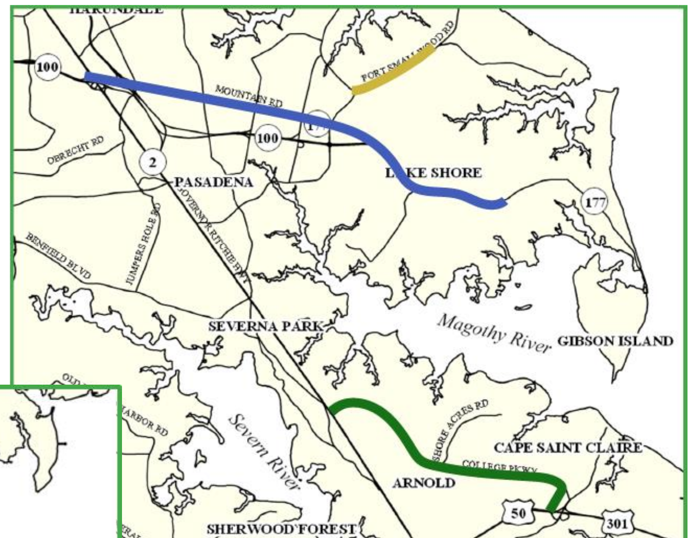
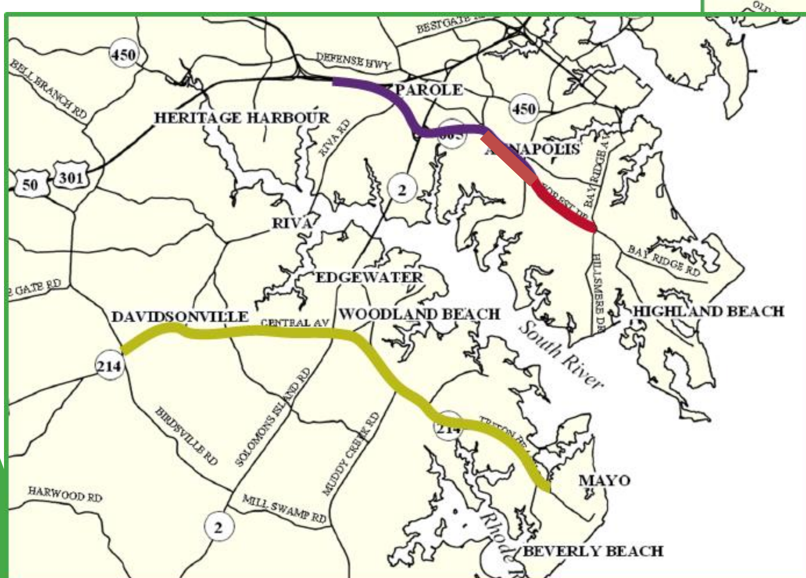
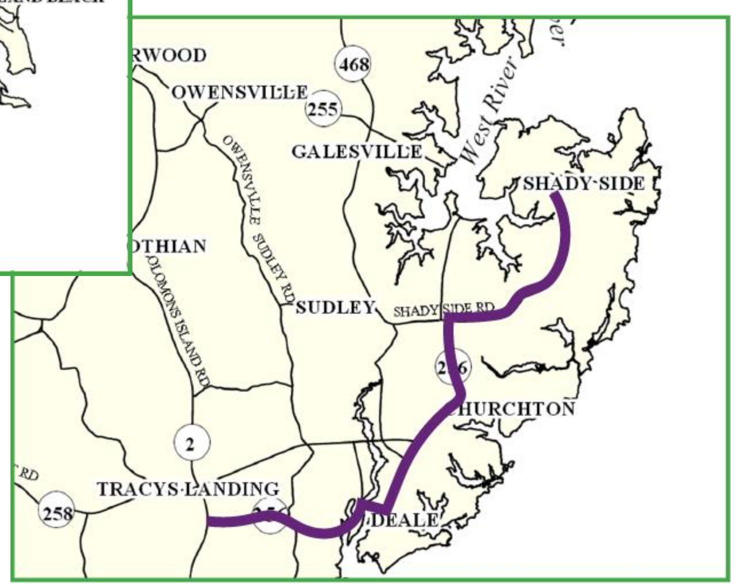
MIIF Study Report

FINAL - June 2016







Major Intersections/Important Facilities (MIIF) Study Final Report

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Brian Ulrich, AICP, Planning Administrator
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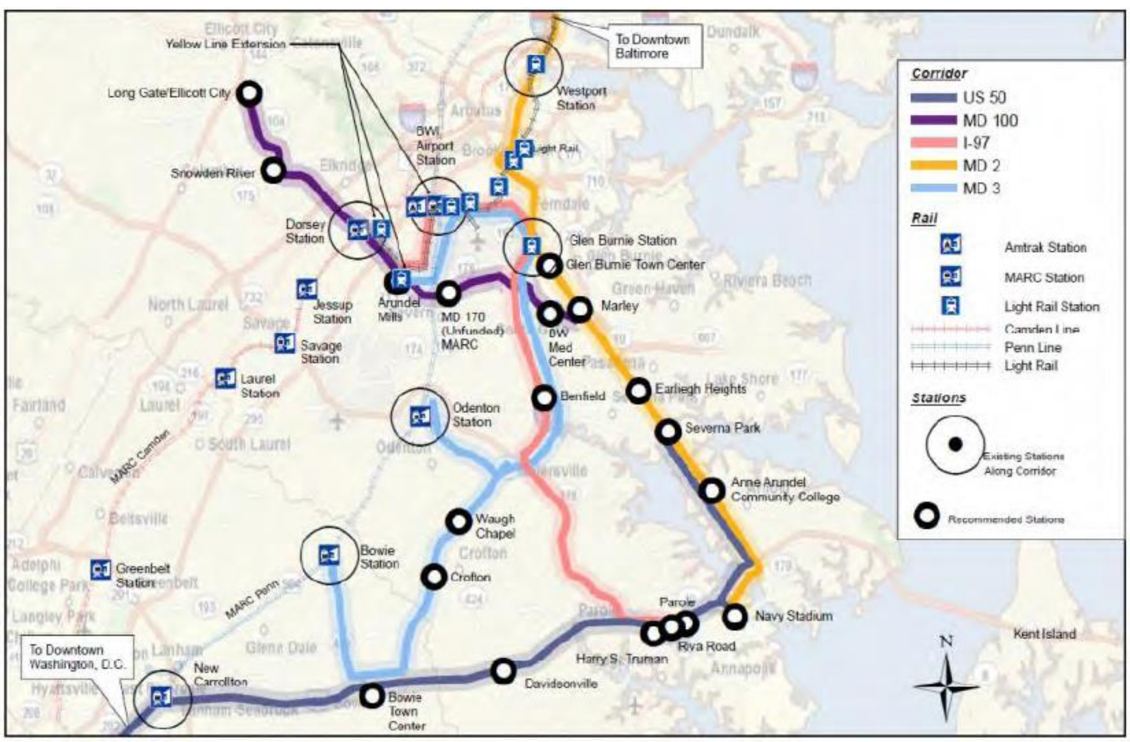
PREFACE

The Major Intersections/Important Facilities Study (MIIF) is the final component of the County Transportation Plan and emphasized seven key corridors that connect the peninsula areas of Anne Arundel County to the rest of the county and the Baltimore/Washington region. These corridors serve as either the primary access or only access to these areas, which was the impetus for this study. While future development is generally minimized in the seven study corridors, the fact that several of the study corridors are near and/or over capacity required a comprehensive planning approach that evaluated multiple modes of transportation options in the corridors.

A key finding of the MIIF Study is that there are a number of operational, intersection, transit, pedestrian, and bicycle improvements that can be implemented to improve traffic operations and multi-modal connectivity along the study corridors. No travel network improvements are proposed in the Baltimore Region Constrained Long Range Plan (CLRP) for any of the study corridors, however two highway capacity improvements on College Parkway and MD 177 are appropriate and necessary in the future based on 2035 forecasts.

Using the regional travel forecasting modeling process and Highway Capacity Manual (HCM) capacity analysis procedures, the study evaluated a range of travel modes and transportation systems management (TSM) strategies. Consistent with the Corridor Growth Management Plan (CGMP), the study indicates that premium transit service between Annapolis and Washington D.C (i.e Express Bus or Commuter Rail) could be an applicable transit strategy to several of the study corridors and warrants further evaluation.

Figure 1: CGMP Preferred Transit Network



With regards to commuter rail, it is important to note the major differences between commuter rail and heavy/light rail transit systems which were eliminated from consideration with the possible exception of the Parole/Annapolis Towne Center area. While light and heavy rail are most applicable in large, dense urban environments such as Washington, DC, Chicago, and Philadelphia, commuter rail is designed to carry commuters from suburban areas to large urban central business districts. This is the case for existing MARC and VRE commuter rail service to downtown Washington D.C. These lines service corridors similar to the Annapolis to Washington corridor and are operating near or at capacity based on the high peak period demands in these corridors. Additional factors to be considered with regards to providing commuter rail service include the high costs of parking in downtown Washington, congested highway travel times between Annapolis and downtown Washington, and existing and proposed land use densities in Prince George's County where existing heavy rail service is near capacity. These variables all directly impact transit ridership demand for commuter rail. Given the proximity of Annapolis to Washington D.C., and the factors cited above, commuter rail service should be evaluated further in the future through a detailed alternatives analysis and travel forecasting process, particularly given that traffic is forecast to continually increase on US 50. Local Bus service would be feasible in several of the study corridors based on household density analysis. The College Parkway and MD 177 corridors show particular promise for this type of transit improvement.

As referenced previously, the MIIF Study is the final component of a larger ongoing project to prepare the County's Transportation Functional Master Plan (TFMP) as recommended in the adopted *General Development Plan* (2009). As stated, the MIIF Study analyzes opportunities to improve travel in the County's major peninsula corridors. Other components will incorporate enhanced pedestrian and bicycle travel; identify potential regulatory changes that may facilitate efficient use of rights of way for all travel modes; evaluate and develop opportunities to improve travel along the County's major highways; identify key relationships between land use patterns and transportation facilities; and recommend intergovernmental coordination strategies.

CHAPTER 1: EXECUTIVE SUMMARY

1.1 OVERVIEW

The Major Intersection/Important Facilities Study is the final component of the response to the 2009 General Development Plan which observed that growth in employment and households is projected to continue over the next 20 years in Anne Arundel County, which will create additional travel demand while the ability to add roadway capacity is limited. As the County continues to experience growth in population and employment, it faces both challenges to mobility and quality of life that are associated with that growth. Some of the study corridors are located in lower density and/or rural locations of the county where preserving the rural character is a primary motivation for many of its residents. This reinforces the need for context-sensitive transportation solutions that minimize the impacts to the natural environment while maintaining the same traffic level of service.

Designing within existing constraints is a key aspect of context sensitive design

The objective of this report is to develop transportation solutions for viable alternative modes of travel, with concept-level impacts and costs. The goal of these recommendations is to enhance mobility, safety, and accessibility for all travel modes in order to preserve the economic vitality and quality of life within the peninsula areas of the County. A map of these corridors is shown on the next page. A glossary of terms and listing of acronyms is provided in **Appendix T**.

This report presents specific recommendations for mobility improvements based on increases in travel demand by the year 2035 in seven key corridors throughout the County:

1. College Parkway: MD 2 to MD 179 – 4.8 miles
2. Forest Drive: Chinquapin Round Road to Bay Ridge Avenue – 2.3 miles
3. MD 173 (Fort Smallwood Road): MD 607 to Bayside Beach Road – 1.7 miles
4. MD 177 (Mountain Road): MD 2 to Lake Shore Drive – 7.8 miles
5. MD 214 (Central Avenue): MD 424 to Shoreham Beach Road – 7.5 miles
6. MD 256 (Deale Road) & MD 468 (Shady Side Road): MD 2 to Snug Harbor Road – 8.1 miles
7. MD 665 (Aris T. Allen Boulevard): US 50 to Chinquapin Round Road – 2.7 miles

These seven corridors represent the busiest roadways in the peninsula areas of the County, and serve as either the primary route or only route into these areas. Several of the study corridors have traffic volumes that lead to recurring rush hour congestion. Improving access is critical to these communities, particularly for emergency response units and during evacuation events.

1.1.1 Purpose and Scope

This document and the proposed recommendations will assist County and State planners, land developers, and decision-makers regarding future investments and priorities for improvements in highway, intersection, transit and non-motorized facilities. The recommendations have been carefully analyzed and vetted through the use of advanced travel forecasting and traffic analysis software models and extensive coordination with local, state, and regional transportation planners. The recommendations focus on intersection improvements which reduce corridor delays while minimizing the right-of-way and environmental impacts, and the need to provide for additional choices within each corridor other than travel by private automobile on the primary routes. These choices also include implementing the County's Complete Streets policy to improve the parallel connections in these study corridors and add redundancy to the transportation system. As appropriate alternative modes of travel such as carpool, rail, bus, cycling, and walking were identified in each corridor, the feasibility of each mode was evaluated. The selected recommendations represent "smart" transportation improvements that aim to:

- provide parallel connections in peninsula areas of county,
- reduce vehicle delays along each corridor,
- enhance travel choices,
- improve regional mobility,
- improve access to peninsula areas of counties,
- improve emergency vehicle access,
- improve safety for vehicles, bicyclists, and pedestrians, and
- support County land use plans while maintaining the character of the corridor.

For each corridor, the recommendations for roadway, transit, bicycle/pedestrian facilities, and land use, along with toolbox strategies to provide enhanced management of day-to-day roadway/traffic operations, as well as travel demand are presented in **Figure 2**. Capital costs for all improvements are also presented.

1.1.2 Project Costs

Planning level construction cost estimates were developed for all roadway, bicycle, and pedestrian improvements, based on costing guidance provided by the Maryland State Highway Administration (MSHA). The raw roadway costs include construction costs such as pavement widening, intersection upgrades, structure upgrades, environmental mitigation, traffic control, and design fees, but do not include the costs of purchases of land for additional rights-of-way. The total estimated construction cost to implement this plan on the seven corridors is **$130.5 million**. These costs exclude the costs for constructing the Mountain Road Corridor Study improvements from MD 648 (Waterford Rd) to Edwin Raynor Road (estimated at over $34 million), as these improvements are currently funded in the FY 17-22 County CIP. See **Table 1.**

1.1.3 Alternatives Tested

Throughout the study, two alternatives were developed and tested for all corridors, including:

1. A No Build Alternative- Only constructing roadways that are currently funded for construction, with no transit or bike/pedestrian improvements.

2. A Build Alternative- Constructing roadway and intersection improvements along each of the study corridors along with transit improvements and bike/pedestrian improvements.

Based on the results of the future conditions analysis, the final and preferred alternative developed, tested, and recommended for each study corridor focused on bicycle, pedestrian, and intersection improvements with an emphasis on Transportation System Management (TSM) strategies which can be implemented with minimal cost and right-of-way impacts.

Figure 2: Corridor Key Map

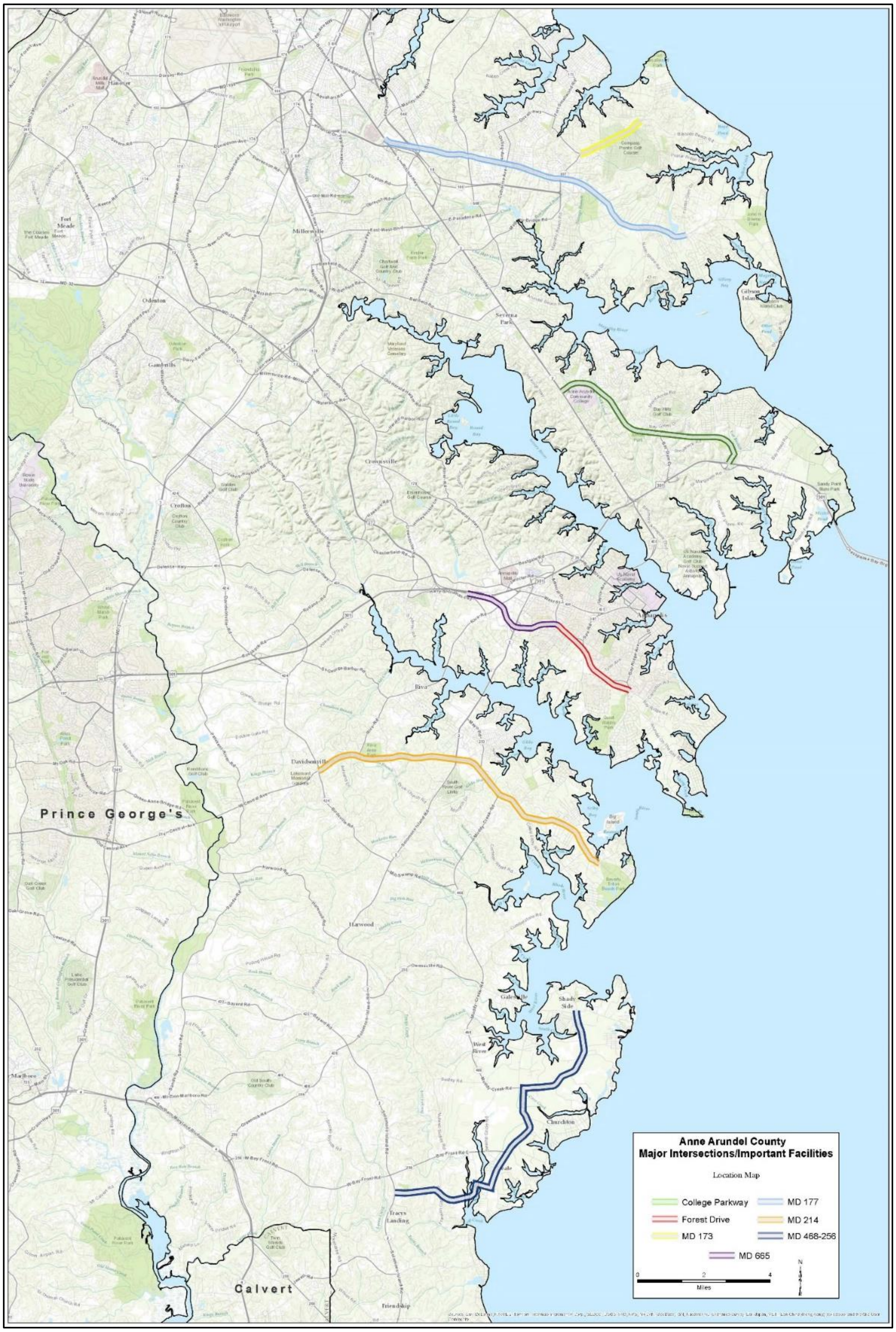


Table 1: Project Costs

Corridor	Roadway Cost
College Parkway	$38,200,000
Forest Drive	$36,700,000
MD 173	$300,000
MD 177	$21,700,000*
MD 214	$26,700,000
MD 256/468	$6,900,000
MD 665	$0
GRAND TOTAL	**$130,500,000**

***Excludes the costs from Mountain Road Corridor Study**

1.1.4 Priorities

Based on a combination of projected benefits in travel time reliability, level of service improvement, introduction of travel choices, and construction impacts and feasibility, the projects were prioritized as near-term (projects that can be implemented with minimal design and construction), mid-term (projects that can be feasibly constructed within a 5-10 year timeframe), and long-term (corresponds with projects that need substantial construction funding and coordination with MSHA and/or BMC and would likely be implemented as a part of the long range planning process). The study recommendations are prioritized below.

Near-Term

- MD 173 bike lanes
- MD 256 & MD 468 bike lanes
- MD 256 sidewalks

Mid-Term

- MD 177 widening including bike lanes and sidewalks
- MD 214 bike lanes
- MD 214 sidewalks
- College Parkway at MD 2 intersection improvement
- College Parkway at MD 179 intersection improvement

Long-Term

- College Parkway widening
- College Parkway bike lane/sidewalks (incorporate in widening project)
- Forest Drive bike lanes/sidewalks (incorporate in future reconstruction)

1.1.5 Next Steps

This document is a stand-alone report that is intended to justify advancing each of these corridors into either final design/construction of Near-Term improvements or into a detailed project planning and preliminary engineering process, including identifying and securing funding commitments in partnership with appropriate State, Federal and private partners. This document builds on elements of the *General Development Plan (2009); GDP Background Report on Transportation (2008), The Corridor Growth Management Plan (2012),* the *Anne Arundel County Pedestrian and Bicycle Master Plan (2012),* and *Complete Streets Guidelines (2014)*. This report will serve as the final component of the Countywide Transportation Master Plan Document and will be used to develop priorities for that document.

1.2 Corridor Analysis

A corridor Level of Service (LOS) analysis was conducted using the AATrvM travel demand model. The AATRvM travel demand model results were compared to existing and forecast roadway capacity which was used to determine the LOS at the highway link level.

1.2.1 College Parkway

College Parkway is projected to carry up to 36,000 vehicles per day in the year 2035 west of Jones Station Road and almost 22,000 vehicles per day east of Jones Station Road, which is over the daily capacity of 20,000 for a two lane arterial. College Parkway provides service to Anne Arundel Community College and is often used as a bypass route for traffic destined to the Chesapeake Bay Bridge. The roadway currently experiences some congestion at the intersections of MD 2 and MD 179, and the segment from west of Jones Station Road (where existing four lane highway tapers to two lanes) to MD 179 is projected to deteriorate to a Level of Service (LOS) F in the year 2035.

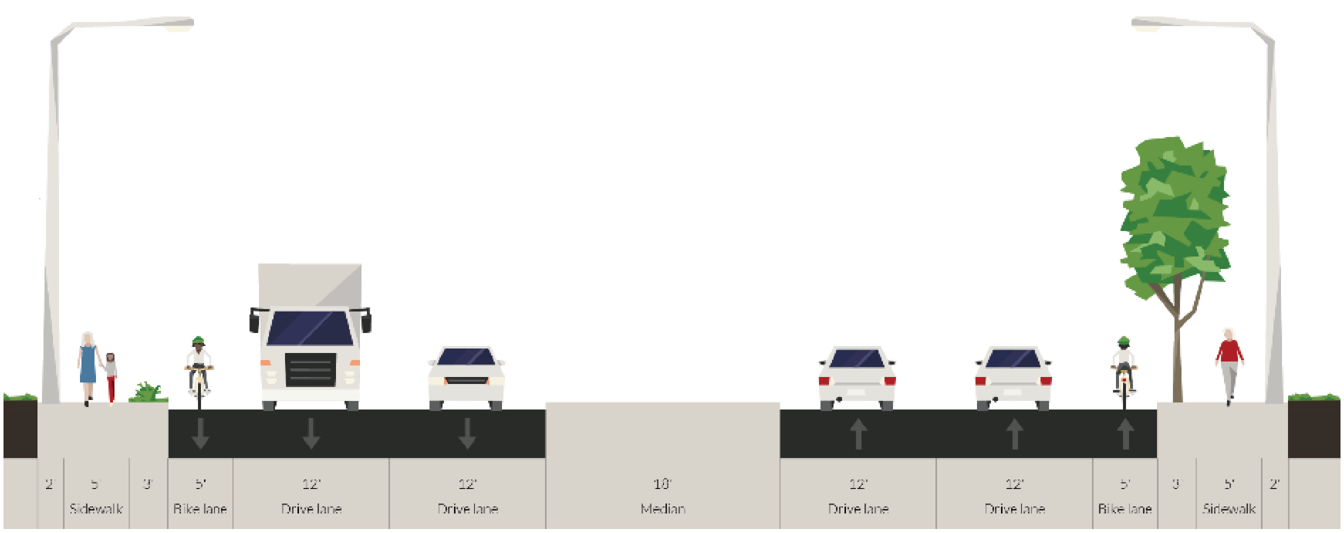
The recommendations for College Parkway include roadway widening improvements, intersection improvements, and bicycle and pedestrian improvements. See **Table 2.**

Table 2: Recommendations for College Parkway

Mode/Strategy	Description
Roadway	• Widen from 2 to 4 lanes from west of Jones Station Road to MD 179 • Add additional southbound left turn lane on MD 2 at College Parkway intersection • Add additional eastbound left turn lane on College Parkway at MD 179 intersection
Transit	• Evaluate the extension of Annapolis Transit Gold Line service in future
Bicycle and Pedestrian	• Extend Broadneck Trail to Baltimore/Annapolis Trail • Add Bicycle Lanes on College Parkway • Connect missing sidewalk gaps on College Parkway
Land Use	• Future development should occur in New Urbanism fashion with complete streets network, no cul-de sacs
Toolbox Elements	• Signal System coordination and optimization • Special Event/evacuation signal timing plan • Anne Arundel Community College sponsored vanpool • Pedestrian and Bicycle connections • Complete Streets/development of parallel connections

The provision of an additional lane in each direction on College Parkway reduces the forecast volume to capacity ratio from 1.10 to 0.57. Typical roadway cross-sections of this alternative are illustrated in **Figure 3**.

Figure 3: College Parkway Proposed Roadway Cross Section



1.2.2 Forest Drive

Forest Drive is projected to carry up to 40,000 vehicles per day east of Spa Road and over 60,000 vehicles per day between Hilltop Lane and Chinquapin Round Road in 2035. It provides an important connection from a number of peninsula areas of the County to MD 665, US 50, and the rest of the Baltimore/Washington region. This roadway experiences congestion between Chinquapin Round Road and Hilltop Lane, as a number of shopping centers are located on the south side of Forest Drive east of Chinquapin Round Road. This leads to large numbers of turning vehicles, effectively reducing the capacity of this roadway segment, which lead to significant delays in the corridor. A previous study conducted by the City of Annapolis using traffic micro-simulation indicated that the intersection of Forest Drive and Chinquapin Round Road would experience congested conditions in the future based on queuing captured in the simulations. The recommendations from the City of Annapolis study included an additional left turn lane on the southbound approach of Chinquapin Round Road at Forest Drive which would alleviate the future congestion at this intersection.

Additional recommendations for Forest Drive include improved transit service and amenities, bicycle lanes on Forest Drive, Access Management on Forest Drive, and connecting sidewalk gaps. See **Table 3**.

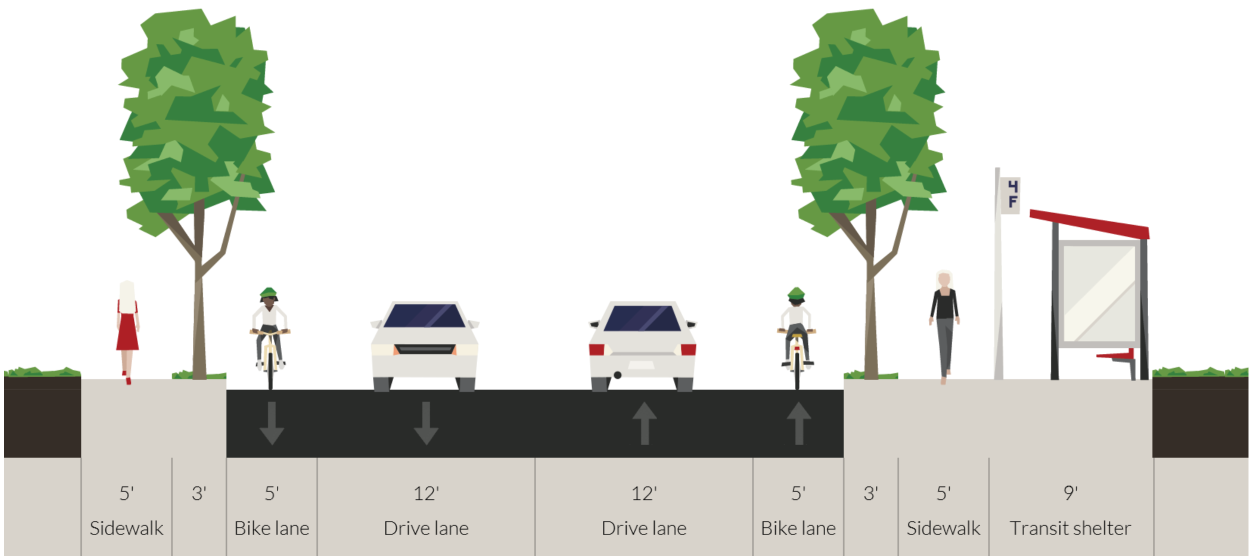
Table 3: Recommendations for Forest Drive

Mode/Strategy	Description
Roadway	• No new travel lanes
Transit	• Extension of existing MTA commuter bus service from Riva Road Park & Ride lot to Bay Ridge Avenue • Improve transit amenities including bus shelters, real time bus information, and improved sidewalk connections
Bicycle and Pedestrian	• Add bicycle lanes on Forest Drive including segment from MD 2 to Chinquapin Round Road • Construct missing sidewalk connections
Land Use	• Allow for increased density and transit-oriented development in Annapolis Towne Center area • Future development should occur in New Urbanism fashion with complete streets network
Toolbox Elements	• Signal System coordination and optimization • Real Time Travel Time Information on Changeable Message Signs • Special Event/evacuation signal timing plan • Annapolis Towne Center shuttle service • Improved Transit service and amenities • Conduct Future Origin-Destination study in study area to determine framework for carpool/vanpool service • Pedestrian and Bicycle connections • Complete Streets/development of parallel connections • Access Management Plan • Reversible Lanes

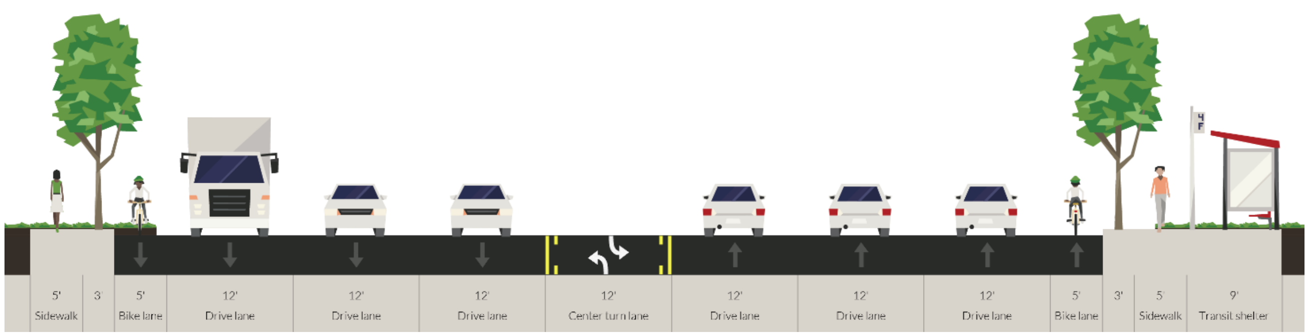
Typical roadway cross-sections of this alternative are illustrated in **Figure 4 .**

Figure 4: Forest Drive Proposed Roadway Cross Sections

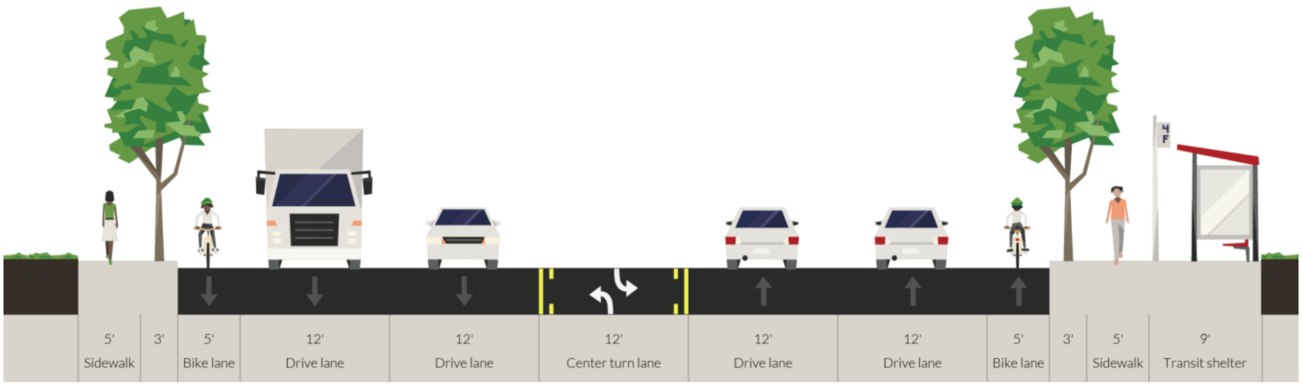
Two Lane- From Old Solomons Road to Chinquapin Round Road



Six Lane- From Chinquapin Round Road to East of Hilltop Lane



Four Lane- From East of Hilltop Lane to East of Hillsmere Drive



1.2.3 MD 173 (Fort Smallwood Road)

MD 173 (Fort Smallwood Road) is projected to carry over 17,000 vehicles per day by 2035. It serves local peninsula area traffic primarily. The corridor is currently not experiencing congestion throughout its entire length during both the morning and afternoon peak periods. Congestion during special events at the pier located at the end of the corridor was cited as a concern during the public meeting.

The recommendations for MD 173 include primarily pedestrian and bicycle improvements and toolbox strategies to better manage congestion during special events at the County pier on weekends. See **Table 4**.

Table 4: Recommendations for MD 173 (Fort Smallwood Road)

Mode/Strategy	Description
Roadway	• Shoulder resurfacing and striping
Transit	• Study feasibility of future bus service if density increases in corridor
Bicycle and Pedestrian	• Construct missing sidewalks between Hog Neck Road and Edwin Raynor Boulevard • Stripe bicycle lanes on existing shoulders of MD 173 between Hog Neck Road and Bayside Beach Road
Land Use	• No land use changes are proposed
Toolbox Elements	• Signal Timing optimization at MD 173 and Hog Neck Road • Special Event/evacuation plan • Improved bicycle connectivity

The proposed roadway cross-sections remain unchanged from existing conditions.

1.2.4 MD 177 (Mountain Road)

MD 177 is projected to carry up to 33,000 vehicles per day by 2035. It connects MD 2 near Marley Station Mall to the peninsula areas of Pasadena. The corridor serves local traffic in Pasadena and Glen Burnie as well as long distance commuters traveling to Baltimore and Annapolis. The roadway has numerous access points and is near capacity between Jumpers Hole Road and MD 648 which leads to congestion in this segment.

The recommendations for MD 177 include roadway improvements, new local bus transit service, bicycle and pedestrian improvements. See **Table 5**.

Table 5: Recommendations for MD 177

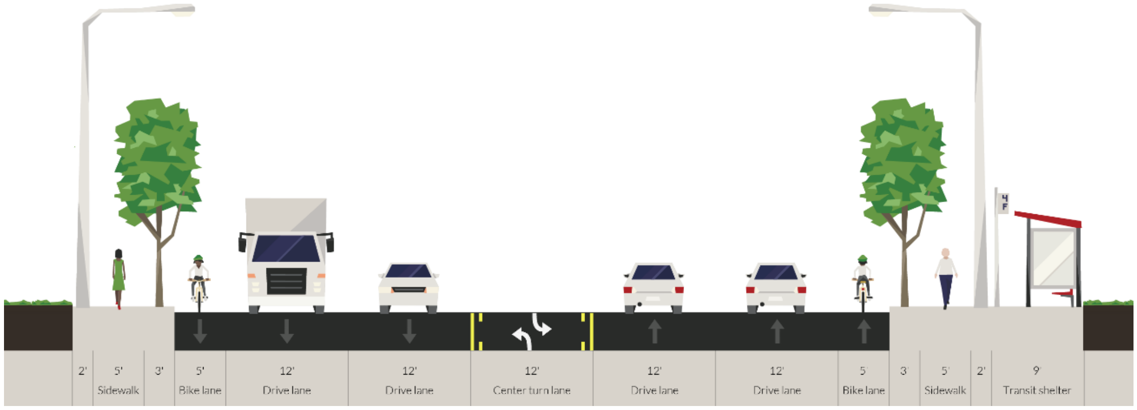
Mode/Strategy	Description
Roadway	• Widen from 2 to 4 lanes between MD 648 (Baltimore-Annapolis Boulevard/Jumpers Hole Road) and MD 648 (Waterford Road) • County's Mountain Road Study Improvements from MD 648 (Waterford Road) to Edwin Raynor Boulevard • Existing County Capital Improvement Projects • Widen from 2 to 3 lanes between Edwin Raynor Road and MD 100
Transit	• Operation of local bus transit service along this corridor
Bicycle and Pedestrian	• Bicycle lanes on MD 177 and connect missing sidewalk connections
Land Use	• No land use changes are proposed
Toolbox Elements	• Signal System Coordination and Optimization • Special Event/evacuation signal timing plan • Improved Transit service and amenities • Pedestrian and Bicycle connections • Complete Streets/development of parallel connections • Access Management Plan

The roadway widening proved to provide adequate levels of service in the future year 2035. The volume to capacity ratio is forecast to be 0.72 in the build condition compared to 1.31 in the no build conditions.

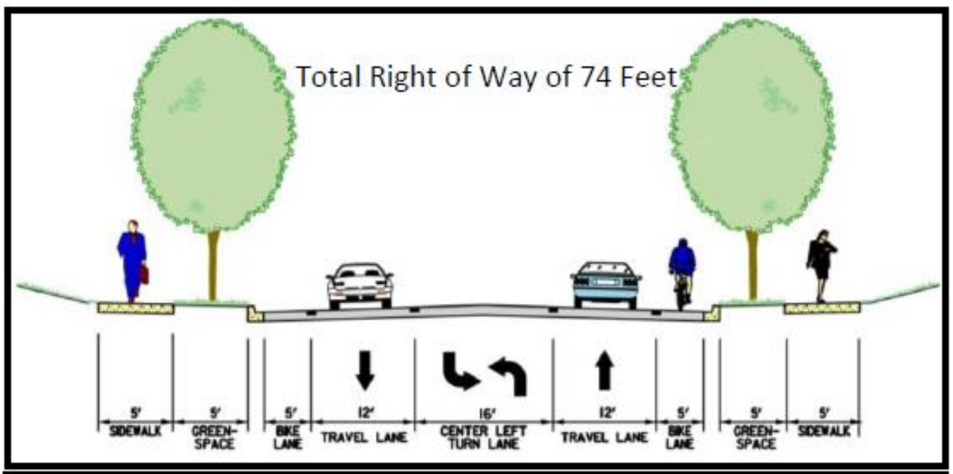
Typical roadway cross-sections of this alternative are illustrated in **Figure 5.**

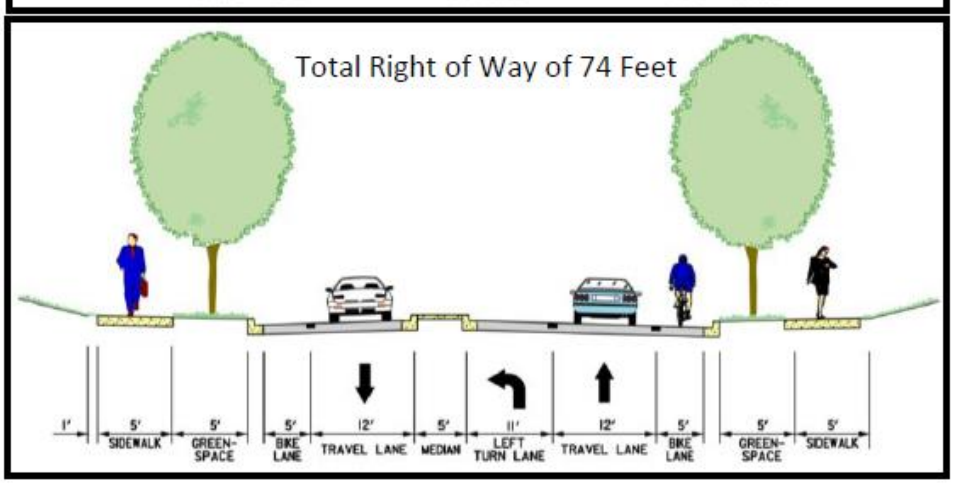
Figure 5: MD 177 Proposed Roadway Cross Sections

Four Lane Section; Jumpers Hole Road to MD 648/Waterford Road



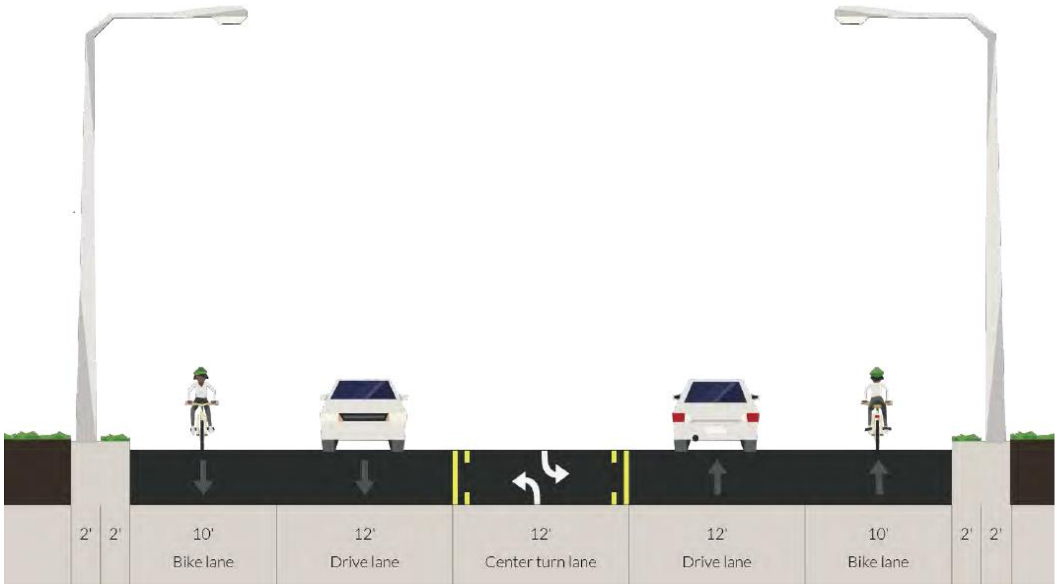
Three Lane Section; MD 648/Waterford Road to MD 100



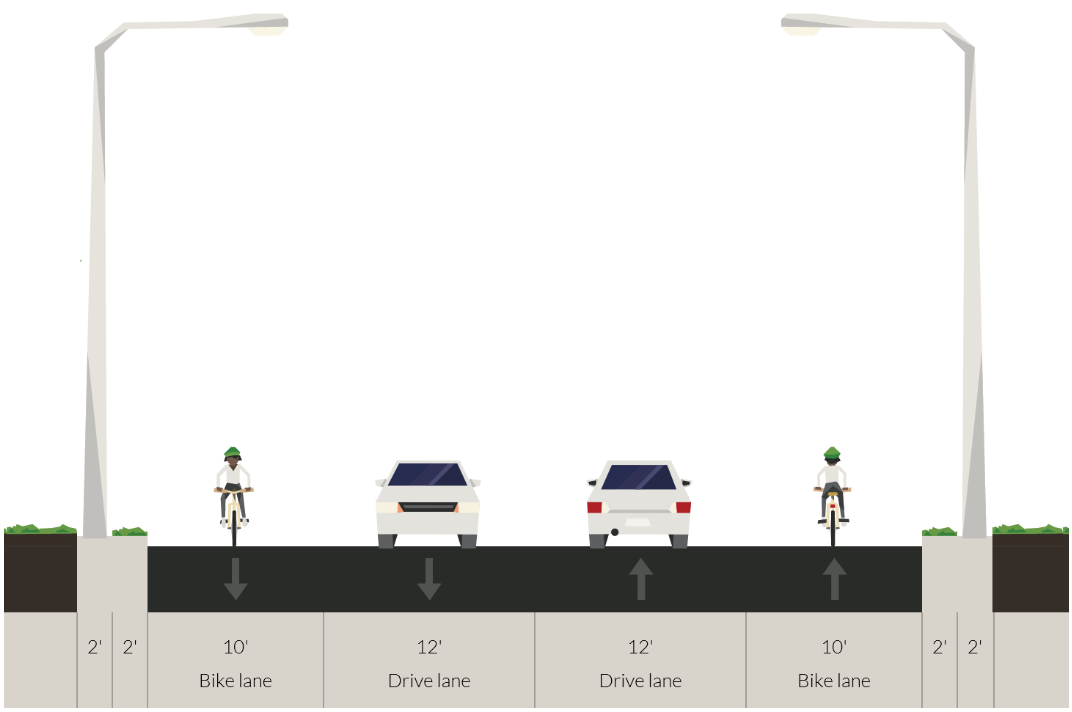


Source: Mountain Road Corridor Study

Three Lane- From MD 100 to South Carolina Ave



Two Lane- East of South Carolina Ave



1.2.5 MD 214 (Central Avenue)

MD 214 is projected to carry up to 27,000 vehicles per day by 2035. MD 214 provides an essential link between the Edgewater area to the rest of the County and Washington D.C. It serves local traffic in Edgewater as well as commuters traveling to job centers in Washington D.C., Fort Meade, the NSA, and Annapolis. The corridor currently experiences congestion at the intersection of MD 468; however, this section is programmed for a capacity improvement which will mitigate this congestion in the future.

The recommendations for MD 214 include travel lane extensions east of MD 2, bicycle improvements throughout most of the corridor and pedestrian improvements in segments. The intersections of MD 214 at Riva Road and MD 214 at Stepneys Lane are recommended to have a traffic signal warrant assessment conducted.

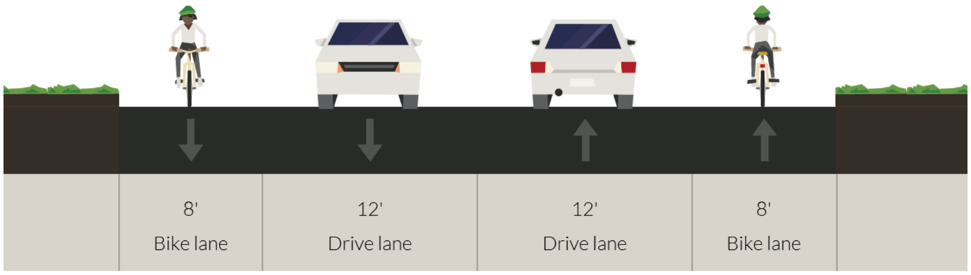
Typical roadway cross-sections of this alternative are illustrated in **Figure 6**.

Table 6: Recommendations for MD 214

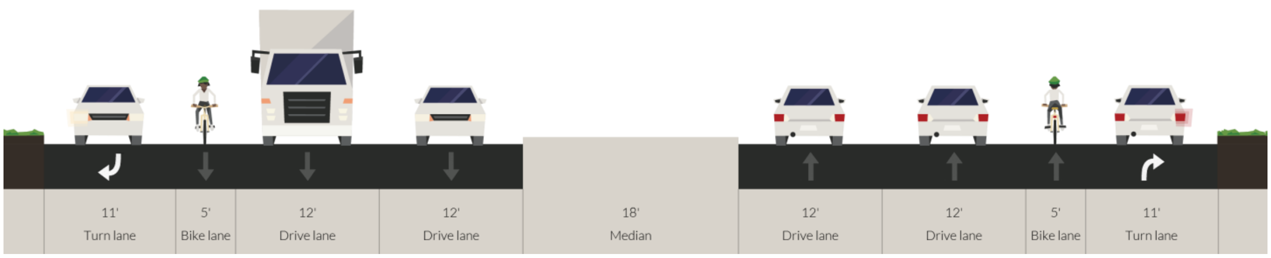
Mode/Strategy	Description
Roadway	• Eastbound travel lane extension to MD 468
Transit	• None
Bicycle and Pedestrian	• Bicycle lanes on shoulders from MD 424 to west of Pike Ridge Road and MD 468 to Shoreham Beach Road; bicycle lanes on proposed curb and gutter cross section from west of Pike Ridge Road to MD 468 • Sidewalks on proposed cross section from west of Pike Ridge Road to MD 468
Land Use	• No land use changes are proposed
Toolbox Elements	• Signal System coordination and optimization • Special Event/evacuation signal timing plan • Improve Pedestrian and Bicycle compatibility

Figure 6: MD 214 Proposed Roadway Cross Sections

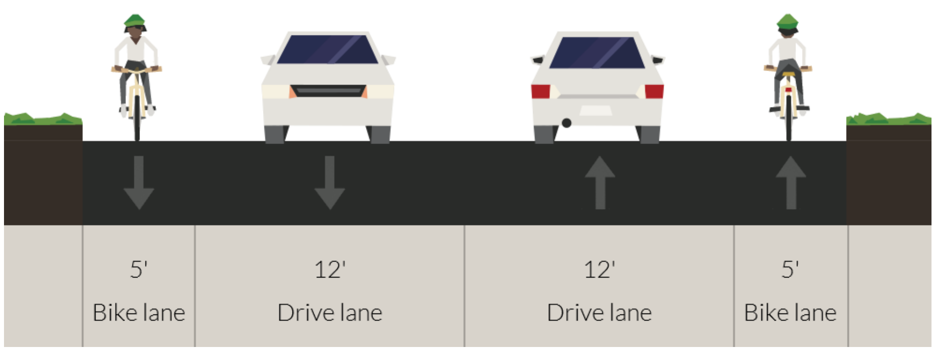
Two Lane from MD 424 to Pike Ridge Road



Four Lane from West of MD 2 to MD 468



Two Lane from MD 468 to Shoreham Beach Road



1.2.6 MD 256 (Deale Road) & MD 468 (Shady Side Road)

MD 256 & MD 468 are projected to carry up to 13,000 vehicles per day by 2035. This corridor provides an essential link between the Shady Side and Deale peninsula areas to MD 2. It serves local traffic in these areas primarily. The corridor currently does not experience peak hour congestion.

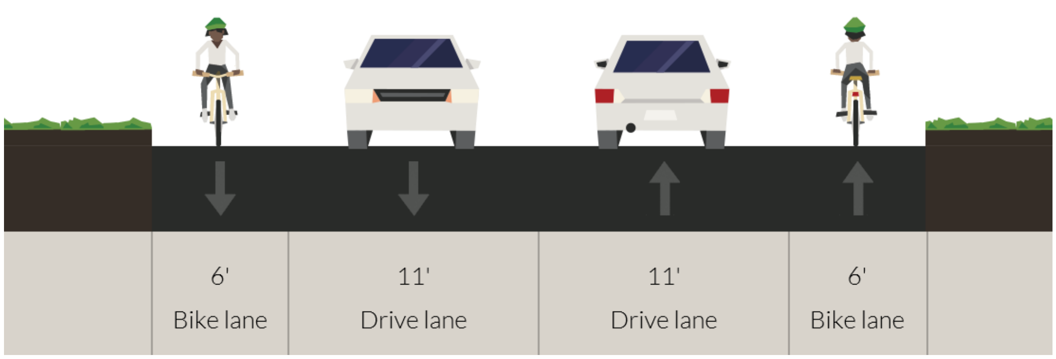
The recommendations for MD 256 & MD 468 include a potential roundabout at MD 2 and MD 256, sidewalks in the central Deale area, and bicycle lanes on the shoulders of MD 256 & MD 468. See **Table 7**.

Table 7: Recommendations for MD 256 & MD 468

Mode/Strategy	Description
Roadway	• Potential roundabout at MD 2 and MD 256
Transit	• None
Bicycle and Pedestrian	• Bicycles lanes on shoulders and sidewalks in central Deale
Land Use	• No land use changes are proposed
Toolbox Elements	• Signal optimization at the intersection of MD 256 and MD 468 • Improve bicycle and pedestrian connectivity

Typical roadway cross-sections of this alternative are illustrated in **Figure 7**.

Figure 7: MD 256 & MD 468 Proposed Typical Cross Section



1.2.7 MD 665 (Aris T. Allen Boulevard)

MD 665 is projected to carry over 65,000 vehicles per day by 2035. This corridor provides an essential link between Forest Drive and US 50/I-97. It serves a combination of local and regional traffic in these areas including commuters to and from Annapolis, Baltimore, Fort Meade/NSA, and Washington, DC. The corridor experiences peak hour congestion associated with queuing and weaving conditions on US 50.

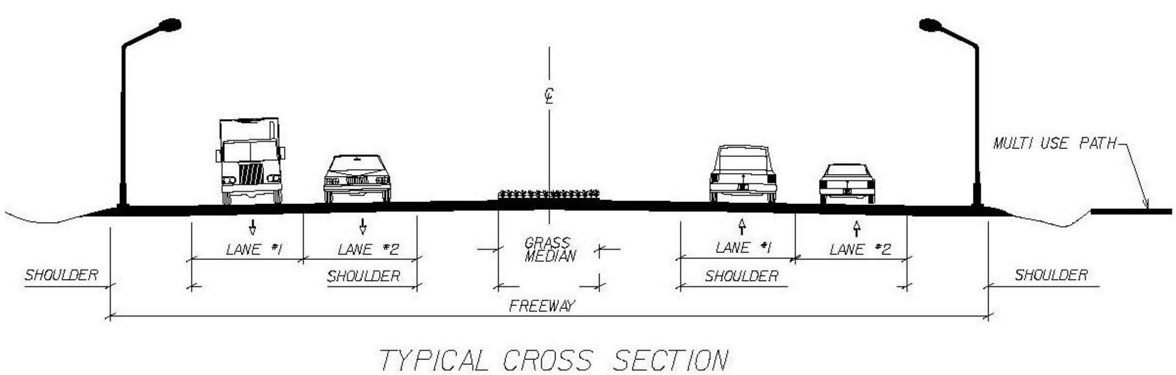
While there were no recommendations developed for MD 665, this corridor is recommended for detailed study as a part of a larger US 50 corridor study which should be conducted in the future based on the recommendations from the Corridor Growth Management Plan. See **Table 8**.

Table 8: Recommendations for MD 665

Mode/Strategy	Description
Roadway	• Future Study Recommended
Transit	• Potential commuter rail to Washington DC with terminus at Annapolis Towne Center • Potential bus rapid transit or light rail with Annapolis Towne Center as the focal point
Bicycle and Pedestrian	• Potential multi-use path parallel to MD 665
Land Use	• Increase density in Annapolis Towne Center and adjacent areas to support high-quality transit service
Toolbox Elements	• Real Time Travel Time information • Carpools and vanpools sponsored by Annapolis Towne Center employers • Improve pedestrian and bicycle network on parallel routes such as Forest Drive

Typical roadway cross-sections of this alternative are illustrated in **Figure 8**.

Figure 8: MD 665 Proposed Typical Cross Section with Multi-Use Path



CHAPTER 2: INTRODUCTION

2.1 INTRODUCTION

The Major Intersection/Important Facilities Study is the last response to the 2009 General Development Plan which observed that growth in employment and households is projected to continue over the next 20 years. This growth will create additional travel demand while the ability to add roadway capacity is limited. This report presents the analysis, forecasting, alternatives development, testing, and recommended improvements to seven corridors that service the peninsula areas within the County's transportation network. As the County continues to experience growth in population and employment, the intersections along the study corridors could become bottlenecks that limit access to the peninsula areas for local residents, commuters, and emergency responders. Improving access to these areas of the County requires a comprehensive strategy of intersection improvements on the primary access routes, limited roadway capacity improvements, complete streets to develop parallel routes into the peninsula areas, transit, bicycle, and pedestrian improvements, Transportation System Management (TSM), and Travel Demand Management (TDM). The objective of this report is to present concept-level transportation solutions with impacts and costs for seven specific corridors that distribute traffic to the peninsula areas of the County. These corridors include:

1. College Parkway: MD 2 to MD 179 – 4.8 miles
2. Forest Drive: Chinquapin Round Road to Bay Ridge Avenue – 2.3 miles
3. MD 173 (Fort Smallwood Road): MD 607 to Bayside Beach Road – 1.7 miles
4. MD 177 (Mountain Road): MD 2 to Lake Shore Drive – 7.8 miles
5. MD 214 (Central Avenue): MD 424 to Shoreham Beach Road – 7.5 miles
6. MD 256 (Deale Road) & MD 468 (Shady Side Road): MD 2 to Snug Harbor Road – 8.1 miles
7. MD 665 (Aris T. Allen Boulevard): US 50 to Chinquapin Round Road – 2.7 miles

This report identifies constraints and opportunities for each corridor and recommends improvements for highway, transit and non-motorized facilities. This document builds on elements of the recently *adopted General Development Plan (2009), GDP Background Report on Transportation (2008), The Corridor Growth Management Plan (2012), the Anne Arundel County Pedestrian and Bicycle Master Plan, (2012), and Complete Streets Guidelines (2014)*. This report will serve as the final component of the Countywide Transportation Master Plan Document.

The approach in this effort was to address forecasted future recurring congestion through evaluation of the major intersections along seven key study corridors in the County, evaluating alternatives with the AATRvM travel demand model using the adopted land use plan and cooperative demographic forecasts to determine what mixture of recommendations, at an intersection and network level, will serve to best reduce future travel congestion, at the lowest capital and operating costs while limiting the impact to the adjacent natural and built environment. It should be noted that the travel demand modeling approach for this effort was a regional approach with a focus on the county, and that this approach was built upon the currently adopted *Baltimore Metropolitan Council Transportation Improvement Plan* and *Constrained Long Range Plan* which are the current policies of the County for future improvements to the transportation network.

The study focused on identifying and analyzing intersection and multi-modal improvements that would improve safety and mobility for all modes in the study corridors at a reasonable cost and minimal right-of-way impact. Improvements were developed to improve traffic circulation within the study corridors and improve their connectivity with the rest of the county and region. This document and the proposed recommendations will assist County planners, land developers, decision makers, and budgets regarding future investments and improvements for highway, transit and non-motorized facilities.

The effort also included a review and revision to the Countywide travel forecasting and travel demand models, compilation of traffic data, intersection and roadway level of service/capacity analyses, modeling of future roadway networks, identification of system and demand management strategies, conceptual footprint assessment including cross-section elements and preliminary costs, and stakeholder and public outreach.

2.2 PURPOSE AND NEED

The focus of this report is to identify near and mid-term transportation solutions for key intersections within each study corridor and develop non-motorized transportation options, with concept-level impacts and costs. The purpose of these recommendations is to enhance mobility and accessibility for all modes of travel in order to preserve the economic vitality and the quality of life within the peninsula areas of the County. Anne Arundel County's transportation planning process is a comprehensive, coordinated and continuous process that follow's current federal regulations and is active at the local, State and Regional level. The emphasis of the study is to reduce corridor delays through low cost intersection and operational improvements and exploring the feasibility of improving alternative travel options such as complete streets, carpool, rail, bus, cycling and walking. The goal of these recommendations is to identify "smart" transportation improvements that reduce delays along each corridor, enhance travel choices, and improve safety for vehicles, bicyclists, and pedestrians while not substantially changing the character of the corridors. This report is a critical component to the County's overall Transportation Master Plan. It will serve several needs including:

- Developing a vision to guide investment in the County's peninsula transportation corridors over the next 20 years
- Assessing, within each corridor, enhanced travel choices, parallel connections, optimal new modes of travel, intermodal connections, and tools for better managing congestion
- Assisting the County in having a greater leadership role in the pursuit of federal and regional transportation funding
- Supporting existing and future land uses including transit-oriented development and smart growth development
- Developing concept level design elements and preliminary construction costs for each orridor
- Developing a 'toolbox' of practical day-to-day strategies to better manage roadway/traffic operations as well as travel demand for each corridor
- Identify longer term right-of-way needs and make informed recommendations about land requirements for future transportation facilities.

2.3 TRANSIT MODE INVESTIGATION

Primary modes assessed in this study included highway, bicycle, pedestrian, and transit. In order to begin identifying appropriate modes of transit, a household and employment density analysis was conducted for each of the seven study corridors to determine if the density met the requirements for transit service. Several of the study corridors had transportation analysis zones that met the density requirements for commuter rail and several other corridors met the thresholds for local bus service.

2.4 ALTERNATIVE SCREENING/MEASURES OF EFFECTIVENESS/PRIORITIZATION

Balancing the need for added roadway footprint with limited right of way, environmental constraints, and the need to provide for more travel choices has been carefully considered on a corridor-by-corridor and segment-by-segment basis to identify which roadway and transit capacity improvements will be most operationally beneficial and justified. Given that most of the recommendations were focused on intersection and bicycle/pedestrian improvements, the right-of-way impacts are minimal overall. The following factors were considered in both screening alternatives to identify preferred concepts as well as developing the final set of recommendations for ranking corridor implementation priorities for advancement into detailed project planning, preliminary and final engineering design, acquisition, and construction:

1. Travel Time Reliability. The ability of travel options in each corridor to provide consistent future peak hour travel times either based on the lack of peak hour vehicle congestion or the provision of alternative roadway connections and modes of travel.
2. Average Daily Traffic. The total daily number of vehicles traversing a particularly point along a roadway over a 24-hour period.
3. Level of Service. A qualitative measure describing operational conditions within a traffic stream, based on service measures such as speed, travel time, freedom to maneuver, traffic interruption, comfort and convenience. For example, LOS A represents free flow, almost complete freedom to maneuver within the traffic stream. LOS F represents forced flow, more vehicles are attempting to use the facility than can be served resulting in stop-and-go traffic.
4. Travel Choices. The number of future available options to travel from one point in a corridor to another, in comparison to existing conditions.
5. Cost. The total dollar value in current year dollars, to design and construct a proposed improvement.
6. Feasibility (environmental, right-of-way impact). The amount of impact from construction of proposed improvements due to sensitive environmental features such as streams, wetlands or personal property such as homes and businesses.
7. Land Use Compatibility. The consistency of recommendations with currently zoned land use regulations and small area plans.

2.5 STAKEHOLDER AND PUBLIC OUTREACH

The Major Intersection/Important Facilities Study process facilitated extensive stakeholder and public outreach along several facets throughout the 24-month timeline:

A Project Management Team met quarterly throughout the 24-month study and provided technical guidance and feedback. Represented agencies included:

- The Maryland State Highway Administration (Regional Intermodal Planning Division, Travel Forecasting and Analysis Division, District 5)
- Anne Arundel County Department of Public Works
- Maryland Transit Administration
- City of Annapolis
- Baltimore Metropolitan Council

A series of public meetings and open houses were held throughout the project. Listening sessions at two locations around the County were held after the completion of the existing conditions analysis in March 2016, and a presentation of preliminary findings open house was held in June of 2016.

This website link is a repository for all technical documents including reports, meeting minutes, graphics, and schedules: http://www.aacounty.org/PlanZone/TransPlan/index.cfm. See **Appendix U** for meeting minutes from the PMT Meetings, public comments, and a response to those comments.

CHAPTER 3: EXISTING CONDITIONS DOCUMENTATION

3.1 INTRODUCTION

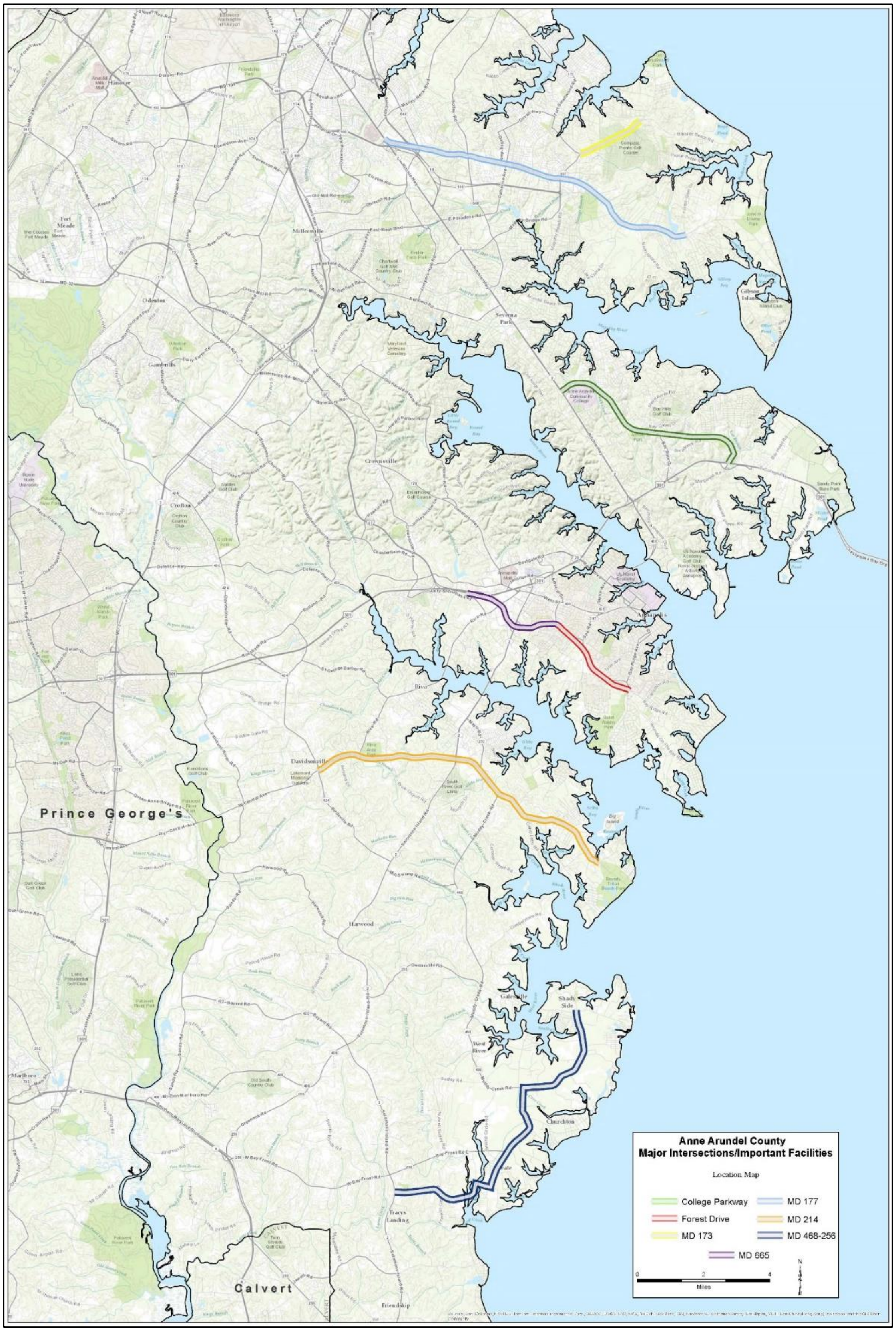
The purpose of this Chapter is to document the existing conditions of transportation-related elements in each of the identified corridors, including existing traffic volumes, existing level of service and existing transportation network characteristics. Existing conditions data was collected through a series of field inventories and windshield surveys including number of lanes, cross-sectional elements, bicycle routes and access, sidewalks, bus stop type and location, and transit ridership. In addition, the key elements of completed transportation studies and land use plans were reviewed to ascertain currently planned future transportation and land use conditions affecting these corridors.

Detailed traffic count data is included in **Appendix I**. Detailed level of service calculations are included in **Appendix L**. Detailed corridor base mapping is included in **Appendices P through S**. Existing transit service mapping is illustrated in **Appendix H**. Summaries of previous transportation and land use plan recommendations affecting the County are included in **Appendix O.**

3.2 EXISTING TRAFFIC VOLUMES

Existing and historical traffic counts were compiled to determine the daily travel demand for each corridor and to obtain the traffic data necessary for roadway capacity analyses and travel demand model validation [e.g. average annual daily traffic (AADT), commuter peak hour traffic volumes]. An illustration of the seven corridors is shown in **Figure 9**.

Figure 9: Corridor Key Map



3.2.1 College Parkway

The County's functional classification for College Parkway is 'Minor Arterial'. The study corridor is approximately 4.8 miles long and runs from MD 2/Governor Ritchie Highway to MD 179/Cape St. Claire Road. College Parkway begins as a four-lane roadway intersecting MD 2 in Arnold. From this intersection, the roadway heads east, gradually curving southeast. There are sections of curbed median throughout the roadway. Between College Manor Drive and Ternwing Drive, the roadway becomes two lanes. At Shore Acres Road, College Parkway begins traveling east again. At Destiny Circle, the roadway turns southeast again and continues until its terminus at Cape St. Claire Road.

The speed limit ranges from 40 to 50 miles-per-hour with eight (8) signalized intersections spread throughout the corridor. The 2012 average annual daily traffic (AADT) volume was 33,802 between MD 2 and Jones Station Road, and 16,932 for the segment east of Jones Station Road.

3.2.2 Forest Drive

The County's functional classification for Forest Drive is 'Principal Arterial' between Chinquapin Round Road/Bywater Road and Hilltop Lane, and 'Minor Arterial' between Hilltop Lane and Bay Ridge Avenue. The study corridor is approximately 2.3 miles long extending from Chinquapin Round Road/Bywater Road to Bay Ridge Avenue. Forest Drive continues on from the MD 665 terminus at Chinquapin Round Road/Bywater Road, transitioning from a 4-lane partially accessed-controlled freeway to a six-lane arterial roadway with sections of curbed median. At South Cherry Grove Avenue, eastbound Forest Drive loses one lane, making the roadway five lanes. Shortly thereafter, in the vicinity of Crystal Spring Farm Road, the roadway drops to four lanes with a center turn lane. Forest Drive regularly gains and loses this center turn lane as it intersects MD 387/Spa Road and Bay Ridge Avenue and represents the southern border of the city of Annapolis.

The speed limit on Forest Drive is 40 miles-per-hour with eight (8) signalized intersections along the study facility. The 2012 AADT was 56,873 between Chinquapin Round Road and Hilltop Lane, 36,241 between Hilltop Lane and Spa Road, and 27,921 between Spa Road and Hillsmere Drive.

3.2.3 MD 173

The County's functional classification for MD 173/Ft. Smallwood Road within the study area is 'Minor Arterial'. The study corridor is approximately 1.7 miles long and runs from Bayside Beach Road to MD 607/Hog Neck Road. MD 173 runs south as a two-lane road and then turns southwest at the intersection of Bayside Beach Road. The roadway has a section of diagonal-striped median. It passes along the northern edge of Jacobsville, where the road then meets the northern end of MD 607.

The speed limit ranges between 40 to 50 miles-per-hour. There is one signalized intersection located at MD 607. The 2012 AADT north of Bayside Beach Road is 12,880 and the 2011 AADT for the segment south of Edwin Raynor Boulevard is 9,252.

3.2.4 MD 177

The County's functional classification for MD 177/Mountain Road is 'Principal Arterial' between MD 2 and MD 648/Baltimore-Annapolis Blvd., and between MD 100 and South Carolina Avenue. MD 177 is classified as a 'Minor Arterial' between MD 648/Baltimore-Annapolis Blvd and MD 100, and between South Carolina Avenue and Forest Glen Drive. The study corridor is approximately 7.8 miles long from MD 2 to Forest Glen Drive. It begins in Pasadena at an intersection with MD 2. The intersection is located just north of the MD 2 interchange with MD 100/Paul T. Pitcher Memorial Highway. The roadway pavement section varies between 22 and 72 feet and has sections of median containing raised-curb, center turn lanes, and stretches of no median.

The corridor continues east as a six-lane divided highway, and drops to four lanes at the intersection with a ramp from southbound MD 10/Arundel Expressway and ramps to and from westbound MD 100. The corridor then passes under MD 10, adds a ramp onto northbound MD 10, and meets the southern end of MD 648/Baltimore-Annapolis Boulevard at Sun Valley. At the next intersection, MD 915/Long Hill Road splits towards the south. MD 177 continues east as a two-lane road with a frequent center turn lane. Travelling eastward, MD 177 intersects another section of MD 648/Waterford Road, as well as Catherine Avenue and Edwin Raynor Boulevard. The roadway then intersects MD 607/Hog Neck Road heading northward and Magothy Bridge Road traveling southward. Continuing east, MD 177 intersects Magothy Beach Road and the terminus of MD 100. MD 177 becomes a three-lane road section past MD 100 with a center lane controlled by directional lane use signals. During rush hours, there are two lanes in the peak hour direction, but at all other times the center lane serves as a center left turn lane. The eastern end of the three-lane section is at South Carolina Avenue in the Lake Shore community. MD 177 continues east as a two-lane road, passing a loop of Old Mountain Road. Shortly thereafter, Forest Glen Drive is located to the north of the roadway.

The speed limit is 40 miles-per-hour and the study corridor has a total of fourteen (14) signalized intersections spread throughout the corridor. The 2012 AADT was 21,241 east of Baltimore Annapolis Boulevard, 12,441 west of MD 607, and 26,221 east of MD 100. The 2011 AADT was 14,900 east of Waterford Road and 18,370 east of Bodkin Avenue.

3.2.5 MD 214

The County's functional classification for MD 214/Central Avenue is 'Principal Arterial' between MD 424/Davidsonville Road and MD 468/Shady Side Road, and 'Minor Arterial' between MD 468 and Shoreham Beach Road. The study corridor is approximately 7.5 miles long from MD 424 to Shoreham Beach Road. MD 214 is two lanes when it meets the southern end of MD 424 in the Davidsonville Historic District. The roadway is 22 to 48 feet wide and has sections of raised-curb median. The highway then gains a second lane westbound at MD 214A (Pike Ridge Road). MD 214 gains a second eastbound lane and a median just east of its intersection with Pike Ridge Road. The highway veers southeast and becomes undivided at Stepneys Lane and meets the southern end of MD 253/Mayo Road opposite South River High School, and then drops back to two lanes before its intersection with MD 468. MD 214 then continues east through the community of Selby-on-the-Bay, passing the entrance to Camp Letts. Shoreham Beach Road then splits off of MD 214 at a fork just prior to Mayo.

The speed limit ranges from 30 to 50 miles-per-hour. There are six (6) signalized intersections spread throughout the corridor. The 2012 AADT is 16,742 for the section immediately east of MD 424, is 15,182 for immediately west of MD 2, and is 19,222 east of MD 468. The 2011 AADT is 25,301 immediately west of MD 468.

3.2.6 MD 256 & MD 468

MD 256 is classified as 'Minor Arterial' between MD 2 and MD 258, and as 'Principal Arterial' between

MD 258 and MD 468. The classification for MD 468 is 'Minor Arterial'. The overall study corridor (MD 256 and MD 468) is approximately 8.1 miles long and runs from MD 2 to Snug Harbor Road. MD 256 begins at its intersection with MD 2 as a two lane road ranging between a 20 and 25-foot wide. It has sections of raised curbed median. The corridor heads east as two-lane Deale Road past Traceys Elementary School and Deale-Traceys Park. MD 256 then enters the community of Deale, which includes several marinas. The road then crosses Traceys Creek and curves north. MD 256 then makes a right-angle turn east at Rockhold Creek Road and crosses Rockhold Creek. At Masons Beach Road (the center of Deale), MD 256 turns north onto Deale Churchton Road, crossing a roundabout with MD 258/Bay Front Road before intersecting with MD 468. MD 468 is a two lane, 24 to 26-foot wide roadway with no median. From that intersection, MD 468 progressively curves east and heads north as two-lane Shady Side Road.

The speed limit along MD 256 ranges from 30 to 45 miles-per-hour. There are two (2) signalized intersections; one at the MD 256/MD468 intersection and the other at the MD 256/Franklin Manor Road intersection. The 2012 AADT immediately east of MD 2 is 2,862 and increases to 9,422 at the terminus with MD 468. The speed limit along MD 468 ranges from 30 to 45 miles-per-hour. The only signalized intersection on MD 468 is located at its intersection with MD 256.

3.2.7 MD 665

The County's functional classification for MD 665/Aris T. Allen Boulevard is 'Freeway'. The study corridor is approximately 2.7 miles long from US 50/301 to its terminus at Bywater Road. MD 665 begins in Parole at a directional interchange with US 50 and US 301 (John Hanson Highway). It is a four lane, 48-foot wide roadway with partial and full access controls, and has various median types including positive barrier, curbed, and unprotected grass. The corridor heads southeast as a four-lane freeway crossing a single-point urban interchange with Riva Road. MD 665 then turns east to meet MD 2 at a partial cloverleaf interchange. Prior to the MD 2 interchange there is an exit ramp from westbound MD 665 to Annapolis Harbor Center Drive, which provides access to the Annapolis Harbour Center. Past MD 2, the highway crosses Church Creek, entering the city of Annapolis and becoming a four-lane divided highway with partial access control. It then intersects Chinquapin Round Road and then terminates at Bywater Road, to continue as Forest Drive. Just prior to its intersection with Chinquapin Round Road, two-foot concrete sidewalks begin on both sides of the roadway that continue into Forest Drive.

The speed limit ranges from 40 to 55 miles-per-hour. The 40 miles-per-hour speed limit is based on the stop condition at Forest Drive. There is one signalized intersection where MD 665 intersects with Chinquapin Round Road (this signal is included in the Forest Drive summary). The 2012 AADT east of Riva Road is 59,752.

3.3 EXISTING LEVEL OF SERVICE

Existing levels of service for each corridor and key intersections were calculated. Level of service (LOS) is a grading system for transportation components (intersections, freeways, ramps, etc.) and a qualitative measure describing operational conditions within a traffic stream, based on such factors as speeds, travel time, freedom to maneuver, and stops. For example, LOS A represents free flow, almost complete freedom to maneuver within the traffic stream. LOS F represents congested flow; more vehicles are attempting to use the roadway than can be served resulting in stop-and-go traffic. While the letter grades correlate to classroom grades, the acceptable level of service grade for most jurisdictions is the letter D, which indicates an efficient use of roadway space but not oversaturated flow. **It should be noted that this analysis is a macroscopic analysis based on roadway geometric characteristics and vehicle traffic composition, and may not always reflect friction caused by weaving, acceleration and deceleration along freeways through interchanges, or along arterials due to variable signal timing patterns which is best captured through detailed traffic micro-simulation.**

Congested and failing peak hour conditions were primarily noted at the following locations:

- at the intersection of College Parkway and MD 2
- at the intersection of College Parkway and MD 179
- along College Parkway from west of Jones Station to MD 179
- at the intersection of MD 177 and New Freetown Road (unsignalized approaches)
- at the intersection of MD 177 and Catherine Avenue
- at the intersection of MD 177 and Edwin Raynor Road
- at the intersection of MD 177 and MD 607 (Hog Neck Road)
- at the intersection of MD 177 and Lake Shore Drive
- along MD 177 from Jumpers Hole Road to Waterford Road
- at the intersection of MD 214 and Riva Road (unsignalized approaches)
- at the intersection of MD 214 and Stepneys Lane (unsignalized approach)
- at the intersection of MD 256 and MD 2 (unsignalized approach)
- at the intersection of MD 256 and MD 468
- along MD 665 between US 50 and Riva Road

In each of the corridors, the known operational and capacity constraints that cause the current congestion will be further addressed in more detailed project planning studies of the individual corridor. The County has previously funded the Mountain Road Corridor project planning study which included a detailed footprint assessment and preliminary engineering cost estimate for improvements to MD 177 between MD 648 (Waterford Road) to Edwin Raynor Road. The next steps for this project area will be final design and construction by MSHA.

Illustrations of existing corridor intersection level of service are shown in **Tables 9 through 14**.

Table 9: College Parkway Existing LOS

Study Intersections	Summary of Results					
	Existing		Existing Delay (seconds per vehicle)		Existing v/c	
	AM	PM	AM	PM		
College Parkway at MD 2	D	E	38.0	67.8	1.10	1.15
College Parkway at Jones Station Road	A	C	9.1	27.2	0.65	0.88
College Parkway at Shore Acres Road	A	A	5.5	6.0	0.67	0.63
College Parkway at Bay Dale Drive	C	D	29.5	38.9	0.84	1.01
College Parkway at MD 179	D	F	48.3	92.4	0.78	0.90

Table 10: Forest Drive Existing LOS

Study Intersections	Summary of Results					
	Existing		Existing Delay (seconds per vehicle)		Existing v/c	
	AM	PM	AM	PM		
Forest Drive at Chinquapin Round Road	B	C	19.9	23.7	0.79	0.84
Forest Drive at Bywater Road	B	B	14.1	13.2	0.79	0.76
Forest Drive at Hilltop Lane	C	C	20.4	26.1	0.68	0.71
Forest Drive at Spa Road	D	D	39.6	46.3	0.94	0.96
Forest Drive at Bay Ridge Avenue	D	D	53.7	42.9	0.92	0.79

Table 11: MD 173 Existing LOS

Study Intersections	Summary of Results					
	Existing		Existing Delay (seconds per vehicle)		Existing v/c	
	AM	PM	AM	PM		
MD 173 at MD 607	C	B	20.7	19.8	0.71	0.73

Table 12: MD 177 Existing LOS

Study Intersections	Summary of Results								
	Existing			Existing Delay (seconds per vehicle)			Existing v/c	
	AM	PM		AM	PM			
MD 177 at MD 2	C	C		21.8	20.4		0.25	0.43
MD 177 at MD 10 off ramp	B	C		19.8	31.6		0.57	0.69
MD 177 at MD 10 on ramp	A	A		2.5	2.2		0.42	0.37
MD 177 at MD 648/Baltimore-Annapolis Boulevard	C	C		29.7	33.7		0.53	0.71
MD 177 at New Freetown Road*	F	F		>100	>100		1.99	0.81
MD 177 at MD 648/Lake Waterford Road	C	D		32.6	45.2		0.68	0.75
MD 177 at Outing Avenue	B	C		18.5	20.3		0.53	0.73
MD 177 at Catherine Avenue	B	E		19.1	72.0		0.55	0.91
MD 177 at Edwin Raynor Boulevard	E	F		75.5	82.2		0.75	0.90
MD 177 at MD 607/Hog Neck Road	D	E		35.7	67.6		0.73	0.95
MD 177 at MD 100	A	C		9.8	28.0		0.57	0.68
MD 177 at Lake Shore Drive	B	F		11.0	> 100		0.66	0.99

*Note: * The stop approach delay reported for LOS for these intersections*

Table 13: MD 214 Existing LOS

Study Intersections	Summary of Results							
	Existing			Existing Delay (seconds per vehicle)			Existing v/c	
	AM	PM		AM	PM			
MD 214 at MD 424	C	D		34.1	38.3		0.84	0.88
MD 214 at Riva Road*	E	F		49.3	> 100		0.14	0.14
MD 214 at MD 2	D	D		36.9	40.8		0.81	0.93
MD 214 at Stepneys Lane*	F	F		> 100	> 100		0.73	2.48
MD 214 at MD 468	B	C		10.2	20.7		0.59	0.84

*Note: * The stop approach delay reported for LOS for these intersections*

Table 14: MD 256 & MD 468 Existing LOS

Study Intersections	Summary of Results								
	Existing			Existing Delay (seconds per vehicle)			Existing v/c	
	AM	PM		AM	PM			
MD 256 at MD 2*	C	E		20.1	44.6		0.17	0.63
MD 256 at MD 258**	A	A		2.4	5.0		0.54	0.74
MD 256 at Franklin Manor Road	A	B		8.5	13.6		0.39	0.76
MD 256 at MD 468	D	E		46.6	55.8		0.56	0.60

*Note: * The stop approach delay reported for LOS for these intersections*

*Note: ** The Intersection Capacity Utilization (ICU) approximates the V/C ratio for these intersections*

3.4 PREVIOUS STUDIES

Prior to developing any future recommendations, a thorough review of previous transportation and land use studies was performed. These studies are indexed in **Table 15**.

Table 15: Master List of Transportation and Land Use Reports Reviewed

Title	Date Published	Publishing Agency
Annapolis Comprehensive Plan	August 2007	City of Annapolis
Anne Arundel County General Development Plan	April 2009	Anne Arundel County
Anne Arundel County Greenways Master Plan	October 2002	Anne Arundel County
Anne Arundel County FY 2015 Approved Capital Budget and Program	July 2014	Anne Arundel County
Anne Arundel County Corridor Growth Management Plan	July 2012	Anne Arundel County
Anne Arundel County Pedestrian and Bicycle Master Plan Update	June 2013	Anne Arundel County
Anne Arundel County Transit Development Plan Update	January 2010	Anne Arundel County
Annapolis Neck Small Area Plan	March 2003	Anne Arundel County
Broadneck Small Area Plan	December 2001	Anne Arundel County
Complete Streets Guidance	November 2013	Anne Arundel County
Deale/Shadyside Small Area Plan	June 2001	Anne Arundel County
Edgewater/Mayo Small Area Plan	February 2002	Anne Arundel County
Glen Burnie Small Area Plan	September 2004	Anne Arundel County
Lake Shore Small Area Plan	May 2004	Anne Arundel County
Pasadena Small Area Plan	August 2004	Anne Arundel County
MSHA Highway Needs Inventory- Anne Arundel County Section	2013	Maryland State Highway Administration

CHAPTER 4: TRAVEL FORECASTING

4.1 INTRODUCTION

This chapter summarizes the travel demand model validation (see **Appendix A** and **Appendix G**), the development of an initial set of alternatives, and the development of travel demand forecasts for the initial set of alternatives (see **Appendix D**).

4.2 MODEL VALIDATION

The travel demand model which was used for this effort was developed from the Baltimore Metropolitan Council's regional travel demand model (version 3.3e), which includes cooperative forecasts of demographic data such as households and jobs for all local jurisdictions in the metropolitan area. The model was further modified for the County's analysis of BRAC (Base Realignment and Closure) related impacts. These modifications included a more refined zone structure and additional details were added to the roadway network. These refinements to the model (referred to as the AATrvM model) were used to develop 2005 simulated volumes which is the validation year of the AATRvM model. Forecasts and were developed under Round 7c land use assumptions and compared to subsequent years of count data 2005-2010 for reasonableness.

As part of the Major Intersections/Important Facilities Study, it was assumed that the model structure would be sufficient, but that adjustments to centroid connections and loadings would be required in some of the study corridors to achieve validation. During the validation process, it was determined that a number of adjustments to the centroid connections would be required in the MD 177/MD 100 area along with adjustments to the functional class of MD 177.

In addition, a 2035 forecast was performed, as opposed to the 2005 validation model run that was previously conducted. Refined corridor level forecasts were developed using standard National Cooperative Highway Research Project processes.

The overall goal of the model validation effort is to improve the model's predictive capabilities and ability to provide reasonable forecasts. This is done by developing a base year model and evaluating how well the model is able to replicate the existing conditions. For this effort, the base year was 2005. Existing traffic data was compiled that represents year 2005 conditions. The model was then input with 2005 roadway characteristics (number of lanes, access controls, capacity, etc.) and 2005 socioeconomic data (households, employment, etc.) and the model was refined and adjusted to best replicate these existing conditions. See **Appendix C**.

The Federal Highway Administration (FHWA) has published targets for model validation, and these targets provided the guidelines for this effort. The validation statistics that were used include volume- to-count ratio, root mean squared error, and Percent Deviation. Emphasis has been placed on the facilities responsible for accommodating higher volumes of traffic (e.g. MD 665, MD 177, etc.) where the target is to simulate within 10%-15% of the observed count volumes. Other facilities that carry less traffic (e.g., MD 173, MD 256, MD 214) would have a higher tolerance during validation; where simulating within ±25 percent of the observed traffic volumes would be considered acceptable. The FHWA targets for volume-to-count ratios are as follows:

- Freeways/Expressways ±7%
- Principal Arterials ±10%
- Minor Arterials ±15%
- Collector Roadways ±25%

Based on the above and the roadway functional classifications used in the AATrvM model (this is slightly different than county functional classifications), MD 665 was validated with a target goal of ±10%, MD 177 was validated with a target goal of ±15%, and College Parkway, MD 173, MD 256 & MD 468, Forest Drive, and MD 214 were validated using targets of ±25% of the count volume. With the base year model replicating observed counts within these targets the future year model should provide reasonable forecasts for the future year being evaluated.

The core of the validation effort included evaluating each corridor individually in order to verify critical link attributes for accuracy. These attributes included number of lanes, facility type, roadway type, etc., in addition to other more qualitative features such as roadway geometry. Addition of collector roadways, repositioning of centroids, and adding centroid connectors were additional techniques used in validation. Also, certain original roadway links were eliminated from the analysis if they were considered redundant for the effort. These techniques have improved vehicular loadings such that the simulated volumes become a better match with the existing counts.

4.2.1 College Parkway

Upon initial investigation, the College Parkway corridor was observed to be already validating. All of the segments were within the FHWA guidelines of ±25%.

4.2.2 Forest Drive

Upon initial investigation, the Forest Drive corridor was observed to be already validating. All of the segments were within the FHWA guidelines of ±25%. Hilltop Lane was added to the highway network which further improved the validation for this corridor.

4.2.3 MD 173

Upon initial investigation, the MD 173 corridor was observed to be already validating. All of the segments were within the FHWA guidelines of ±25%.

4.2.4 MD 177

The MD 177 corridor has historically undersimulated in both the BMC and AATrvM models, and this was the case with the current state of the AATrvM model. The initial validation showed this corridor to be undersimulating by 13-76% with many of the links undersimulating by 40-60%.

The consultant team reviewed the MD 177 network coding in detail and extended this review south of MD 100 which indicated that the loadings in this area needed to be reoriented to direct more trips to

MD 177 as what occurs in the field. This corridor reacted very well to these adjustments; though it was determined that too many trips were being diverted to MD 100 via MD 607. Further adjustments to MD 177 to increase the free flow speed and capacity further improved the validation, though some segments were still undersimulating. After consulting with the county, final adjustments were made to the MD 177 corridor, including changing the functional classification of the parallel route, MD 100, from freeway to expressway, and this further improved the validation results on MD 177. The performance of the corridor showed great improvement overall with the majority of the links validating within the FHWA thresholds.

4.2.5 MD 214

Upon initial investigation, the MD 214 corridor was observed to be already validating. All of the segments were within the FHWA guidelines of ±25%.

4.2.6 MD 256 & MD 468

MD 256/MD 468 was not coded into the existing AATrvM model as this is a two lane highway located in a rural portion of the county. The consultant team coded MD 256/MD 468 as a collector in the AATrvM model and conducted several iterations of model runs after adjusting centroid loadings to develop a reasonable validation of the study corridor. Given the low volumes on MD 256 and MD 468, some of the segments remain outside of the FHWA thresholds. However, it should be noted that the segments that are outside of the FHWA thresholds are sections of MD 256 and MD 468 that are either carrying particularly low volumes, i.e. 3-6k ADT or are located at the very edge of the model network where there are minimal options for centroid loadings. Given these factors, no additional adjustments were made to this corridor. To account for the difference between observed and simulated for the validation links associated with the centroid locations, the growth factors from the adjacent links was used to develop the year 2035 forecasts at these locations.

4.2.7 MD 665

Though MD 665 has many characteristics of a freeway in the short section between US 50 and MD 2, the facility is coded in the AATrvM model as a Principal Arterial. The initial model results indicated that one segment was outside of the FHWA threshold by 1% (11% compared to 10% threshold). After making adjustments to validate the MD 177 corridor and adding MD 256 into the network, this segment was within 10% of the observed count which is acceptable.

4.3 MODE INVESTIGATION, LAND USE, AND TRANSIT NODE IDENTIFICATION

An initial screening effort aimed to identify the most viable modes of travel in each study corridor was conducted. Primary modes assessed in this study include highway (vehicle), transit (bus and rail), bicycle, and pedestrian. In order to better understand how land use can support transit, some guidance is presented from the Institute of Transportation Engineers (ITE) in the graphic below regarding what levels of residential and non-residential density support various modes of transit. Local bus service is recommended above a density of 4-5 dwelling units per acre, light rail service is recommended above a density of 9 dwelling units per acre, and frequent-level bus is recommended only above a density of 15 units per acre. Providing transit to areas with employment densities of 14 jobs per acre is recognized as a minimum threshold to begin to reduce auto mode share, while greater than 20 jobs per acre can have moderate shifts away from auto mode share. See **Table 16** below.

Table 16: Minimum Density Requirements for Transit Service

Type of Service	Minimum Housing Density Dwelling Units per Acre (DUA)	Minimum Population Density/ Minimum Non-Residential Floor Space
Local Bus (1 hour service)	4 – 5	3,000 – 4,000 people per square mile. 5 – 8 million square feet concentration of non-residential floor space.
Intermediate Bus (1 bus every ½ hour)	6 – 7	5,000 – 6,000 people per square mile. 8 – 20 million square feet concentration of non-residential floor space.
Frequent Level Bus (A bus every 10 minutes)	15	10,000 people per square mile. 15 – 20 million square feet of non-residential floor space.
Light Rail	9 (between ¼ and ½ mile of route)	35 – 50 million square feet of non-residential floor space.
Commuter Rail	1 – 2	100 million square feet of non-residential floor space.

Source: ITE "A Toolbox for Alleviating Traffic Congestion"

In addition, the Maryland Transit Guidelines developed by the Maryland Transit Administration state that transit service should be provided to activity centers that produce a relatively high number of trips. **Table 17** illustrates the minimum density requirements for activity centers.

Table 17: Maryland Transit Guideline Minimum Density Levels for Activity Centers

Activity Center	Urban	Suburban	Rural
Business concentrations (number of employees)	500	300	100
Shopping centers (size in square feet)	350,000	200,000	50,000
Hospitals (number of beds)	200	100	all
Colleges (number of students)	2000	1000	all
Housing developments (number of dwelling units)	400	200	100

An analysis was performed using the County's existing Traffic Analysis Zone (TAZ) structure. The analysis included estimating the amount of square footage per employee (the model land use input file is coded in employees), and the TAZ analysis was conducted using square footage. The household and employment densities were then calculated for each TAZ in or adjacent to the study corridors. The analysis included only those zones within ½ mile of any of the seven study corridors. A limitation of this analysis is that it does not include projects currently undergoing rezoning or any other area plans where increased density is recommended. However, the analysis for each corridor includes the additional housing units and/or number of jobs that would be required to achieve the minimum ITE thresholds for transit service. The results of this analysis are presented in each corridor modal assessment on the following pages. The land use analysis recommendations, (i.e. increased households or employment) were based on the assumption that the land use would remain consistent, i.e. households were added in existing residential areas and employment was added where land use is currently zoned for employment. The density was calculated by dividing the number of households in each study corridor TAZ by the number of acres in each corresponding TAZ. The density for each zone was then compared to both the ITE and MTA thresholds for providing transit service. While ITE lists thresholds for specific types of transit service, the MTA thresholds were developed for bus service only. It should be noted that the MTA thresholds are lower than the ITE thresholds that were used in the previous CGMP density analysis.

The analysis indicates that in the existing and year 2035 conditions, there are some opportunities to implement and/or improve existing transit service in some of the study corridors. The fact that there are a number of zones with both the employment and residential density to support transit means that alternative modes of travel (particularly combined with increased employment density in Activity Centers such as the Annapolis Towne Center) can supplement the targeted expansion of the roadway network. Without these improvements, many residents will be forced to commute by car to work on congested roadways for longer distances to locations both within the County and outside of the County. Without improvements to non-motorized modes of travel, short Home-Based-Work trips, Home-Based-Shopping trips, and Home-Based-Other trips will also rely on vehicles as the primary mode of travel. This situation is compounded by the fact that many of the subdivisions in the study corridors were developed in typical suburban fashion with cul-de-sacs and limited connectivity between neighborhoods which leads to an over-reliance of vehicles for short trips, many of which are concentrated on primary routes such as Forest Drive and MD 177.

In order to begin identifying appropriate modes of transit within each corridor, varying levels and modes of transit were considered, including commuter rail, heavy rail, light rail, streetcar, commuter bus, premium bus, local bus, and bus rapid transit. More detailed information on transit can be found in the Transit Primer (**Appendix N**). Where applicable, the regional travel modeling tool and model input files were used to identify the following key issues regarding alternative modes of travel:

- If currently approved land use patterns and future travel demand support new transit service.
- If additional land use density, or increased service frequency and/or speed (through priority treatments) would make transit a viable travel choice.
- If provision of alternative modes of travel would result in any measurable reduction in projected daily vehicle traffic and/or levels of congestion.

The analysis indicates that in the existing and year 2035 conditions, there are some opportunities to implement and/or improve existing transit service in most of the study corridors. The fact that there are a number of zones with both the employment and residential density to support transit means that alternative modes of travel (particularly combined with increased employment density in Activity

Centers such as the Annapolis Towne Center) can supplement the targeted expansion of the roadway network. The East Central portion of the county around Annapolis shows potential as the terminus for a commuter rail line between downtown Washington D.C and Annapolis. Annapolis Town Center could serve as a potential transit station, and the Forest Drive, College Parkway, MD 665, and MD 214 corridors should be included in a future alternatives analysis for commuter rail as there are transportation analysis zones that meet the density requirements for commuter transit service in each of these study areas. This is consistent with the CGMP which recommended commuter bus service for the US 50 corridor. The ITE density threshold for commuter bus service is slightly higher than the threshold for commuter rail service; therefore, commuter rail would also be an acceptable strategy for this corridor. Commuter rail service would provide greater capacity and more consistent travel times and headways than commuter bus service, leading to increased transit modal shares and opportunities for transit oriented development around the commuter rail stations.

In order to begin identifying appropriate modes of transit within each corridor, varying levels and technologies of transit were considered including commuter rail, heavy rail, light rail, streetcar, commuter bus, premium bus, local bus, and bus rapid transit. More detailed information on transit can be found in **Appendix N**.

A brief discussion for each corridor is presented below.

4.3.1 College Parkway

This corridor is currently served by existing Annapolis Transit bus service which runs from Edgewater to Arnold/Anne Arundel Community College. Given that the residential and employment densities are both below the minimum thresholds for heavy and light rail transit service, and there are no significant forecast changes in density, these options were not retained for further study. As **Table 18** illustrates, a number of TAZs within the College Parkway corridor meet the minimum employee thresholds for bus transit service based on MTA guidelines, though none of the zones meet the ITE density requirements for bus transit service. Given the large number of additional households that would be required to meet the ITE density requirements for local bus service, it is recommended to study extending the Annapolis Gold Route from Anne Arundel Community College to MD 179, particularly if the County changes zoning in the study corridor to allow for increased household density. Given the proximity of this corridor to the major US 50 commuting route to and from Washington, D.C., this corridor could be a part of a future alternatives analysis study for commuter rail from Annapolis to Washington, D.C. Most of the zones along the study corridor meet the density requirements for commuter rail, and potential stations could be located near US 50.

Table 18: College Parkway Mode Investigation

Existing Transit	• Annapolis Transit • MTA Transit along MD 2 and at the Anne Arundel Community College
Potential Improvements/Modes	• Annapolis Transit Gold Route Extension • MTA Route 14 Extension/Adjustment; consider Paratransit • Sidewalks • Bicycle Lanes • Multi-use Paths • Intersection Improvements • Future Commuter Rail to Washington, D.C. (Long-term)
Potential Stations	• US 50 at MD 179, Anne Arundel Community College
Potential Terminals	• US 50 at MD 179, Anne Arundel Community College
Modal Connections	• MTA Bus Routes 230, 14; Paratransit service

4.3.2 Forest Drive

This corridor is currently served by the Annapolis Transit bus service which runs from Chinquapin Round Road to Hilltop Lane. Given that the residential and employment densities are both below the minimum thresholds for heavy and light rail transit service and there are no significant forecast changes in density, these options were not retained for further study. A review of the existing Annapolis Transit ridership indicated that approximately 3% of all daily corridor trips are made by Annapolis Transit, which equates to approximately 200 peak hour Annapolis Transit trips in the Forest Drive Corridor. The household and employment density analysis (**Table 19**) illustrates that all of the zones in the Forest Drive Corridor meet the minimum thresholds for bus service based on MTA guidelines, and several of the zones also meet the ITE thresholds for bus service. All of the zones in the corridor study area meet the ITE threshold for commuter rail, which should be noted given this corridor leads directly to US 50, which is a major commuting route between Annapolis and Washington, D.C. Forest Drive also serves the Annapolis Towne Center which has the potential to be a multi-modal terminal, given the Transit-Oriented nature of the development and the proximity to US 50 and downtown Annapolis.

The City of Annapolis has completed a pre-NEPA analysis and planning study funded by the Baltimore Regional Transportation Board (BRTB) for the Annapolis/Parole Intermodal Center and the County has requested additional funding for planning, design, Right-of-Way and construction in the Fiscal Year 2017 Priority Letter to MDOT. The density analysis also illustrates moderate growth is forecast for the study corridor; however a detailed review of the demographic file used in the modeling and density analysis indicated that the employment associated with the proposed Crystal Springs mixed-use development was not accurately reflected in the demographic file. An additional travel demand model run was conducted to include the estimated 500 employees associated with the retail component of Crystal Springs. A number of zones in the study corridor show no change or minimal growth in households and employment between 2005 and 2035, though other zones show moderate to significant growth. Existing bus service routing and headway should be reviewed and adjusted to maximize transit service in the Forest Drive corridor. Adjusting routes to better serve the proposed multi-modal station at Annapolis Towne Center and existing MTA Commuter Bus stops would enhance mobility options for commuters with and without vehicles which in an important environmental justice consideration.

Table 19: Forest Drive Mode Investigation

Existing Transit	• Annapolis Transit
Potential Improvements/Modes	• Commuter Rail to Washington D.C (Long-Term). • Sidewalks • Multi-use Paths • Bicycle Lanes • Intersection Improvements
Potential Stations	• Annapolis Towne Center
Potential Terminals	• Annapolis Towne Center
Modal Connections	• MTA Commuter Bus, Greyhound, Annapolis Transit

4.3.3 MD 173

This corridor is located in a low density residential area, and there is currently no transit service serving the corridor. There is a small commercial hub at the study corridor's terminus at MD 607/Hog Neck Road. An analysis of the household and employment density illustrates that all of the zones in the study corridor meet the MTA guidelines for transit service, and that one of the zones will also meet the ITE threshold for bus service by the year 2035 (see **Table 20**). It should also be noted that a number of additional zones would be approaching the ITE threshold for bus service by the year 2035, indicating this corridor could be a feasible transit corridor in the future.

Table 20: MD 173 Mode Investigation

Existing Transit	• None
Potential Improvements / Modes	• Future Local Bus Service (Long-Term) • Sidewalks • Multi-use Paths • Bicycle Lanes
Potential Stations	• None
Potential Terminals	• None
Modal Connections	• Dependent on bus route selected

4.3.4 MD 177

This corridor is currently served by existing Regional Transportation Agency (RTA) of Central Maryland Transit bus service which runs from MD 648/Baltimore-Annapolis Boulevard to New Freetown Road. Given that the residential and employment densities are both below the minimum thresholds for heavy and light rail transit service, and there are no significant forecast changes in density, these options were not retained for further study. The existing RTA Route 201/J provides service to the Glen Burnie/Cromwell Light Rail Station. The existing and forecast density along MD 177 illustrate that several of the zones meet the ITE thresholds for local bus service (see **Table 21**). All of the zones meet the MTA guidelines for transit service.

Table 21: MD 177 Mode Investigation

Existing Transit	• Regional Transportation Agency of Central Maryland Transit
Potential Improvements / Modes	• Sidewalks • Multi-use Paths • Access Management • Intersection Improvements • Roadway Widening • Additional Local Bus Service
Potential Stations	• None
Potential Terminals	• None
Modal Connections	• None

4.3.5 MD 214

This corridor is located in a low density residential area, and there is currently no transit service along the corridor; however, Annapolis Transit serves the Market at South River Colony, located near the intersection of MD 214 and MD 2. The employment densities meet the MTA guidelines for transit service in some of the zones, but none of the zones meet the ITE thresholds for local bus service based on employment and household densities in the study corridor (see **Table 22**). A few of the zones meet the ITE thresholds for commuter rail service, so this corridor could be included as part of a future commuter rail alternatives analysis study.

Table 22: MD 214 Mode Investigation

Existing Transit	• None
Potential Improvements / Modes	• Potential Commuter Rail to Washington D.C (Long-Term). • Sidewalks • Multi-use Paths • Bicycle Lanes • Intersection Improvements
Potential Stations	• MD 2 at MD 214
Potential Terminals	• MD 2 at MD 214
Modal Connections	• Pedestrian connections to Mayo Elementary School and South River High School (crosswalk)

4.3.6 MD 256 & MD 468

This corridor is located in a low density residential area, and there is currently no transit service serving the corridor. Given that the residential and employment densities are both below the minimum thresholds for heavy and light rail transit service and there are no significant forecast changes in density, these options were not retained for further study. By the year 2035, only one of the zones in the study corridor will meet the ITE threshold for commuter rail, and none of the zones meet the ITE threshold for local bus service (see **Table 23**). A couple of the zones are forecast to meet the MTA guidelines for transit service by the year 2035, but overall, this corridor is not forecast to have the density levels required to support transit service.

Table 23: MD 256 & 468 Mode Investigation

Existing Transit	• None
Potential Improvements / Modes	• Sidewalks • Multi-use Paths • Bicycle Lanes; Shoulder widening and pavement improvement for consistency • Intersection Improvements
Potential Stations	• None
Potential Terminals	• None
Modal Connections	• None

4.3.7 MD 665

The density analysis indicated that the majority of the zones along the study corridor meet the MTA guidelines for transit service (see **Table 24**). In the future conditions, TAZ 366, which corresponds with the Annapolis Towne Center area, will have a household density that meets the threshold for light rail service which is consistent with the future land use plans for Annapolis Towne Center. The City of Annapolis has completed a pre-NEPA analysis and planning study funded by BRTB for the Annapolis/Parole Intermodal Center and the County has requested additional funding for planning, design, Right-of-Way, and construction in the Fiscal Year 2017 Priority Letter to MDOT. The Annapolis Transit Green Route will be re-routed to this area, and the intermodal center could serve as a future hub for Greyhound, Local Bus, Express Bus, and potential commuter and/or light rail service in the future. Improving transit amenities such as bus stop, shelters, and branding would help encourage the town center as a transit destination.

Table 24: MD 665 Mode Investigation

Existing Transit	• MTA 220/230 (serving the Harry S. Truman Park-n-Ride lot via Riva Rd.)
Potential Improvements/Modes	• Multi-modal transit station at Annapolis Towne Center • Commuter Rail • Interchange Improvements • Bicycle Connectivity – parallel route connecting Chinquapin Round Rd. with Parole Town Center
Potential Stations	• Multi-modal transit station at Annapolis Towne Center
Potential Terminals	• Multi-modal transit station at Annapolis Towne Center
Modal Connections	• MTA Commuter Bus, Annapolis Transit, Greyhound, Airport Shuttle

4.4 RELATIONSHIP TO LAND USE

The County's land use patterns represent a suburban jurisdiction located between the two major urban centers of Washington, D.C. and Baltimore, with identified town centers (e.g. Glen Burnie, Odenton, Parole), activity centers (e.g. Arundel Mills, BWI airport), job centers (e.g. Ft. Meade/NSA), government centers (Annapolis), institutions, extended commercial districts along its major arterial highways, and low density residential uses in other areas. Previous transportation investments in both roadway and bus and rail transit have been made to support travel between those urban job centers and between major town, activity and employment centers through the county. This study reflects both current and future travel demand through, into, within and out of the county, as well as the impact of roadway widening and introduction of other modes of travel in each of these corridors.

The impact of proposed roadway and/or transit improvements on adjacent land uses in terms of density and activities, right-of-way availability, connectivity to existing transit/bicycle and pedestrian facilities, supporting infrastructure (park & ride lots, transit stations) is considered and evaluated at a county and regional context.

4.5 TRAVEL FORECASTS AND LEVEL OF SERVICE

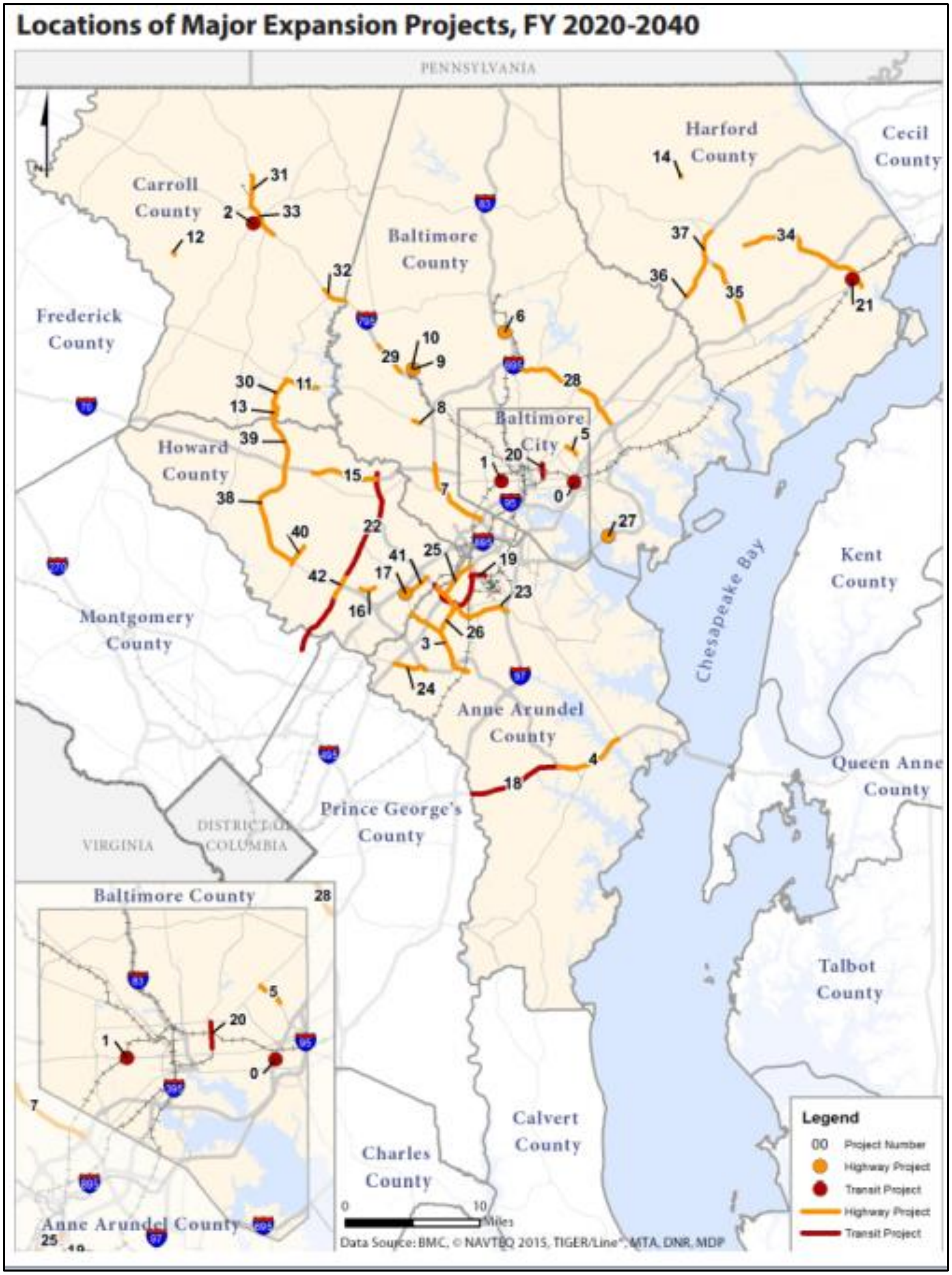
4.5.1 CLRP Plan Scenario

The current Constrained Long-Range Plan (CLRP) scenario represents the future "no-build" year 2035 condition for this analysis; and represents:

- Existing highway and transit networks
- Highway and transit projects currently under construction
- Planned highway and transit projects in CLRP

This scenario includes all CLRP projects within Anne Arundel County, and major CLRP projects in neighboring jurisdictions. There were no CLRP projects in any of the seven study corridors. This scenario was the pivot-point in which other forecasts were compared. An illustration of the CLRP network from Maximize 2040 is shown in **Figure 10.**

Figure 10: CLRP Network



4.6 BUILD SCENARIO

The Build Scenario included the CLRP network plus the roadway widening of College Parkway from two to four lanes from west of Jones Station Road to MD 179 and MD 177 from Jumpers Hole Road to Waterford Road. Only the roadway widening improvements were modeled as regional travel demand models do not explicitly model intersection improvements, bicycle lanes, or sidewalks.

4.7 SUMMARY OF FORECASTS

During the analysis of the results of the No Build (CLRP) and Build (CLRP + widening), the following findings were derived:

- Widening the section of College Parkway between Bay Dale Drive and MD 179 would improve the Level of Service to A in the year 2035 compared to LOS F conditions in the No Build conditions.
- Widening the section of MD 177 from Jumpers Hole Road to Waterford Road would improve the Level of Service to B in the year 2035 compared to LOS F conditions in the No Build conditions.

4.7.1 College Parkway

Without any improvement along College Parkway (No Build) growth in daily traffic volumes averages 6% for the study corridor. With the roadway widening the growth in traffic volumes would still average 6% or 0.4% annually; indicating this widening would not induce additional vehicle trips unless the land use forecasts along the corridor are changed in the future.

4.7.2 Forest Drive

No roadway capacity or major transit improvements were recommended for the Forest Drive corridor. Therefore, the Build and No Build forecasts are statistically equal with only minor changes in volume between the scenarios resulting from the equilibrium assignment instability. Growth in daily traffic volumes along this corridor ranges from 12% (east of Chinquapin Round Road) to 7% (west of Bay Ridge Avenue). Overall, the average growth along the corridor segments is 9.9%, or 0.3% annually.

4.7.3 MD 173

No roadway capacity or major transit improvements were recommended for the MD 173 (Fort Smallwood Road) corridor. Therefore, the Build and No Build forecasts are statistically equal with only minor changes in volume between the scenarios resulting from the equilibrium assignment instability. ADT growth along this corridor is 15% (between MD 607 and Bayside Beach Road) 0.5% annually.

4.7.4 MD 177

Without any additional improvements in the corridor (No Build Scenario), growth in daily traffic volumes along this corridor ranges from 5% (east of Edwin Raynor) to 56% (east of Jumpers Hole). Overall, the average growth along the corridor segments is 17.5%, or 0.54% annually. With the capacity improvements in the Build scenario, the volumes on that link segment would increase by 10% while the adjacent link segments would remain similar to the No Build conditions. Overall the volumes along the corridor segments are increased by 2.4% in the Build scenario when compared to the No Build Scenario. The ADT growth with the capacity improvement would increase to 72% or 1.84% annually.

4.7.5 MD 214

No roadway capacity or major transit improvements were recommended for the MD 214 (Central Avenue) corridor. Therefore, the Build and No Build forecasts are statistically equal with only minor changes in volume between the scenarios resulting from the equilibrium assignment instability. ADT growth along this corridor ranges from 8% (east of MD 2) to 15% (east of MD 424).

4.7.6 MD 256 & MD 468

No roadway capacity or major transit improvements were recommended for the MD 256/468 corridor. Therefore, the Build and No Build forecasts are statistically equal with only minor changes in volume between the scenarios resulting from the equilibrium assignment instability. ADT growth along this corridor ranges from 11% (east of MD 2) to 19% (south of MD 468). Overall, the average growth rate along this corridor is 19% or 0.6% annually.

4.7.7 MD 665

No capacity or major transit improvements were recommended for the MD 665 corridor. Therefore, the Build and No Build forecasts are statistically equal with only minor changes in volume between the scenarios resulting from the equilibrium assignment instability. ADT growth along this corridor ranges from 20% (east of MD 2) to 28% (east of Riva Road). Overall, the average growth rate along this corridor is 25.6% or 0.76% annually.

Detailed corridor-by-corridor forecasts are summarized in **Figures 11 through 19**.

4.8 SUMMARY OF NO BUILD AND BUILD LEVEL OF SERVICE

Generally, where roadway widening projects were planned (MD 177 and College Parkway), the portions of those roadways widened showed improved level of service in relation to the No-Build future condition.

Figure 11: College Parkway 2035 AADT and LOS

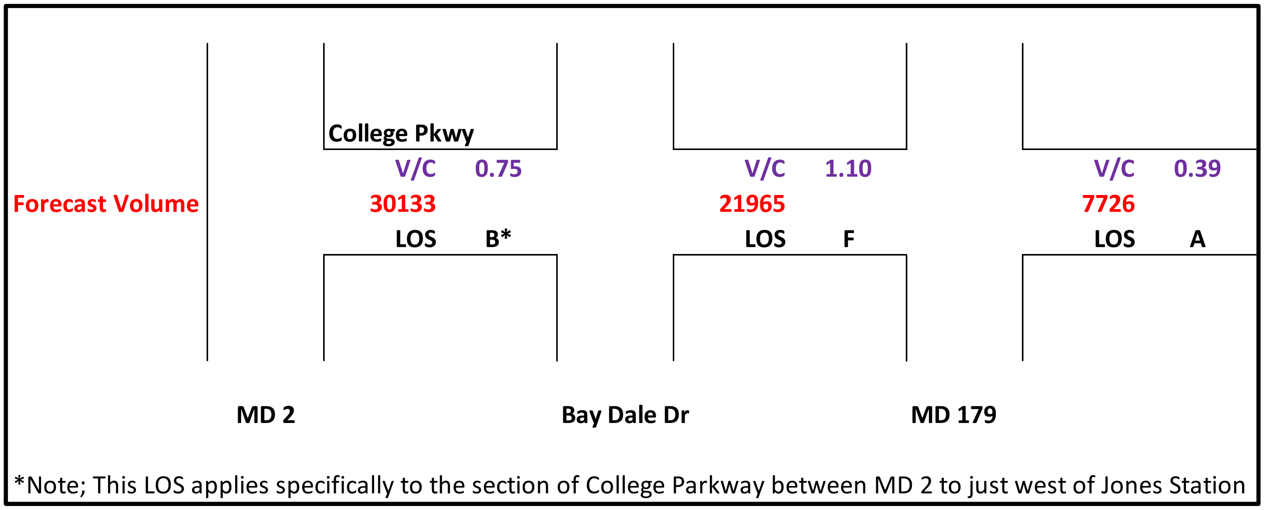


Figure 12: College Parkway 2035 AADT and LOS with Roadway Widening

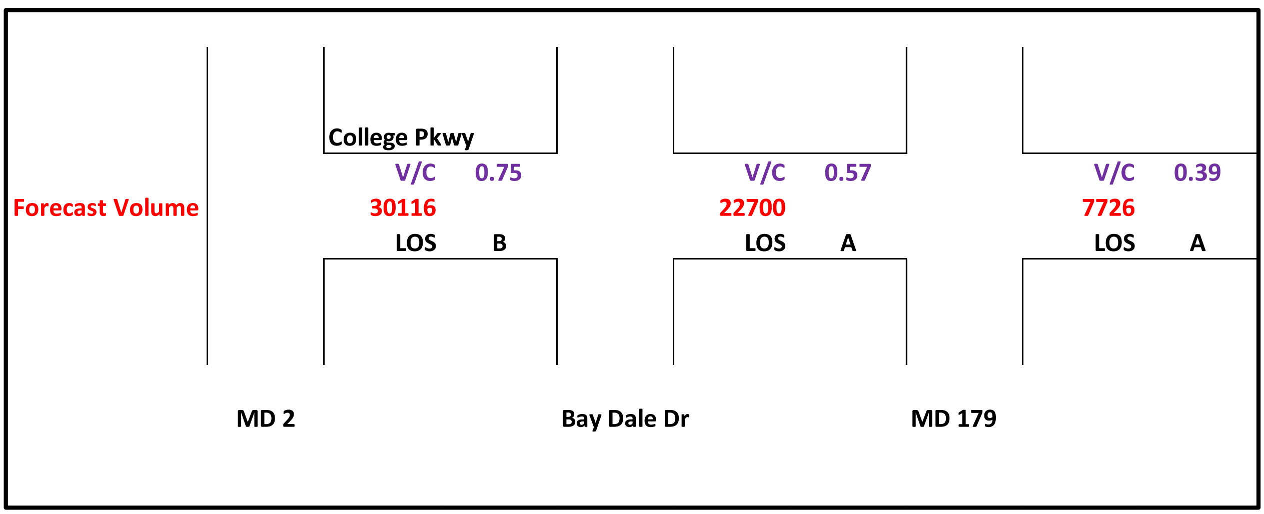


Figure 13: Forest Drive 2035 AADT and LOS

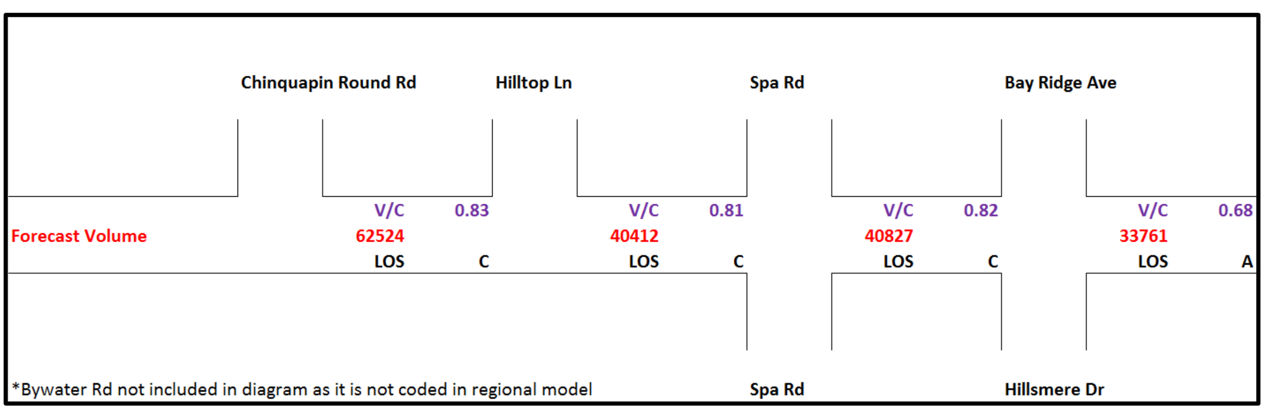


Figure 14: MD 173 2035 AADT and LOS

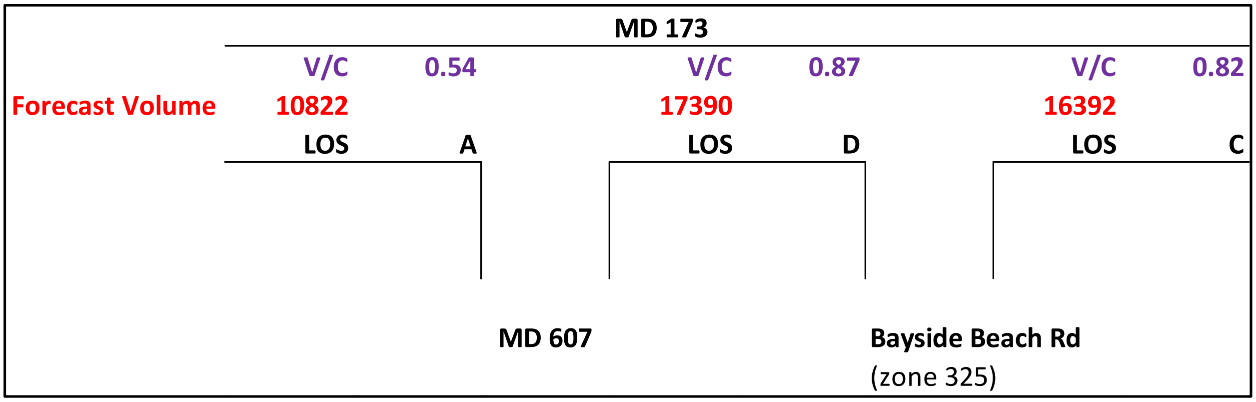


Figure 15: MD 177 2035 AADT and LOS

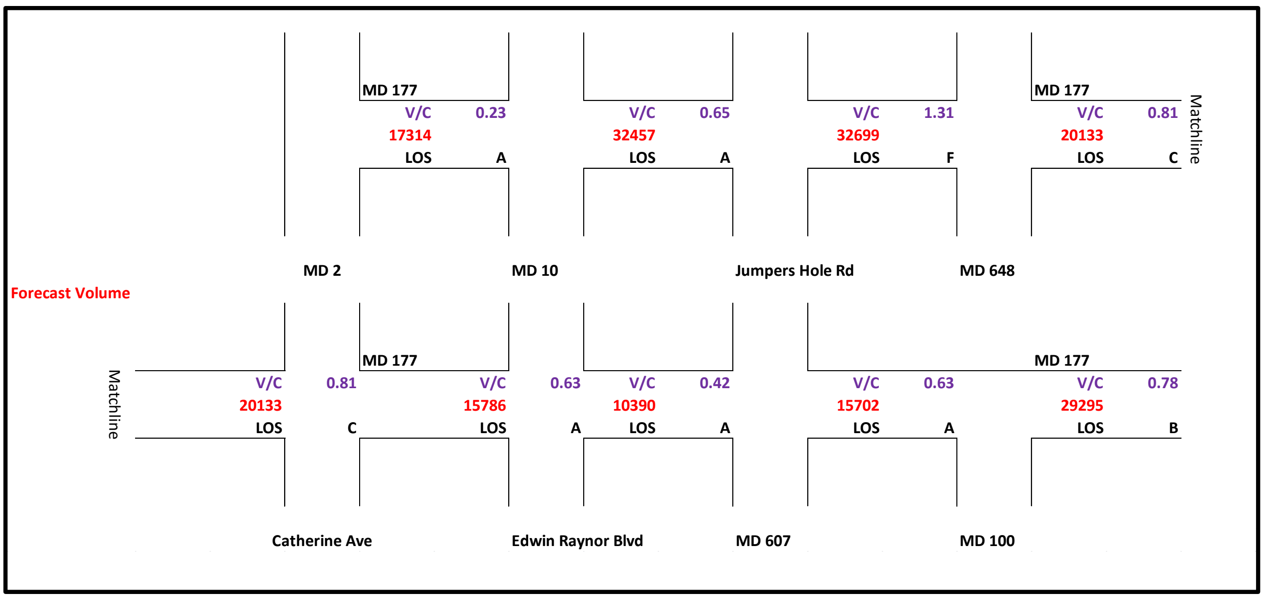


Figure 16: MD 177 2035 AADT and LOS with Roadway Widening

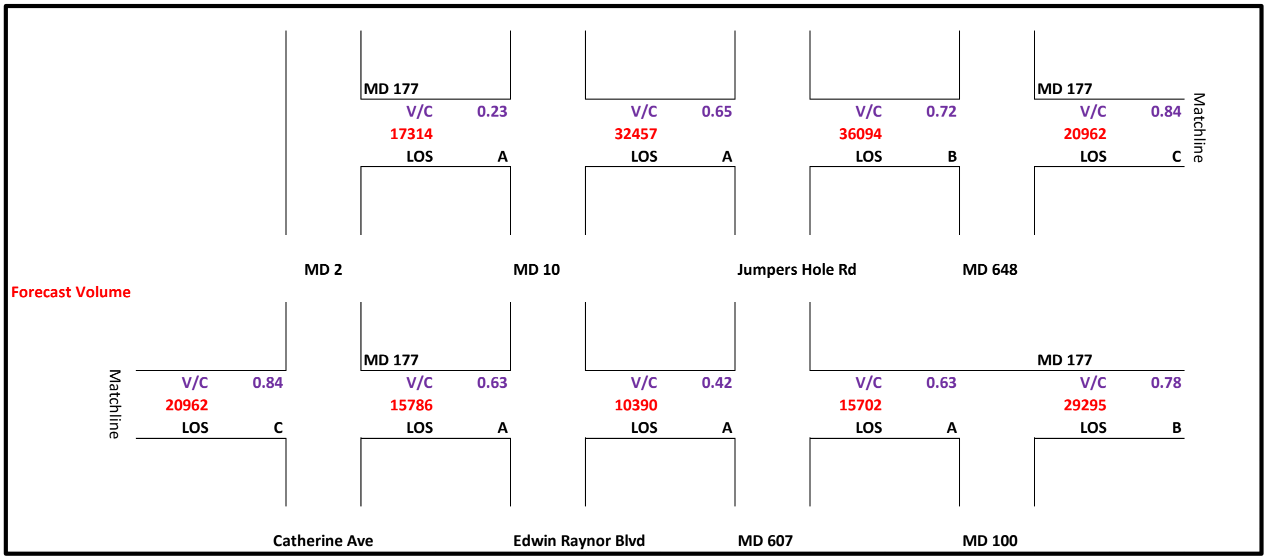


Figure 17: MD 214 2035 AADT and LOS

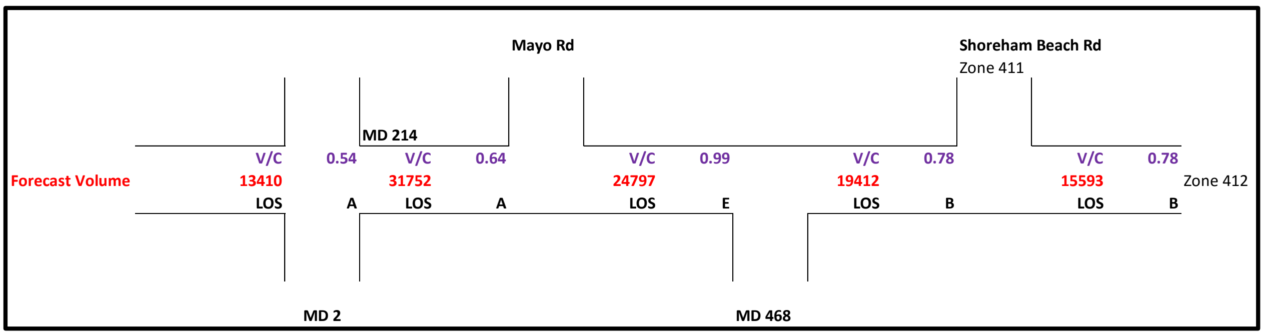


Figure 18: MD 256 & MD 468 2035 AADT and LOS

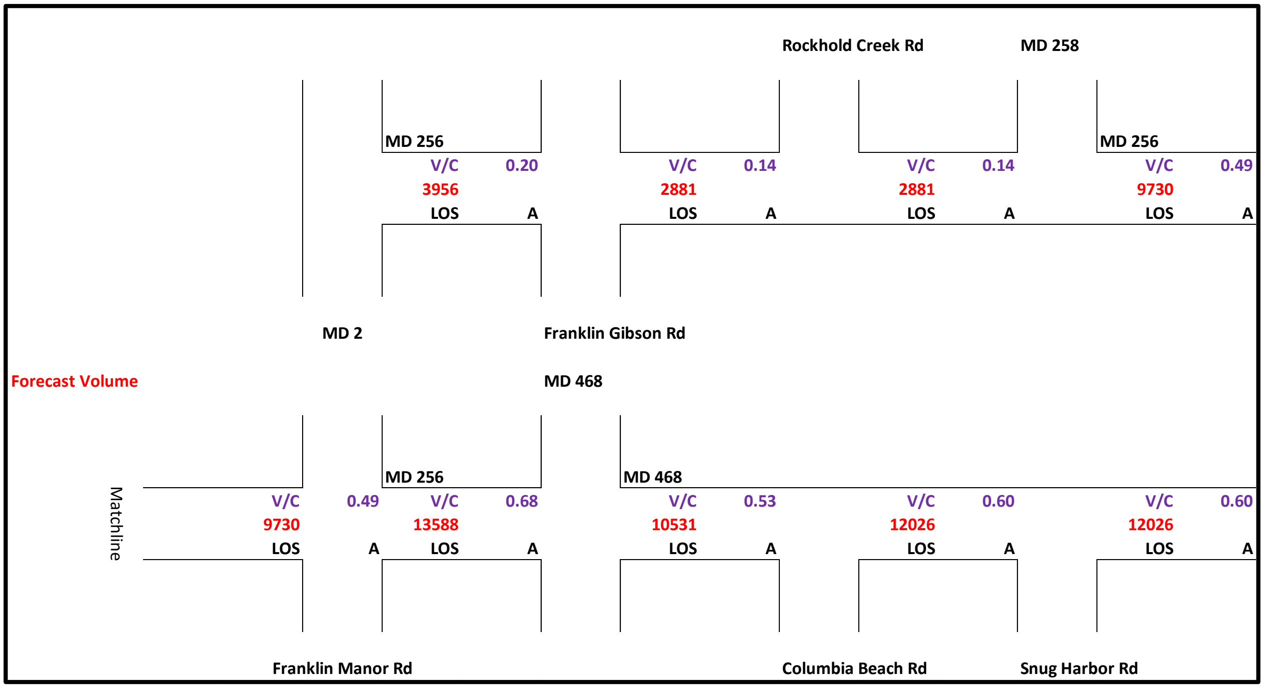
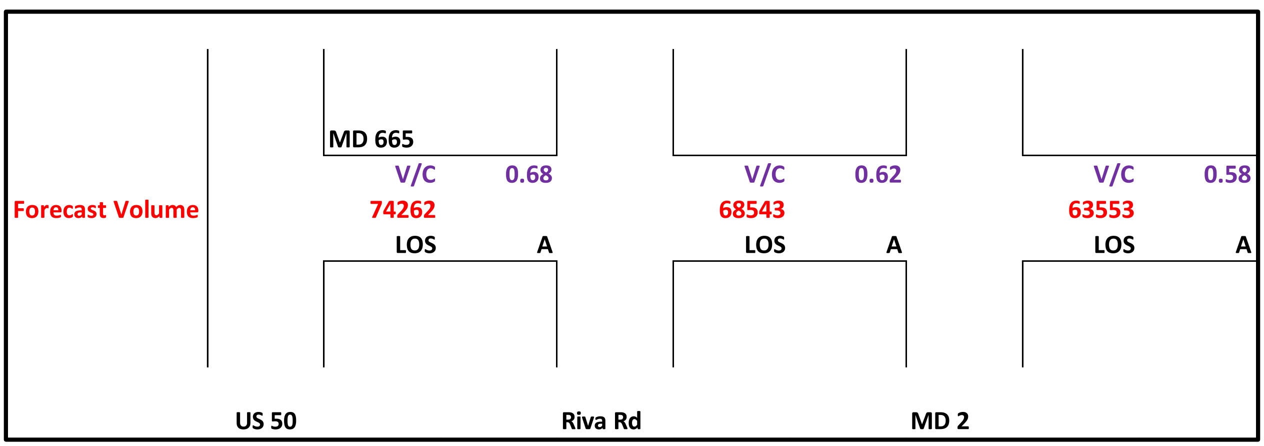


Figure 19: MD 665 2035 AADT and LOS



CHAPTER 5: CORRIDOR TOOLBOX STRATEGIES

5.1 TOOLBOX STRATEGIES

The discussion of toolbox strategies focuses on short-term day-to-day strategies to enhance roadway/traffic operations as well as better manage the demand for travel on the roadway network. The two types of toolbox strategies include Transportation System Management and Transportation Demand Management. Descriptions of a range of measures are presented for each category, followed by specific applications for each study corridor.

5.1.1 System Management Strategies

Transportation system management (TSM) strategies are improvements that enhance operations of the existing transportation network without directly providing increased roadway capacity through traditional strategies such as roadway widening (see **Appendix M**). Through better management of the transportation network and traffic control systems, traffic can flow more efficiently without the provision of any additional roadway capacity.

5.1.1.1 Signal System Operations

Signal retiming has significant benefits for the traveling public. One of the direct benefits is the reduced delay experienced by motorists. Delay savings are more apparent for motorists traveling along coordinated signalized arterials. Motorists experience fewer stops and reduced fuel consumption. Apart from the direct benefits, there also is a general public perception of reduced delay during travel. A side benefit may be reduced motorist frustration and improved safety.

Traffic responsive signal control that adjusts signal timing parameters such as cycle lengths, in real-time has the ability to improve traffic operations when compared to traditional fixed-time control systems. These systems use vehicle detection to manage signal coordination designed to optimize flow throughout the roadway network. Different measures of effectiveness such as optimal travel time on the mainline or reduced overall delay can be targeted depending on the priorities of the area or corridor. The County currently has adaptive control on several corridors, such as Riva Road Jennifer Road and Forest Drive, and the State is considering several more.

5.1.1.2 Traveler Information and Intelligent Transportation Systems

Traveler information can be disseminated through a variety of media including variable message boards, radio, internet, telephone, and in-vehicle or handheld navigation systems. Travelers who are informed about weather and driving conditions, delays and detours, parking and other situations that may affect their travel can use the information to make decisions and increase the mobility, safety, and satisfaction of their trip.

Detection of traffic conditions and communication throughout the transportation system is the principle behind intelligent transportation systems. It allows real-time response in the form of active traffic management and can be used to measure the results of implemented strategies.

5.1.1.3 Event Traffic Management

Event and incident management is a specific type of traveler information that guides travelers through hazardous or atypical situations. These could include crashes, police activity, disabled vehicles, inclement weather, construction, or special events. There are a number of regional monitoring systems such as the MSHA Coordinated Highways Action Response Team (CHART) currently operating in the region that collaborate to monitor, respond, and share information across jurisdictions. The use of devices such as Closed Circuit Television Cameras, Variable Message Signing, Highway Advisory Radio, Roadway Weather Information Systems, and Automated Traffic Recorders are a few devices that allow for improved monitoring and response during emergency situations, and is useful in presenting real-time travel information such as travel times to the general public. It should also be noted that other toolbox strategies, such as the provision of subscription bus service for special events, could also be applied to ease congestion for major events.

5.1.1.4 Demand Management Strategies

Transportation demand management (TDM) strategies are techniques that focus on influencing driver behavior and demand. Transportation demand derives from individual decisions based on numerous factors such as trip purpose, available modes, distance, and costs. By shifting these factors to favor non-auto travel for some travelers, programmatic TDM strategies have the potential to have a large positive impact. Managing trips may include:

- Trips shifted to another mode
- Trips shifted to another time (outside of peak hour)
- Trips shifted to another route
- Trips not made

By making other options more appealing, TDM aims to sway drivers away from choosing to drive alone during peak rush hours.

5.1.1 Bus Rapid Transit

Bus Rapid Transit (BRT) represents a shift in perception, so decision-makers recognize that buses can provide high quality service which can attract discretionary travelers (those who have alternative travel options). For many trips, BRT can provide faster and more direct service than urban rail, since routes can accommodate multiple bus routes from various destinations, reducing the need for transfers.

Bus Rapid Transit is considered a more affordable alternative to Rail for improving transit service quality and attracting travelers who would otherwise drive on congested urban corridors. It was initially implemented in less developed countries such as Brazil and Columbia during the 1990s, but the concept has become widely accepted by transportation planners and transit advocates throughout the world.

Bus Rapid Transit systems are usually implemented through a cooperative effort involving local planning agencies and transit service providers. Bus lanes and other BRT design features sometimes are incorporated into Complete Streets projects. To be effective, it requires coordination of roadway design and management, bus purchasing, transit operations, local land use planning decisions, transit marketing and TDM programs.

5.1.2 Paratransit

Paratransit is a special transportation service for people with disabilities, often provided as a supplement to fixed-route bus and rail systems by public transit agencies. Paratransit services may vary considerably on the degree of flexibility they provide their customers. At their simplest they may consist of a taxi or small bus that will run along a more or less defined route and then stop to pick up or discharge passengers on request. At the other end of the spectrum—fully demand responsive transport—the most flexible paratransit systems offer on-demand call-up door-to-door service from any origin to any destination in a service area. In addition to public transit agencies, Paratransit services are operated by community groups or not-for-profit organizations, and for-profit private companies or operators.

5.1.3 Promote Transit Use/Transit Priority

Transit has to be comfortable and convenient in order for users to perceive it as a viable mode of transportation. Faster travel times, more frequent service, and enhanced traveler information can encourage commuters to ride transit. Bus speeds can be improved by implementing bus priority treatments that help buses maneuver through traffic. Queue jumps allow a bus to bypass traffic through an intersection by accessing a restricted or underused lane. Signals can be programmed to detect approaching buses and give them an early or extended green indication to minimize the amount of time they spend behind traffic.

Apart from improved service which includes providing new service, reducing headways, and modifying routes, adequate amenities for riders to improve passenger comfort both on and off transit vehicles can also promote the use of transit. Shelters, benches, lighting, and adequate sidewalk access at transit stops can make riding transit a more pleasant experience. Wayfinding signs in areas served by transit, route maps at transit stops, and real-time vehicle location information (e.g. NextBus) can make taking transit much easier for those unfamiliar with the service.

5.1.4 Promote Carpooling

By having more people using one vehicle, carpooling reduces each person's travel costs and results in less demand for roadway space. Carpooling can be promoted through a variety of ways including tolling on select travel lanes, designated high occupancy vehicle lanes, parking priority, or direct financial incentives that can be applied at many levels. Car sharing, such as Zip Car, also falls under this category. It should be noted that the County currently promotes rideshare programs through two separate Transportation Management Associations (TMA): the BWI business Partnership and the Annapolis Regional Transportation Management Association, who are affiliated with the business communities of West County and the Annapolis area. The expansion of these TMAs and creation of new TMAs are encouraged.

5.1.5 Employer Based Incentives

Employers can help employees form vanpools through rideshare matching. Rideshare matching helps potential vanpoolers locate others nearby with similar schedules. Regional rideshare services in most areas allow interested employees to register for matching services directly at no cost. Employers can direct their employees to these free services. Rideshare agencies can also help organize vanpools directly with employees.

Employees realize a variety of benefits from vanpooling including cost savings, decreased vehicle wear and tear, time savings in regions with HOV lanes, and the ability to talk, eat, sleep, or read while commuting. Vanpool participants report saving up to $3,000 or more a year on gas, car maintenance, and wear and tear as well as reduced stress and commuting time. The primary employer advantage is the need for fewer parking spaces; other advantages include less employee stress and improved productivity.

5.1.6 Alternative Work Schedule Arrangement

Alternative work arrangements could be established and encouraged to allow employees greater flexibility. Flexible work hours reduce traffic volume and congestion during peak times by shifting drivers' commutes to less congested periods. Flexible schedules and staggered work hours help increase productivity and reduce costs of overtime and sick leave for businesses. The reduced road and parking lot congestion minimizes wasted time and frustration. Also, the flexible work hours allow workers to determine their own schedule at times, and build their work hours around other appointments that may typically result in absences.

5.1.7 Pedestrian and Bicycle Enhancements

Creating a bicycle network and roadways with bicycle compatibility can be accomplished in several measures:

- Bicycle Routes: Installing signs and pavement markings that designate bike routes on the street in a shared lane arrangement with vehicles.
- Bicycle Lanes: Creating exclusive right-of-way through the use of pavement markings along a roadway. These lanes can be adjacent to a vehicle lane or can be separated by a physical barrier for enhanced safety and comfort.
- Bicycle Trails: Can include shared use paths along a roadway or an off-street path or trails.

Each is appropriate in different circumstances but have similar goals of promoting the use of public roadway space for modes other than vehicles and guiding cyclists through convenient routes and making them feel safe and comfortable while riding.

Pedestrian enhancements can include new or widened sidewalks, improving ADA compliance, implementing audible and accessible pedestrian indication signals, implementing countdown timers for pedestrians, and providing well-maintained and well-lit sidewalks. These enhancements make a pedestrian facility more accessible and attractive.

Both pedestrian and bicycle enhancements should aim to improve connections to other modes of transportation– especially so that transit riders can complete their trips safely and conveniently. Additionally, adequate design of bicycle and pedestrian facilities will encourage more people to take advantage of them.

5.1.8 Traffic Calming

Traffic calming consists of using physical, regulatory, or enforcement measures to either control speed or manage traffic volume on a particular street. Typical devices may include chokers, chicanes, speed humps, or roundabouts. Additionally, access restrictions to particular streets at certain points and times of day can be implemented to discourage through trips and reduce traffic volumes where appropriate.

5.1.9 Complete Streets

The County developed Complete Streets guidance in 2013 using the MD 648/Baltimore-Annapolis Road corridor as a case study. The emphasis of this guidance was on creating truly multi-modal arterial environments. Complete Streets policies also emphasize the development of parallel facilities in congested areas, particularly areas with a large number of access points on the primary highway. By developing lower functional class roadways parallel to the primary highway, short distance trips and/or trips destined to shopping or office developments can be diverted away from the primary highway which reduces demand and improves traffic flow on the primary highway by removing large numbers of turning vehicles at driveways. The lower functional class parallel routes can also be used for the development of bicycle routes, as these roadways would have lower volumes and design speeds than primary highways and serve as a safer environment for bicyclists. Other important benefits of a Complete Streets network are that the additional network redundancy can reduce the impacts of non-recurring congestion on the primary arterial (i.e. congestion occurring from traffic accidents, breakdowns, construction delays), improve access for emergency vehicles during peak periods, and provide additional roadway capacity for emergency evacuations. Complete Streets policies also aid the development of access management plans on primary corridors as access can be provided to retail and office areas from the secondary routes.

5.1.10 Access Management

Access Management involves changing roadway designs and land use development patterns to limit the number of driveways and intersections on arterials and highways, constructing medians to control turning movements, encouraging Clustered development, creating more pedestrian-oriented Streetscapes, improved Connectivity, and Road Space Reallocation to encourage efficiency. Although Access Management is primarily intended to improve motor vehicle traffic flow, it can support Travel Demand Management by integrating transportation and land use planning, and by improving Transportation options. It can help convert automobile-oriented strip development into more Accessible land use patterns that are better suited to walking, cycling and public transit.

Below are ten access management strategies (CUTR 1998; Dixon, Yi and Brown 2012).

1. Lay the foundation for access management in your local comprehensive plan.
2. Limit the number of driveways per lot (generally, one per parcel).
3. Locate driveways away from intersections.
4. Connect parking lots and consolidate driveways (so vehicles can travel between parcels without reentering an arterial).

5. Provide residential access through neighborhood streets (residential driveways should generally not connect directly to arterials).
6. Increase minimum lot frontage on major streets (minimum lot sizes on major arterials should be larger than on minor streets).
7. Promote a Connected street system (avoid street networks that force all local traffic onto arterials).
8. Encourage internal access to outparcels (i.e., locations in shopping centers located on arterial streets).
9. Regulate the location, spacing and design of driveways.
10. Coordinate with the Department of Transportation.

5.1.11 Time-of-Day Controls/Active Traffic Management

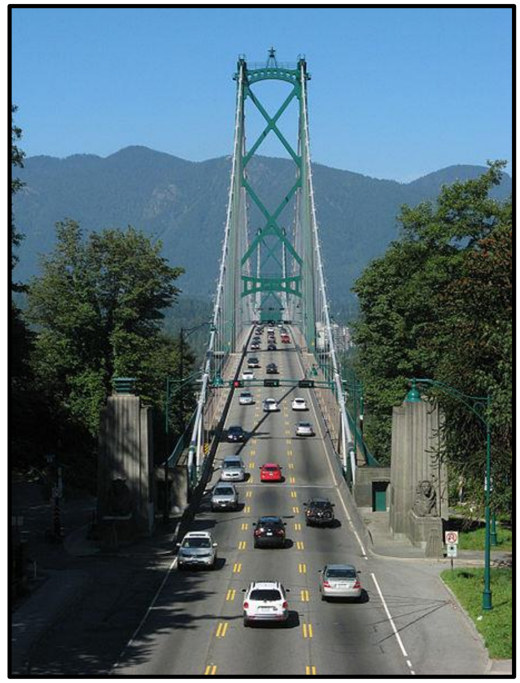
Time-of-Day Controls covers a variety of strategies developed to mitigate peak period traffic congestion in urban areas. Management strategies include vehicle demand management and travel demand management, the former relating to control of vehicles that want to use the facility during given time periods, and the latter to actions to help reduce the overall demand for travel during those periods.

Entrance ramp controls are the primary components of freeway surveillance and control essential for managing recurring congestion. Because of the predictability of recurrent congestion, a set of fixed-time controls can provide substantial benefit to the public by reducing mainline congestion. However, since traffic demand during the peak periods do fluctuate slightly from day to day, traffic responsive and integrated ramp metering control can provide somewhat better improvements in actively managing recurring congestion. In addition, they are capable of adjusting to unusual traffic conditions (because of incidents, work zones, or special events), something that fixed-time ramp metering cannot do.

5.1.12 Reversible Lanes

A reversible lane is a lane in which traffic may travel in either direction, depending on certain conditions usually based on the time of day. Typically, it is meant to improve traffic flow during rush hours, by having overhead traffic lights and lighted street signs notify drivers which lanes are open or closed to driving or turning.

Reversible lanes are also commonly found in tunnels and on bridges, and on the surrounding roadways – even where the lanes are not regularly reversed to handle normal changes in traffic flow. The presence of lane controls allows authorities to close or reverse lanes when unusual circumstances (such as construction or a traffic mishap) requires the use of fewer or more lanes to maintain the orderly flow of traffic. Some more recent implementations of reversible lanes use a movable barrier to establish a physical separation between allowed and disallowed lanes of travel. The Dallas I-30 HOV lanes are an example of this system being implemented in the U.S. In some systems, a concrete barrier is moved during low-traffic periods to switch a central lane from one side of the road to another; some examples are the five-lane San Diego-Coronado Bay Bridge in San Diego, California, the seven-lane Tappan Zee Bridge on the Hudson River in New York and the eight-lane Auckland Harbour Bridge across the Waitemata Harbour in Auckland, New Zealand. Other systems use retractable cones or bollards which are built into the road, or retractable fences which can divert traffic from a reversible ramp. The two center lanes of the six-lane Golden Gate Bridge are reversible; they are southbound during morning rush hour and northbound at evening rush hour. Prior to the installation of a movable median barrier in January 2015, they were demarcated by vertical yellow markers placed manually in sockets in the roadway.



Many urban freeways have entirely separate carriageways (and connecting ramps) to hold reversible lanes (the reversible lanes in such a configuration are often referred to as "express lanes"). Generally, traffic flows in one direction or another in such a configuration (or not at all); the carriageways are not "split" into two-lane roadways during non-rush periods. Typically, this sort of express lane will have fewer interchanges than the primary lanes, and many such roadways only provide on ramps for inbound traffic, and off ramps for outbound traffic. This is the case with the I-395 HOT lanes in Northern Virginia.

5.2 CORRIDOR APPLICATIONS

5.2.1 College Parkway

College Parkway is projected to carry up to 36,000 vehicles per day in the year 2035 west of Jones Station Road and over 21,000 vehicles east of Jones Station Road, which is over the daily capacity of 20,000 for a two lane arterial. College Parkway provides service to Anne Arundel Community College and is often used as a bypass route for traffic destined to the Chesapeake Bay Bridge. The roadway currently experiences some congestion at the intersections of MD 2 and MD 179, and the segment from west of Jones Station Road to MD 179 is projected to deteriorate to a Level of Service (LOS) F in the year 2035.

The recommended toolbox strategies for this corridor are listed in **Table 25.**

Table 25: College Parkway Corridor Toolbox

	Tool	Overview	Highly Recommended	Possible	Not Applicable
1	Signal System Operations	Signal System Timing, Detection	X		
2	Traveler Information and Intelligent Transportation Systems	Real Time Travel Information, Changeable Message Signs		X	
3	Event Traffic Management	Sporting Event Planning, Evacuation Planning	X		
4	Demand Management Strategies	Mixed Use Development, New Urbanism Development		X	
5	Bus Rapid Transit	Ranges from limited bus stops to Light Rail Transit quality			X
6	Paratransit	On demand transit service for persons with disabilities			X
7	Promote Transit Use/Transit Priority	Add service, modify existing service, reduce headways	X		
8	Promote Carpooling	HOV lanes, ridesharing programs		X	
9	Employer Based Incentives	Employee sponsored vanpools, rideshare matching	X		
10	Pedestrian and Bicycle Enhancements	On and off street bicycle and pedestrian facilities	X		
11	Traffic Calming	Raised crosswalks, chicanes, neckdowns		X	
12	Complete Streets	Developing parallel roadway connections	X		
13	Access Management	Driveway consolidation, internal site circulation		X	
14	Time-of-Day Controls/Active Traffic Management	Traffic responsive signal timing, HOT lanes		X	

5.2.2 Forest Drive

Forest Drive is projected to carry up to 40,000 vehicles per day east of Spa Road and over 60,000 vehicles per day between Hilltop Lane and Chinquapin Round Road in 2035. It provides an important connection from a number of peninsula areas of the County to MD 665, US 50 and the rest of the Baltimore/Washington region. This roadway experiences congestion between Chinquapin Round Road and Hilltop Lane, as a number of shopping centers are located on the south side of Forest Drive east of Chinquapin Round Road. This leads to large numbers of turning vehicles, which lead to additional delays in the corridor.

The recommended toolbox strategies for this corridor are listed in **Table 26.**

Table 26: Forest Drive Corridor Toolbox

	Tool	Overview	Highly Recommended	Possible	Not Applicable
1	Signal System Operations	Signal System Timing, Detection	X		
2	Traveler Information and Intelligent Transportation Systems	Real Time Travel Information, Changeable Message Signs	X		
3	Event Traffic Management	Sporting Event Planning, Evacuation Planning	X		
4	Demand Management Strategies	Mixed Use Development, New Urbanism Development	X		
5	Bus Rapid Transit	Ranges from limited bus stops to Light Rail Transit quality		X	
6	Paratransit	On demand transit service for persons with disabilities			X
7	Promote Transit Use/Transit Priority	Add service, modify existing service, reduce headways	X		
8	Promote Carpooling	HOV lanes, ridesharing programs	X		
9	Employer Based Incentives	Employee sponsored vanpools, rideshare matching	X		
10	Pedestrian and Bicycle Enhancements	On and off street bicycle and pedestrian facilities	X		
11	Traffic Calming	Raised crosswalks, chicanes, neckdowns			X
12	Complete Streets	Developing parallel roadway connections	X		
13	Access Management	Driveway consolidation, internal site circulation	X		
14	Time-of-Day Controls/Active Traffic Management	Traffic responsive signal timing, HOT lanes		X	
15	Reversible Lanes	Using one or more travel lanes for multiple directions depending on time of day		X	

5.2.3 MD 173

MD 173 is projected to carry over 17,000 vehicles per day by 2035. It serves local peninsula area traffic primarily. The corridor is currently not experiencing congestion throughout its entire length during both the morning and afternoon peak periods. Congestion during special events at the pier located at the end of the corridor was cited as a concern during the March 2016 public meeting.

The recommended toolbox strategies for this corridor are shown in **Table 27**.

Table 27: MD 173 Corridor Toolbox

	Tool	Overview	Highly Recommended	Possible	Not Applicable
1	Signal System Operations	Signal System Timing, Detection	X		
2	Traveler Information and Intelligent Transportation Systems	Real Time Travel Information, Changeable Message Signs			X
3	Event Traffic Management	Sporting Event Planning, Evacuation Planning	X		
4	Demand Management Strategies	Mixed Use Development, New Urbanism Development			X
5	Bus Rapid Transit	Ranges from limited bus stops to Light Rail Transit quality			X
6	Paratransit	On demand transit service for persons with disabilities			X
7	Promote Transit Use/Transit Priority	Add service, modify existing service, reduce headways		X	
8	Promote Carpooling	HOV lanes, ridesharing programs			X
9	Employer Based Incentives	Employee sponsored vanpools, rideshare matching			X
10	Pedestrian and Bicycle Enhancements	On and off street bicycle and pedestrian facilities	X		
11	Traffic Calming	Raised crosswalks, chicanes, neckdowns		X	
12	Complete Streets	Developing parallel roadway connections		X	
13	Access Management	Driveway consolidation, internal site circulation			X
14	Time-of-Day Controls/Active Traffic Management	Traffic responsive signal timing, HOT lanes			X

5.2.4 MD 177

MD-177 is projected to carry up to 33,000 vehicles per day by 2035. It connects MD 2 near Marley Station Mall to the peninsula areas of Pasadena. The corridor serves local traffic in Pasadena and Glen Burnie as well as long distance commuters traveling to Baltimore and Annapolis. The roadway has numerous access points and is near capacity between Jumpers Hole Road and MD 648 which leads to congestion in this segment.

The recommended toolbox strategies for this corridor are illustrated in **Table 28.**

Table 28: MD 177 Corridor Toolbox

	Tool	Overview	Highly Recommended	Possible	Not Applicable
1	Signal System Operations	Signal System Timing, Detection	X		
2	Traveler Information and Intelligent Transportation Systems	Real Time Travel Information, Changeable Message Signs		X	
3	Event Traffic Management	Sporting Event Planning, Evacuation Planning		X	
4	Demand Management Strategies	Mixed Use Development, New Urbanism Development	X		
5	Bus Rapid Transit	Ranges from limited bus stops to Light Rail Transit quality			X
6	Paratransit	On demand transit service for persons with disabilities			X
7	Promote Transit Use/Transit Priority	Add service, modify existing service, reduce headways	X		
8	Promote Carpooling	HOV lanes, ridesharing programs		X	
9	Employer Based Incentives	Employee sponsored vanpools, rideshare matching		X	
10	Pedestrian and Bicycle Enhancements	On and off street bicycle and pedestrian facilities	X		
11	Traffic Calming	Raised crosswalks, chicanes, neckdowns			X
12	Complete Streets	Developing parallel roadway connections	X		
13	Access Management	Driveway consolidation, internal site circulation	X		
14	Time-of-Day Controls/Active Traffic Management	Traffic responsive signal timing, HOT lanes		X	

5.2.5 MD 214

MD 214 is projected to carry up to 27,000 vehicles per day by 2035. MD 214 provides an essential link between the Edgewater area to the rest of the County and the Washington D.C. region. It serves local traffic in Edgewater as well as commuters traveling to job centers in Washington D.C., Fort Meade, the NSA, and Annapolis. The corridor currently experiences congestion at the intersection of MD 468; however, this section is programmed for a capacity improvement which will mitigate this congestion in the future.

The recommended toolbox strategies for this corridor are shown in **Table 29**.

Table 29: MD 214/Central Avenue Corridor Toolbox

	Tool	Overview	Highly Recommended	Possible	Not Applicable
1	Signal System Operations	Signal System Timing, Detection	X		
2	Traveler Information and Intelligent Transportation Systems	Real Time Travel Information, Changeable Message Signs			X
3	Event Traffic Management	Sporting Event Planning, Evacuation Planning	X		
4	Demand Management Strategies	Mixed Use Development, New Urbanism Development		X	
5	Bus Rapid Transit	Ranges from limited bus stops to Light Rail Transit quality			X
6	Paratransit	On demand transit service for persons with disabilities			X
7	Promote Transit Use/Transit Priority	Add service, modify existing service, reduce headways			X
8	Promote Carpooling	HOV lanes, ridesharing programs		X	
9	Employer Based Incentives	Employee sponsored vanpools, rideshare matching			X
10	Pedestrian and Bicycle Enhancements	On and off street bicycle and pedestrian facilities	X		
11	Traffic Calming	Raised crosswalks, chicanes, neckdowns		X	
12	Complete Streets	Developing parallel roadway connections		X	
13	Access Management	Driveway consolidation, internal site circulation		X	
14	Time-of-Day Controls/Active Traffic Management	Traffic responsive signal timing, HOT lanes		X	

5.2.6 MD 256 & MD 468

MD 256 & MD 468 are projected to carry up to 13,000 vehicles per day by 2035. This corridor provides an essential link between the Shady Side and Deale peninsula areas to MD 2. It serves local traffic in these areas primarily. The corridor currently does not experience peak hour congestion.

The recommended toolbox strategies for this corridor are shown in **Table 30.**

Table 30: MD 256 & MD 468 Corridor Toolbox

	Tool	Overview	Highly Recommended	Possible	Not Applicable
1	Signal System Operations	Signal System Timing, Detection	X		
2	Traveler Information and Intelligent Transportation Systems	Real Time Travel Information, Changeable Message Signs			X
3	Event Traffic Management	Sporting Event Planning, Evacuation Planning			X
4	Demand Management Strategies	Mixed Use Development, New Urbanism Development			X
5	Bus Rapid Transit	Ranges from limited bus stops to Light Rail Transit quality			X
6	Paratransit	On demand transit service for persons with disabilities			X
7	Promote Transit Use/Transit Priority	Add service, modify existing service, reduce headways			X
8	Promote Carpooling	HOV lanes, ridesharing programs			X
9	Employer Based Incentives	Employee sponsored vanpools, rideshare matching			X
10	Pedestrian and Bicycle Enhancements	On and off street bicycle and pedestrian facilities	X		
11	Traffic Calming	Raised crosswalks, chicanes, neckdowns		X	
12	Complete Streets	Developing parallel roadway connections			X
13	Access Management	Driveway consolidation, internal site circulation			X
14	Time-of-Day Controls/Active Traffic Management	Traffic responsive signal timing, HOT lanes		X	

5.2.7 MD 665

MD 665 is projected to carry over 65,000 vehicles per day by 2035. This corridor provides an essential link between Forest Drive and US 50/I-97. It serves a combination local and regional traffic in these areas including commuters to and from Annapolis, Baltimore, Fort Meade/NSA, and Washington, D.C. The corridor experiences peak hour congestion associated with queuing and weaving conditions on US 50.

The recommended toolbox strategies for this corridor are shown in **Table 31.**

Table 31: MD 665 Corridor Toolbox

	Tool	Overview	Highly Recommended	Possible	Not Applicable
1	Signal System Operations	Signal System Timing, Detection			X
2	Traveler Information and Intelligent Transportation Systems	Real Time Travel Information, Changeable Message Signs	X		
3	Event Traffic Management	Sporting Event Planning, Evacuation Planning		X	
4	Demand Management Strategies	Mixed Use Development, New Urbanism Development			X
5	Bus Rapid Transit	Ranges from limited bus stops to Light Rail Transit quality		X	
6	Paratransit	On demand transit service for persons with disabilities			X
7	Promote Transit Use/Transit Priority	Add service, modify existing service, reduce headways		X	
8	Promote Carpooling	HOV lanes, ridesharing programs	X		
9	Employer Based Incentives	Employee sponsored vanpools, rideshare matching	X		
10	Pedestrian and Bicycle Enhancements	On and off street bicycle and pedestrian facilities	X		
11	Traffic Calming	Raised crosswalks, chicanes, neckdowns			X
12	Complete Streets	Developing parallel roadway connections		X	
13	Access Management	Driveway consolidation, internal site circulation			X
14	Time-of-Day Controls/Active Traffic Management	Ramp metering, traffic responsive signal timing, HOT lanes		X	

CHAPTER 6: CORRIDOR FOOTPRINT ASSESSMENT

6.1 RECOMMENDED CROSS SECTIONS

This section illustrates and describes the potential right-of-way impacts caused by the cross-sections footprints within the corridors recommended for physical widening improvements. New lanes, bicycle lanes, and sidewalks are highlighted in the footprint snapshot figures. The full footprint assessment of each corridor is included as **Appendix E.**

1. College Parkway. Widening from 2 to 4 lanes from west of Jones Station Road and MD 179.
2. Forest Drive. The addition of bicycle lanes between Chinquapin Round Road and Bay Ridge Avenue.
3. MD 173. Bicycle lanes are recommended to be striped on the existing shoulders between MD 607 and Bayside Beach Road. Therefore, there are no changes in the existing cross section.
4. MD 177. Widening from 2 to 4 lanes between Jumpers Hole Road and Waterford Road.
5. MD 214. The addition of bicycle lanes and sidewalks from west of Pike Ridge Road to MD 468.
6. MD 256 & MD 468. Bicycle lanes are recommended to be striped on the existing shoulders between MD 2 and Snug Harbor Road. Therefore, there are no changes in the existing cross section.
7. MD 665. There are no proposed changes to the existing cross section.

6.2 IMPACT ASSESSMENT

County GIS data was used to compare the proposed typical cross sections through each corridor to the existing right-of-way available in order to identify any constraints as well as any areas of environmental sensitivity that need to be considered. Detailed right-of-way summaries are included in **Appendix E**.

6.3 RIGHT-OF-WAY CONSIDERATIONS

6.3.1 College Parkway:

The width of county-owned right-of way on College Parkway ranges from 110 to 200 feet as the County had previously planned for College Parkway to be widened to 4 lanes from west of Jones Station Road to MD 179. The proposed cross section of College Parkway is recommended to include an additional two 12’ travel lanes, an 18-foot median, a minimum of 5’ bicycle lanes and 5’ sidewalks in both directions, and the planned extension of the Peninsula Trail on the north side of the roadway. Due to the large width of existing County-owned right-of-way, there are no right-of-way impacts associated with this improvement. For a full set of plan sheets showing the entire corridor please see **Appendix P.**

6.3.2 Forest Drive:

Bicycle Lanes on Forest Drive: An additional 10’ of roadway would be needed to accommodate bicycle lanes on Forest Drive. As this roadway was recently streetscaped and reconstructed by the county, the bicycle lanes on this corridor would be implemented on a future reconstruction project which would likely not occur in the next 25 years given the typical lifecycle of highway projects.

The footprint assessment for Forest Drive illustrates that there would be right-of-way impacts at multiple locations along the corridor when bicycle lanes are added on a future reconstruction project. It is highly recommended not to retrofit, or prepare a separate PS&E exclusively for bicycle lanes given the cost of roadway reconstruction which was just encumbered by the County on the recent improvements. **Figure 20** represents a snapshot of the anticipated right-of-way impacted area if these improvements are implemented (see **Appendix E** for the detailed right-of-way impacts analysis). For a full set of plan sheets showing the entire corridor please see **Appendix Q.**

Figure 20: Forest Drive Right-of-Way Impacts

6.3.3 MD 173:

Bicycle Lanes on MD 173: Bicycle lanes would be striped on the existing shoulders of MD 173, and there would be no right-of-way impacts.

6.3.4 MD 177:

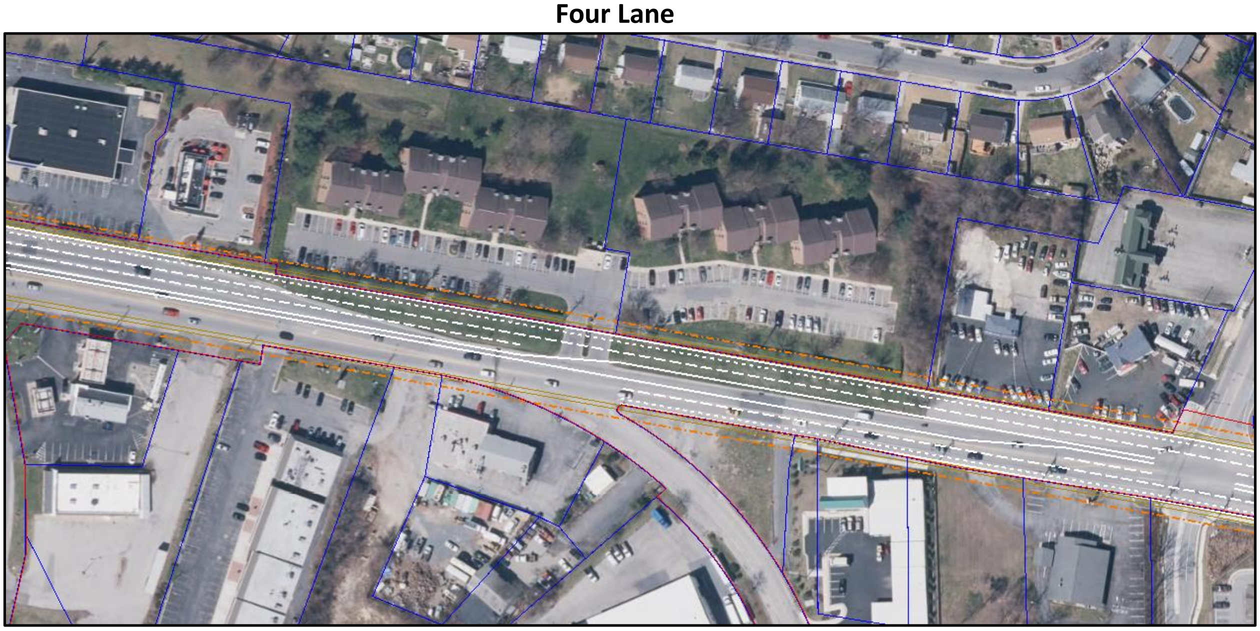
Bicycle Lanes on MD 177: The County's "Mountain Road Study" recommended a preferred alternative cross section that included bicycle lanes as illustrated in **Figure 5.** This cross section would be constructed between MD 648/Waterford Road and Edwin Raynor Boulevard. The analysis from TM 4 recommended matching this proposed cross section from Edwin Raynor Boulevard to MD 100.

The Mountain Road Study established the proposed right-of-way for the preferred concept and completed cost estimates including right-of-way impact analysis. Areas of right-of-way impacts were computed and categorized by adjacent land uses. The zoning categories along Mountain Road were determined using the "My Anne Arundel Zoning Viewer," available on the County's Office of Planning and Zoning website.

The available right-of way along MD 177 varies greatly throughout the study corridor. One segment between Woods Road and Lake Shore Drive is only 36 feet wide, which is less than the paved width of roadway. Most sections are between 50 feet and 80 feet, depending on the turn-lane configurations. The segment between MD 10 and MD 2 is approximately 100 feet wide. See **Figure 21** for the proposed widening from Jumpers Hole Road to MD 648/Waterford Road. Detailed right-of-way calculations are included in **Appendix E**. For a full set of plan sheets showing the entire corridor please see **Appendix R.**

Figure 21: MD 177 Right-of Way-Impacts

Four Lane



To improve the eastern segment of MD 177, The County's "Mountain Road Study" recommended a three-lane preferred alternative cross section that included bicycle lanes as illustrated in **Figure 5.** The analysis from TM 4 recommended matching this proposed cross section from Edwin Raynor Boulevard to MD 100 as well. The MIIF Study team also recommends a narrower buffer between the proposed sidewalks and curbing, to minimize at least 6 feet of right-of-way impacts, as shown in **Figure 22**.

Figure 22: Proposed MD 177 Right-of-Way Impacts
Three Lane

6.3.5 MD 214:

Bicycle Lanes on MD 214: The bicycle lanes would be striped on the shoulders of MD 214 from MD 424 to Pike Ridge Road and east of MD 468. The shoulders would need to be improved to MSHA standards for bicycle lanes to safely accommodate bicycle lanes east of MD 468. The section from Pike Ridge Road to Stepneys Lane would require additional roadway surface to accommodate the bicycle lanes, and would be located inside of the right-turn lanes. Sidewalks are also recommended to be implemented within this segment.

Travel Lane Extensions: The segment of MD 214 east of Stepneys Lane is recommended to be a four-lane roadway, with through lanes extended eastward to the MD 468 intersection. There would be minor right-of-way impacts on both sides of MD 214 within this segment, with several properties potentially impacted. There would also be some minor impacts in other portions of the corridor due to the shoulder/bicycle lane improvements. **Figure 23** illustrates a portion of the proposed two lane concept with bicycle lanes. For a full set of plan sheets showing the entire corridor see **Appendix S.**

Figure 23: Proposed MD 214 Right-of-Way Impacts
Two Lane

6.3.6 MD 256 & MD 468:

The proposed bicycle lanes would be striped on the shoulders of MD 256/Deale Road and MD 468/Shady Side Road which would require improving the shoulders to SHA standards at some locations. There would be minor right-of-way impacts associated with these improvements, as represented in **Figure 24**. The recommended implementation of a roundabout (traffic circle) at the intersection of MD 2 and MD 256 would not require any right-of-way acquisition.

Figure 24: MD 256 & MD 468 Right-of-Way Impacts

6.3.7 MD 665:

MD 665 was recommended for detailed study as a part of a larger US 50 corridor study. Therefore, there are no recommendations for this corridor at this time outside of future bicycle compatibility. The county is currently studying a multi-use off-road path parallel to MD 665.

6.4 ENVIRONMENTAL FEATURES

A preliminary assessment of the impact of the proposed roadway cross-sections to streams and wetlands is summarized, based on the available County GIS mapping.

6.4.1 College Parkway:

There are two streams associated with the Magothy River that terminate just north of College Parkway. The locations are:

- east of Jones Station Road/Kimwood Road
- east of Bellerive Road

The stream east of Jones Station Road terminates approximately 60' north of College Parkway which is beyond the limits of the widening. Therefore, this stream would not be impacted by the widening. However, appropriate erosion control measures should be taken during construction to mitigate run-off to this area. The stream east of Bellerive Road terminates approximately 200 feet north of College Parkway which is also beyond the limits of the widening.

6.4.2 MD 177:

There are several streams that traverse MD 177 throughout the study corridor, and a pond in close proximity to the roadway. These include:

- Stoney Creek west of Solley Road
- Eli Cove Creek west of Outing Avenue
- Main Creek west of MD 100
- Cooks Pond is just south of MD 177 at Dock Road

Stoney Creek would be impacted by the proposed roadway widening between Jumpers Hole Road and MD 648/Lake Waterford. The widening would likely require new box culverts at this location, and proper planning is important to ensure this resource is not adversely affected during construction.

6.4.3 MD 214:

There are several streams that traverse MD 214 throughout the study corridor. These include:

- Beards Creek east of Beards Point Road
- Scotts Cove Branch west of Pike Ridge Road
- Glebe Branch west of MD 468
- Pooles Gut west of Shoreham Beach Road

Beards Creek and Scotts Cove Branch are west of Pike Ridge Road and would not be impacted by the proposed bicycle lane improvements in that cross section as the bicycle lanes would be striped on the existing shoulders. Glebe Branch will be impacted by the programmed improvements at MD 214 and MD 468. Pooles Gut is over 100 feet north of MD 214 and would not be impacted by the proposed bicycle lanes on the shoulders.

6.4.4 MD 256 & MD 468:

There are several streams and rivers that traverse or are nearby the MD 256/468 the study corridor. These include:

- Tracy's Creek east of Franklin Gibson Road
- Rockhold Creek directly east of Tracy's Creek
- Deep Cove Creek south of MD 468 (Muddy Creek Road)
- South Creek south of Shady Rest Road

The bridges over Tracy's Creek and Rockhold Creek are recommended to have shared bike lanes as there is not sufficient width to accommodate exclusive bike lanes. Given the low traffic volumes and cost of bridge reconstruction, this is the most feasible approach for these segments. Deep Cove Creek does not impact MD 256 as it terminates prior to crossing the roadway. The South Creek would be potentially impacted during shoulder improvements and mitigation measures should be taken during the shoulder restriping process.

CHAPTER 7: COST ASSESSMENT

7.1 ROADWAY IMPROVEMENTS

Planning-level cost estimates were developed for the recommended improvements along the study corridors using MSHA cost estimating procedures, estimated construction quantities based on the concept designs, and unit bid prices from past construction projects. The costs do not include right-of-way acquisition as these costs can vary widely across a corridor. The MSHA planning level cost estimating procedures account for items that cannot be designed and estimated without detailed survey information (i.e. preliminary design phase) such as drainage culverts, bridges, and utility relocation, by adding these items as a percentage of excavation, asphalt paving, and striping costs which can be estimated during the concept design phase.

7.2 Summary

In order to estimate the total recommendation costs, the roadway costs for each corridor were aggregated, and the total estimated cost to implement this plan on the seven study corridors is **$130.5 million** as shown in **Table 32**. **The costs for MD 177 do not include the costs of the Mountain Road Study improvements as these would be constructed under a separate project by MHSA**.

Table 32: Total Plan Costs

Corridor	Roadway Cost
College Parkway	$38,200,000
Forest Drive	$36,700,000
MD 173	$300,000
MD 177	$21,700,000*
MD 214	$26,700,000
MD 256/468	$6,900,000
MD 665	$0
GRAND TOTAL	**$130,500,000**

***Does not include Mountain Road Study costs**

CHAPTER 8: SUMMARY AND RECOMMENDATIONS

8.1 SUMMARY AND RECOMMENDATIONS

The approach in this study was to address forecasted future recurring congestion through evaluation of the major intersections along seven key study corridors in the County, evaluating alternatives with the AATRvM travel demand model using the adopted land use plan and cooperative demographic forecasts to determine what mixture of recommendations, at an intersection and network level, will serve to best reduce future travel congestion, at the lowest capital and operating costs while limiting the impact to the adjacent natural and built environment.

The existing conditions were documented, a travel demand model was refined and validated, alternative scenarios and traffic forecasts were developed and tested at both a corridor and intersection level, for the following scenarios:

1. A No Build Alternative- Only constructing roadways that are currently funded for construction, with no transit or bike/pedestrian improvements.

2. A Build Alternative- Constructing roadway and intersection improvements along each of the study corridors along with transit improvements and bike/pedestrian improvements.

Balancing the need for added roadway footprint with limited right of way, environmental constraints, and the need to provide for more travel choices was carefully considered on a corridor-by-corridor and segment-by-segment basis to identify which roadway, transit, bicycle, and pedestrian improvements will be most operationally beneficial and justified. The focus of this study was on developing intersection level improvements that could significantly reduce congestion in the study corridors at moderate construction costs. The additional focus was on the development of multi-modal and parallel connections along the study corridors as these improvements can further improve traffic operations on the primary corridors by diverting local vehicle trips and shifting existing vehicle trips to other modes such as transit, bicycling, and walking. An additional benefit of developing parallel connections in the peninsula areas of the county would be the added transportation network redundancy that is critical for emergency responders and emergency evacuation/special event situations.

8.2 PRIMARY SCREENING CRITERIA:

In screening the alternatives to evaluate the preferred option, several factors are considered:

1. Travel Time Reliability. The ability of travel options in each corridor to provide consistent future peak hour travel times either based on the lack of peak hour vehicle congestion or the provision of alternative roadway connections and modes of travel.

2. Average Daily Traffic. The total daily number of vehicles traversing a particularly point along a roadway over a 24-hour period.

3. Level of Service. A qualitative measure describing operational conditions within a traffic stream, based on service measures such as speed, travel time, freedom to maneuver, traffic interruption, comfort and convenience. For example, LOS A represents free flow, almost complete freedom to maneuver within the traffic stream. LOS F represents forced flow, more vehicles are attempting to use the facility than can be served resulting in stop and go traffic.

4. Travel Choices. The number of future available options to travel from one point in a corridor to another, in comparison to existing conditions.

5. Cost. The total dollar value in current year dollars, to design and construct a proposed improvement.

6. Feasibility (environmental, right-of-way impact).The amount of impact from construction of proposed improvements due to sensitive environmental features such as streams, wetlands or personal property such as homes and businesses.

7. Land Use Compatibility. The consistency of recommendations with currently zoned land use regulations and small area plans.

8.2.1 College Parkway

The No-Build scenario failed to address problems with congestion that are forecasted to affect the roadway by 2035. The CLRP did not include any projects on College Parkway, and the section from west of Jones Station Road (where existing four lane section tapers to two lanes) to MD 179 is forecast to operate at over-capacity conditions. The Build alternative for College Parkway improves the roadway to provide additional highway capacity and more reliable travel times with a LOS of A with the roadway widened. Pedestrian and bicycle improvements recommended for this corridor under the build alternative will provide additional modal choices for the corridor.

8.2.2 Forest Drive

Forest Drive is not forecast to have failing Levels of Service in the future, however congestion currently exists in the shopping center areas around Chinquapin Round Road and Bywater Lane. While the recent signal timing optimization and capacity enhancements have improved the LOS on Forest Drive, a comprehensive access management and complete streets plan is recommended in this area to improve the traffic flow. The City of Annapolis Forest Drive Study recommendation to add an additional left turn lane on the southbound approach of Chinquapin Round would also help alleviate congestion at the critical intersection entering the study area. Additional recommendations on advanced signage will further improve lane utilization and traffic flow in this area. Pedestrian and bicycle improvements recommended for this corridor under the build alternative will provide additional modal choices for the corridor. To address public concerns regarding emergency vehicle access on Forest Drive, the bicycle lanes on Forest Drive could be designed with a slightly wider buffer and lane width which would effectively allow the bicycle lanes to be utilized by emergency vehicles when the vehicle travel lanes are blocked due to residual queuing related to crashes. The effective width of the bicycle lane and buffer should be a maximum of 9’ to discourage vehicles from using the bicycle lanes during peak hour conditions. The typical width for an ambulance is 8 while most fire trucks are between 8’ and 10’.

8.2.3 MD 173

No roadway or new transit service improvements are proposed in either alternative due to constrained growth forecasts in this portion of the County, but the build alternative provides additional travel choices through enhanced pedestrian and bicycle facilities along the corridor.

8.2.4 MD 177

The MD 177 (Mountain Road) corridor is expected to have a number of improvements constructed between Solley/Waterford Road and Edwin Raynor Road based on the results of the County-funded Mountain Road Study which provide acceptable levels of service during both the morning and afternoon peak periods for this segment of the study area. The improvements recommended in the Build Scenario include widening MD 177 from Jumpers Hole Road to Waterford Road from two to four lanes which would address the failing LOS based on forecasted volumes for the year 2035. The LOS would improve from F to B with this improvement.

8.2.5 MD 214

No roadway or new transit service improvements are proposed in either alternative due to constrained growth forecasts in South County, but the build alternative provides additional travel choices through enhanced pedestrian and bicycle facilities along the corridor.

8.2.6 MD 256 & MD 468

No roadway or new transit service improvements are proposed in either alternative due to constrained growth forecasts in South County, but the build alternative provides additional travel choices through enhanced pedestrian and bicycle facilities along the corridor.

8.2.7 MD 665

MD 665 (Aris T. Allen Boulevard) is forecast to have one weaving segment with a failing Level of Service in the future, however congestion currently exists in the interchange areas of Riva Road and MD 2 which is related to congestion on US 50 and the respective side streets. It is recommended that MD 665 be included in the more detailed study for US 50 recommended in the CGMP.

8.3 STUDY RECOMMENDATION

The following summarizes the combined recommended roadway, transit, bicycle and pedestrian, land use and toolbox strategy elements for each corridor.

8.3.1 College Parkway

College Parkway is projected to carry up to 36,000 vehicles per day in the year 2035 west of Jones Station Road and over 21,000 vehicles east of Jones Station Road, which is over the daily capacity of

20,000 for a two lane arterial. College Parkway provides service to Anne Arundel Community College and is often used as a bypass route for traffic destined to the Chesapeake Bay Bridge.

The recommendations for College Parkway include roadway and intersection improvements, sidewalks, and bicycle lanes. See **Table 33**.

The provision of additional lanes from west of Jones Station Road to MD 179 would improve the LOS from F to A in the future conditions.

Table 33: College Parkway Plan Recommendation

Mode/Strategy	Description
Roadway	• Widen from 2 to 4 lanes from west of Jones Station Road to MD 179
Transit	• Extend existing Annapolis Gold Route from Annapolis Community College to MD 179 • Improve visibility of existing county paratransit service
Bicycle and Pedestrian	• Bicycles lanes and sidewalks • Broadneck Trail extension to Baltimore/Annapolis trail
Intersection	• Improve intersection of MD 2 and College Parkway • Add left turn lane on eastbound College Parkway at MD 179
Toolbox Elements	• Signal System Timing/detection • Sporting Event Planning/evacuation planning • Add transit service • Employer sponsored vanpools/rideshare matching • On and off street bicycle lane/sidewalks • Developing parallel connections

8.3.2 Forest Drive

Forest Drive is projected to carry up to 40,000 vehicles per day east of Spa Road and over 60,000 vehicles per day between Hilltop Lane and Chinquapin Round Road in 2035. It provides an important connection from a number of peninsula areas of the County to MD 665, US 50, and the rest of the Baltimore/Washington region. Public feedback on the Forest Drive corridor indicated that there are concerns regarding traffic congestion, future development, and emergency vehicle access. A number of proposed developments would increase traffic volumes in the corridor in the future. These developments include:

- Stop & Shop – 8 vehicle fueling position gasoline station
- Quiet Waters Preserve – 72 townhomes and 86 single-family homes
- Village Greens – 89 townhomes
- Rocky Gorge – 31 townhomes and 17 single-family homes
- Bay Village – pharmacy (built), restaurant and office space
- 1503 Forest Drive – general office and specialty retail space
- Crystal Springs- mixed use development with approximately 500 residential units and 250,000

square feet of retail

- Rodgers Property – 45 townhomes

The AATrvM travel demand model demographic files were reviewed in detail to verify these proposed developments were included. The review indicated that all of the development was included in the Round 7c cooperative forecasts with the exception of the retail employment associated with Crystal Springs. Using the *ITE Trip Generation Manual,* the number of retail employees was estimated at 500 for this development. A supplemental travel demand model run was conducted with 500 retail employees added to the appropriate TAZ corresponding with Crystal Springs. These model results illustrated a 2% increase in forecast demand compared to the original model runs. Additional HCM analysis was conducted using Synchro which indicated the intersection of Forest Drive and Spa Road would operate at a LOS E during the PM peak hour with the additional employment from Crystal Springs included. This is consistent with the PM peak hour LOS E SimTraffic results from the City of Annapolis Forest Drive Study. Therefore, the recommendations from that study should be implemented at Spa Road (additional left turn lane on northbound Spa Road, additional right turn lane on eastbound Forest Drive, new traffic signal at Crystal Spring Farm Road). It should be noted that the new signal at Crystal Spring Farm Road would require coordination with the existing signal system in place on Forest Drive.

Additional travel demand model runs were conducted to determine the impacts of developing a parallel roadway connection to Forest Drive. Two model runs were conducted. The first model run included a two lane minor arterial between Spa Road and Chinquapin Round Road, and the second model run included a two lane minor arterial between Spa Road and MD 2. The results from the first model run indicated a 5% decrease in mainline traffic volumes on Forest Drive between Spa Road and Chinquapin Round Road. The second model run indicated that extending the parallel arterial to MD 2 would reduce traffic volumes by over 7% on Forest Drive in this same segment. Given this benefit to traffic operations on Forest Drive, the county should re-examine the feasibility of constructing a parallel roadway south of Forest Drive. This would require coordination with the proposed Crystal Springs development, and the purchase of several easements within existing developments. However, both the existing and proposed developments would benefit from this proposed connection, as it would provide direct access to their communities without using Forest Drive between Chinquapin Round Road and Spa Road. Moreover, this proposed parallel connection would directly address the public concerns regarding emergency vehicle access to the Forest Drive corridor as emergency vehicles would have an additional route potentially between MD 2 and Spa Road.

An additional consideration for Forest Drive is the proposed right-in/right-out access point proposed by MSHA immediately west of Chinquapin Round Road. Given the short weaving distance between this new access point and the Chinquapin Round Road intersection, MSHA should study this entire area in detail as a part of an intersection upgrade project at Chinquapin Round Road.

The recommendations for Forest Drive also include new sidewalks and bicycle lanes. See **Table 34**.

Table 34: Forest Drive Plan Recommendation

Mode/Strategy	Description
Roadway	• Intersection Improvements at Spa Road and Chinquapin Round Road
Transit	• Extension of existing MTA commuter bus service from Riva Road Park & Ride lot to Bay Ridge Avenue • Improve transit amenities including bus shelters, real time bus information, and improved sidewalk connections
Bicycle and Pedestrian	• Add bicycle lanes on Forest Drive including segment from MD 2 to Chinquapin Round Road • Construct missing sidewalk connections
Land Use	• Allow for increased density and transit-oriented development in Annapolis Towne Center area • Future development should occur in New Urbanism fashion with complete streets network
Toolbox Elements	• Signal System coordination and optimization • Real Time Travel Time Information on Changeable Message Signs • Special Event/evacuation signal timing plan • Annapolis Towne Center shuttle service • Improved Transit service and amenities • Conduct Future Origin-Destination study in study area to determine framework for carpool/vanpool service • Pedestrian and Bicycle connections • Complete Streets/development of parallel connections • Access Management Plan • Reversible Lanes

8.3.3 MD 173

MD 173 is projected to carry over 17,000 vehicles per day by 2035. It serves local peninsula area traffic primarily. The corridor is currently not experiencing congestion throughout its entire length during both the morning and afternoon peak periods. Congestion during special events at the pier located at the end of the corridor was cited as a concern during the March public meeting.

The recommendations for MD 173 include primarily pedestrian and bicycle improvements and toolbox strategies to better manage congestion. See **Table 35**.

Table 35: MD 173 Plan Recommendation

Mode/Strategy	Description
Roadway	• Shoulder resurfacing and striping
Transit	• Improve visibility of existing county paratransit service
Bicycle and Pedestrian	• construct sidewalks west of MD 607, add bike lanes on existing shoulders
Intersection	• none
Toolbox Elements	• Signal timing optimization at MD 607 and MD 173 • Special Event/Evacuation Planning • On street bicycle facilities on MD 173

The proposed roadway cross-section remains unchanged from existing conditions.

8.3.4 MD 177

MD 177 is projected to carry up to 33,000 vehicles per day by 2035. It connects MD 2 near Marley Station Mall to the peninsula areas of Pasadena. The corridor serves local traffic in Pasadena and Glen Burnie as well as long distance commuters traveling to Baltimore and Annapolis. The roadway has numerous access points and is near capacity between Jumpers Hole Road and MD 648 which leads to congestion between Jumpers Hole Road and MD 607.

The recommendations for MD 177 include roadway improvements, new transit service, bicycle and pedestrian improvements. See **Table 36**.

The roadway widening between Jumpers Hole Road and Solley/Waterford Road proved to provide adequate levels of service in the future for this segment. The recommendations developed in the MSHA MD 177 Operational Analysis Study and the County-funded Mountain Road Study would improve the LOS to D or better for the remaining study intersections with the exception of Lake Shore Drive which would have an acceptable LOS with optimized signal timing.

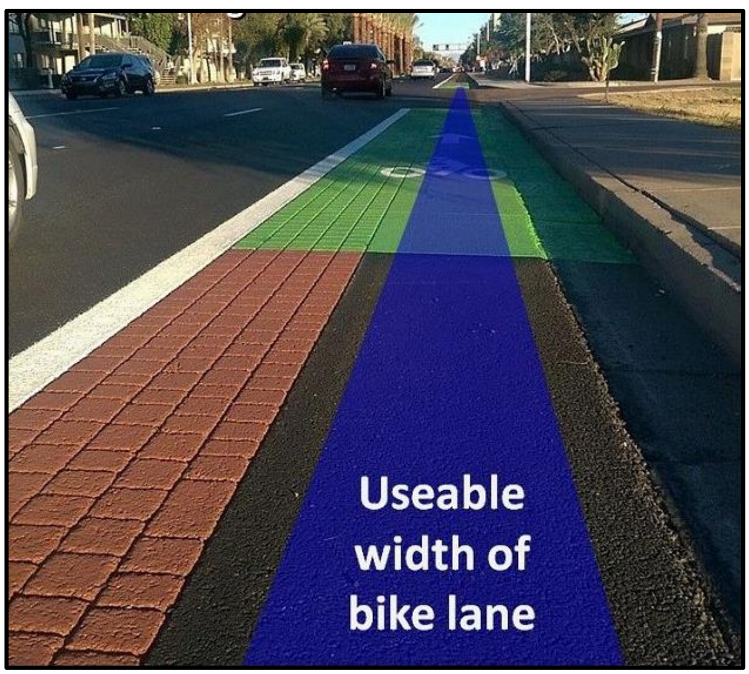
Table 36: MD 177 Plan Recommendation

Mode/Strategy	Description
Roadway	• Widen from 2 to 4 lanes between MD 648 (Baltimore/Annapolis Road) and MD 648 (Waterford Road) • Mountain Road Study Improvements from MD 648 (Waterford Road) to Edwin Raynor Road • Existing County Capital Improvement Projects
Transit	• Operation of local bus transit service along this corridor
Bicycle and Pedestrian	• Bicycle lanes on MD 177 and connect missing sidewalk connections
Land Use	• No land use changes are proposed
Toolbox Elements	• Signal System Coordination and Optimization • Special Event/evacuation signal timing plan • Improve Transit Service • Improve visibility of existing County paratransit service • Improved Transit service and amenities • Pedestrian and Bicycle connections • Complete Streets/development of parallel connections • Access Management Plan

8.3.5 MD 214

MD 214 is projected to carry up to 27,000 vehicles per day by 2035. MD 214 provides an essential link between the Edgewater area to the rest of the County and the Washington D.C. region. It serves local traffic in Edgewater as well as commuters traveling to job centers in Washington D.C., Fort Meade, the NSA, and Annapolis. The corridor currently experiences congestion at the intersection of MD 468; however, this section is programmed for a capacity improvement which will mitigate this congestion in the future.

The recommendations for MD 214 include bicycle and pedestrian improvements. The public comments for the MD 214 corridor focused on the unsafe conditions for bicycle and pedestrians in the corridor. Given these public concerns and the high vehicular speeds on MD 214, the buffer between the bicycle lanes and vehicle lanes is recommended to be either increased in width by 1-2 feet or a textured pavement surface



Textured bike lane buffer

should be used to clearly delineate the bicycle lanes from the vehicle travel lanes. See **Table 37** for a list of MD 214 recommendations.

Table 37: MD 214 Plan Recommendation

Mode/Strategy	Description
Roadway	• Shoulder Improvements
Transit	• None
Bicycle and Pedestrian	• Bicycle lanes on shoulders from west of Pike Ridge Road to MD 424 and MD 468 to Shoreham Beach Road; bicycle lanes on proposed curb and gutter cross section from west of Pike Ridge Road to MD 468 • Sidewalks on proposed cross section from west of Pike Ridge Road to MD 468
Land Use	• No land use changes are proposed
Toolbox Elements	• Signal System coordination and optimization • Special Event/evacuation signal timing plan • Implement paratransit service • Improve Pedestrian and Bicycle compatibility

8.3.6 MD 256 & MD 468

MD 256 & MD 468 are projected to carry up to 13,000 vehicles per day by 2035. This corridor provides an essential link between the Shady Side and Deale peninsula areas to MD 2. It serves local traffic in these areas primarily. The corridor currently does not experience peak hour congestion.

The recommendations for MD 256 & MD 468 include potential intersection improvements, and bicycle lanes on existing and new shoulders. See **Table 38**.

Table 38: MD 256 & MD 468 Plan Recommendation

Mode/Strategy	Description
Roadway	• Shoulder Improvements
Transit	• None
Bicycle and Pedestrian	• Bicycle lanes on shoulders, new sidewalks in Central Deale
Intersection	• Potential roundabout at MD 2 and MD 256/468
Toolbox Elements	• Signal timing optimization at MD 256 and MD 468 • On street bicycle facilities, sidewalks

8.3.7 MD 665

MD 665 is projected to carry over 65,000 vehicles per day by 2035. This corridor provides an essential link between Forest Drive and US 50/I-97. It serves a combination of local and regional traffic in these areas including commuters to and from Annapolis, Baltimore, Fort Meade/NSA, and Washington DC. The corridor experiences peak hour congestion associated with queuing and weaving conditions on US 50.

MD 665 is recommended for future detailed operational analysis as a part of a larger US 50 operational analysis and alternatives study. See **Table 39**.

Table 39: MD 665 Plan Recommendation

Mode/Strategy	Description
Roadway	• Future detailed study with US 50
Transit	• none
Bicycle and Pedestrian	• off street bicycle trail
Intersection	• none
Toolbox Elements	• Real time travel information, changeable message signs • HOV lanes, ridesharing programs • Employer sponsored vanpools, rideshare matching for Annapolis Towne Center area • Off street bicycle trail

8.3.8 Corridor Prioritization

The Major Intersections/Important Facilities Study comprises numerous recommendations across 7 corridors and multiple modes of travel that cannot be implemented all at once. Decisions will have to be made as to which projects and which corridors should be prioritized to make the most efficient use of available resources. Measures of performance used for prioritization include Average Daily Traffic (ADT) volumes, level of service, travel time, modal connectivity, and cost.

Based on a combination of projected benefits in travel time reliability, level of service improvement, introduction of travel choices, and construction impacts and feasibility, the projects were prioritized as near-term, or projects that can be implemented with minimal design and construction, mid-term, or projects that can be feasibly constructed within a 5-10 year timeframe, and long-term which corresponds with projects that need substantial construction funding and coordination with MSHA and/or BMC and would likely be implemented as a part of the long range planning process. The study recommendations are prioritized below.

Near-Term

- MD 173 bike lanes
- MD 256 & MD 468 bike lanes
- MD 256 sidewalks

Mid-Term

- MD 177 widening including bike lanes and sidewalks
- MD 214 bike lanes
- MD 214 sidewalks
- College Parkway at MD 2 intersection improvement
- College Parkway at MD 179 intersection improvement

Long-Term

- College Parkway widening
- College Parkway bike lane/sidewalks (incorporate in widening project)
- Forest Drive bike lanes/sidewalks (incorporate in future reconstruction)

8.4 NEXT STEPS AND IMPLEMENTATION

8.4.1 Coordination with Further County Planning Efforts

This document is the final stand-alone report that is intended to justify advancing each of these corridors into either final design/construction for near-term improvements or detailed project planning and preliminary engineering for the remaining improvements, and identifying and securing funding commitments in partnership with appropriate State, Federal and private partners. This document builds on and supports the findings and recommendations of the recently adopted *General Development Plan (2009); GDP Background Report on Transportation, (2008);* the *Anne Arundel County Pedestrian and Bicycle Master Plan, (2012),* and *Complete Streets Guidelines (2014).*

Response to Public Comments:

In response the public comments received at the June public meetings, in which the materials from the draft MIIF report was presented, some additional recommendations have been made to be included into the study for several of the corridors, specifically the following:

MD 214:

The development of the Park and the possible lifting of the moratorium were not included in the original scope of the study. Due to the possible impacts, an updated traffic analysis will be conducted in FY 17 to include the traffic associated with both public and private development which will include updated transportation infrastructure recommendations.

Emergency response concerns have been forwarded to the Office of Emergency Management. One of the recommendations has been interconnections between subdivisions to allow for connectivity that would parallel MD 214 in certain areas that could allow for an alternate route in the even the roadway is closed. This could include gated connections that would be opened only in emergency situations. We will work with the communities and various county and state agencies to investigate the best locations for these permanent and emergency connections.

The state has recently turned down a request for a signal at Loch Haven and MD 214 due to it not meeting signal warrants. While no specific improvement was recommended in the study, we will work with the community and the state to look at alternative improvements that could address the problem including interconnectivity between Loch Haven and Selby or alternative intersection improvements that do not involve signalization.

Forest Drive:

The County agrees that the study tools used do not accurately reflect the operational deficiencies. At the City of Annapolis's request, the County has placed the Forest Drive and Chinquapin Round Road intersection in the 2016 Priority Letter to the Maryland Department of Transportation (MDOT) for planning and design money. Further study of this intersection with more appropriate traffic analysis tools that more accurately reflect traffic operations is required.

College Parkway:

While the widening addressed corridor Level of Service (LOS), community support is vital to moving a project from a recommended infrastructure improvement to a funded project. The Transportation Functional Master Plan (TFMP) will take community support into account during the prioritization process before any projects move to funded status.

Countywide:

The County is in the process of hiring a transportation planner whose primary (but not only) focus will be on bicycle and pedestrian issues. Their job will be to implement many of the recommendations of the *Complete Streets Guidance* report and *Pedestrian and Bicycle Master Plan: 2013 Plan Update* including updating the Design Manual Standards as well as County ordinances, for a more comprehensive approach to bicycle infrastructure that is not limited to the study corridors.

8.4.2 Partnering and Funding

Within the County, the Major Intersections/Important Facilities Study, as part of the ultimate Transportation Master Plan, will need formal adoption by the County Council. Once adopted it becomes a formal policy, the County can then revise the priority letter to the State Secretary of Transportation. This letter will serve as justification for revising the County's transportation priorities for the Baltimore Metropolitan Council's Consolidated Long-Range Transportation Plan, and ultimately, if successfully advanced through Project Development, the State's Consolidated Transportation Program.

As five of the study corridors are State roadways, in order to advance each project, extensive project coordination with State and Federal agencies, and detailed environmental documentation will be required. The Mid-Term and Long-Term projects will need to go through the following steps in coordination with the Maryland State Highway's Office of Planning and Preliminary Engineering:

1. Detailed Project Planning Study. During this phase the project's logical termini, and purpose and need are identified, and alternatives are developed, and initial public outreach begins
2. Project Development. During this phase, detailed environmental analyses is undertaken, such as development of peak-hour traffic forecasts, capacity and level of service/traffic simulation, air and noise analyses, development of preliminary geometry (cross-sections and vertical and horizontal alignment), hydraulic analysis, environmental impacts (streams, wetlands, historical and cultural resources), right-of-way impacts, construction cost estimates, refinement of alternatives, as well as Federal Highway coordination and additional public outreach. Specific steps include:

a. Alternatives Retained for Detailed Study

b. Environmental Alternatives/Draft and Final Environmental Impact Statement

c. Location and Design Approval/Record of Decision of Preferred Alternative

3. Final Engineering Design. During this stage, final construction documents are prepared including specific mitigation for any utility, environmental or property impacts, detailed field reviews are performed, approvals from necessary permitting agencies such as the Maryland Department of the Environment are sought, and final itemized construction costs are developed. In addition, a detailed Transportation Management Plan is developed to minimize impacts to traffic during construction.

4. Acquisition. During this stage all right-of-way is acquired, and relocation is performed

5. Construction. During this stage, the improvement is constructed.

Funding sources may include the US DOT (Federal Highway Administration, Federal Transit Administration), State (Maryland Department of Transportation CTP), Grants (e.g. Transportation Investments Generating Economic Recovery) or private funding (developer improvements).

It should again be noted that all of the aforementioned agencies have been engaged in the development of this plan and are receptive to considering each of the recommended improvements for more detailed planning and project development.