition, turn penalty and turn prohibitions are imposed at some intersections to account for real and perceived travel time needed to traverse an intersection and to prevent illegal maneuvers on one-way facilities.

FIGURE 2-4
TP+ Model Highway Network

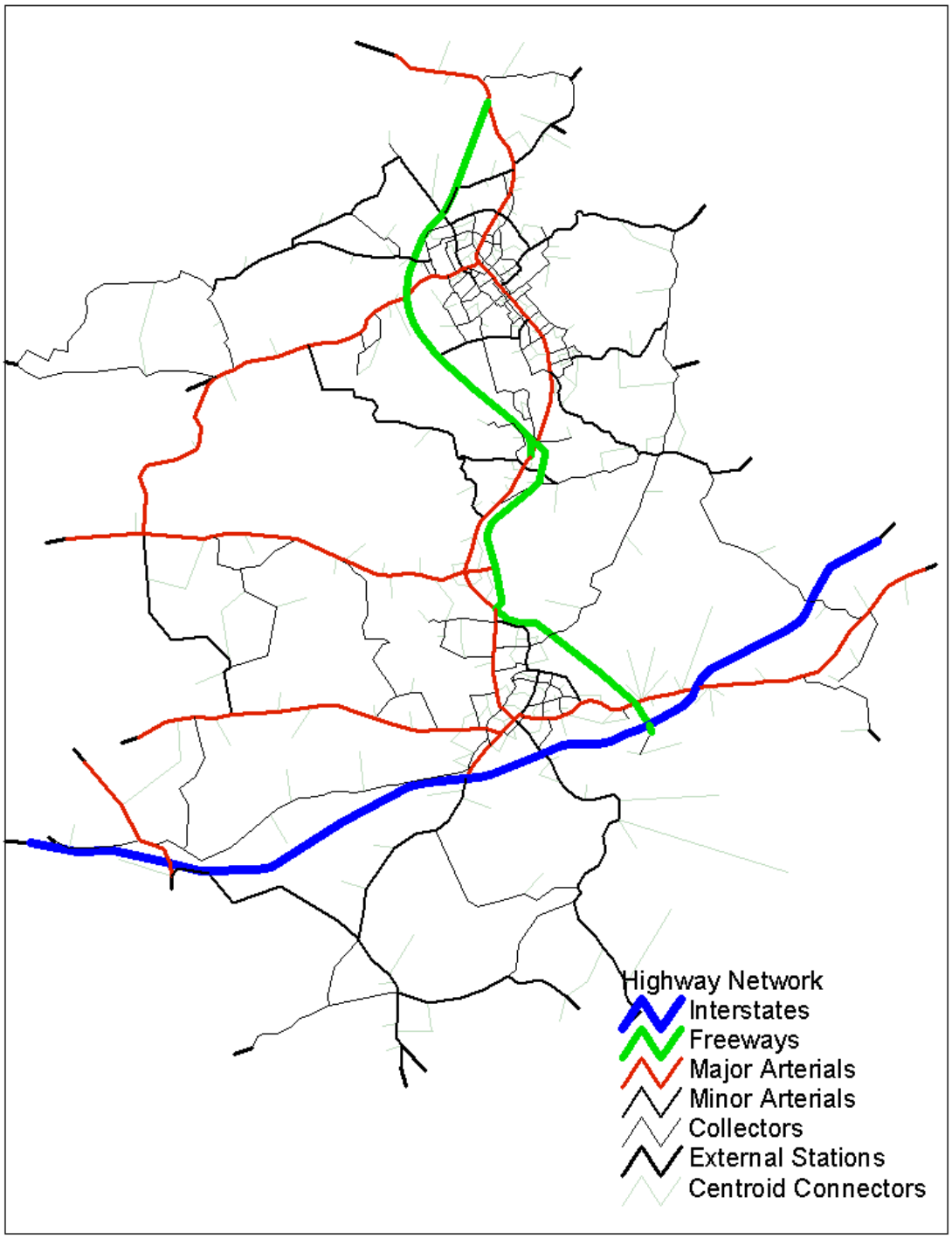


Table 2-3
Free-Flow Speed and Capacity Table

		Area Type					
		1	**2**	**3**	**4**	**5**	**6**
Functional Class	**1**	50 (1300)	55 (1300)	58 (1300)	58 (1300)	60 (1300)	65 (1300)
	2	45 (1200)	48 (1200)	50 (1200)	53 (1200)	55 (1200)	55 (1200)
	3	27 (750)	33 (750)	37 (750)	40 (1050)	45 (1100)	50 (1150)
	4	25 (700)	30 (700)	32 (700)	35 (925)	40 (950)	45 (1075)
	5	20 (350)	23 (350)	25 (350)	27 (350)	30 (350)	35 (350)

Where: XX = speed in miles per hour

(XXX) = Capacity (LOS C) in passenger cars per hour per lane

Functional Classes	***Area Types***
1 – Interstate	1 – Urban commercial
2 – Freeway	2 – Urban residential
3 – Principal Arterial	3 – University (Virginia Tech)
4 – Minor Arterial	4 – Suburban commercial
5 – Collector	5 – Suburban residential
	6 - Rural

Chapter 3
MODEL STRUCTURE AND DEVELOPMENT

3.1 Overview

The major objectives of this modeling effort are to

- Migrate model components and data associated with the existing Blacksburg/Christiansburg model from the MINUTP to TP+ platform.
- Develop socioeconomic and highway network data for the new base year 2003 and expanded modeling domain.
- Validate the 2000 base year model using traffic counts, Census 2000, Census for Transportation Planning Package (CTPP), and 2003 socioeconomic data.
- Develop a 2030 forecasting model with updated socioeconomic, land use and network data.

This 2003 Blacksburg/Christiansburg/Montgomery County travel demand model is a derivative of the 1999 Blacksburg/Christiansburg model, which was developed on the MINUTP platform. Most of the original model's methodologies remain intact, with some modifications to improve the model's operation and performance. TP+ is the software platform for this travel demand model. Traffic count data, Census 2000, updated socioeconomic, land use and network data provide a basis for model validation.

In the following sections, the model structure is described, and model components are discussed in detail. The results of model migration from the MINUTP to TP+ are summarized; the migrated TP+ model closely replicates the MINUTP model. During the validation process, a few elements in the model chain were changed, and these refinements are documented.

3.2 Model Structure

The 2003 Blacksburg/Christiansburg/Montgomery County travel demand model is a traditional travel demand forecast model consisting of trip generation, highway skim/path-building, trip distribution, time of day factoring and vehicle trip conversion, and traffic assignment (see Figure 3-1 for model structure). It is a 24-hour travel demand model. Individual model components and their key features are discussed in the following sections.

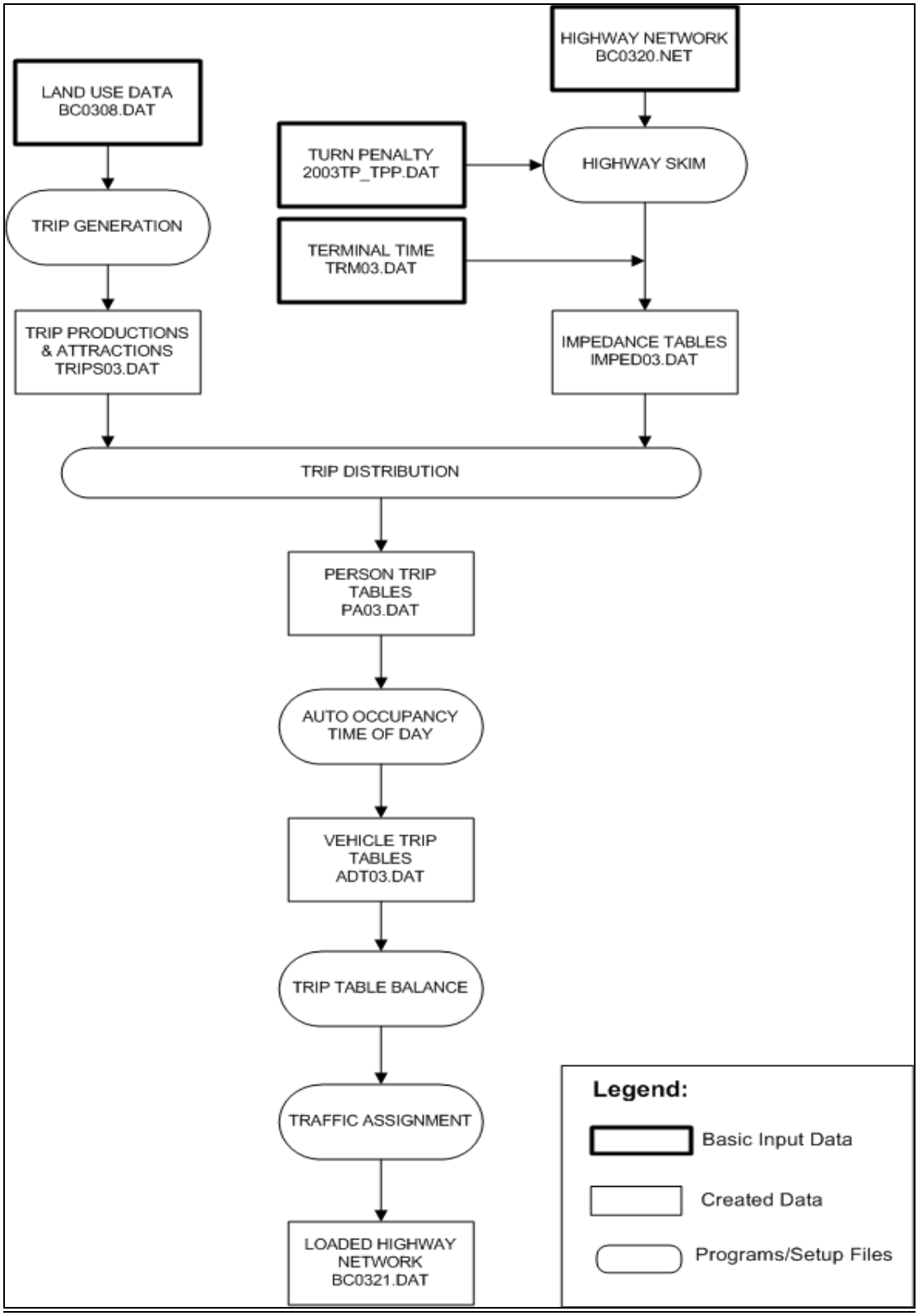


Figure 3-1. Model Structure of the Blacksburg/Christiansburg/Montgomery County MPO Model

3.2.1 Trip Generation

The trip generation step establishes the relationship between trip productions, attractions, land use, and socioeconomic characteristics of the region. The intent of this module is to estimate the magnitude of trip making for each TAZ, given its socioeconomic and land use characteristics. The trip generation model developed for the Blacksburg-Christiansburg-Montgomery County study area estimates the number of trips by trip purposes by TAZs. This trip generation model uses the following trip purposes:

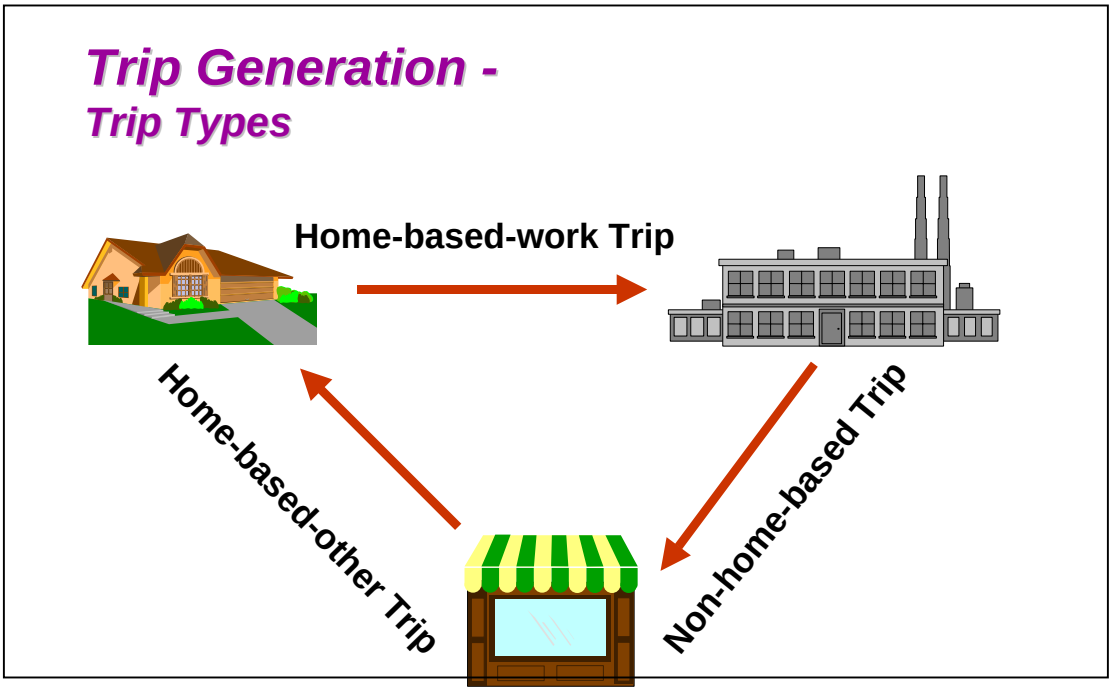
- Home-based work (HBW)
- Home-based other (HBO)
- Non-home based (NHB)
- Internal-External Trips (IX/XI)
- Through Trips (XX)

These trips by trip purposes are defined in the same way as those commonly found in traditional four-step travel demand models.

- Home-based work (HBW) - all work trips with the origin at the traveler's home or trips returning home from the traveler's workplace
- Home-based other (HBO) - a trip with one end at home and completed for a non-work purpose (i.e. shopping, school, etc.)
- Non-home based (NHB): a trip that neither begins nor ends at home.

Figure 3-2 illustrates a hypothetical "tour" (trip chain) of a traveler and the purpose assigned to each trip.

FIGURE 3-2. Definition of Trips by Trip Purposes



In this particular example, a traveler begins the journey from home and visits two different sites (work and a store) before returning home. The traveler actually accomplishes three trips: the first trip is an HBW trip; the second one an NHB trip; and the third trip is an HBO trip.

Trip chains can sometimes cause HBW trips to be underestimated. In the example above, the traveler's leaves work, and on the way home from work, makes a stop at a store. The question is whether this sequence of events should be counted as an NHB followed by an HBO trip, or whether it is really one HBW trip. For the purposes of this study, if a sequence of trips had work and home as the ultimate trip ends, and the duration of time spent at the intermediate stop was fifteen minutes or less, then the trips were collapsed into an HBW trip.

Trip generation models developed for the study area yield trip productions and trip attractions. A trip from home-to-work and another from work-to-home constitute two productions at the home end and two attractions at the work end. A non-home-based trip is the exception to this rule. These trips neither begin nor end at a traveler's home and trip ends are referred to as origins or destinations in this case.

1999 Home Interview Survey and Model Development

In the 1999 model development, a telephone home interview survey was conducted in the spring of 1999. The trip survey records covered information on origin and destination, purpose of travel, time-of-day the trip began and ended, primary mode of travel, number of vehicle occupants, and type of land use at the origin and destination. A total of 1,885 trips were recorded during the survey. Survey records were expanded to represent all trips that occur within the study area on a typical working weekday. Expansion factors were developed for each TAZ by dividing the 1999 population of the TAZ by the number of survey respondents residing in the TAZ.

Based on this home interview data, a set of regression equations was developed for estimating trip productions and attractions. Regression models assume a linear relationship between the socioeconomic variables and trip making. Trip rates were derived by trip purpose and model areas within the modeling domain. The modeling domain was divided into four separate areas: Town of Blacksburg, Town of Christiansburg, Montgomery County outside of the towns, and the Virginia Tech campus. Except for the Virginia Tech campus, separate production and attraction equations were developed for each trip purpose in each of these areas. Trip production and attraction equations are based on the following socioeconomic data for each TAZ: total population, households, retail employment, non-retail employment, and total employment. Virginia Tech was considered to be a special generator and was treated differently. IX/XI trips were estimated as proportions of productions and attractions, and the proportions varied with general

locations such as Blacksburg, Christiansburg, and Montgomery County.

2003 Model Update

A few refinements were made in the 2003 model validation, while maintaining the basic model structure. Table 3-1 shows the final trip production and attraction equations. The original stand-alone estimation procedure for Virginia Tech as a special generator was eliminated. Instead, trip production and attractions estimation is integral part of the trip generation process. Trip production rates are the same as or similar to those used for the town of Blacksburg, with adjustment factors to account for the differences between the town and the university. Adjustment factors were also used in the other areas of the modeling domain, as a result of model validation. Trip attraction equations were based on the Charlottesville model. Charlottesville is a similar urban area. Albemarle County is approximately the same size as Montgomery County, Charlottesville is approximately the same size as Blacksburg/Christiansburg, and both have large universities.

Trip Balancing

When the production and attraction models are applied, the total number of productions for a trip purpose will not necessarily equal the total number of attractions. This is a normal circumstance since, for example, HBW and HBO productions are related to household characteristics (population, number of households) while their attractions are generally estimated using other socioeconomic variables such as employment. Hence, prior to applying the trip distribution model, it is essential to balance or "normalize" productions and attractions over the modeling domain. The selection of the controlling trip end (production or attraction) mainly depends upon the level of confidence in the data source (population, households, or employment). Because we generally have a greater degree of confidence in household data (population, number of households) than we do in employment data, this usually dictates that trip totals be balanced to productions.

The recommended controls for the trip generation models are as follows:

Trip Purpose	Model Control
Home-Based Work	Production
Home-Based Other	Production
Non-home-Based	Attraction

NHB trips differ from HBW and HBO trips in that neither end of the trip is at home. They also differ in that the number of NHB productions for a given zone will be equal to the number of NHB attractions for

the same zone. And, since the attraction end is generally considered to be the best estimate of where NHB trips take place, we balance NHB trips to attractions.

Table 3-1. Trip Production and Attraction Equations

Areas	Trip Purposes	Productions	Attractions
Blacksburg	HBW	P=1.63*HH*Wadj	A=1.421*TEMP
	HBO	P=3.51*HH*Oadj	A=2.71*HH
	NHB	P=6.41* NREMP	A=3.59* NREMP*Nadj
Christiansburg	HBW	P=0.599*Pop*Wadj	A=1.421*TEMP
	HBO	P=1.39*Pop*Oadj	A=4.43*REMP
	NHB	P=1.22*Pop	A=0.818*TEMP
Montgomery County	HBW	P=0.907*HH*Wadj	A=1.421*TEMP
	HBO	P=5.39*HH*Oadj	A=1.87*NREMP
	NHB	P=1.36* NREMP	A=0.34*NREMP
VA Tech	HBW	P=1.63*HH*Wadj	A=1.421*TEMP
	HBO	P=1.48*POP *Oadj	A=1.004*Enrol*TEMP/TOTEMP+ 9.789*REMP+0.654*NREMP+ 0.622*HH
	NHB	P=6.41* NREMP	A=0.5*Enrol*TEMP/TOTEMP +1.43*REMP+0.504*NREMP+ 0.884*HH

Notations:

HH=Households

Pop=Population

REMP=Retail Employment

NREMP= Non-Retail Employment

TEMP= Total Employment

ENROL=total enrollment at VA Tech

TOTEMP=total employment at VA Tech

Wadj=HBW adjustment factor

Oadj=HBO adjustment factor

Nadj=NHB adjustment factor

3.2.2 Trip Distribution

The trip distribution model estimates travel between transportation analysis zones (TAZs) using the productions and attractions generated by each TAZ, as well as impedance between each pair of TAZs. In this trip distribution process, a standard gravity model formulation is used for each trip purpose. No K factors were used in the trip distribution process to account for travel behavior that the model did not directly measure.

Data used by the gravity model include:

- Trip Ends - developed by the trip generation model for each trip purpose (production and attraction trip ends to be "connected").

- Friction Factors - used to determine the probability of spatial interaction given a specific trip type and the travel time between two given zones. In the 1999 model development process, friction factors were developed, based on the 1999 Home Interview Survey and an iterative procedure reported in NCHRP 365. The goal of the iterative procedure is to successively modify the friction factors until the model trip length frequency (TLF) matches the observed TLF. Observed and estimated numbers of trips (T) were used to modify the friction factors F at each iteration *i*, for a specific time interval *t*:

$$F_t^{i+1} = F_t^i * (T_t^{obs} / T_t^i)$$

  The 1999 model friction factors for HBO and NHB were directly used in this model, and HBW friction factors were adjusted, based on the 2000 Census data. Table 3-2 shows the final friction factors that resulted from this process. The numbers in the table measure the likelihood that a trip of a particular purpose and duration will be made.

- Highway Travel Times - travel times provide a measure of spatial separation between TAZs. Highway travel time includes zone-to-zone travel time and terminal time. Zone-to-zone travel times (free-flow and congested) are derived from the 2003 base year network. Assumptions with regard to terminal times are as follows: two minutes for Town of Blacksburg, Town of Christiansburg and Virginia Tech zones, one minute for zones in the rural part of Montgomery County, and zero minutes for the external stations.

- Intrazonal Travel Times - intrazonal travel time, for any given TAZ, is assumed to be 50% of that TAZ's travel time to its nearest TAZ neighbor.

Table 3-2 Final Friction Factors

Time (minutes)	HBW	HBO	NHB
1	0	5530	4140
2	0	5440	4100
3	11100	5330	4040
4	11100	5200	3980
5	11100	5030	3920
6	11100	4430	1820
7	11100	1560	850
8	10550	800	390
9	9600	410	250
10	8350	200	210
11	6800	170	150
12	5420	130	110
13	4280	80	70
14	3570	60	65
15	2880	50	60
16	2400	40	40
17	2020	20	30
18	1830	10	30
19	1700	0	30
20	1520	0	28
21	1370	0	22
22	1100	0	0
23	920	0	0
24	620	0	0
25	340	0	0
26	230	0	0
27	110	0	0
28	60	0	0
29	40	0	0
30	0	0	0

3.2.3 Auto Occupancy

Once person trips have been estimated for the different trip purposes, they need to be converted to vehicle trips. In addition, trips that enter or leave the region (internal-external) are added to the internal trip tables. These internal-external trips are already in vehicle trip format and do not need to be converted. The final step before highway assignment is a trip balancing process that converts productions and attractions to origins and destinations.

To convert motorized person trips to vehicle trips, the model procedure uses auto occupancy rates, or the ratios of person trips to auto vehicle trips. This conversion is only applied to the three internal trip purposes and then added to the external-internal trip tables (vehicle trips) in preparation for traffic assignment. Table 3-3 shows the auto occupancy rates for the Blacksburg / Christiansburg model as developed from the local home interview survey, which was conducted in the spring of 1999.

TABLE 3-3
Auto Occupancy Rates

Source	HBW	HBO	NHB
1999 Blacksburg / Christiansburg	1.05	1.31	1.63
1990 NPTS	1.11	1.67	1.66

Trip tables produced by the model chain are in production and attraction (P/A) format. These tables represent trip-making over a 24-hour period for all trip purposes. The highway trip tables must be translated to origin-destination (O-D) format before they can be assigned to the network. This procedure is referred to as trip balancing. The assumption is that daily trips have a directional balance. For example, someone who leaves their home for work in the morning, and makes no other trips during the day, will return home from work in the evening.

3.2.4. Trip Assignment

The final step in the development of the traffic model is the assignment of vehicle trip tables to the highway network. The model uses an equilibrium assignment process, with a capacity restraint algorithm to assign traffic to the highway network. Capacity restraint algorithms differ by the speed of facility.

The highway assignment in this model utilizes the Bureau of Public Roads (BPR) function, the most commonly used formula in travel demand forecast models, and its modified forms. This formula is a function of the volume-to-capacity ratio of a roadway segment and free-flow speed/time. The parameters for BPR functions have been updated in different urban areas to obtain better traffic assignments or speed estimations. One common modification is to change the formula's coefficient and exponent with respect to the speed class for the facility. Interstates and freeways, which generally have posted speed limits between 50 and 65 miles per hour, typically represent an over assignment of traffic by the model if the formula is the same as lower facility types. Table 7.2 shows the volume-delay functions used by the Blacksburg-Christiansburg-Montgomery County model.

TABLE 3-4
Volume Delay Function Equations

Facility Type	Speed Range	VDF Equation
Interstates and Freeways	50 – 65 MPH	Tc = T0 (1 + 0.30(V/C)^7)
Freeways and Principal Arterials	40 – 50 MPH	Tc = T0 (1 + 0.30(V/C)^6)
Principal and Minor Arterials	30 – 40 MPH	Tc = T0 (1 + 0.30(V/C)^5)
Minor Arterials and Collectors	20 – 30 MPH	Tc = T0 (1 + 0.15(V/C)^4)

Notes: Tc=congested time; T0 = free-flow time; V= volume; C= capacity at LOS C

3.2.5 Model Data and Files

The model set consists of model programs, input data files and output data files. Model programs are all TP+ scripts, which contain the commands, the input specifications, parameters, and output designations for the models. These programs are a sequential process, composed of four major components: trip generation, highway skim, trip distribution, and trip assignment. See Appendix B for scripts.

Major data files are named BC03XX.Y00 (year 2000) or BC30xx.Y30 (year 2030), where XX is a 2 or 3-character identifier, as follows:

08 = land use
20 = unloaded highway network
21 = loaded highway network (daily trips)

Besides land use and network files, input files also include:

2003TP_TPP=turn penalty file
TR03.DAT=terminal time
BB0309_TPP.DAT= the friction factors file

Besides loaded network file, major output files also include:

BCTrips.DAT = trip ends
IMPED03.DAT = highway travel time and distances matrices, including terminal times
PA03.DAT = person trip tables
ADT03.DAT = vehicle trip tables

3.3 Model Migration

The 1999 Blacksburg/Christiansburg model is a MINUTP-based sequential process, composed of trip generation, highway skim/path-building, trip distribution, time of day factoring and vehicle trip conversion, and traffic assignment. In the first stage of model development, the 1999 MINUTP model was migrated to the TP+ platform. The TP+ model retains the same structure. That is, each of the MINUTP components was translated into its counterpart in TP+. The conversion was verified, based on the results from the comparisons between the models.

Trip Generation

No changes were made in the migration process, except that TP+ uses real numbers as opposed to integers used in the MINUTP. This difference contributed to the differences in the production and attraction results. Overall, the differences are less than 0.2%. For individual TAZs, there are some differences for IX/XI trips that result from the rounding errors.

Highway Skim/Path-building

The 1999 MINUTP network contains approximately 1,278 nodes (excluding centroids and external stations) and 1,645 links. Link attributes include federally designated functional classification, posted speed, capacity, street name, area type, number of lanes, length (in miles), and directional data (indicating if the link accommodates one-way or two-way traffic). The MINUTP network was converted to a TP+ highway network file without any change. As a result, both network files are identical in terms of the link records.

Based on the highway network, speed look-up table, terminal time, and intra-zonal time, the skims of free-flow time and distance were generated. These skims were compared with those created from the MINUTP model. In general, the differences between the MINUTP version and TP+ are not significant. Specifically, 11 TAZ's (3,7,21,24,38,39,61,91,139,145,152) were selected to compare the travel time, distance and average speed. The results show that the ratios of distance from TP+ to that from MINUTP are all 1.00 and the ratios of time are close to 1. The relative and absolute differences of time are very small.

Trip Distribution

The MINUTP trip distribution procedure was converted to TP+ without any change, except for the fact that TP+ uses real numbers as opposed to integers used in the MINUTP. Trip distributions were done for 6 trip purposes: HBW, HBO, NHB, XX, XI, and IX.

The total trips by trip purposes are almost identical to the MINUTP results. The intra-zonal totals are close to the MINUTP output with less than 1 percent difference overall, but have some minor differences by trip purposes. The ratios range from 0.93 to 1.03. Trip length values are close between TP+ and MINUTP results, with 1 percent difference. The relative differences range from –7% to 3% for different trip purposes.

Trip interchanges by trip purposes for selected pairs of TAZs were extracted to compare with the MINUTP counterparts. The absolute differences are minor.

Vehicle Trip Conversion

As noted earlier, auto occupancy rates for the Blacksburg / Christiansburg model were developed from the local home interview survey conducted in the spring of 1999. These rates were used to convert person trips to vehicle trips. The original MINUTP script used time of day factors to create AM and PM trip tables, although these tables were not used in the later process. Nevertheless, this factoring element is converted to TP+.

Balanced trip interchanges by trip purposes for selected pairs of TAZs were extracted to compare with the MINUTP counterparts. The absolute differences are minor.

Traffic Assignment

Equilibrium process was used to assign vehicle trips to the highway network. Assignment results are summarized for the pre-defined screenlines/cutlines and compared with the MINUTP results. The difference is overall 3%, ranging from –5% to 7% for individual screenlines/cutlines. The TP+ simulated total screenline volume is 1.7% higher than observed volume from the traffic count, the same magnitude of difference as the MINUTP model results.

Overall, the migration from the initial MINUTP to TP+ platform is mechanically verified, yielding similar demand by trip purposes and roadways as in the original MINUTP model.

Chapter 4
MODEL VALIDATION

4.1. VALIDATION BENCHMARKS

Federal agencies such as the Environmental Protection Agency (EPA) and the Federal Highway Administration (FHWA) issue reports and guidelines about measures and allowable margins of error for travel demand model validation. These guidelines include: "Model Validation and Reasonableness Checking Manual" (FHWA, 2001) and National Cooperative Highway Research Program (NCHRP) Report 365, "Travel Estimation Techniques for Urban Planning" (Transportation Research Board, 1998). Based on these reports, the following guidelines are used for model validation:

1. Home Based Work (HBW) Trips are within 5% of comparable trips from the CTPP.
2. Simulated trip length frequency distributions (TLF) are similar to the observed TLF distributions.
3. Regional Relative VMT error is under 5%: (Estimated VMT-Observed VMT)/Observed VMT.
4. Relative volume error--assigned traffic volume versus traffic count volume:
    - Freeways <7%,
    - Principal arterials <10%,
    - Minor arterials <15%,
    - Collectors <25%
5. Screenline/cutline
    - Screenline/Cutline Analysis (Assigned traffic vs. Observed traffic).

4.2. VALIDATION RESULTS

4.2.1 Socioeconomic Data

Socioeconomic data are an important element of the travel demand modeling process. They are used in the trip generation step. Table 4-1 shows a summary of population, households, and employment data by jurisdictions.

Table 4-1: Summary of Base Year (2003) MPO Study Area Land Use

Locality	Total Population	Households	Total Jobs	Retail Jobs	Non-Retail Jobs
Blacksburg*	31,637	13,338	12,043	2,589	9,454
Virginia Tech	9,066	315	8,717	289	8,428
Blacksburg + VA Tech	40,703	13,653	20,760	2,878	17,882
Christiansburg	17,697	7,409	12,427	5,131	7,296
Montgomery County*	16,250	6,593	3,188	273	2,915
MPO Region Total	74,650	27,655	36,375	8,282	28,093

* The Blacksburg data reported here do not include Virginia Tech. Montgomery County data are for the portion of the County within the modeling domain boundary but outside of the towns of Blacksburg and Christiansburg. Total County population and households were respectively 83,629 and 31,054 in 2000.

As discussed in Chapter 2, Baker initially prepared the base year socioeconomic data, based on 2000 Census and Virginia Employment Commission (VEC) data. The MPO conducted an extensive review of the initial data and made the final adjustments based on local data. The current version used in the base year model was approved by the MPO on February 15, 2005.

Some demographic indicators are compared with the national data in Table 4-2. The demographic indicators for the study area seem to be within reasonable bounds. Average household size for Blacksburg, Christiansburg, Montgomery County as well as the modeling domain is lower than the national average, which may be attributed to the presence of non-group quarter students in the general population. Workers per household for the whole Montgomery County are in line with the national average in 2000, which is slightly lower than the job-household ratio in the modeling domain. The towns of Blacksburg and Christiansburg are job-rich employment centers. Montgomery County has a higher number of vehicles per household than the 2000 national average.

Table 4-2: Demographic Indicators

	Persons per Household	Workers per Household (Jobs-HH Ratio)	Vehicles per Household
Blacksburg 2003	2.37	(1.52)	(NA)
Christiansburg 2003	2.39	(1.68)	(NA)
Montgomery County 2003	2.46	(0.48)	(NA)
MODELING DOMAIN 2003	2.40	(1.32)	(NA)
Montgomery County 2000	2.40	1.23	1.92
NPTS 1990 Nationwide	2.56	1.27	1.77
NPTS 1995 Nationwide	2.63	1.33	1.78
NPTS 2001/Census 2000	2.59	1.22	1.69

* Virginia Tech is not included in the calculations of household size for Blacksburg and the modeling domain.

4.2.2 Trip Generation

Table 4-3 shows the results from the trip generation model. Overall, trip generation indicators are in line with national averages. Motorized person trips per household are slightly higher than the 1990 national average. The model produces 9.6 person trips per household for all internal passenger travel, while 1990 average daily person trips per household were 9.2 for urbanized areas with 50,000-199,999 people (NCHRP 365). Variations in motorized trip rates per household are wide, as the NCHRP 365 reports trip rates ranging from 8 to 14. This wide variation may be caused by household sizes, geographical characteristics and other factors. Person trips per capita eliminate the impact of household sizes. The National Personal Travel Survey (NPTS) reported 4.3 average daily person trips per capita in 1995 and 4.1 in 2001. Walk trips accounted for 8.6% of daily trips in 2001, and thus motorized daily person trips per capita averaged roughly 3.73 in 2001. This model generates 3.56 person trips per capita, which is close to the national average.

Table 4-3 also shows the percentage of trips by purposes for residents inside the modeling domain. Home-Based-Other (HBO) trips are a predominant trip purpose, accounting for over fifty percent of total passenger trips. The second largest trip purpose is NHB with about twenty five percent, followed by HBW trips, which account for approximately twenty three percent of the trips. The shares of trips by purposes are in the reasonable range, compared with similar sized areas in the country as reported in NCHRP 365.

Table 4-3: Trip Generation Statistics

MOTORIZED TRIPS by TRIP PURPOSES		Percent	% Average Trips in 1990 *	Person Trips Per HH	Person Trips Per Capita
HBW	60,830	22.9%	20%	2.20	0.81
HBO	139,456	52.5%	57%	5.04	1.87
NHB	65,269	24.6%	23%	2.36	0.87
SUBTOTAL	**265,555**			**9.60**	**3.56**
External Vehicle Trips					
I-X	63,171				
X-I	63,171				
X-X	24,102				
NPTS 2001					**3.7**

*for urban areas with population between 50,000 and 199,999, based on 1990 data (NCHRP 365).

HBW trip productions are also compared with estimated trips based on the 2000 CTPP data. It was estimated that there were roughly 58,778 HBW trips in 2000 based on the 2000 CTPP data, and in 2003 HBW trips would increase to 61,854. HBW productions for the modeling domain total 60,830. The

difference between CTPP estimates and modeled productions is within the 5% threshold.

4.2.3 Trip Distribution

Benchmarks used in this validation process include:

- Average trip length by trip purpose
- Trip length frequency distribution by trip purpose
- Comparison with previous model validation

It should be noted that there is no exactly comparable data set available. The 1999 home interview survey data represent the sampled drivers' (not households') travel behavior in 1999. Because it surveyed only one driver in a household, it may be biased for the purpose of modeling household travel behavior. In addition, this model has a new base year (2003) and an expanded modeling domain. The new areas included in the current modeling domain are mostly rural areas, and evidence suggests that rural travelers tend to have longer trips than urban travelers. There is also evidence that trip length has been slightly increasing over the years. CTPP data show that average commuting times have increased by two minutes between 2000 and 1990 for Montgomery County.

Therefore, it is more important to discuss the relative magnitudes rather than absolute differences between the model validation results and previous survey results. Table 4-4 shows average trip length by trip purposes. As can be seen, average trip lengths for this 2003 model are slightly higher than the observed trip lengths for all trip purposes except for NHB in 1999. The difference is small for trip lengths for NHB. These results seem reasonable, considering the relative magnitude and direction of change and the caveats previously discussed.

Table 4-4: Average Trip Length by Trip Purposes

Trip Purpose	Observed 1999	Modeled 2003
HBW	10.39 minutes	11.31 minutes
HBO	7.81 minutes	9.47 minutes
NHB	7.43 minutes	7.24 minutes

Similarly, there are some differences in the shapes of trip length frequency distributions between modeled results and observed data. Figures 4-1 to 4-3 show trip length frequency distribution by trip purposes and periods. The overall shapes for HBW and HBO reflect longer trips for this model validation than those in the 1999 survey data and MINUTP model. The trip length frequency distribution for NHB trips from this validation is close to those observed and estimated in the 1999 model validation.

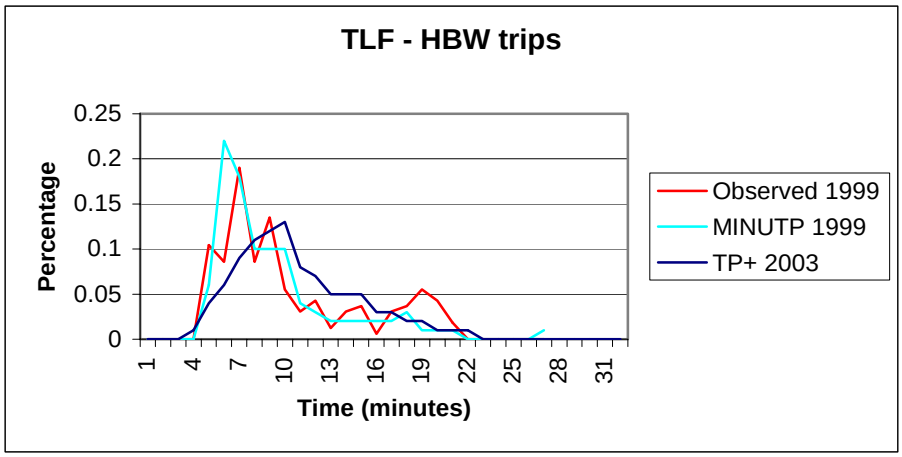


Figure 4-1. HBW Trip Length Distribution

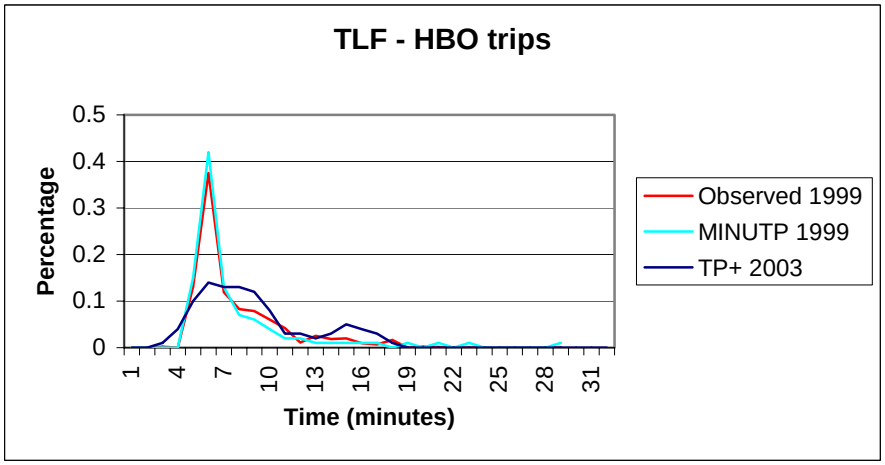


Figure 4-2. HBO Trip Length Distribution

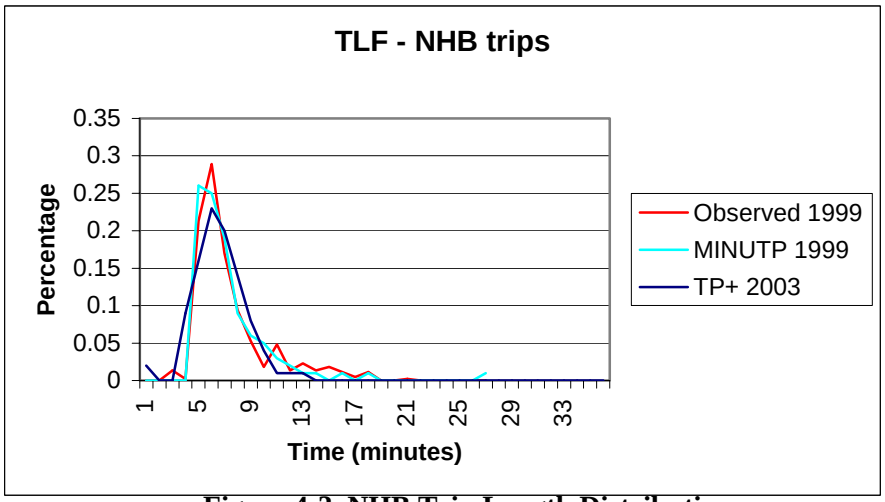


Figure 4-3. NHB Trip Length Distribution

4.2.4 Auto Occupancy

As a reasonableness check, model auto occupancy rates were compared to rates from the Nationwide Personal Transportation Study (NPTS) conducted in 1990, for urban areas with populations between 50,000 and 199,999 (see Table 3-3). The HBW and NHB rates for Blacksburg / Christiansburg match the 1990 national rates very closely. The 2001 National Household Travel Survey reported auto occupancy rate of 1.1 for HBW, which is close to that used in the model. The HBO rate is a little bit low. But one must keep in mind that the NPTS rates are national averages, and locally collected data is generally regarded to be more reflective of local conditions than nationally collected data.

4.2.5 Traffic Assignment

Traffic count data are used to compare observed versus estimated traffic volumes, and VMT values are calculated using traffic volumes and link distance for all links with counts and for pre-defined screenlines/cutlines. It should be understood that there is inherent error in the traffic data collection process. "*Traffic volumes vary greatly by season and by day of the week. Count errors can be caused by variation in the mix of vehicles in the traffic stream. Regularly occurring local events, special events, and accidents can distort the counts on large portions of the highway system. Errors can also be due to mechanical counter failure, field personnel mistakes, or improper counter location*." (FHWA 1990). The uncertainty of data quality for these locations contributes to the overall relative error.

The sources of the traffic count data used in the validation process are from the field tube counts in 2004, published counts and count databases from Virginia Department of Transportation and from special studies. In many cases, the traffic count data are not real counts but factored data, i.e., an actual traffic count taken from an earlier year or years ago was multiplied by a growth factor to derive the 2003 count. The 2004 tube counts were factored to 2003, and so were the 1999 tube counts from the last model validation. Counts used in the last model validation also included counts dated back to 1993/1995 and some turning movement counts; these counts are deemed unreliable and not used in this model validation.

Screenlines and cutlines were created to assess major traffic movements in the modeling domain. Screenlines extend across the whole modeling domain, while cutlines extend across a corridor. Model volumes are compared to ground counts for all roadways bisected by the cutline/screenline to determine if the modeled traffic flowing across the cutline/screenline is representative of the count data. Figure 4-5 shows the location of screenlines and cutlines in the modeling domain.

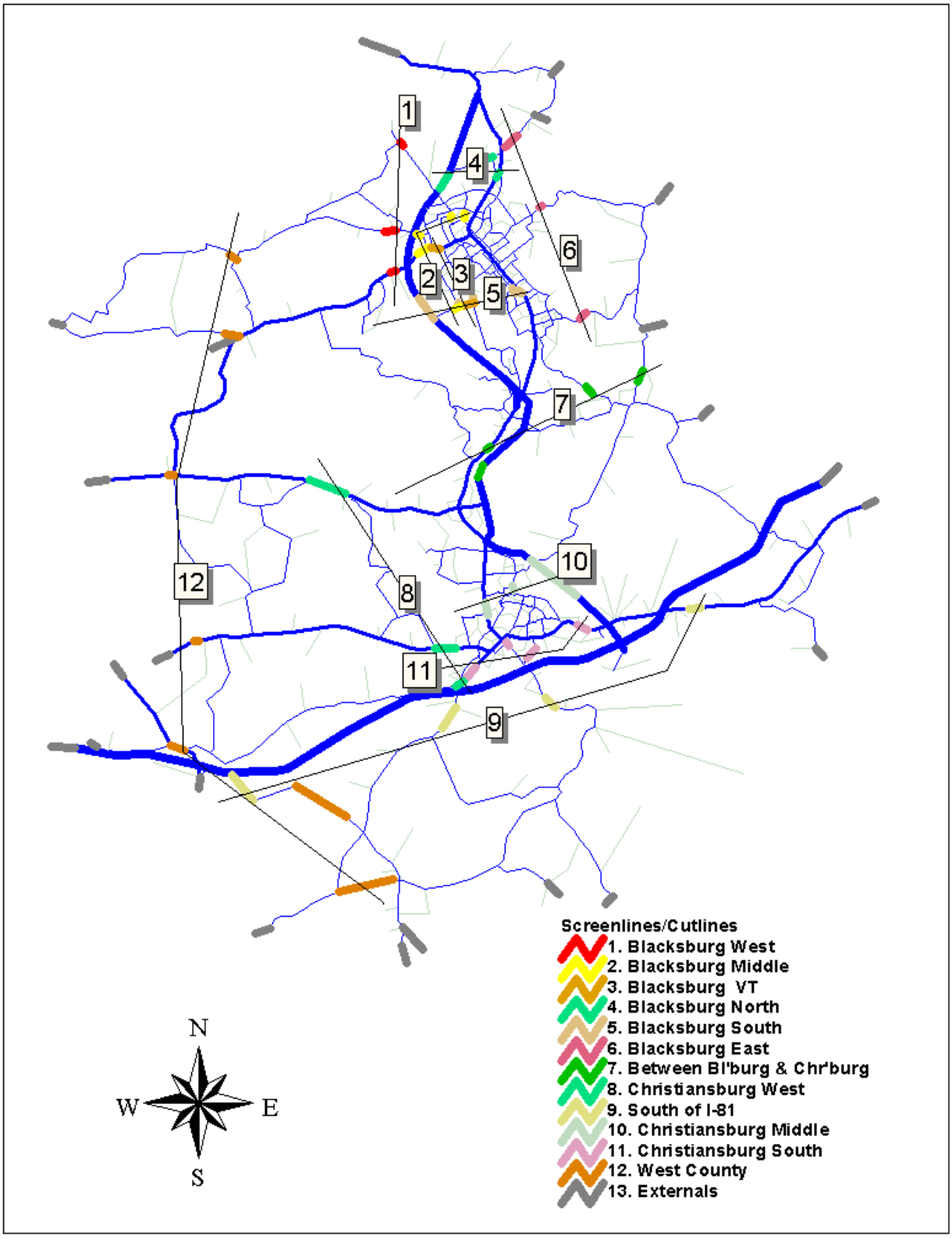


Figure 4-5. Screenline and Cutlines

Table 4-6 shows simulated volumes and relative assignment errors in comparison with observed traffic volumes by facility types at all traffic count locations. Table 4-7 shows simulated volumes and relative assignment errors in comparison with observed traffic volumes by facility types for the model screenlines/cutlines. As can be seen, the simulated traffic volumes are slightly higher than the observed traffic volumes for these locations as a whole. The overall relative errors are 0.2% for all count locations and 1.9% for screenline locations, which are within the benchmark of 5%. Similarly, simulated VMT distributions by facility types are within a reasonable range of the observed VMT distribution at both regional and screenline level (see Table 4-8 and Table 4-9 respectively).

Table 4-6. Simulated Versus Observed VOLUMES at All Traffic Count Stations

Facility Type	Simulated Volume	Observed Volume	Difference	% Error	Benchmark
Interstate & Freeway	321,981	306,997	14,984	4.88%	±7%
Principal Arterial	755,834	763,509	-7,675	-1.01%	±10%
Minor Arterial	253,899	230,581	23,318	10.11%	±15%
Collector	150,077	176,999	-26,922	-15.21%	±25%
Total	**1,481,790**	**1,478,086**	**3,704**	**0.25%**	

Table 4-7. Simulated Versus Observed VOLUMES at Screenlines/Cutlines

Facility Type	Simulated Volume	Observed Volume	Difference	% Error	Benchmark
Interstate & Freeway	110,562	106,041	4,521	4.26%	±7%
Principal Arterial	244,604	251,470	-6,866	-2.73%	±10%
Minor Arterial	97,739	89,050	8,689	9.76%	±15%
Collector	35,629	32,551	3,077	9.45%	±25%
Total	**488,534**	**479,113**	**9,421**	**1.97%**	

Table 4-8. Simulated versus Observed VMT at All Traffic Count Stations

Facility Type	Observed VMT	Simulated VMT	Difference	% Error	VMT Distribution	
					Simulated	Observed
Interstate & Freeway	156,029	161,458	5,429	3.48%	40.60%	39.87%
Principal Arterial	153,478	159,550	6,072	3.96%	40.12%	39.22%
Minor Arterial	50,296	52,017	1,721	3.42%	13.08%	12.85%
Collector	31,548	24,664	-6,884	-21.82%	6.20%	8.06%
Total	**391,351**	**397,689**	**6,338**	**1.62%**	**100.00%**	**100.00%**

Table 4-9. Simulated versus Observed VMT at Model Screenlines/Cutlines

Facility Type	Observed VMT	Simulated VMT	Difference	% Error	VMT Distribution	
					Simulated	Observed
Interstate & Freeway	55,252	58,985	3,733	6.76%	14.83%	14.12%
Principal Arterial	49,936	48,320	-1,616	-3.24%	12.15%	12.76%
Minor Arterial	18,816	18,262	-554	-2.94%	4.59%	4.81%
Collector	5,069	4,377	-692	-13.65%	1.10%	1.30%
Total	**129,073**	**129,944**	**871**	**0.67%**	**100.00%**	**100.00%**

Another measure for evaluating assigned traffic volumes is the Percent Root Mean Square of Error (RMSE), which measures deviation between simulated and observed traffic volumes weighted by observed traffic volumes. Percent RMSE is defined as follows:

$$\%RMSE = ((\Sigma_j (Model_j - Count_j)^2 / (Number\ of\ Counts - 1))^{0.5} * 100) / (\Sigma_j Count_j / Number\ of\ Counts)$$

A lower percent RMSE indicates a better validated model. In a perfectly validated model, the percent RMSE would be zero, indicating no error in every link with observed traffic counts. The percent RMSE values depend on the size of the modeling domain, the quality of the traffic count database, as well as the validity of the model. Current modeling practice indicates a very good validation if RMSE is below 30 percent for a regional model, while regional models for some large urban areas have RMSE errors larger than 40 percent.

Table 4-10 shows percent RMSE by facility types for all count locations and the model screenlines/cutlines and also gives examples for percent RMSE from other regional travel demand models. When compared to other models, the Blacksburg-Christiansburg-Montgomery County area model shows good results in terms of %RMSE by facility types for screenline locations and all count locations. The screenline portion of the model performs better than the modeling domain as a whole.

Table 4-10: Percent RMSE by Facility Types

Facility Type	Blacksburg All Count % RMSE	Blacksburg Screenline % RMSE	Harrisonburg All Count % RMSE	Harrisonburg Screenline % RMSE	Richmond All Count % RMSE	Hampton All Count % RMSE
Interstate & Freeway	13.45	13.64	8.02		19.7	17.27
Principal Arterial	25.21	11.40	22.01	20.89	32.1	58.85
Minor Arterial	36.47	36.72	37.09	28.62	50.5	29.66
Collector	57.53	73.95	55.36	54.70	87.3	40.35
Total	**29.52**	**20.33**	**33.85**	**27.23**	**43.7**	**32.77**

Table 4-11: Observed versus Simulated Volumes for Model Screenlines/Cutlines

Screenline/Cutline	Observed Volume	Simulated Volume	Percent Difference	% RMSE
1. Blacksburg West of RT460	30,942	32,301	-4.21%	5.34
2. Blacksburg Middle Section	58,698	59,281	-0.98%	26.51
3. Blacksburg West of VT	32,299	31,737	1.77%	23.86
4. Blacksburg North	24,440	24,055	1.60%	38.66
5. Blacksburg South	65,743	64,806	1.45%	30.49
6. Blacksburg East	8,957	8,144	9.98%	21.88
7. Between Blacksburg & Christiansburg	60,638	54,840	10.57%	17.04
8. Christiansburg West	26,775	27,976	-4.29%	6.69
9. East-West South of I-81	**26,521**	**29,064**	-8.75%	20.27
10. Christiansburg Middle	69,995	63,696	9.89%	15.68
11. Christiansburg South	40,938	38,847	5.38%	15.23
12. West County	42,589	44,364	-4.00%	21.89
13. External Cordon	174,566	174,545	0.01%	1.71
Grand Total*	663,100	653,658	1.44%	**18.03**

*Grand Total includes external station volumes in the calculation.

Overall, the model produces reasonably good results that closely match the observed volumes at the screenlines/cutlines and greatly surpass benchmarks and deviations. Table 4-11 shows the observed versus simulated volumes for the model screenlines/cutlines. The relative percentage error is about 1.4 % for all the screenlines/cutlines together.

The coefficients of determination (R^2) indicate how well correlated the simulated and observed volumes are. The coefficients of determinations (R^2) comparing assigned and counted link volumes are 0.96 and 0.99 for the entire model and the screenlines/cutlines, respectively, well above the benchmark of 0.88. Figures 4-6 and 4-7 show assigned versus observed volumes for all counted links in the modeling domain and for the screenlines/cutlines, respectively.

In comparison with the 1999 MINUTP model, this 2003 model validation has produced results that are better than or very similar to the performance of the original 1999 MINUTP models.

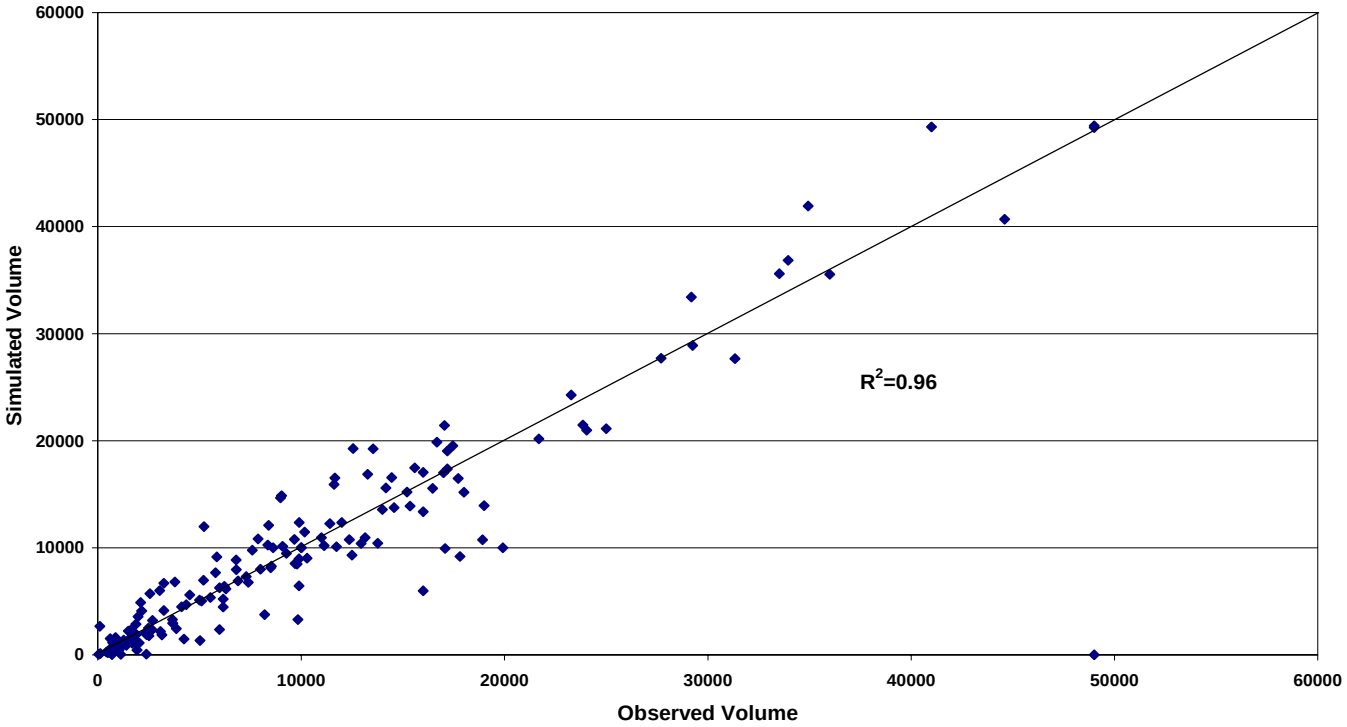


Figure 4-6: Assigned versus Observed Volumes for All Count Locations in the Entire Model Area

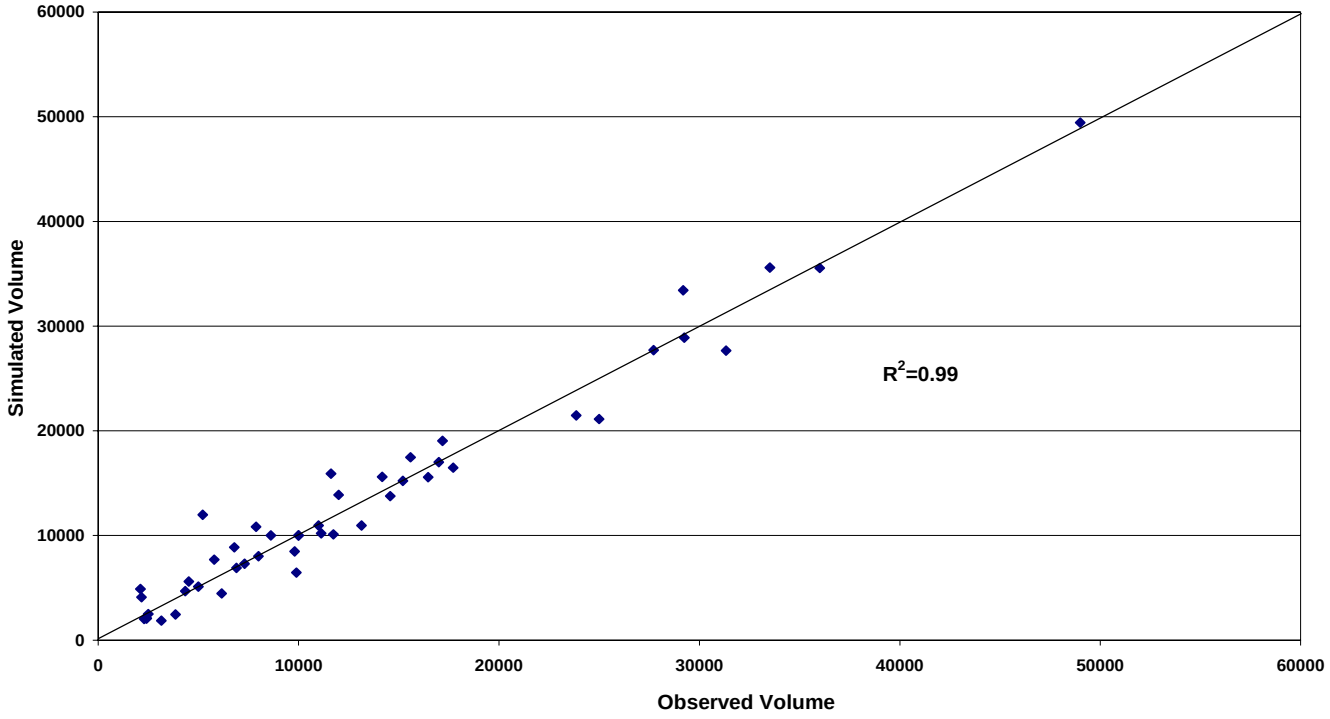


Figure 4-7: Assigned versus Observed Volumes for Model Screenlines/Cutlines

Chapter 5
Forecast Model for 2030

5.1 LAND USE PROJECTIONS

Table 5-1: Summary of Forecast Year (2030) Study Area Land Use

Locality	Total Population	Households	Total Jobs	Retail Jobs	Non-Retail Jobs
Blacksburg*	40,966	19,189	15,692	3,075	12,617
Virginia Tech	11,738	5,499	11,072	367	10,705
Blacksburg + VA Tech	52,704	24,688	26,764	3,442	23,322
Christiansburg	24,873	10,747	15,779	6,515	9,264
Montgomery County*	24,262	10,984	5,406	830	4,576
MPO Region Total	101,839	46,419	47,949	10,787	37,162

* The Blacksburg data reported here do not include Virginia Tech. Montgomery County data are for the portion of the County within the modeling domain boundary but outside of the towns of Blacksburg and Christiansburg.

Table 5-2: Summary of Study Area Land Use Changes (2003-2030)

Jurisdictions	Population Increase (number)	Population % Increase (percent)	Households Increase (number)	Households Increase (percent)	Total Employment (number)	Total Employment (percent)
Blacksburg*	9,329	29.5%	5,851	43.9%	3,649	30.3%
Virginia Tech	2,672	29.5%	5,184	1645.7%	2,355	27.0%
Blacksburg + VA Tech	12,001	29.5%	11,035	80.8%	6,004	28.9%
Christiansburg	7,176	40.5%	3,338	45.1%	3,352	27.0%
Montgomery County*	8,012	49.3%	4,391	66.6%	2,218	69.6%
MPO Region Total	27,189	36.4%	18,764	67.9%	11,574	31.8%

* The Blacksburg data reported here do not include Virginia Tech. Montgomery County data are for the portion of the County within the modeling domain boundary but outside of the towns of Blacksburg and Christiansburg.

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APPENDIX A

SOCIOECONOMIC DATA
BY
TAZ

	BASE YEAR -- 2003					YEAR 2030 PROJECTIONS				
TAZ	Retail Employ-ment	Non-Retail Employ-ment	Total Employ-ment	Pop	HH	Retail Employ-ment	Non-Retail Employ-ment	Total Employ-ment	Pop	HH
1	0	1	1	163	56	0	1	1	373	175
2	0	0	0	41	18	0	0	0	197	92
3	0	7	7	702	233	0	8	8	875	410
4	0	29	29	540	194	20	97	117	686	321
5	0	7	7	307	112	0	8	8	385	180
6	2	14	16	205	72	6	27	33	257	120
7	73	227	300	2968	926	87	275	362	3642	1706
8	0	21	21	525	196	6	42	48	649	304
9	5	31	36	550	184	8	41	49	677	317
10	0	6	6	153	65	0	7	7	194	91
11	0	230	230	199	70	11	266	277	260	122
12	0	11	11	103	46	5	27	32	137	64
13	0	1	1	528	236	0	1	1	655	307
14	0	53	53	217	106	4	65	69	273	128
15	2	5	7	271	123	2	6	8	339	159
16	17	1	18	215	96	21	13	34	269	126
17	124	76	200	542	257	133	107	240	668	313
18	34	76	110	89	38	39	93	132	115	54
19	43	29	72	225	112	47	41	88	279	131
20	26	714	740	3377	1318	59	825	884	4142	1940
21	38	27	65	1933	920	44	47	91	2373	1112
22	39	7	46	29	11	44	23	67	137	64
23	0	2	2	217	97	0	2	2	375	176
24	0	0	0	368	152	0	0	0	564	264
25	0	4	4	341	134	0	5	5	456	214
26	14	8	22	95	46	23	37	60	157	74
27	7	9	16	437	164	23	64	87	549	257
28	0	7	7	113	48	0	8	8	342	160
29	7	31	38	61	23	30	108	138	376	176
30	0	9	9	183	90	0	10	10	304	142
31	381	720	1101	643	280	430	885	1315	796	373
32	8	30	38	213	88	11	41	52	267	125
33	134	104	238	820	383	145	141	286	1008	472
34	112	94	206	258	131	121	125	246	319	149
35	23	1	24	559	251	38	50	88	699	327
36	0	373	373	4348	1975	19	439	458	5338	2501
37	27	459	486	1	1	49	535	584	1	0
38	0	99	99	214	69	0	125	125	193	86
39	168	300	468	148	44	107	451	558	276	120
40	168	300	468	76	32	189	370	559	105	49
41	24	111	135	179	89	30	132	162	226	106
42	83	0	83	227	95	87	15	102	285	134
43	4	37	41	181	71	7	46	53	227	106
44	258	301	559	62	42	283	384	667	85	40
45	54	43	97	140	82	58	58	116	175	82
46	121	300	421	594	236	140	363	503	730	342
47	366	138	504	48	20	388	213	601	65	30
48	0	8	8	139	59	0	9	9	175	82

	BASE YEAR -- 2003					YEAR 2030 PROJECTIONS				
TAZ	Retail Employ-ment	Non-Retail Employ-ment	Total Employ-ment	Pop	HH	Retail Employ-ment	Non-Retail Employ-ment	Total Employ-ment	Pop	HH
49	70	106	176	662	319	78	134	212	814	381
50	0	9	9	273	135	0	10	10	343	161
51	0	26	26	701	365	6	46	52	864	405
52	0	27	27	78	31	3	36	39	108	51
53	0	13	13	435	212	7	36	43	537	252
54	0	0	0	325	153	0	0	0	417	195
55	0	0	0	248	137	0	0	0	311	146
56	0	27	27	249	106	6	46	52	317	148
57	0	0	0	671	283	0	0	0	841	394
58	0	2	2	158	66	0	2	2	202	95
59	70	56	126	54	32	76	76	152	82	38
60	0	5	5	885	421	0	6	6	1087	509
61	14	124	138	1366	609	22	150	172	1679	787
62	0	0	0	156	57	0	0	0	206	96
63	13	1822	1835	66	32	94	2097	2191	348	163
64	0	6	6	13	1	0	7	7	91	43
65	20	410	430	20	2	39	475	514	114	53
66	0	2466	2466	7269	9	22	3109	3131	9408	4407
67	4	786	790	922	304	11	994	1005	1197	561
68	0	2	2	3	1	0	2	2	4	2
69	60	1145	1205	0	0	71	1461	1532	0	0
70	0	0	0	0	0	0	0	0	0	0
71	31	515	546	0	0	36	659	695	0	0
72	194	3514	3708	872	1	227	4480	4707	1129	529
73	112	125	237	781	326	172	175	347	904	383
74	7	183	190	236	111	37	218	255	266	125
75	104	181	285	47	28	104	221	325	47	28
76	15	23	38	13	7	25	43	68	13	7
77	71	60	131	402	162	121	290	411	402	162
78	1	134	135	426	182	1	144	145	454	195
79	131	49	180	50	21	131	79	210	50	21
80	9	139	148	172	78	19	149	168	172	78
81	0	1	1	379	167	0	11	11	379	167
82	0	15	15	271	121	0	15	15	271	121
83	0	57	57	84	37	0	87	87	84	37
84	0	189	189	534	222	6	199	205	684	292
85	143	48	191	361	143	173	78	251	568	239
86	21	15	36	1	1	21	25	46	1	1
87	564	144	708	122	56	564	244	808	122	56
88	135	588	723	579	223	155	648	803	579	223
89	83	20	103	403	165	93	40	133	549	233
90	0	27	27	319	155	0	27	27	319	155
91	0	1	1	347	175	0	1	1	347	175
92	0	0	0	184	81	0	0	0	184	81
93	9	92	101	179	85	9	92	101	179	85
94	97	67	164	232	110	107	67	174	232	110
95	9	98	107	354	146	9	98	107	354	146
96	50	105	155	944	422	100	155	255	1074	482

	BASE YEAR -- 2003					YEAR 2030 PROJECTIONS				
TAZ	Retail Employ-ment	Non-Retail Employ-ment	Total Employ-ment	Pop	HH	Retail Employ-ment	Non-Retail Employ-ment	Total Employ-ment	Pop	HH
97	0	6	6	462	222	5	21	26	462	222
98	79	79	158	779	330	129	119	248	802	341
99	48	306	354	559	215	58	346	404	577	223
100	26	484	510	704	310	46	564	610	727	321
101	32	133	165	1022	385	62	183	245	1242	487
102	250	58	308	329	164	300	158	458	329	164
103	0	25	25	196	78	0	25	25	219	89
104	10	50	60	627	250	45	85	130	784	323
105	1	1	2	240	93	1	1	2	240	93
106	0	0	0	54	29	40	40	80	683	322
107	0	1434	1434	119	35	0	1634	1634	119	35
108	0	34	34	860	345	0	34	34	1090	452
109	0	0	0	147	72	0	0	0	147	72
110	626	839	1465	77	38	676	889	1565	77	38
111	78	319	397	98	35	298	479	777	1862	856
112	7	17	24	475	189	27	25	52	622	257
113	0	0	0	287	120	30	50	80	969	437
114	0	2	2	257	109	0	2	2	359	156
115	3	4	7	147	58	103	84	187	917	416
116	78	206	284	250	88	148	216	364	883	383
117	530	112	642	0	0	540	127	667	0	0
118	427	55	482	38	7	627	95	722	38	7
119	1191	142	1333	266	123	1329	222	1551	266	123
120	165	335	500	993	432	175	415	590	1771	794
121	19	289	308	498	194	29	339	368	661	270
122	0	5	5	793	264	0	5	5	793	264
123	0	0	0	93	39	0	0	0	110	50
124	26	39	65	116	46	29	89	118	172	78
125	0	11	11	39	14	0	12	12	47	21
126	0	6	6	167	60	0	6	6	195	88
127	0	0	0	19	7	0	50	50	20	9
128	0	0	0	20	8	0	0	0	49	22
129	0	0	0	0	0	0	50	50	30	14
130	0	1	1	124	54	0	1	1	140	63
131	0	0	0	126	46	0	0	0	142	64
132	0	142	142	16	8	0	172	172	416	188
133	0	6	6	598	230	0	6	6	998	452
134	0	0	0	56	19	0	0	0	64	29
135	0	0	0	17	7	0	20	20	18	8
136	0	4	4	138	50	0	400	400	184	83
137	0	2	2	76	31	0	2	2	87	39
138	0	0	0	57	19	0	0	0	65	29
139	0	0	0	66	22	0	0	0	78	35
140	6	37	43	174	74	7	41	48	207	94
141	1	41	42	91	36	1	45	46	107	48
142	0	27	27	55	19	0	30	30	83	38
143	0	3	3	211	24	0	53	53	284	129
144	0	16	16	240	83	0	18	18	292	132

	BASE YEAR -- 2003					YEAR 2030 PROJECTIONS				
TAZ	Retail Employ-ment	Non-Retail Employ-ment	Total Employ-ment	Pop	HH	Retail Employ-ment	Non-Retail Employ-ment	Total Employ-ment	Pop	HH
145	0	0	0	92	38	0	0	0	106	48
146	0	13	13	278	100	0	14	14	315	143
147	0	0	0	134	52	0	0	0	153	69
148	0	23	23	420	156	0	25	25	707	320
149	0	6	6	71	26	0	56	56	339	154
150	0	3	3	3	2	0	3	3	13	6
151	0	284	284	157	48	0	334	334	202	92
152	0	4	4	6	4	0	4	4	16	7
153	50	43	93	329	120	55	47	102	419	190
154	0	9	9	202	78	0	9	9	229	104
155	0	11	11	145	57	0	12	12	164	74
156	4	0	4	159	89	4	0	4	266	121
157	0	0	0	115	45	0	0	0	135	61
158	0	0	0	72	28	0	0	0	84	38
159	2	2	4	51	22	2	2	4	58	26
160	0	14	14	102	38	0	15	15	129	58
161	0	6	6	186	72	0	6	6	240	109
162	0	13	13	208	82	0	14	14	601	272
163	0	23	23	316	119	0	25	25	356	161
164	1	7	8	349	143	1	7	8	638	289
165	0	1	1	25	10	0	1	1	144	65
166	0	34	34	402	138	0	37	37	431	195
167	0	3	3	194	79	0	3	3	288	130
168	12	0	12	141	59	13	0	13	177	80
169	0	2	2	104	41	0	2	2	120	54
170	17	83	100	818	320	37	133	170	1592	721
171	10	28	38	123	55	11	31	42	219	99
172	0	6	6	256	108	0	6	6	298	135
173	0	6	6	98	31	0	6	6	120	54
174	0	0	0	378	148	0	0	0	450	204
175	10	5	15	146	55	11	5	16	172	78
176	0	3	3	311	109	0	3	3	368	167
177	9	189	198	803	316	29	239	268	907	411
178	0	0	0	130	55	0	0	0	156	71
179	0	7	7	60	21	0	7	7	208	94
180	0	972	972	163	59	100	1422	1522	459	208
181	55	79	134	874	342	155	129	284	1047	474
182	5	70	75	842	301	5	77	82	896	406
183	3	0	3	345	145	3	0	3	474	215
184	0	0	0	10	5	0	0	0	50	23
185	16	4	20	286	97	18	4	22	397	180
186	0	57	57	34	13	0	63	63	53	24
187	0	249	249	1212	559	0	349	349	1784	808
188	0	14	14	281	100	0	15	15	572	259
189	30	3	33	222	145	33	53	86	415	188
190	0	61	61	134	93	0	67	67	171	77
191	7	3	10	156	71	7	3	10	191	87
192	0	0	0	0	68	0	50	50	140	63

	BASE YEAR -- 2003					YEAR 2030 PROJECTIONS				
TAZ	Retail Employ-ment	Non-Retail Employ-ment	Total Employ-ment	Pop	HH	Retail Employ-ment	Non-Retail Employ-ment	Total Employ-ment	Pop	HH
193	0	0	0	12	116	0	0	0	263	119
194	0	61	61	315	134	0	67	67	365	165
195	6	3	9	95	40	6	3	9	109	49
196	0	8	8	61	25	0	8	8	69	31
197	0	24	24	82	34	0	26	26	98	44
198	0	8	8	280	105	0	8	8	317	144
199	0	23	23	63	22	0	25	25	75	34
200	3	14	17	91	30	3	15	18	148	67
201	0	0	0	228	89	0	0	0	421	191
202	0	6	6	445	184	0	6	6	740	335
203	0	66	66	77	37	300	116	416	175	79
204	0	4	4	14	7	0	4	4	20	9
205	0	15	15	25	7	0	17	17	65	29
206	0	8	8	20	5	0	8	8	140	63
207	40	1760	1800	730	286	30	2860	2890	930	449

APPENDIX B
TP+ MODEL SCRIPTS

```
;*************************************************************************
;    Blacksburg/Christiansburg/Montgomery County Area MPO
;    2003 TP+ Travel Demand Forecasting Model
;    MICHAEL BAKER JR. INC,
;;******************  FILENAME:  BCMMODELTP+2003.S  ***********************
; TP+ migration Feb.,2004 FL
; TAZ 2003     7/7/2004  FL
; MPO Finalized TAZ  2/15/2005
;*************************************************************************
;*************************************************************************
; 1.  User Defined Variables
;
;-------------------------------------------------------------------------
; Functional Classes (FUNC)
;
; 1  = Interstate
; 2  = Freeway
; 3  = Principal Arterial
; 4  = Minor Arterial
; 5  = Collector
; 8  = External Stations
; 9  = Centroid Connector
;
;-------------------------------------------------------------------------
; Area Type (AREA)
;
; 1  = Urban Commercial
; 2  = Urban Residential
; 3  = University (Virginia Tech)
; 4  = Suburban Commercial
; 5  = Suburban Residential
; 6  = Rural
; 8  = External Stations
; 9  = Centroid Connector
;
;-------------------------------------------------------------------------
*DEL BLBG*.PRN
;*************************************************************************
; 2.  Trip Generation
;
RUN PGM=TRIPGEN
Report a=y,p=y,ac=y,pc=y

FILEI
     ZDATI[1] = BC0308.DAT, select=1,1, z=#2,HH=#3,Pop=#4,nremp=#5,remp=#6,temp=#7
     zdati[2] = BC0308.DAT, select=2,1,
z=#2,PHBWSG=#3,AHBWSG=#4,PHBOSG=#5,AHBOSG=#6,PNHBSG=#7,ANHBSG=#8
     ZDATI[3] = BC0308.DAT, select=3,1, z=#2,XX=#3,PXI=#4, AIX=#5
;-------------------------------------------------------------------------

PARAMETERS
     zones =241
     maxpurps = 6

;VT 2003
 Enrol=25819
 TotEmp=8717
;
; Purposes       1 = Home Based Work
;                2 = Home Based Other
;                3 = Non Home Based
;                4 = External-External (X-X)
;                5 = Internal-External (IX)
;                6 = External-Internal (XI)
;
;
```

```
;
; Regression Equations
;-------------------------------------------------------------------------
;Productions
IF (I=1-65,207)
  phbw = (1-0.01)*1.63*HH*1.27    ;HBW productions, Blacksburg with adj factors based
on CTPP and growth rates
  pxhbw = 0.01*1.63*HH*1.27
  phbo = (1-0.01)*3.51*HH*1.2     ;HBO productions, Blacksburg
  pxhbo = 0.01*3.51*HH*1.2
  pnhb = (1-0.01)*6.41*NREMP      ;NHB productions, Blacksburg
  pxnhb = 0.01*6.41*NREMP
;
;-------------------------------------------------------------------------

ELSEIF (I=73-122)
  phbw = (1-0.04)*0.599*Pop*1.57     ;HBW productions, Christiansburg with adj factor
based on CTPP
  pxhbw = 0.04 * 0.599 * Pop*1.57
  phbo = (1-0.04)*1.39*Pop*1.2       ;HBO productions, Christiansburg
  pxhbo = 0.04 * 1.39 * Pop*1.2
  pnhb = (1-0.04)*1.22*Pop           ;NHB productions, Christiansburg
  pxnhb = 0.04 * 1.22 * Pop
;
;-------------------------------------------------------------------------

ELSEIF (I=123-206)
  phbw = (1-0.01)*0.907*HH*2.85      ;HBW productions, Montgomery Co with adj factor
based on CTPP
  pxhbw = 0.01*0.907*HH*2.85
  phbo = (1-0.01)*5.39*HH*1.2       ;HBO productions, Montgomery Co
  pxhbo = 0.01*5.39*HH*1.2
  pnhb = (1-0.01)*1.36*NREMP        ;NHB productions, Montgomery Co
  pxnhb = 0.01*1.36*NREMP
;
;-------------------------------------------------------------------------

ELSE
phbw=0
pxhbw=0
phbo=0
pxhbo=0
pnhb=0
pxnhb=0

ENDIF
;
;-------------------------------------------------------------------------
;-------------------------------------------------------------------------
;-------------------------------------------------------------------------
;Attractions
IF (I=1-65,207)
  ahbw = (1-0.01)*1.421*TEMP           ;HBW Attractions, Blacksburg
  axhbw = 0.01*1.421*TEMP
  ahbo = (1-0.01)*2.71*HH              ;HBO Attractions, Blacksburg
  axhbo = 0.01*2.71*HH
  anhb = (1-0.01)*3.59*NREMP*1.1       ;NHB Attractions, Blacksburg
  axnhb = 0.01*3.59*HH*1.1
;
;-------------------------------------------------------------------------

ELSEIF (I=73-122)
  ahbw = (1-0.05)*1.421*TEMP           ;HBW Attractions, Christiansburg
  axhbw = 0.05*1.421*TEMP
  ahbo = (1-0.05)*4.43*REMP            ;HBO Attractions, Christiansburg
  axhbo = 0.05*4.43*REMP
  anhb = (1-0.05)*0.818*TEMP           ;NHB Attractions, Christiansburg
```

```
  axnhb = 0.05*0.818*TEMP
;
;-------------------------------------------------------------------------

ELSEIF (I=123-206)                    ;HBW Attractions, Montgomery Co
  ahbw = (1-0.01)*1.421*TEMP
  axhbw = 0.01*1.421*TEMP
  ahbo = (1-0.01)*1.87*NREMP          ;HBO Attractions, Montgomery Co
  axhbo = 0.01*1.87*NREMP
  anhb = (1-0.01)*0.34*NREMP          ;NHB Attractions, Montgomery Co
  axnhb = 0.01*0.34*NREMP
;
;-------------------------------------------------------------------------

ELSE
ahbw=0
axhbw=0
ahbo=0
axhbo=0
anhb=0
axnhb=0

ENDIF
;
;-------------------------------------------------------------------------


IF (I=66-72)
  phbw = (1-0.01)*1.63*HH*1.27 ;HBW productions, Blacksburg with adj factor based on
CTPP
  pxhbw = 0.01*1.63*HH*1.27
  phbo = (1-0.01)*1.48*POP     ;HBO productions, Blacksburg
  pxhbo = 0.01*1.48*POP
  pnhb = (1-0.01)*6.41*NREMP   ;NHB productions, Blacksburg
  pxnhb = 0.01*6.41*NREMP

ahbw = (1-0.01)*1.421*TEMP
axhbw = 0.01*1.421*TEMP
ahbo = (1-0.01)*(1.004*Enrol*TEMP/TOTEMP + 9.789*REMP + 0.654*NREMP + 0.622*HH)
axhbo = 0.01* (1-0.01)*(1.004*Enrol*TEMP/TOTEMP + 9.789*REMP + 0.654*NREMP + 0.622*HH)
anhb = (1-0.01)*(0.5*Enrol*TEMP/TOTEMP +1.43*REMP + 0.504*NREMP + 0.884*HH)
axnhb = 0.01*(0.5*Enrol*TEMP/TOTEMP +1.43*REMP + 0.504*NREMP + 0.884*HH)

ENDIF

;External-External Productions
IF (i>219)
pxx=XX
ENDIF
;Internal-External Productions
PIX=pxnhb+pxhbo+pxhbw
;External-External Attractions
IF (i>219)
aXX=XX
ENDIF
;External - Internal Attractions
AXI=axhbw+axhbo+axnhb

; Assign production/attraction values to default arrays
p[1]=phbw
p[2]=phbo
p[3]=pnhb
p[4]=pxx
p[5]=PIX
p[6]=PXI

a[1]=ahbw
```

```
a[2]=ahbo
a[3]=anhb
a[4]=axx
a[5]=AIX
a[6]=AXI

PHASE=ADJUST
Report trace=y
; Balance productions and attractions
a[1] = a[1] * p[1][0]/a[1][0] ; production constrained
a[2] = a[2] * p[2][0]/a[2][0]
;a[4] = a[4] * p[4][0]/a[4][0]
a[6] = a[6] * p[6][0]/a[6][0]
p[3] = a[3]                   ; attraction constrained
p[5] = p[5] * a[5][0]/p[5][0]


;Output Trip Ends
FILEO
 PAO = BCTripS.DAT, FORM=8.0,LIST= Z(4.0),p[1], p[2], p[3], p[4], p[5], p[6], a[1],
a[2], a[3], a[4], a[5], a[6]
ENDPHASE
ENDRUN
;
;-------------------------------------------------------------------------
;*************************************************************************
;
;---------------------------------------------------------------
;            3--PATH BUILDING
;---------------------------------------------------------------

RUN PGM=HWYLOAD
ID= highway initial skims

zones =241

Neti=BC0320.NET
TURNPENI=2003TP_TPP.DAT, LIST=Y

Mato=IMPED03.TEM, MO=1-2, NAME=time,dist

PHASE=LINKREAD

;                                    AREA TYPE
;                                UrbanCom  UrbanRes  Univ    SubCom  SubRes  Rural
  Spdcap Lanes=1-9,Speed[11]=    50,       55,       58,     58,     60,     65    ;Interstate
  Spdcap Lanes=1-9,Speed[21]=    45,       48,       50,     53,     55,     55    ;Freeway
  Spdcap Lanes=1-9,Speed[31]=    27,       33,       37,     40,     45,     50    ;Principal
Arterial
  Spdcap Lanes=1-9,Speed[41]=    25,       30,       32,     35,     40,     45    ;Minor
Arterial
  Spdcap Lanes=1-9,Speed[51]=    20,       23,       25,     27,     30,     35    ;Collector
  Spdcap Lanes=1-9,Speed[61]=    0,        0,        25                            ;Centroid
Connector

  Spdcap Lanes=1-9,Capacity[11]= 1300,     1300,     1300,   1300,   1300,   1300  ;Interstate
  Spdcap Lanes=1-9,Capacity[21]= 1200,     1200,     1200,   1200,   1200,   1200  ;Freeway
  Spdcap Lanes=1-9,Capacity[31]= 750,      750,      750,    1050,   1100,   1150  ;Principal
Arterial
  Spdcap Lanes=1-9,Capacity[41]= 700,      700,      700,    925,    950,    1075  ;Minor
Arterial
  Spdcap Lanes=1-9,Capacity[51]= 350,      350,      350,    350,    350,    350   ;Collector
  Spdcap Lanes=1-9,Capacity[61]= 0,        0,        9999                          ;Centroid
Connector

    T0 = ((li.distance)/speedfor(li.lanes,LI.spdclass))*60.0

ENDPHASE

PHASE=ILOOP
```

```
  Path=TIME, trace=(I=112 && J=33,59,142),
  PENI=1,
    mw[1]=pathtrace(TIME), noaccess=0,         ;zone-to-zone times
    mw[2]=pathtrace(li.distance), noaccess=0   ;zone-to-zone distances
ENDPHASE

ENDRUN

;.....................................................................

RUN PGM=MATRIX

Mati=IMPED03.TEM
zdati[1] = TRM03.DAT,Z=1-5,oterm=6-10,dterm=11-15  ; origin term time(min) &
destination term tm (min)

Mato=IMPED03.DAT, MO=5-6, NAME=time,dist

FILLMW mw[1] = MI.1.1  ;hwy time
FILLMW mw[6] = MI.1.2  ;hwy DISTANCE

mw[3] = zi.1.oterm[i]  ;origin terminal time
mw[4] = zi.1.dterm[j]  ;destination terminal time


;insert intrazonals here - 50% of nearest interzonal time
      mw[7][i] = 0.50*LOWEST(1,1,0.001,1000,i)

JLOOP
      IF (I=220-241) MW[7][I] = 32767
ENDJLOOP

JLOOP
      mw[5] = mw[1] + mw[3] + mw[4] + MW[7]
ENDJLOOP

ENDRUN

;.....................................................................

;---------------------------------------------------------------
;            4--TRIP DISTRIBUTION
;---------------------------------------------------------------


*del BLBG*.prn

RUN PGM=TRIPDIST

;File I/O

FILEI
     zdati[1] =
BCTRIPS.DAT,Z=#1,P1=#2,P2=#3,P3=#4,P4=#5,P5=#6,P6=#7,A1=#8,A2=#9,A3=#10,A4=#11,A5=#12,
A6=#13
     MATI = IMPED03.DAT
FILEO
     mato = IPA03.dat, mo=1-6, name=HBW,HBO,NHB,XX,XI,IX

PARAMETERS
     zones    = 241
     maxiters = 88

;Reporting
report zdat=y  ;
report acomp=1 ;
```

```
;Read in friction factors
LOOKUP FILE=BB0309_TPP.DAT, LIST=y, INTERPOLATE=Y, NAME=ff,
    LOOKUP[1]=1,RESULT=2,
    LOOKUP[2]=1,RESULT=3,
    LOOKUP[3]=1,RESULT=4,
    LOOKUP[4]=1,RESULT=5,
    LOOKUP[5]=1,RESULT=6,
    LOOKUP[6]=1,RESULT=7

SETPA P[1]=ZI.1.P1, A[1]=ZI.1.A1        ;HBW
SETPA P[2]=ZI.1.P2, A[2]=ZI.1.A2        ;HBO
SETPA P[3]=ZI.1.P3, A[3]=ZI.1.A3        ;NHB
SETPA P[4]=ZI.1.P4, A[4]=ZI.1.A4        ;X-X
SETPA P[5]=ZI.1.P5, A[5]=ZI.1.A5        ;I-X
SETPA P[6]=ZI.1.P6, A[6]=ZI.1.A6        ;X-I

;Declare skim matrix
mw[11] = MI.1.1


;Distribute trips using gravity model and report trip frequency
  GRAVITY   PURPOSE=1, LOS=MW[11], FFACTORS=ff
  GRAVITY   PURPOSE=2, LOS=MW[11], FFACTORS=ff
  GRAVITY   PURPOSE=3, LOS=MW[11], FFACTORS=ff
  GRAVITY   PURPOSE=4, LOS=MW[11], FFACTORS=ff
  GRAVITY   PURPOSE=5, LOS=MW[11], FFACTORS=ff
  GRAVITY   PURPOSE=6, LOS=MW[11], FFACTORS=ff

  FREQUENCY VALUEMW=1  BASEMW=11,  RANGE=1-300
  FREQUENCY VALUEMW=2  BASEMW=11,  RANGE=1-300
  FREQUENCY VALUEMW=3  BASEMW=11,  RANGE=1-300
  FREQUENCY VALUEMW=4  BASEMW=11,  RANGE=1-300
  FREQUENCY VALUEMW=5  BASEMW=11,  RANGE=1-300
  FREQUENCY VALUEMW=6  BASEMW=11,  RANGE=1-300

ENDRUN

;.....................................................................

RUN PGM=MATRIX

Mati=IPA03.dat

Mato=PA03.dat, MO=1-5, NAME=HBW,HBO,NHB,XX,XI

FILLMW mw[1] = MI.1.1
FILLMW mw[2] = MI.1.2
FILLMW mw[3] = MI.1.3
FILLMW mw[4] = MI.1.4

JLOOP
mw[5] = mI.1.5 + mI.1.6
ENDJLOOP

ENDRUN

;.....................................................................


;-----------------------------------------------------------------
;            5--AUTO DRIVERS & TIME OF DAY
;-----------------------------------------------------------------

RUN PGM=MATRIX

Mati=PA03.dat
```

```
Mato[1]=AM03.dat,     MO=11,14,17,21,24,27,31,34,37
Mato[2]=PM03.dat,     MO=12,15,18,22,25,28,32,35,38
Mato[3]=ADT03.dat,    MO=13,16,19,23,26,29,33,36,39
MATO[4]=ADT03_2.DAT,  MO=1

;   from Household Survey

JLOOP

mw[11] = mI.1.1 * 0.244 + mI.1.1.T * 0.061    ; HBW AM   32%, 80/20 split, 1.05 Occupancy
mw[12] = mI.1.1 * 0.048 + mI.1.1.T * 0.191    ; HBW PM   25%, 20/80 split, 1.05 Occupancy
mw[13] = mI.1.1 * 0.476 + mI.1.1.T * 0.476      ; HBW ADT 100%, 50/50 split, 1.05 Occupancy
mw[14] = mI.1.2 * 0.030 + mI.1.2.T * 0.070      ; HBO AM   13%, 30/70 split, 1.31 Occupancy
mw[15] = mI.1.2 * 0.102 + mI.1.2.T * 0.044      ; HBO PM   19%, 70/30 split, 1.31 Occupancy
mw[16] = mI.1.2 * 0.382 + mI.1.2.T * 0.382      ; HBO ADT 100%, 50/50 split, 1.31 Occupancy
mw[17] = mI.1.3 * 0.031 + mI.1.3.T * 0.031      ; NHB AM   10%, 50/50 split, 1.63 Occupancy
mw[18] = mI.1.3 * 0.046 + mI.1.3.T * 0.046      ; NHB PM   15%, 50/50 split, 1.63 Occupancy
mw[19] = mI.1.3 * 0.307 + mI.1.3.T * 0.307      ; NHB ADT 100%, 50/50 split, 1.63 Occupancy

mw[21] = mI.1.4 * 0.040 + mI.1.4.T * 0.010    ; HBW AM    5%, 80/20 split, 1.00 Occupancy
mw[22] = mI.1.4 * 0.008 + mI.1.4.T * 0.032      ; HBW PM    4%, 20/80 split, 1.00 Occupancy
mw[23] = mI.1.4 * 0.085 + mI.1.4.T * 0.085      ; HBW ADT  17%, 50/50 split, 1.00 Occupancy
mw[24] = mI.1.4 * 0.006 + mI.1.4.T * 0.014      ; HBO AM    2%, 30/70 split, 1.00 Occupancy
mw[25] = mI.1.4 * 0.028 + mI.1.4.T * 0.012      ; HBO PM    4%, 70/30 split, 1.00 Occupancy
mw[26] = mI.1.4 * 0.135 + mI.1.4.T * 0.135      ; HBO ADT  27%, 50/50 split, 1.00 Occupancy
mw[27] = mI.1.4 * 0.0025 + mI.1.4.T * 0.0025    ; NHB AM  0.5%, 50/50 split, 1.00 Occupancy
mw[28] = mI.1.4 * 0.010 + mI.1.4.T * 0.010      ; NHB PM    2%, 50/50 split, 1.00 Occupancy
mw[29] = mI.1.4 * 0.280 + mI.1.4.T * 0.280      ; NHB ADT  56%, 50/50 split, 1.00 Occupancy

mw[31] = mI.1.5 * 0.040 + mI.1.5.T * 0.010    ; HBW AM    5%, 80/20 split, 1.00 Occupancy
mw[32] = mI.1.5 * 0.008 + mI.1.5.T * 0.032      ; HBW PM    4%, 20/80 split, 1.00 Occupancy
mw[33] = mI.1.5 * 0.160 + mI.1.5.T * 0.160      ; HBW ADT  32%, 50/50 split, 1.00 Occupancy
mw[34] = mI.1.5 * 0.006 + mI.1.5.T * 0.014      ; HBO AM    2%, 30/70 split, 1.00 Occupancy
mw[35] = mI.1.5 * 0.028 + mI.1.5.T * 0.012      ; HBO PM    4%, 70/30 split, 1.00 Occupancy
mw[36] = mI.1.5 * 0.230 + mI.1.5.T * 0.230      ; HBO ADT  46%, 50/50 split, 1.00 Occupancy
mw[37] = mI.1.5 * 0.0025 + mI.1.5.T * 0.0025    ; NHB AM  0.5%, 50/50 split, 1.00 Occupancy
mw[38] = mI.1.5 * 0.010 + mI.1.5.T * 0.010      ; NHB PM    2%, 50/50 split, 1.00 Occupancy
mw[39] = mI.1.5 * 0.110 + mI.1.5.T * 0.110      ; NHB ADT  22%, 50/50 split, 1.00 Occupancy

MW[1] = MW[13]+MW[16]+MW[19]+MW[23]+MW[26]+MW[29]+MW[33]+MW[36]+MW[39]

ENDJLOOP

ENDRUN

;.....................................................................

;-------------------------------------------------------------
;            6--TRIP ASSIGNMENT
;-------------------------------------------------------------

; BALANCE TRIP TABLE

RUN PGM=MATRIX

Mati=ADT03_2.DAT

Mato=BC0314.DAT, MO=1

JLOOP
      mw[1] = mI.1.1 * .5 + mI.1.1.T * .5
ENDJLOOP

ENDRUN

;.....................................................................

RUN PGM=HWYLOAD

FILEI
```

```
     neti = BC0320.NET
     mati[1]= BC0314.DAT
        TURNPENI=2003TP_TPP.DAT, LIST=Y        ;TURN PENALTIES

FILEO
     neto = BC0321.NET

  Spdcap Lanes=1-9,Speed[11]=    50,       55,       58,     58,     60,     65    ;Interstate
  Spdcap Lanes=1-9,Speed[21]=    45,       48,       50,     53,     55,     55    ;Freeway
  Spdcap Lanes=1-9,Speed[31]=    27,       33,       37,     40,     45,     50    ;Principal
Arterial
  Spdcap Lanes=1-9,Speed[41]=    25,       30,       32,     35,     40,     45    ;Minor
Arterial
  Spdcap Lanes=1-9,Speed[51]=    20,       23,       25,     27,     30,     35    ;Collector
  Spdcap Lanes=1-9,Speed[61]=    0,        0,        25                            ;Centroid
Connector

  Spdcap Lanes=1-9,Capacity[11]= 1300,     1300,     1300,   1300,   1300,   1300  ;Interstate
  Spdcap Lanes=1-9,Capacity[21]= 1200,     1200,     1200,   1200,   1200,   1200  ;Freeway
  Spdcap Lanes=1-9,Capacity[31]= 750,      750,      750,    1050,   1100,   1150  ;Principal
Arterial
  Spdcap Lanes=1-9,Capacity[41]= 700,      700,      700,    925,    950,    1075  ;Minor
Arterial
  Spdcap Lanes=1-9,Capacity[51]= 350,      350,      350,    350,    350,    350   ;Collector
  Spdcap Lanes=1-9,Capacity[61]= 0,        0,        9999                          ;Centroid
Connector


PARAMETERS
     zones = 241  ;
     maxiters = 75 ;

PHASE=LINKREAD

       T0 = ((li.distance)/speedfor(li.lanes,LI.spdclass))*60.0
       C = CAPACITYFOR(LI.LANES,LI.CAPCLASS)/0.10
;      DEFINE LINK CLASSES:
      IF (LI.SPDCLASS=11-16,21-26,36)     linkclass = 1
      IF (LI.SPDCLASS=34,35,45,46)        linkclass = 2
      IF (LI.SPDCLASS=32,33,42-44,55,56)  linkclass = 3
      IF (LI.SPDCLASS=31,41,51-54,63)     linkclass = 4


ENDPHASE

FUNCTION {
   COST[1]=TIME
   COST[2]=TIME
   COST[3]=TIME
   COST[4]=TIME
   TC[1]=T0 * (1 + 0.30 * (V/C) ^ 7)
   TC[2]=T0 * (1 + 0.30 * (V/C) ^ 6)
   TC[3]=T0 * (1 + 0.30 * (V/C) ^ 5)
   TC[4]=T0 * (1 + 0.15 * (V/C) ^ 4)
}

PHASE=ILOOP
       PATHLOAD path=cost, VOL[1]=MI.1.1,
       PENI=1
ENDPHASE


PHASE=ADJUST
       PARAMETERS COMBINE=EQUI
       PARAMETERS GAP= 0.01
ENDPHASE

ENDRUN

;.....................................................................
```

```
*COPY BLBG*.PRN BLBG2003.RPT
*DEL BLBG*.PRN

;==================END=================================================
```