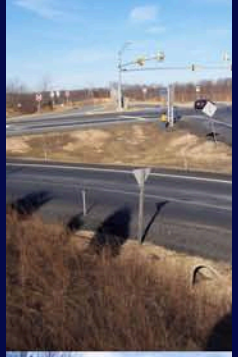
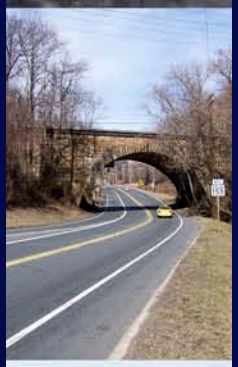
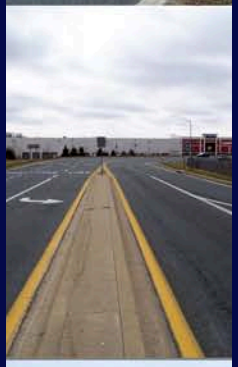
BRAC Base Realignment and Closure








Traffic and Intersection Improvement Studies for Base Realignment and Closure

Aberdeen Proving Ground

Harford County, Maryland

Summary Report

June 2008

MARYLAND

SHA State Highway Administration

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BRAC

ABERDEEN PROVING GROUND

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BRAC Executive Summary

Aberdeen Proving Ground

Base Realignment and Closure, or "BRAC," is the congressionally authorized process the U.S. Department of Defense has used to reorganize and consolidate its base structure to more efficiently and effectively support the military. In November 2005, Congress voted to approve the final recommendations of the BRAC Commission, and Maryland benefited by gaining additional military and civilian positions. Direct and indirect jobs coming to Maryland over the next six to ten years are estimated at 40,000 to 60,000. Fort George Meade, Aberdeen Proving Ground (APG), and the National Naval Medical Center at Bethesda (NNMC) will be gaining most of these positions. In preparation for this action, Maryland State Highway Administration (SHA) initiated a study of the highway transportation needs associated with BRAC at these installations. This report presents the results of the studies conducted at APG.

In preparing for BRAC impacts, APG has also embarked on an Enhanced Use Leasing (EUL) program to lease out portions of federal land for private base-related developments. Because significant impacts on the transportation system could result if the form, placement and sequencing of new development are not well coordinated with transportation investments, both BRAC and EUL needs were considered during the course of this study.

The study process involved four components:

- Identifying the study area and conducting traffic studies (counts, forecasts, analysis) at 47 locations
- Developing short-term (2015) intersection improvement concepts and determining the costs and impacts associated with each concept
- Selecting priority short-term intersection improvements for inclusion in the Maryland Department of Transportation's Consolidated Transportation Program (CTP)
- Identifying long-term (2030) needs for corridors and intersections

The focus of the study was on arterial and collector roadways. Mainline I-95 and its interchanges were not included in this study because they are included in the Maryland Transportation Authority's (MdTA) ongoing efforts to improve I-95. However, the study does include I-95 interchange ramps and intersections that are either owned by the MdTA or are adjacent to planned MdTA projects.

The results of SHA's traffic studies indicate that the existing roadway capacity will be insufficient to accommodate the influx of new traffic due to the BRAC/EUL action at APG. Under existing (2006) conditions, two intersections, MD 755 @ MD 24 and MD 155 @ US 40 @ MD 7A, are failing (Level of Service F) during the PM peak hour. Results of traffic analyses based on travel forecasts indicate that a total of 31 intersections (out of 47 analyzed) are projected to operate at failing conditions for either the AM or PM peak hour in 2015.

To prepare for this anticipated increase in traffic volumes, the study team is recommending improvements at these 31 locations. However, the level of available funding, including State and Federal funds, is not sufficient to program all of the needed short-term improvements identified in this study. Therefore SHA, in coordination with Harford County and the APG Garrison Commander, developed a list of priority intersections that are recommended for improvement, should funding become available.

In addition to developing short-term improvements for the most critical intersections near APG, SHA evaluated long-term needs to identify corridors that may require improvements to operate at acceptable levels of service in the year 2030. Three corridors identified by the study team are being recommended for further study to determine whether corridor-level (as opposed to intersection-level) improvements are needed.

A possible extension of MD 715 to the north was also examined as an alternate route for traffic and a way to potentially alleviate congestion on MD 22 and other parallel roadways. Three alignment options were analyzed, and the alignment that was thought to best illustrate the potential diversion of traffic is expected to divert approximately 18% of the traffic from the MD 543 corridor and approximately 0.5% of the traffic from the MD 22 corridor in 2030.

Intersection of MD 22 and MD 462

Intersection of US 40 and MD 152

Intersection of MD 155 @ US 40 @ MD 7A

BRAC Introduction

Aberdeen Proving Ground

Base Realignment and Closure, or "BRAC," is the congressionally authorized process the U.S. Department of Defense has used to reorganize and consolidate its base structure to more efficiently and effectively support the Military. In November 2005, Congress voted to approve the final recommendations of the BRAC Commission and Maryland benefited by gaining additional military and civilian positions. It is estimated that between 40,000 and 60,000 direct and indirect jobs will be coming to Maryland over the next six to ten years. Fort George Meade, Aberdeen Proving Ground (APG), and the National Naval Medical Center at Bethesda (NNMC) will be gaining most of these positions. Two other installations within Maryland will also be affected by BRAC (Fort Detrick in Frederick County and Andrews Air Force Base in Prince George's County), but they are expected to have higher increases in personnel resulting from non-BRAC related growth.

The State Highway Administration's (SHA) Regional and Intermodal Planning Division (RIPD) is coordinating the transportation needs assessments associated with the five major military installations affected by the BRAC initiative in Maryland. As a first step, the Travel Forecasting Section conducted traffic studies to identify the intersections and corridors most affected by BRAC in 2011 (the year that Congress mandated the completion of BRAC in Maryland), 2015, and 2030. Then, based on the results of these traffic studies, RIPD created an action plan outlining the steps to develop improvement concepts for intersections or short roadway segments that are projected to have a failing level of service (LOS) in the most immediate years of the BRAC planning process. The team also worked with decision-makers and local government officials to develop a list of priority intersections that could be funded in the Maryland Department of Transportation's Consolidated Transportation Program (CTP) based on available funding. The purpose of this report is to present the results of the short-term intersection and long-term studies at APG.

The studies included analyses of the traffic impacts due to BRAC on the roadway network that serves APG (including Edgewood Arsenal) in Harford and Cecil Counties, Maryland, and recommendations for

Intersection of MD 24 and Hanson Road

transportation system improvements that would allow traffic to operate at acceptable levels of service in 2015 and 2030. The focus of the short-term (2015) analysis was to identify low-cost improvements at the intersections most affected by BRAC that could be constructed quickly with the available funding and minimal impacts to the environment. The focus of the long-term (2030) analysis was to identify both corridor-level and additional intersection improvements that would require a greater level of study.

In preparing for BRAC impacts, APG has also embarked on an Enhanced Use Leasing (EUL) program to lease out significant portions of federal land for private developments. The EUL program helps to improve utilization of Department of Defense-owned property and reduces base operating costs while stimulating the local job market and fostering cooperation between the military services and the private sector. Because significant impacts on the transportation system could result if the form, placement and sequencing of new development are not well-coordinated with transportation investments, both BRAC and EUL needs were considered during the course of this study.

In addition, Maryland Senate Bill 206/House Bill 366 created the authority for State and local governments to enter into agreements with the military and developers for a PILOT, or a payment in lieu of taxes, which improvements upon Enhanced Use Lease (EUL) property are already subject to. This legislation provides flexibility to adjust tax payments to reflect that military installations provide some governmental services, like fire and police protection while also allowing for flexibility in providing vital public services that the EUL projects will create the need for.

The study process involved four components:

1. Identifying the study area and conducting traffic studies (counts, forecasts, analysis) at 47 locations
2. Developing short-term (2015) intersection improvement concepts and determining the costs and impacts associated with each concept
3. Selecting priority short-term intersection improvements for inclusion in the Maryland Department of Transportation's Consolidated Transportation Program (CTP)
4. Identifying long-term (2030) needs for corridors and intersections (not yet considered for inclusion in the CTP)

BRAC

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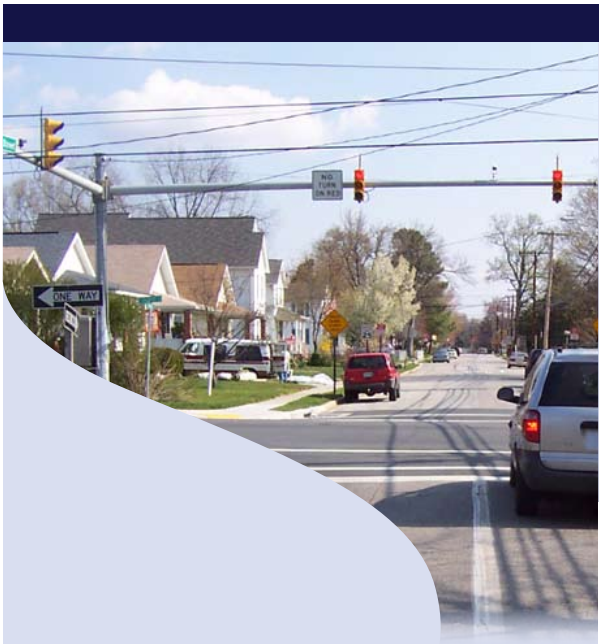
Idenfication of the Study Area

Traffic studies began by identifying the area around APG that is likely to be most affected by the BRAC/EUL initiative. Because the purpose of the study was to identify roadway improvements related to the effects of the BRAC/EUL action on APG, the study area encompasses the roadway network in the vicinity of APG. Therefore, the study area is bounded by I-95 to the north, APG and/or the Chesapeake Bay to the south, MD 152 to the west, and MD 272 to the east. Most of the study area is located in southern Harford County, Maryland, including sections of MD 152, MD 24, MD 755, MD 22, MD 132, MD 543, MD 155, MD 7, MD 159, and US 40, with a portion of the study area, including MD 222, MD 272 and a section of US 40, located just across the Susquehanna River in Cecil County, Maryland.



Because the study area includes a large number of roads and intersections, it was determined that the study should focus on the “major” roads and intersections. These are defined as:

- All State and US routes that fall within the study area
- All intersections and interchanges involving two MD/US/Interstate roadways within the study area
- All signalized intersections located between US 40 and APG access points.

The Maryland Transportation Authority (MdTA) owns, operates, and maintains I-95 in Maryland from the southwestern limit of Baltimore City

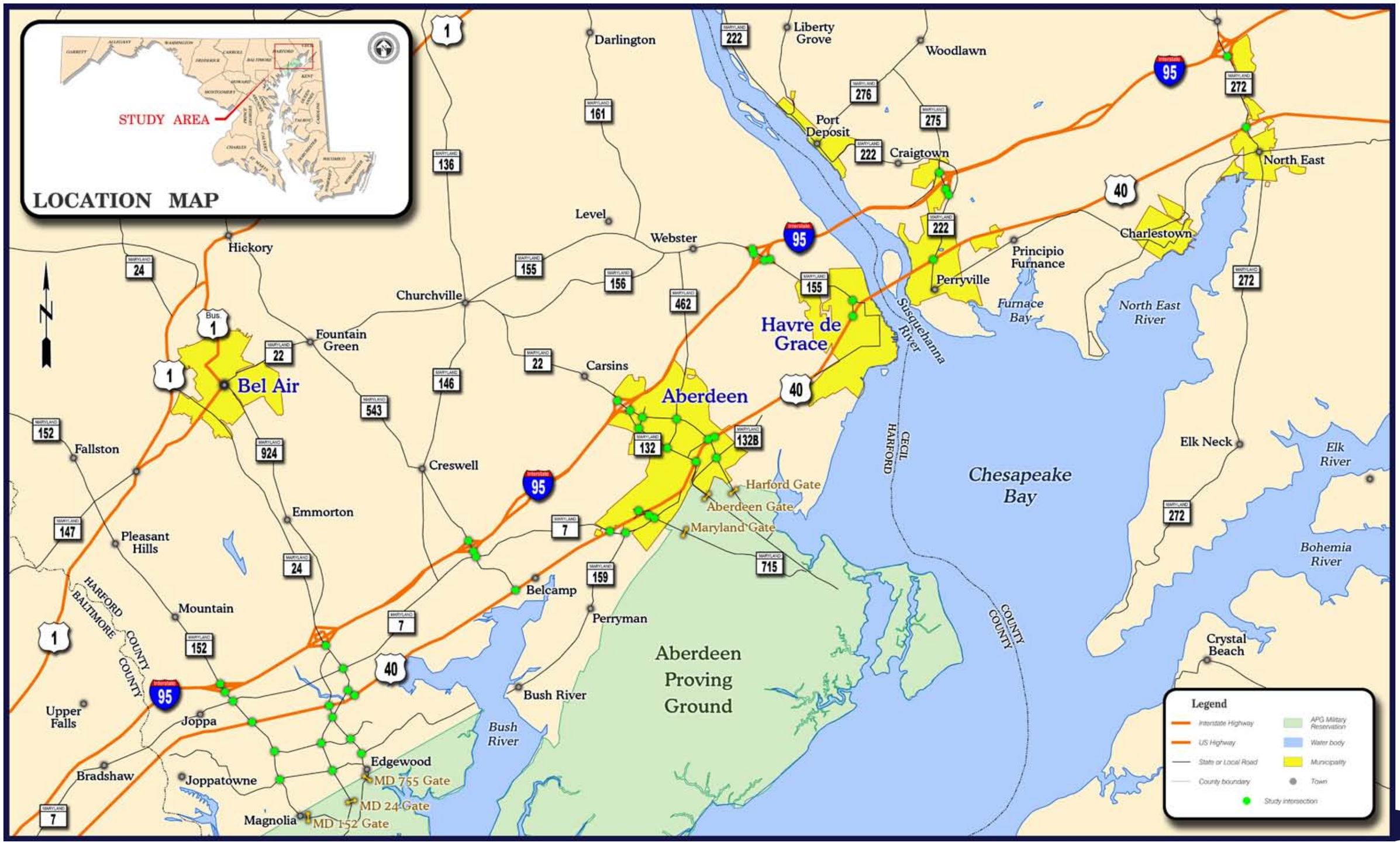
I-95 Master Plan Study

north to the Delaware State Line. Between 2000 and 2002 the MdTA, in cooperation with the Federal Highway Administration (FHWA) and the Maryland Department of Transportation (MDOT), conducted the ***I-95 Master Plan Study: I-95/I-895(N) Split to the Delaware State Line***. The I-95 Master Plan identified the logical termini for four independent projects:

- I-95 Section 100: I-95, I-895(N) Split to North of MD 43
- I-95 Section 200: I-95, North of MD 43 to North of MD 22
- I-95 Section 300: I-95, North of MD 22 to North of MD 222
- I-95 Section 400: I-95, North of MD 222 to the Delaware State Line

The focus of the SHA Traffic and Intersection Improvement Studies for APG BRAC was on arterial and collector roadways and intersections. Although certain intersections associated with I-95 interchanges were analyzed as part of this study, any improvement concepts developed for these locations will ultimately be developed as part of MdTA's I-95 studies. The BRAC Study includes MdTA interchanges that fall within Section 200 (currently in the planning phase) and Section 300 (MdTA has not yet initiated I-95 Section 300 Planning Study) and intersections that are either owned by the MdTA or are adjacent to planned MdTA projects. Under the I-95 Section 200 study, the MdTA is developing interchange alternatives at MD 152, MD 24, MD 543, and MD 22. Each of the I-95 ramp termini on the arterial roadways (i.e., on MD 24, MD 543, MD 22, MD 155, MD 222 and MD 272) were analyzed as intersections in this study. All improvement efforts made in the vicinity of the I-95 ramp termini, including any widening of structures over I-95, will continue to be coordinated with MdTA as the planning process progresses to ensure that the improvements meet the needs of both SHA and MdTA and that these efforts are applied in the most beneficial manner.

In addition, two locations in the study area are currently in the early phases of design. Prior to the beginning of the BRAC intersection improvement study, SHA began development of design concepts for MD 715 from US 40 to the APG gate, including the intersections of MD 715 @ US 40 and MD 715 @ Old Philadelphia Road. SHA also began design of various concepts for the MD 159 @ MD 7 @ US 40 intersection. The intersections from both projects have been included in the BRAC study to ensure that the effects of BRAC growth are accommodated in their designs. The resulting study area is comprised of 47 intersections, and the roadways that connect them, as shown in **Figure 1**.


LOCATION MAP
STUDY AREA
Darlington
Liberty Grove
Woodlawn
Port Deposit
Craigtown
North East
Level
Webster
Hickory
Churchville
Fountain Green
Bel Air
Carsins
Aberdeen
Havre de Grace
Perryville
Principio Furnance
Charlestown
Furnace Bay
North East River
Susquehanna River
Fallston
Creswell
Emmorton
Pleasant Hills
Mountain
Belcamp
Perryman
Harford Gate
Aberdeen Gate
Maryland Gate
Chesapeake Bay
Elk Neck
Elk River
Bohemia River
Crystal Beach
Aberdeen Proving Ground
Bush River
Upper Falls
Joppa
Bradshaw
Joppatowne
Edgewood
MD 755 Gate
MD 24 Gate
MD 152 Gate
Magnolia
HARFORD COUNTY
BALTIMORE COUNTY
CECIL COUNTY
Legend
Interstate Highway
US Highway
State or Local Road
County boundary
APG Military Reservation
Water body
Municipality
Town
Study intersection

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Aberdeen Proving Ground

Travel Forecasting

A comprehensive traffic study was conducted by SHA to evaluate several different short-term and long-term scenarios. The purpose of the traffic studies was to analyze the impacts to traffic operations that are anticipated due to the BRAC/EUL action at APG (including Edgewood Arsenal) and to develop recommendations for transportation system improvements. A series of Technical Memoranda was prepared to document the various stages of the study. The final traffic report is entitled ***BRAC Transportation Study Aberdeen Proving Ground, Harford County, Technical Memorandum No. 2A: Future Conditions (Year 2015 and 2030) Analyses Final Report*** (April 2008), and can be made available by SHA upon request.

The following scenarios were evaluated as part of the full comprehensive traffic studies:

- Existing Conditions
- Existing Conditions With BRAC/EUL Growth Only (assumed to be 2011)
- Future Conditions – All Northern Gates Open
  - 2015 No-BRAC
  - 2015 With BRAC
  - 2030 No-BRAC
  - 2030 With BRAC
  - 2030 With BRAC – MD 715 Extended Options
- Future Conditions – Without Aberdeen Gate
  - 2015 With BRAC – Without Aberdeen Gate
  - 2030 With BRAC – Without Aberdeen Gate
  - 2030 With BRAC – MD 715 Extended Options – Without Aberdeen Gate

Two APG gate usage conditions were studied: one with all three gates open (the Maryland Gate (MD 715), the Harford Gate (MD 22) and the Aberdeen Gate (MD 132)), and one where only the Maryland Gate and the Harford Gate are in use (without Aberdeen Gate). The "Without Aberdeen Gate" analysis was based on a possibility presented in the APG Final Environmental Impact Statement (FEIS) released in July 2007. While the gate options will affect queuing just outside the gates, closing the Aberdeen Gate would not generally change the required intersection improvements beyond those that were developed for the "All Northern Gates Open" scenarios, where all three gates are being utilized. The study team determined that the traffic data set from the scenario with all northern gates open was the most likely future scenario and therefore was the one used for the development of short-term (2015) improvement concepts and long-term (2030) needs.

Travel Forecasts

The future "With BRAC" scenarios were analyzed using the Round 7.0 socioeconomic data in conjunction with a new version (3.3) of the Baltimore Metropolitan Council (BMC) model. Round 7.0 includes the growth expected from the BRAC action, which includes all military and EUL development expected to occur within the existing APG fence line. In addition, Round 7.0 includes BRAC-related development, which refers to all development and secondary growth that is expected to occur as a byproduct of BRAC at APG, such as additional employment for families and additional retail and services development to support the increased population.

Prior to the approval of the Round 7.0 land use forecasts, an interim scenario was investigated to identify, at a very preliminary level, potential intersection improvements which might be required as a result of the BRAC/EUL action. This scenario

represents "Existing Conditions With BRAC/EUL Growth Only" (no background growth was included) and was assumed to correspond to 2011, the year of BRAC completion.

APG representatives provided SHA with estimated new trips based upon the anticipated number of new jobs, as well as estimates of the percentages of new trips that would use each open gate. These new trips were added directly to the existing traffic data to estimate travel patterns and traffic volumes at the study area intersections, without any consideration of background growth rates or additional trips created by off-post development resulting from the new personnel at APG. This preliminary analysis was intended to provide a starting point for discussions with APG representatives regarding the distribution of traffic volumes at the APG gates and the impacts of those volumes on the nearby roadway network. While the recommendations based on this analysis may not reflect the full level of necessary transportation system improvements, this interim study allowed SHA to get an "early jump" on the improvements required as a result of the BRAC/EUL action and begin planning for them.

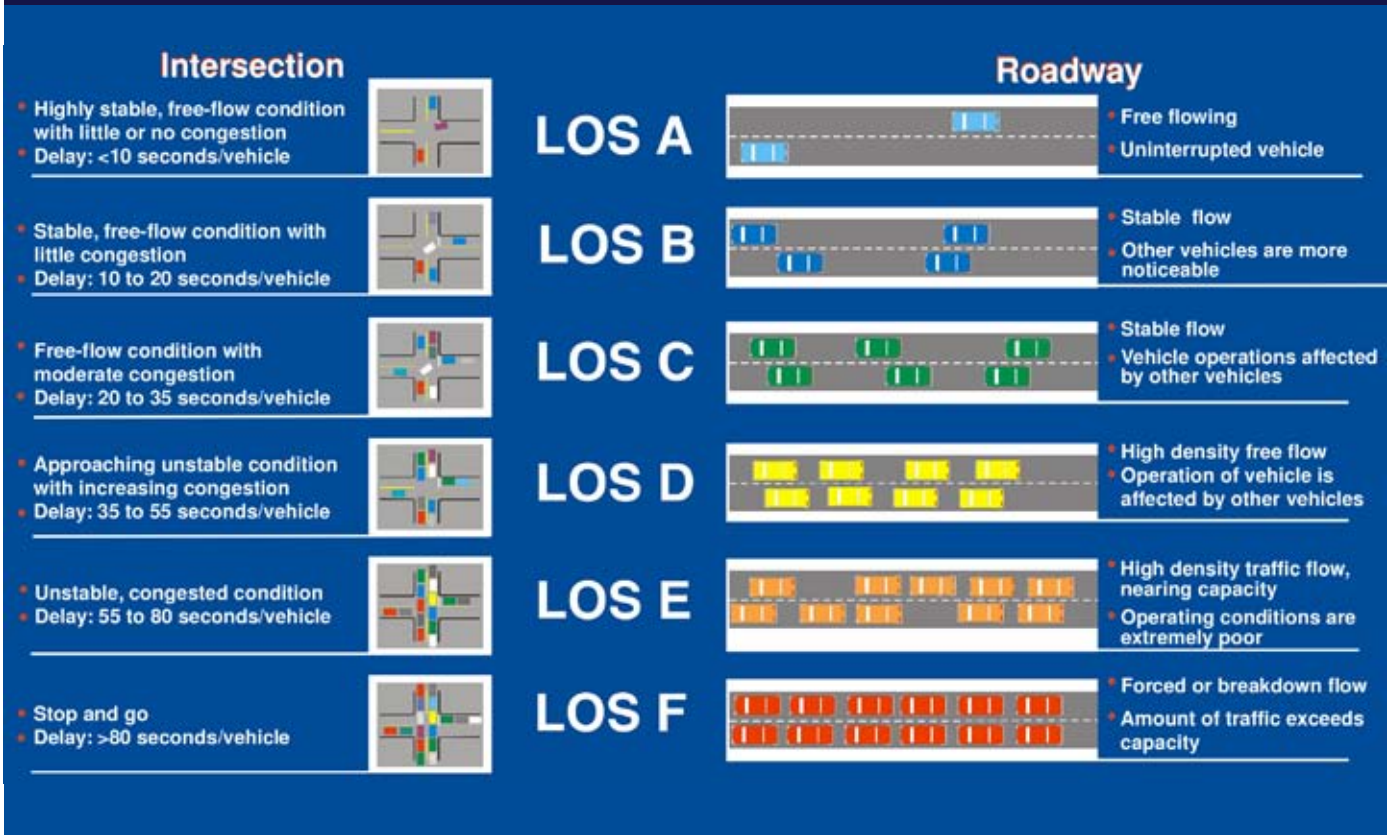
The "With BRAC" analyses for 2015 and 2030 began with use of the Round 7.0 socioeconomic data in conjunction with version 3.3 of the Baltimore Metropolitan Council (BMC) model. Round 7.0 was intended to produce the most realistic results of BRAC/EUL needs in the study area because it included the most up-to-date BRAC/EUL information. Average Daily Traffic (ADT) volumes were extracted from the model and input into a spreadsheet developed in accordance with National Cooperative Highway Research Program (NCHRP) Report 255: Highway Traffic Data for Urbanized Area Project Planning and Design. The model, by design, is a regional model. On a large scale the model is assumed to provide an accurate prediction of travel trends based upon the available data. However, because the model is designed for large scale forecasts, link values need to be obtained to predict small-scale values, such as turning movement volumes, at an individual intersection. Using a comparison between existing ADT data and the model output ADTs for the existing year, the NCHRP 255 method is able to reconcile many of the differences that may be introduced by the model simply due to its regional nature. Once refined, the future ADTs, the existing ADTs, and the existing turning movement volumes were used in conjunction with a second method taken from NCHRP 255 to develop balanced future turning movement volumes.

Traffic Operational Analysis

The study team developed peak hour traffic volumes for all of the intersections and interchanges under study based on the refined ADTs and existing peak hour turning movement volumes. The results were then analyzed and calibrated to reflect expected future traffic conditions in this area. Once the impacts of the additional traffic volumes on the existing roadway network had been assessed, the study team determined the improvements that would be required to accommodate the new trips.

To understand the operations at the key intersections and interchanges in the study area, a capacity

Figure 2: Level of Service (LOS)



analysis was conducted to determine the volume to capacity (v/c) ratio and Level of Service (LOS) at these intersections and interchanges for both the existing and future conditions. The LOS is a qualitative measure of traffic operations related to quantitative measures, such as average delay per vehicle expected at an intersection or density. Each LOS represents a range of intersection operation conditions and are quantified by applying a LOS letter grade as shown in **Figure 2**.

Traffic analyses are based on the morning hour and the evening hour of the day with the highest hourly traffic volumes, commonly known as the AM and PM peak hours. Roadways must be designed to adequately serve the peak hour traffic volume in the peak direction of flow. Since most traffic traveling one way during the morning peak is traveling the opposite way during the evening peak, both sides of a facility must generally be designed to accommodate the peak directional flow during the peak hour.

Critical Lane Volume (CLV) analysis is the standard SHA methodology for the preliminary analysis of intersection improvements, and is used to determine the volume to capacity ratio (v/c ratio) of an intersection. CLV analyses were performed on the 47 intersections identified for the study.

The study team determined the anticipated impacts to traffic operations in 2015 and 2030 resulting from the BRAC/EUL action in addition to the normal growth that could be expected for the region. This analysis included all military and EUL development inside the existing APG fence line, as well as the additional retail space, services, and employment outside of APG necessary to support the increased population due to the BRAC/EUL action.

For the 2015 and 2030 conditions, if an intersection functioned at LOS F during a particular peak hour with existing lane configurations, then improvements were developed to allow the intersection to function at LOS E or better during that peak hour. Under existing conditions, two intersections, MD 755 @ MD 24 and MD 155 @ US 40 @ MD 7A, were identified as failing during the PM peak hour, with a LOS F.

BRAC
Aberdeen Proving Ground

Short-Term Intersection Development

In analyzing the 47 study area intersections, the study team focused on the short-term, immediate effects on traffic operations due to the BRAC/EUL initiative through 2015. The 31 intersections listed below were forwarded for more detailed study because they were projected to operate at LOS F for either the AM or PM peak hour in 2015. These intersections are shown, by number, in **Figure 3**, and **Table 1** summarizes the LOS and v/c for each study area intersection under Existing, 2015 No-Build, and 2015 Build conditions.

1. MD 152 @ MD 7
2. MD 24 @ MD 7
3. MD 755 @ US 40
4. MD 755 @ MD 24
5. MD 755 @ Hanson Road
6. MD 24 @ Hanson Road

7a. MD 543 @ I-95 SB On/Off Ramps
7b. MD 543 @ I-95 NB On/Off Ramps

8. MD 543 @ MD 7
9. MD 543 @ US 40
10. MD 159 @ MD 7 @ US 40

11a. MD 715 @ US 40 EB On Ramp
11b. MD 715 @ US 40 WB On/Off Ramps

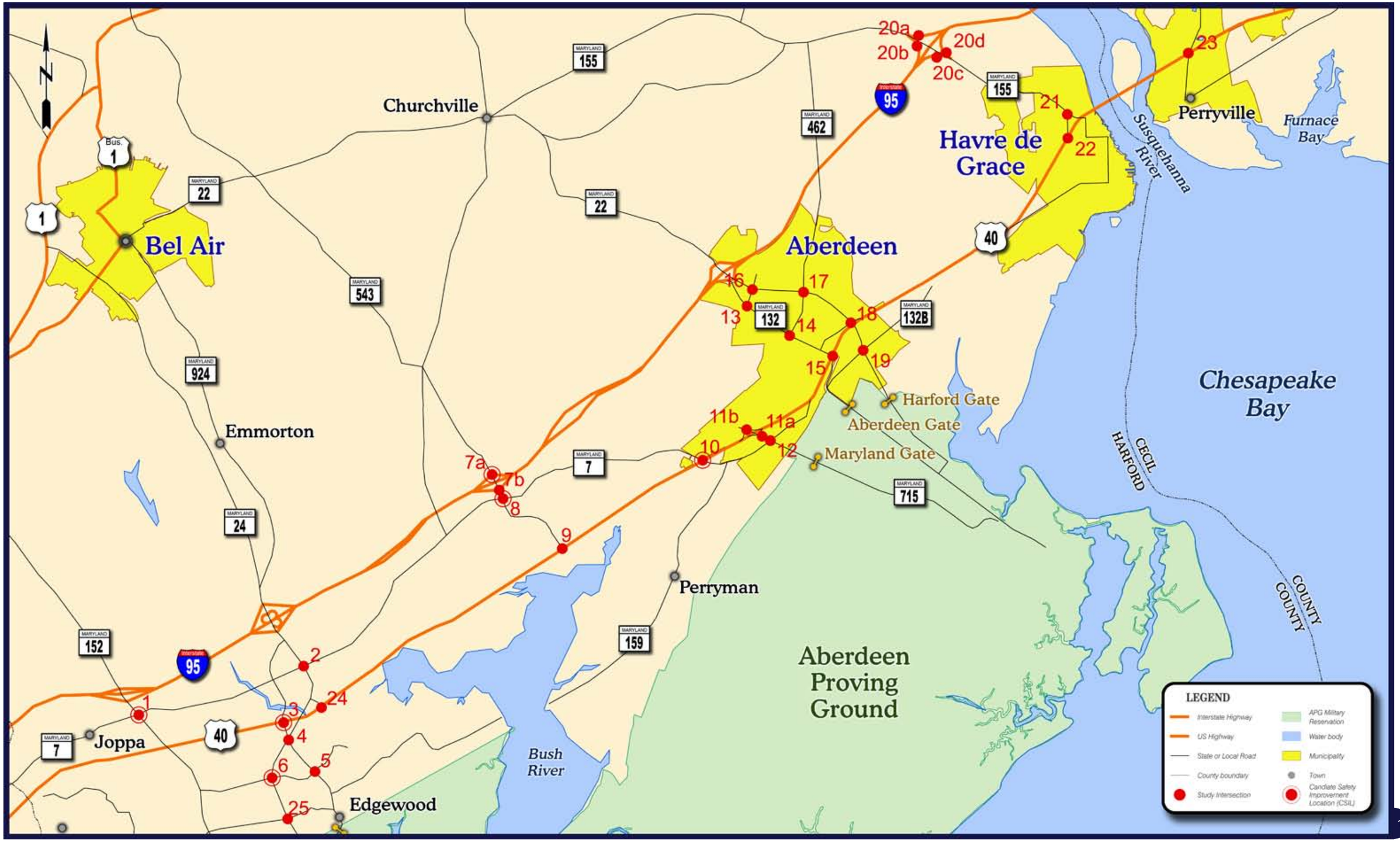
12. MD 715 @ Old Philadelphia Road
13. MD 132 @ MD 132A (Beards Hill Road)
14. MD 132 @ MD 462
15. MD 132 @ US 40
16. MD 22 @ MD 132A (Beards Hill Road)
17. MD 22 @ MD 462
18. MD 22 @ US 40 On/Off Ramps
19. MD 22 @ MD 132 B (North Post Road)

20a. MD 155 @ I-95 SB off ramp
20b. MD 155 @ I-95 SB on ramp
20c. MD 155 @ I-95 NB off ramp
20d. MD 155 @ I-95 NB on ramp

21. MD 155 @ MD 763 (Superior Street)
22. MD 155 @ US 40 @ MD 7A
23. MD 222 @ US 40
24. US 40 @ Otter Creek Ramp to MD 24
25. MD 24 @ Trimble Road
26. US 40 @ MD 22 On/Off Ramps

Six of the study area intersections were designated as Candidate Safety Improvement Locations (CSIL) over the past three years, which are locations where the crash rate exceeds the statewide average for similarly designed roadways:

- MD 152 @ MD 7 – secondary CSIL for 2005
- MD 755 @ US 40 – secondary CSIL for 2005
- MD 24 @ Hanson Road – priority CSIL for 2006
- MD 543 @ I-95 SB On Ramp – priority CSIL for 2006
- MD 543 @ MD 7 – priority CSIL for 2005; secondary CSIL for 2006
- MD 159 @ MD 7 @ US 40 – secondary CSIL for 2005


N
Bus. 1
1
MARYLAND 22
Bel Air
Churchville
MARYLAND 155
MARYLAND 462
MARYLAND 22
MARYLAND 543
MARYLAND 924
Emmorton
MARYLAND 24
MARYLAND 152
Interstate 95
MARYLAND 7
Joppa
40
Edgewood
Bush River
MARYLAND 159
Perryman
Aberdeen
MARYLAND 132
MARYLAND 132B
Havre de Grace
MARYLAND 155
Interstate 95
40
Perryville
Susquehanna River
Furnace Bay
Chesapeake Bay
Harford Gate
Aberdeen Gate
Maryland Gate
MARYLAND 715
CECIL COUNTY
HARFORD COUNTY
Aberdeen Proving Ground
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20b
20c
20d
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22
23
24
25
LEGEND
Interstate Highway
US Highway
State or Local Road
County boundary
Study Intersection
APG Military Reservation
Water body
Municipality
Town
Candidate Safety Improvement Location (CSIL)

Table 1: Existing (2006), 2015 No-Build, and 2015 Build Traffic Data Summary

Intersection	Existing Volumes				2015 No-Build				2015 Build (Improved to LOS E or Better)			
	AM		PM		AM		PM		AM		PM	
	LOS	v/c	LOS	v/c	LOS	v/c	LOS	v/c	LOS	v/c	LOS	v/c
MD 152 @ I-95 SB On / Off Ramps	A	0.61	B	0.64	C	0.81	D	0.86	-	-	-	-
MD 152 @ I-95 NB On / Off Ramps	A	0.48	C	0.72	B	0.63	E	0.95	-	-	-	-
MD 152 @ MD 7	B	0.70	C	0.81	F	1.04	F	1.24	C	0.74	E	0.99
MD 152 @ US 40	A	0.52	C	0.73	C	0.78	E	0.97	-	-	-	-
MD 152 @ Hanson Road	A	0.53	B	0.71	B	0.64	D	0.83	-	-	-	-
MD 152 @ Trimble Road	A	0.49	A	0.53	A	0.61	B	0.69	-	-	-	-
MD 24 @ I-95 NB On / Off Ramps	A	0.51	B	0.66	B	0.71	D	0.88	-	-	-	-
MD 24 @ MD 7	C	0.72	D	0.87	F	1.12	F	1.27	D	0.88	E	0.96
MD 24 @ Otter Creek Ramp to US 40	A	0.55	B	0.65	B	0.67	D	0.85	-	-	-	-
US 40 @ Otter Creek Ramp to MD 24	A	0.43	B	0.67	C	0.75	F	1.12	B	0.63	E	0.92
MD 755 @ US 40	A	0.47	C	0.73	B	0.71	F	1.11	A	0.62	E	0.97
MD 755 @ MD 24	C	0.80	F	1.02	E	0.99	F	1.31	C	0.74	D	0.90
MD 755 @ Hanson Road	B	0.71	E	0.92	D	0.90	F	1.18	C	0.78	D	0.82
MD 755 @ Willoughby Beach Road	A	0.56	C	0.75	B	0.70	E	0.98	-	-	-	-
MD 24 @ Hanson Road	D	0.83	E	0.95	F	1.15	F	1.23	C	0.80	D	0.90
MD 24 @ Trimble Road	C	0.81	C	0.79	F	1.08	F	1.03	C	0.74	C	0.74
MD 543 @ I-95 SB On / Off Ramps	C	0.76	B	0.68	F	1.18	F	1.04	D	0.90	C	0.77
MD 543 @ I-95 NB On / Off Ramps	A	0.48	C	0.76	F	1.42	F	1.49	D	0.82	D	0.90
MD 543 @ MD 7	B	0.71	C	0.75	F	1.27	F	1.20	E	0.92	E	0.96
MD 543 @ US 40	B	0.64	C	0.80	F	1.02	F	1.34	B	0.72	E	0.97
MD 159 @ MD 7 @ US 40	D	0.82	C	0.74	F	1.82	F	1.41	E	0.97	D	0.87
MD 159 @ Old Philadelphia Road	A	0.38	A	0.37	D	0.89	B	0.71	-	-	-	-
MD 715 @ US 40 EB On Ramp	A	0.18	A	0.39	A	0.61	F	1.07	A	0.61	B	0.66
MD 715 @ US 40 WB On / Off Ramps	A	0.20	A	0.38	B	0.63	F	1.02	B	0.63	A	0.59
MD 715 @ Old Philadelphia Road	A	0.51	A	0.54	F	1.84	F	1.51	E	0.98	E	0.94
MD 132 @ MD 132A (Beards Hill Road)	A	0.47	C	0.77	D	0.89	F	1.32	C	0.73	D	0.88
MD 132 @ MD 462	A	0.48	A	0.46	F	1.04	E	0.99	C	0.78	D	0.82
MD 132 @ US 40	B	0.64	B	0.67	F	1.43	F	1.43	E	0.93	E	0.93
MD 22 @ I-95 SB Off Ramp	A	0.29	A	0.32	A	0.56	A	0.61	-	-	-	-
MD 22 @ I-95 NB Off Ramp	A	0.32	A	0.48	A	0.58	D	0.86	-	-	-	-
MD 22 @ MD 132A (Beards Hill Road)	A	0.56	C	0.72	F	1.06	F	1.30	D	0.84	D	0.90
MD 22 @ MD 462	C	0.80	C	0.74	F	1.59	F	1.31	E	0.98	E	0.93
MD 22 @ US 40 On / Off Ramps	A	0.55	A	0.57	F	1.12	F	1.11	D	0.83	E	0.95
US 40 @ MD 22 On / Off Ramps	A	0.48	A	0.51	D	0.90	F	1.04	D	0.87	E	0.91
MD 22 @ MD 132B (North Post Road)	A	0.53	C	0.75	F	1.21	F	1.53	E	0.95	E	0.93
MD 155 @ I-95 SB Off Ramp	A	0.46	E	0.97	B	0.69	F	1.38	B	0.69	D	0.83
MD 155 @ I-95 SB On Ramp	A	0.59	E	0.99	C	0.79	F	1.40	C	0.79	C	0.77
MD 155 @ I-95 NB Off Ramp	C	0.78	E	0.91	C	0.76	F	1.25	C	0.76	C	0.76
MD 155 @ I-95 NB On Ramp	A	0.48	D	0.85	C	0.78	F	1.17	C	0.78	B	0.66
MD 155 @ MD 763 (Superior Street)	A	0.48	D	0.87	B	0.70	F	1.24	B	0.70	E	0.97
MD 155 @ US 40 @ MD 7A	C	0.73	F	1.06	F	1.16	F	1.72	C	0.78	E	0.96
MD 222 @ I-95 SB On / Off Ramps	A	0.49	B	0.68	B	0.65	D	0.83	-	-	-	-
MD 222 @ I-95 NB Off Ramp	A	0.51	A	0.57	B	0.69	B	0.71	-	-	-	-
MD 222 @ I-95 NB On Ramp	A	0.58	A	0.61	D	0.83	C	0.81	-	-	-	-
MD 222 @ US 40	B	0.68	E	0.93	E	0.95	F	1.48	D	0.86	D	0.89
MD 272 @ I-95 NB On / Off Ramps	A	0.41	A	0.37	A	0.51	A	0.47	-	-	-	-
MD 272 @ US 40	B	0.63	B	0.68	C	0.79	E	0.92	-	-	-	-

Methodology

Once it was determined which intersections were recommended for improvement, site visits were conducted to gather additional data. Study team members took photos and documented information about the topography and environmental features found at each location, and noted anything unusual that could influence the intersection design process. Photographs were also used to verify the features shown on aerial mapping of the study area.

Information collected during field reviews was used in conjunction with aerial photography to develop sketch-level intersection improvement design concepts. Improvement concepts were developed using AASHTO 2001 and SHA design standards, assuming twelve-foot-lanes. **Table 2** shows the design speeds assumed in developing improvement concepts.

Once the initial concepts were created using aerial photography as a base map, the limits of disturbance were determined for each location. Using an environmental inventory provided by SHA, the study team calculated the area of impact within the limits of disturbance for wetlands, streams, floodplains, parks and forests, as well as right-of-way impacts and displacements to residential and commercial properties. Aerial photography, GIS data and information obtained from the APG FEIS were also used to estimate potential environmental impacts.

The study team developed cost estimates for each intersection improvement concept using COST-EST, SHA's Excel-based spreadsheet. The range of costs presented for each intersection is the total project cost and includes right-of-way costs, preliminary

Table 2: Design Speed Assumptions

Roadway Segment	Design Speed (MPH)
US 40 from MD 152 to MD 222	60
MD 7 from MD 152 to US 40	55
MD 22 from I-95 to North Post Road	55
MD 715 from US 40 to Old Philadelphia Road	55
MD 543 from I-95 to US 40	55
MD 152 from I-95 to Trimble Road	55
MD 24 from I-95 to Trimble Road / Willoughby Beach Road	55
MD 159	45
MD 132 from US 40 to Beards Hill Road	45
MD 155 from I-95 to MD 763	50
MD 155 from MD 763 to US 40	40
US 222 from I-95 to US 40	55
I-95	70
Beards Hill Road	40
MD 462 (Paradise Road) between MD 132 and MD 22	40
MD 763	40
Old Philadelphia Road	45
Trimble Road	45
Hanson Road	45
Willoughby Beach Road	45
MD 755 from US 40 to Willoughby Beach Road	50

engineering (PE) costs (PE costs were estimated as 25% of neat construction costs), and total construction costs. Right-of-way costs were estimated using data supplied by the SHA District 4 Office of Real Estate. For cost estimating purposes, the pavement overlay was assumed to be a two-inch hot mix asphalt (HMA) Surface, and full depth pavement was assumed to consist of two-inch HMA Surface, six-inch HMA Base, and eight-inch Graded Aggregate Base. Sidewalks were assumed to be five inches thick and at least five feet wide. For reconstruction and/or widening, it was assumed that existing traffic signals would be entirely replaced. Quantities were estimated using design concept drawings, information collected from site visits, and aerial photography. SHA's 2007 Highway Construction Cost Estimating Manual was used to obtain unit costs.

For intersection concepts that initially had an unusually high cost or a large number of right-of-way or environmental impacts, the study team sought other, less impactive ways to improve the intersection's LOS, while still achieving a LOS E or better. Below is a summary of the recommended improvements, cost estimates, and environmental impacts associated with each intersection.

Description of Short-Term Intersection Concepts

The 31 intersection concepts are described below and depicted on aerial mapping, which can be found in **Appendix A**. In addition, Table 3 at the end of this section summarizes the traffic data, cost estimates, and impacts for each intersection.

Intersection 1: MD 152 @ MD 7

This intersection was identified as a secondary Candidate Safety Improvement Location for 2005. Without improvements, this intersection is forecasted to operate at LOS F during both peak hours in 2015, with an AM peak v/c of 1.04 and a PM peak v/c of 1.24. Making the recommended improvements will allow the intersection to function at LOS C during the AM peak hour, with a v/c of 0.74, and LOS E during the PM peak hour, with a v/c ratio of 0.99. The recommended improvements include:

Intersection 1: MD 152 @ MD 7

- Create separate through and right turn lanes on MD 152 in the northbound direction
- Add a second left turn lane on MD 152 in the southbound direction
- Create separate through and right turn lanes on MD 7 in the westbound direction.

These proposed improvements would impact ten properties, totaling 0.59 acres, as well as 300 linear feet of streams and 0.2 acres of forests. The total cost is estimated at approximately $3.5 – $6.5 million. As part of SHA's ongoing improvements in this area, right turn lanes were added in both directions on MD 152 and were accounted for in the intersection analysis. Since this intersection is part of the MdTA's Section 200 studies, the MdTA will evaluate and improve this intersection during the MD 152 interchange reconstruction.

Intersection 2: MD 24 @ MD 7

Without improvements, this intersection is forecasted to operate at LOS F during both peak hours in 2015, with an AM peak v/c ratio of 1.12 and a PM peak v/c ratio of 1.27. Making the recommended improvements will allow the intersection to function at LOS D during the AM peak hour, with a v/c ratio of 0.88, and LOS E during the PM peak hour, with a v/c ratio of 0.96. The recommended improvements include:

Intersection 2: MD 24 @ MD 7

- Add one left turn lane to MD 24 in the southbound direction

- Add one left turn lane to MD 7 in the westbound direction
- Create separate through and right turn lanes and add one additional through lane (for a total of two) on MD 7 in the eastbound direction.

These proposed improvements would impact 18 properties, totaling 1.19 acres, as well as 150 linear feet of streams. The total cost is estimated at approximately $6.5 - $11.5 million. The MdTA's Section 200 proposed improvements to MD 24 north of MD 7 are compatible with this proposed intersection design.

Intersection 3: MD 755 @ US 40

This intersection was listed as a secondary Candidate Safety Improvement Location for 2005. Without improvements, in 2015 this intersection is forecasted to operate at LOS B during the AM peak hour with a v/c ratio of 0.71 and LOS F during the PM peak hour with a v/c ratio of 1.11. Making the recommended

Intersection 3: MD 755 @ US 40

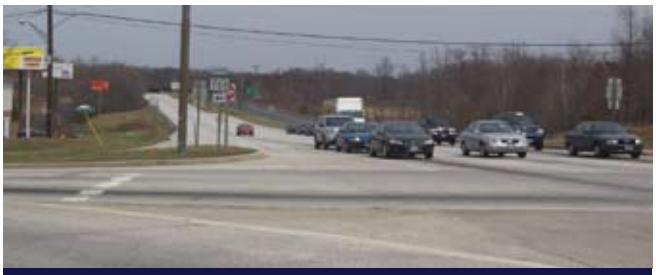
improvements will allow the intersection to function at LOS A during the AM peak hour, with a v/c ratio of 0.62, and LOS E during the PM peak hour, with a v/c ratio of 0.97. The recommended improvements include:

- Add one through lane to US 40 in the westbound direction
- Add one through lane to US 40 in the eastbound direction.

These proposed improvements would impact six properties, totaling 0.51 acres, as well as 100 linear feet of streams and 0.1 acres of floodplains. The total cost is estimated at approximately $6.0 - $11.0 million. As a part of SHA's ongoing improvements in this area, a right turn lane is to be added on southbound MD 755 to westbound US 40 under contract HA 276, and was accounted for in the intersection analysis.

Intersection 4: MD 755 @ MD 24

Without improvements, in 2015 this intersection is forecasted to operate at LOS E during the AM peak hour with a v/c ratio of 0.99 and LOS F during the PM peak hour with a v/c ratio of 1.31. Making



Intersection 4: MD 755 @ MD 24

the recommended improvements will allow the intersection to function at LOS C during the AM peak hour, with a v/c ratio of 0.74, and LOS D during the PM peak hour, with a v/c ratio of 0.90. The recommended improvements include:

- Add one through lane to MD 755 in the southbound direction
- Add one left turn lane to MD 24 in the westbound direction
- Add one through lane to MD 24 so that the rightmost lane in the eastbound direction is a combined through/right.

These proposed improvements would impact 13 properties, totaling 0.40 acres, as well as 600 linear feet of streams, 0.7 acres of wetlands and 0.3 acres of forests. The total cost is estimated at approximately $4.5 - $8.5 million. A southbound left turn lane on MD 24 will be added as part of a developer project.

Intersection 5: MD 755 @ Hanson Road

Without improvements, in 2015 this intersection is forecasted to operate at LOS D during the AM peak hour with a v/c ratio of 0.90 and LOS F during

Intersection 5: MD 755 @ Hanson Road

the PM peak hour with a v/c ratio of 1.18. Making the recommended improvements will allow the intersection to function at LOS C during the AM peak hour, with a v/c ratio of 0.78, and LOS D during the PM peak hour, with a v/c ratio of 0.82. The recommended improvements include:

- Create separate through and right turn lanes on MD 755 in the northbound direction
- Add one through lane to MD 755 in the southbound direction.

These proposed improvements would impact 11 properties, totaling 0.43 acres, and would result in 2 commercial displacements. No environmental features would be impacted. The total cost is estimated at approximately $4.0 – $8.0 million.

Intersection 6: MD 24 @ Hanson Road

This intersection was listed as a priority Candidate Safety Improvement Location for 2006. Without improvements, in 2015 this intersection is forecasted to operate at LOS F during both peak hours, with an AM peak v/c ratio of 1.15 and a PM peak v/c ratio of 1.23. Making the recommended improvements will allow the intersection to function at LOS C during the AM peak hour, with a v/c ratio of 0.80, and LOS D during the PM peak hour, with a v/c ratio of 0.90. The recommended improvements include:

Intersection 6: MD 24 @ Hanson Road

- Add one through lane to MD 24 in the northbound direction
- Add one through lane to MD 24 in the southbound direction.

These proposed improvements would impact five properties, totaling 1.15 acres, as well as 500 linear feet of streams and 0.25 acres of forests. The total cost is estimated at approximately $7.0 – $12.0 million.

Intersection 7a: MD 543 @ I-95 SB On/Off Ramp

The southbound on ramp was identified as a priority Candidate Safety Improvement Location for 2006. Without improvements, in 2015 this intersection is forecasted to operate at LOS F during both peak hours, with an AM peak v/c ratio of 1.18 and a PM peak v/c ratio of 1.04. Making one recommended improvement will allow the intersection to function at LOS D during the AM peak hour, with a v/c ratio of 0.90, and LOS C during the PM peak hour, with a v/c ratio of 0.77. The recommended improvement is to add one left turn lane to MD 543 in the northbound direction.

Intersection 7a: MD 543 @ I-95 SB On/Off Ramp

This proposed improvement would not impact any residential or commercial properties, as the limit of disturbance remains within the State-owned right-of-way. However, it would impact 0.02 acres of wetlands. The total cost is estimated at approximately $14.0 - $19.0 million. The MdTA has noted that it will improve this interchange during Section 200 construction.

Intersection 7b: MD 543 @ I-95 NB On/Off Ramp

Without improvements, in 2015 this intersection is forecasted to operate at LOS F during both peak hours with a v/c ratio in the AM peak hour of 1.42 and a PM peak hour v/c ratio of 1.49. Making the recommended improvements will allow the intersection to function at LOS D during both peak hours with an AM peak hour v/c ratio of 0.82, and a PM peak hour, with a v/c ratio of 0.90. The recommended improvements include:

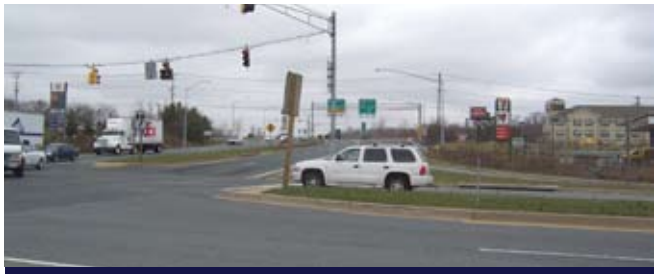
Intersection 7b: MD 543 @ I-95 NB On/Off Ramp

- Add one through lane to MD 543 in the northbound direction
- Convert the free right lane on the I-95 NB off ramp to a signalized triple right.

These proposed improvements would not impact any residential or commercial properties, though they would impact 0.13 acres of wetlands. The total cost is estimated at approximately $18.0 - $23.0 million. The MdTA has noted that it will improve this interchange during Section 200 construction.

Intersection 8: MD 543 @ MD 7

This intersection was identified as a priority Candidate Safety Improvement Location for 2005 and as a secondary Candidate Safety Improvement Location for 2006. Without improvements, this intersection is forecasted to operate at LOS F during both peak hours in 2015, with an AM peak v/c ratio of 1.27 and a PM peak v/c ratio of 1.20. Making the recommended improvements will allow the intersection to function at LOS E during the AM peak hour, with a v/c ratio of 0.92, and LOS E during the PM peak hour, with a v/c ratio of 0.96. The recommended improvements include:



Intersection 8: MD 543 @ MD 7

- Add one left turn lane to MD 543 in the southbound direction
- Add one left turn lane to MD 7 in the eastbound direction.

These proposed improvements are all within the SHA right-of way and would not impact any residential or commercial properties, or environmental features. The total cost is estimated at approximately $1.5 - $3.5 million. A double left turn configuration from southbound MD 543 to eastbound MD 7 will be constructed as part of a developer project, and has been submitted as a candidate Fund 76 project. The MdTA will further improve this intersection during the MD 543 interchange reconstruction under Section 200.

Intersection 9: MD 543 @ US 40

Without improvements, this intersection is forecasted to operate at LOS F during both peak hours in 2015, with an AM peak v/c ratio of 1.02 and a PM peak v/c ratio of 1.34. Making the recommended improvements will allow the intersection to function at LOS B during the AM peak hour, with a v/c ratio of 0.72, and LOS E during the PM peak hour, with a v/c ratio of 0.97. The recommended improvements include:

Intersection 9: MD 543 @ US 40

- Add one left turn lane to US 40 in the westbound direction
- Add one through lane to US 40 in the eastbound direction.

These proposed improvements would impact one property, totaling 0.36 acres, as well as 145 linear feet of streams. The total cost is estimated at approximately $3.5 - $6.5 million.

Intersection 10: MD 159 @ MD 7 @ US 40

This intersection was identified as a secondary Candidate Safety Improvement Location for 2005. Without improvements, this intersection is forecasted to operate at LOS F during both peak hours in 2015, with an AM peak v/c ratio of 1.82 and a PM peak v/c ratio of 1.41. Making the recommended improvements will allow the intersection to function at LOS E during the AM peak hour, with a v/c ratio of 0.97, and LOS D during the PM peak hour, with a v/c ratio of 0.87. The recommended improvements include:

Intersection 10: MD 159 @ MD 7 @ US 40

- Create separate through and right turn lanes on MD 159 in the westbound direction
- Add two left turn lanes to MD 7 in the eastbound direction
- Add two through lanes and one left turn lane to US 40 in the westbound direction
- Add two through lanes to US 40 in the eastbound direction

These proposed improvements would result in one commercial displacement and 39 properties impacted, totaling 7.11 acres, as well as 1480 linear feet of streams and 0.18 acres of floodplains. The total cost is estimated at approximately $22.0 - $27.0 million. It should be noted that linking this intersection improvement to MD 715 @ US 40 could be further evaluated (initial construction cost estimates are about $6 - $8 million for the extension) but may require a formal planning study. In addition, the team evaluated reducing the improvement by providing one through lane in each direction on US 40, which would result in a v/c ratio of 1.11 in the AM and 1.01 in the PM for 2015.

Intersection 11a: MD 715 @ US 40 EB On Ramp

Without improvements, in 2015 this intersection is forecasted to operate at LOS A during the AM peak hour with a v/c ratio of 0.61 and LOS F during the PM peak hour with a v/c ratio of 1.07. Adding one through lane and one right turn lane to MD 715 in the northbound direction will allow the intersection to function at LOS A during the AM peak hour, with a v/c ratio of 0.61, and LOS B during the PM peak hour, with a v/c ratio of 0.66.

Intersection 11a: MD 715 @ US 40 EB On Ramp

This proposed improvement would impact four properties, totaling 1.08 acres, but no environmental features would be impacted. The total cost is estimated at approximately $7.5 - $12.5 million.

Intersection 11b: MD 715 @ US 40 WB On/Off Ramps

Without improvements, in 2015 this intersection is forecasted to operate at LOS B during the AM peak hour with a v/c ratio of 0.63 and LOS F during the PM peak hour with a v/c ratio of 1.02. Adding one through lane to the US 40 on ramp in the westbound direction will allow the intersection to function at LOS B during the AM peak hour, with a v/c ratio of 0.63, and LOS A during the PM peak hour, with a v/c ratio of 0.59.

Intersection 11b: MD 715 @ US 40 WB On/Off Ramps

This proposed improvement would not impact any residential or commercial properties, or environmental features. The total cost is estimated to be approximately $5.0 - $10.0 million.

Intersection 12: MD 715 @ Old Philadelphia Road

Without improvements, in 2015 this intersection is forecasted to operate at LOS F during both peak hours, with an AM peak v/c ratio of 1.84 and a PM peak v/c ratio of 1.51. Making the recommended improvements will allow the intersection to function at LOS E during the AM peak hour, with a v/c ratio of 0.98, and LOS E during the PM peak hour, with a v/c ratio of 0.94. The recommended improvements include:

Intersection 12: MD 715 @ Old Philadelphia Road

- Add two through lanes to MD 715 in the northbound direction
- Add two through lanes to MD 715 in the southbound direction

- Create separate left turn and shared through/ right lanes on Old Philadelphia Road, resulting in a total of two approach lanes in the westbound direction
- Create separate left turn, through, and right turn lanes on Old Philadelphia Road, resulting in a total of three approach lanes in the eastbound direction.

These proposed improvements would impact 13 properties, totaling 2.33 acres, as well as 443 linear feet of streams. The total cost is estimated at approximately $15.0 - $20.0 million. The Aberdeen Department of Public Works is currently developing plans for proposed improvements along Old Philadelphia Road. Additional improvements that could be considered during detailed design include widening MD 715 to three lanes in each direction from the bridge to the APG gate. The construction cost for this extension of the improvement would be approximately $15.0 - $20.0 million.

Intersection 13: MD 132 @ MD 132A (Beards Hill Road)

Without improvements, in 2015 this intersection is forecasted to operate at LOS D during the AM peak hour with a v/c ratio of 0.89 and LOS F during the PM peak hour with a v/c ratio of 1.32. Making the recommended improvements will allow the intersection to function at LOS C during the AM peak hour, with a v/c ratio of 0.73, and LOS D during the PM peak hour, with a v/c ratio of 0.88. The recommended improvements include:

Intersection 13: MD 132 @ MD 132A (Beards Hill Road)

- Add one left turn lane to MD 132 in the northbound direction
- Create separate through and right turn lanes on MD 132 in the southbound direction.

These proposed improvements would impact 19 properties, totaling 1.42 acres, but would not impact any environmental features. The total cost is estimated at approximately $6.5 - $11.5 million.

Intersection 14: MD 132 @ MD 462

Without improvements, in 2015 this intersection is forecasted to operate at LOS F during the AM peak hour with a v/c ratio of 1.04 and LOS E during the PM peak hour with a v/c ratio of 0.99. Making the recommended improvements will allow the intersection to function at LOS C during the AM peak hour, with a v/c ratio of 0.78, and LOS D during the PM peak hour, with a v/c ratio of 0.82. The recommended improvements include:

Intersection 14: MD 132 @ MD 462

- Create separate through and right turn lanes on MD 132 in the northbound direction
- Create separate through and left turn lanes on MD 132 in the southbound direction.

These proposed improvements would impact 16 properties, totaling 0.77 acres, as well as 0.14 acres of forests. The total cost is estimated at approximately $3.5 - $6.5 million.

Intersection 15: MD 132 @ US 40

Without improvements, this intersection is forecasted to operate at LOS F during both peak hours in 2015, with AM and PM peak v/c ratios of 1.43. Making the recommended improvements will allow the intersection to function at LOS E during both the AM and PM peak hours, where both v/c ratios are 0.93. The recommended improvements include:

Intersection 15: MD 132 @ US 40

- Add one through lane to MD 132 in the northbound direction
- Add one through lane to MD 132 in the southbound direction
- Add one through lane to US 40 in the westbound direction
- Add two through lanes to US 40 in the eastbound direction.

These proposed improvements would result in 13 commercial displacements and impact 43 properties, totaling 1.35 acres. No additional environmental features would be impacted. The total cost is estimated at approximately $22.0 - $27.0 million.

Intersection 16: MD 22 @ MD 132A (Beards Hill Road)

Without improvements, this intersection is forecasted to operate at LOS F during both peak hours in 2015, with an AM peak v/c ratio of 1.06 and a PM peak v/c ratio of 1.30. Making the recommended improvements will allow the intersection to function at LOS D during the AM peak hour with a v/c ratio of 0.84, and LOS D during the PM peak hour with a v/c ratio of 0.90. The recommended improvements include:

Intersection 16: MD 22 @ MD 132A (Beards Hill Road)

- Add one through lane to MD 22 in the westbound direction
- Add one through lane and one left turn lane to MD 22 in the eastbound direction
- Add one left turn lane to Beards Hill Road in the southbound direction
- Add one left turn lane to Beards Hill Road in the northbound direction.

These proposed improvements would impact four properties, totaling 0.56 acres, but would not impact any environmental features. The total cost is estimated at approximately $7.5 - $12.5 million. As a part of SHA's ongoing improvements in this area, the recommended left turn improvements are now in place. In addition, the Aberdeen Department of Public Works is currently working on a land development project adjacent to this intersection. It should be noted that a developer request for a new access point at Middleton Road has been denied, as it would not benefit the system.

Intersection 17: MD 22 @ MD 462

Without improvements, this intersection is forecasted to operate at LOS F during both peak hours in 2015, with an AM peak v/c ratio of 1.59 and a PM peak v/c ratio of 1.31. Making the recommended improvements will allow the intersection to function at LOS E during the AM peak hour with a v/c ratio of 0.98, and LOS E during the PM peak hour with a v/c ratio of 0.93. The recommended improvements include:

Intersection 17: MD 22 @ MD 462

- Add one through lane to MD 22 in the westbound direction
- Add one through lane to MD 22 in the eastbound direction
- Create separate through and left turn lanes, and add one left turn lane to MD 462 in the southbound direction
- Create separate through and right turn lanes on MD 462 in the northbound direction.

These proposed improvements would result in 13 residential displacements and impact 55 properties, totaling 1.50 acres, as well as 12 linear feet of streams. All but one of the displacements could be avoided if through lanes are not added to MD 22, but this would result in AM and PM peak v/c ratios of 1.18 and 1.17, respectively. While these improvements may be further refined in detailed design to further minimize impacts, it should be noted that the median cannot be narrowed at this location for safety reasons. The total cost is estimated at approximately $9.5 - $14.5 million. As a part of SHA's ongoing improvements in this area, a signal system has recently been installed at this intersection.

Intersection 18: MD 22 @ US 40 On/Off Ramps

Without improvements, this intersection is forecasted to operate at LOS F during both peak hours in 2015, with an AM peak v/c ratio of 1.12 and a PM peak v/c ratio of 1.11. Making the recommended improvements will allow the intersection to function at LOS D during the AM peak hour with a v/c ratio of 0.83, and LOS E during the PM peak hour with a v/c ratio of 0.95. The recommended improvements include:

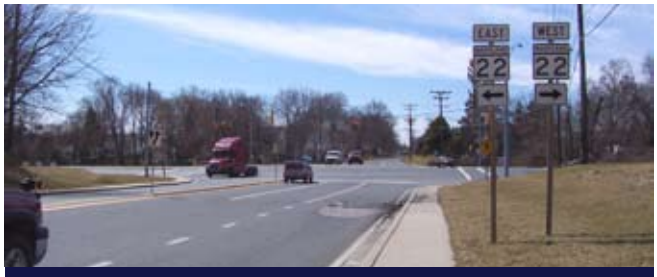
Intersection 18: MD 22 @ US 40 On/Off Ramps

- Add one through lane to MD 22 in the eastbound direction
- Add one left turn lane to US 40 On/Off Ramp in the eastbound direction.

These proposed improvements would impact three properties, totaling 1.25 acres, as well as 50 linear feet of streams, 0.15 acres of floodplains, and 1.86 acres of forests. Maintenance of railroad and modification of railroad catenaries and overhead electric would be required. The total cost is estimated at approximately $50.0 - $60.0 million, which includes widening and redecking of three bridges.

Intersection 19: MD 22 @ MD 132 B (North Post Road)

Without improvements, this intersection is forecasted to operate at LOS F during both peak hours in 2015, with an AM peak v/c ratio of 1.21 and a PM peak v/c ratio of 1.53. Making the recommended improvements will allow the intersection to function at LOS E during the AM peak hour with a v/c ratio of 0.95, and LOS E during the PM peak hour with a v/c ratio of 0.93. The recommended improvements include:



Intersection 19: MD 22 @ MD 132 B (North Post Road)

- Add two through lanes to MD 22 in the westbound direction
- Add one through lane and one left turn lane to MD 22 in the eastbound direction.

These proposed improvements would impact 18 properties, totaling 1.93 acres, as well as 0.88 acres of forests. The total cost is estimated at approximately $12.0 - $17.0 million. This cost does not include the bridge widening which was included in the recommended improvements for the MD 22 @ US 40 On/Off ramps. Another option that could be considered in detailed design is to provide only one lane in each direction, which would result in AM and PM peak v/c ratios of 0.95 and 1.11 respectively, and would avoid the bridge widening.

Intersection 20a: MD 155 @ I-95 SB Off Ramp

Without improvements, in 2015 this intersection is forecasted to operate at LOS B during the AM peak hour with a v/c ratio of 0.69 and LOS F during the PM peak hour with a v/c ratio of 1.38. Adding one through lane to MD 155 in the westbound direction will allow the intersection to function at LOS B during the AM peak hour, with a v/c ratio of 0.69, and LOS D during the PM peak hour, with a v/c ratio of 0.83.

Intersection 20a: MD 155 @ I-95 SB Off Ramp

This proposed improvement would not impact any residential or commercial properties, but would impact 504 linear feet of streams. The total cost is estimated at approximately $4.0 - $8.0 million. The MdTA will improve this interchange during Section 300 construction.

Intersection 20b: MD 155 @ I-95 SB On Ramp

Without improvements, in 2015 this intersection is forecasted to operate at LOS C during the AM peak hour with a v/c ratio of 0.79 and LOS F during the PM

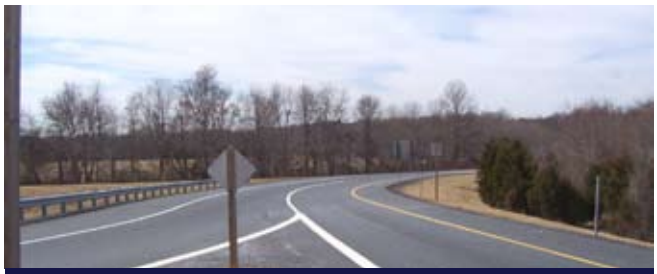
peak hour with a v/c ratio of 1.40. Adding one through lane to MD 155 in the westbound direction will allow the intersection to function at LOS C during the AM peak hour, with a v/c ratio of 0.79, and LOS C during the PM peak hour, with a v/c ratio of 0.77.

Intersection 20b: MD 155 @ I-95 SB On Ramp

This proposed improvement would not impact any residential or commercial properties, but would impact 392 linear feet of streams. The total cost is estimated at approximately $3.5 - $6.5 million. As part of SHA's ongoing improvements in this area, a bypass lane was installed from westbound MD 155 to southbound I-95 under SHA contract HA 295. The MdTA will further improve this interchange during Section 300 construction.

Intersection 20c: MD 155 @ I-95 NB Off Ramp

Without improvements, in 2015 this intersection is forecasted to operate at LOS F during both peak hours with an AM peak hour v/c ratio of 1.15 and a PM peak hour v/c ratio of 1.25. Adding one through lane to MD 155 in the westbound direction will allow the intersection to function at LOS C with a v/c ratio of 0.76 during both peak hours.



Intersection 20c: MD 155 @ I-95 NB Off Ramp

This proposed improvement would not impact any residential or commercial properties, as the improvement would be within the State-owned right-of-way. However, 513 linear feet of streams would be impacted. The total cost is estimated at approximately $1.0 – $3.0 million. Base widening for the westbound MD 155 lane drop and a left turn lane from eastbound MD 155 to northbound I-95 will be constructed as part of the Bulle Rock development project. The MdTA will further improve this interchange during Section 300 construction.

Intersection 20d: MD 155 @ I-95 NB On Ramp

Without improvements, in 2015 this intersection is forecasted to operate at LOS C during the AM peak hour with a v/c ratio of 0.78 and LOS F during the PM peak hour with a v/c ratio of 1.17. Adding one through lane to MD 155 in the westbound direction will allow the intersection to function at LOS C during the AM peak hour, with a v/c ratio of 0.78, and LOS B during the PM peak hour, with a v/c ratio of 0.66.

Intersection 20d: MD 155 @ I-95 NB On Ramp

This proposed improvement would not impact any residential or commercial properties, but would impact 690 linear feet of streams. The total cost is estimated at approximately $1.0 - $3.0 million. A new traffic signal has been installed at this intersection and base widening will also be completed as part of the Bulle Rock development project. The MdTA will further improve this interchange during Section 300 construction.

Intersection 21: MD 155 @ MD 763 (Superior Street)

Without improvements, in 2015 this intersection is forecasted to operate at LOS B during the AM peak hour with a v/c ratio of 0.70 and LOS F during the PM peak hour with a v/c ratio of 1.24. Adding one through lane to MD 763 in the westbound direction will allow

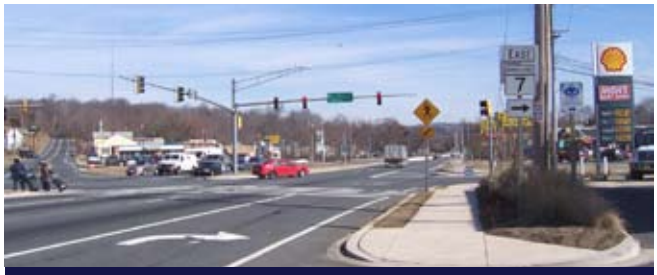
Intersection 21: MD 155 @ MD 763 (Superior Street)

the intersection to function at LOS B during the AM peak hour, with a v/c ratio of 0.70, and LOS E during the PM peak hour, with a v/c ratio of 0.97.

This proposed improvement would impact 16 properties, totaling 0.51 acres, as well as 254 linear feet of streams. The total cost is estimated at approximately $3.0 - $6.0 million. Havre de Grace town officials have requested improvements to the downhill grade in this area to address speed and geometric design issues. The MdTA will improve this interchange during Section 300 construction.

Intersection 22: MD 155 @ US 40 @ MD 7A

Without improvements, this intersection is forecasted to operate at LOS F during both peak hours in 2015, with an AM peak v/c ratio of 1.16 and a PM peak v/c ratio of 1.72. Making the recommended improvements will allow the intersection to function at LOS C during the AM peak hour with a v/c ratio of 0.78, and LOS E during the PM peak hour with a v/c ratio of 0.96. It is important to note that Havre de Grace town officials have requested geometric improvements to alleviate delays at this location. The recommended improvements include:



Intersection 22: MD 155 @ US 40 @ MD 7A

- Create separate left turn, through and right turn lanes on MD 7A, resulting in total of three approach lanes in the northbound direction
- Convert the existing shared through/left lane to an exclusive left turn lane, and add one left turn lane and one thru/right turn lane to MD 155 in the southbound direction
- Add one through lane to US 40 in the westbound direction
- Add two through lanes and one left turn lane to US 40 in the eastbound direction.

These proposed improvements would result in one commercial displacement and impact 28 properties, totaling 2.10 acres. Approximately 230 linear feet of streams and 0.29 acres of floodplains would also be impacted. The total cost is estimated at approximately $14.0 - $19.0 million.

Intersection 23: MD 222 @ US 40

Without improvements, in 2015 this intersection is forecasted to operate at LOS E during the AM peak hour, with a v/c ratio of 0.95 and LOS F during the PM peak hour with a v/c ratio of 1.48. Making the recommended improvements will allow the intersection to function at LOS D during the AM peak hour with a v/c ratio of 0.86, and LOS D during the PM peak hour with a v/c ratio of 0.89. The recommended improvements include:

Intersection 23: MD 222 @ US 40

- Create separate through and left turn lanes on MD 222 in the southbound direction
- Add two left turn lanes to US 40 in the eastbound direction.

These proposed improvements would not impact any residential or commercial properties, but would impact 0.33 acres of forests. The total cost is estimated at approximately $7.0 - $12.0 million.

Intersection 24: US 40 @ Otter Creek Ramp to MD 24

Without improvements, in 2015 this intersection is forecasted to operate at LOS C during the AM peak hour with a v/c ratio of 0.75 and LOS F during the PM peak hour with a v/c ratio of 1.12. Adding one through lane to US 40 in the westbound direction will allow the

Intersection 24: US 40 @ Otter Creek Ramp to MD 24

intersection to function at LOS B during the AM peak hour, with a v/c ratio of 0.63, and LOS E during the PM peak hour, with a v/c ratio of 0.92.

This proposed improvement would impact one property, totaling 0.81 acres, but would have no impacts to environmental features. The total cost is estimated at approximately $4.0 - $8.0 million.

Intersection 25: MD 24 @ Trimble Road

Without improvements, this intersection is forecasted to operate at LOS F during both peak hours in 2015, with an AM peak v/c ratio of 1.08 and a PM peak v/c ratio of 1.03. Making the recommended improvements will allow the intersection to function at LOS C during both peak hours with a v/c ratio of 0.74. The recommended improvements include:

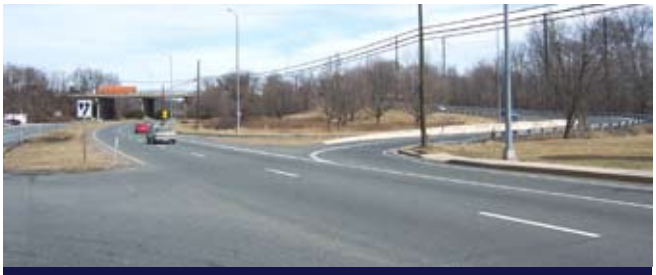
Intersection 25: MD 24 @ Trimble Road

- Add one through lane to MD 24 in the northbound direction
- Add one through lane to MD 24 in the southbound direction.

These proposed improvements would impact three properties, totaling 0.98 acres, but no environmental features would be impacted. The total cost is estimated at approximately $5.0 - $10.0 million.

Intersection 26: US 40 @ MD 22 On/Off Ramps

Without improvements, in 2015 this intersection is forecasted to operate at LOS D during the AM peak hour with a v/c ratio of 0.90 and at LOS F during the PM peak hour with a v/c ratio of 1.04. The recommended improvement is to add an additional right turn lane from the MD 22 On/Off Ramp to US 40 in the westbound direction. This improvement would



Intersection 26: US 40 @ MD 22 On/Off Ramps

allow the intersection to function at LOS D during the AM peak hour with a v/c ratio of 0.87, and LOS E during the PM peak hour with a v/c ratio of 0.91.

This proposed improvement would not have any right-of-way or environmental impacts, and the total cost is estimated at approximately $1.0 – $3.0 million. Other designs may be considered for this location in the future, such as a Continuous Green T configuration.

Implementation of Short-Term (2015) Intersection Improvements

Once the study team determined the full range of needs and intersection improvements, the next step in the process was to determine the priority of intersection improvements to be implemented. Based on the cost estimates developed for all 31 intersections, the total cost of the short-term improvements at APG would be in the range of $273 - $407 million, including the design, construction, and ROW acquisition phases. The level of available funding is not sufficient to program all of the needed improvements. Therefore SHA, in coordination with Harford County and the APG Garrison Commander, developed a list of priority intersections that were desired to be implemented, should funding become available. **Table 4** below denotes the priority; the intersections indicated with a “P1” are the top priorities and those with a “P2” are secondary priorities. The priority of the P1 intersection improvements was based on the forecasted 2015 LOS and v/c ratios as well as the proximity of the intersection to APG and cost. The P2 priorities were based on 2015 LOS and v/c ratios only. The asterisks denote potential MdTA projects to be constructed with I-95 Sections 200 and 300, and intersection numbers refer to locations shown in **Figure 3** and on aerial mapping in **Appendix A**.

Table 3: Summary of Short-Term Intersection Improvement Concepts

Intersection			Traffic Data (2015)								Right-of-Way				Environmental Features					Costs			Distance from APG		CSIL	MdTA Project
Number	Name	Proposed Improvement	No-Build (AM LOS)	No-Build (AM V/C)	No-Build (PM LOS)	No-Build (PM V/C)	Build (AM LOS)	Build (AM v/c)	Build (PM LOS)	Build (PM v/c)	Res. Disp.	Com. Disp.	Proper-ties Impacted	Total Right-of-Way (acres)	Wetlands (acres)	Streams (linear feet)	Flood-plains (acres)	Parks (acres)	Forests (acres)	Right-of-Way (millions)	Total Construc-tion (mil-lions)	Total Cost (mil-lions)	Nearest Gate	Distance (miles)		
1	MD 152 @ MD 7	NB MD 7: New exclusive RT to replace thru-right; WB MD 7: New exclusive RT to replace thru-right; SB MD 152: New LT to create double left onto EB MD 7	F	1.04	F	1.24	C	0.74	E	0.99	0.00	0.00	10.00	0.59	0.00	300.00	0.00	0.00	0.20	$0.4	$2.5 - $4.5	3.5 - $6.5	MD 715	10.87	Yes	Section 200 Phase 1
2	MD 24 @ MD 7	SB MD 24: New exclusive LT to create double left; EB MD 7: Add new thru and RT lanes; WB MD 7: New LT to create double left	F	1.12	F	1.27	D	0.88	E	0.96	0.00	0.00	18.00	1.19	0.00	150.00	0.00	0.00	0.00	$1.0	$4.5 - $8.5	$6.5 - $11.5	MD 715	9.21		Section 200 Phase 1
3	MD 755 @ US 40	EB and WB US 40: New thru lane in each direction	B	0.71	F	1.11	A	0.62	E	0.97	0.00	0.00	6.00	0.51	0.00	100.00	0.10	0.00	0.00	$0.7	$4.0 - $8.0	$6.0 - $11.0	MD 715	8.63	Yes	
4	MD 755 @ MD 24	WB MD 24: New exclusive LT to create double left; EB MD 24: Add one thru lane to create shared thru/right; SB MD 755: New thru lane	E	0.99	F	1.31	C	0.74	D	0.90	0.00	0.00	13.00	0.40	0.70	600.00	0.00	0.00	0.30	$0.5	$3.0 - $6.0	$4.5 - $8.5	MD 715	8.72		
5	MD 755 @ Hanson Road	NB MD 755: New exclusvie RT to replace thru-right SB MD 755: New thru lane	D	0.90	F	1.18	C	0.78	D	0.82	0.00	2.00	11.00	0.43	0.00	0.00	0.00	0.00	0.00	$1.7	$2.0 - $4.0	$4.0 - $8.0	MD 715	8.72		
6	MD 24 @ Hanson Road	NB and SB MD 24: New thru lane in each direction	F	1.15	F	1.23	C	0.80	D	0.90	0.00	0.00	5.00	1.15	0.00	500.00	0.00	0.00	0.25	$1.3	$5.0 - $10.0	$7.0 - $12.0	MD 715	9.32		
7A	MD 543 @ I-95 SB On/ Off Ramps	NB MD 543: New exclusive LT to create double left	F	1.18	F	1.04	D	0.90	C	0.77	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	$0.0	$11.5 - $16.5	$14.0 - $19.0	MD 715	5.43		Section 200 Phase II
7B	MD 543 @ I-95 NB On / Off Ramps	NB MD 543: New thru lane (from 2-3 lanes) NB off-ramp: 2 new RT lanes to create signalized triple right	F	1.42	F	1.49	D	0.82	D	0.90	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	$0.0	$14.5 - $19.5	$18.0 - $23.0	MD 715	5.43		Section 200 Phase II
8	MD 543 @ MD 7	SB MD 543: New exclusive LT to create double left EB MD 7: New exclusive LT to create double left	F	1.27	F	1.20	E	0.92	E	0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	$0.0	$1.0 - $3.0	$1.5 - $3.5	MD 715	5.20	Yes	Section 200 Phase II
9	MD 543 @ US 40	WB US 40: New exclusive LT to create double left EB US 40: New thru lane	F	1.02	F	1.34	B	0.72	E	0.97	0.00	0.00	1.00	0.36	0.00	145.00	0.00	0.00	0.00	$0.3	$2.5 - $4.5	$3.5 - $6.5	MD 715	4.02		
10	MD 159 @ US 40 @ MD 7	EB US 40: 2 new thru lanes; WB US 40: 2 new thru lanes and new LT to create double left; WB MD 159: New exclusive RT to replace thru-right; EB MD 7: 2 new LT lanes to create triple left	F	1.82	F	1.41	E	0.97	D	0.87	0.00	1.00	39.00	7.11	0.00	1480.00	0.18	0.00	0.00	$7.0	$17.5 - $22.5	$22.0 - $27.0	MD 715	1.72	Yes	
11A	MD 715 @ US 40 EB On Ramp	WB MD 715: New exclusive RT to create 2-lane ramp and new thru lane	A	0.61	F	1.07	A	0.61	B	0.66	0.00	0.00	4.00	1.08	0.00	0.00	0.00	0.00	0.00	$1.2	$5.0 - $10.0	$7.5 - $12.5	MD 715	0.90		
11B	MD 715 @ US 40 WB On Ramp	WB US 40: New thru lane	B	0.63	F	1.02	B	0.63	A	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	$0.0	$4.0 - $8.0	$5.0 - $10.0	MD 715	0.90		
12	MD 715 @ Old Philadelphia Road	NB MD 715: 2 new thru lanes; SB MD 715: 2 new through lanes; EB Old Phil Rd: Create separate left, thru and right lanes (3 lanes total); WB Old Phil Rd: New exclusive LT lane"	F	1.84	F	1.51	E	0.98	E	0.94	0.00	0.00	13.00	2.33	0.00	443.00	0.00	0.00	0.00	$2.4	$10.0 - $15.0	$15.0 - $20.0	MD 715	0.65		
13	MD 132 @ MD 132A (Beards Hill Road)	SB MD 132: New exclusive RT to replace thru-right NB MD 132: New LT to create double left	D	0.89	F	1.32	C	0.73	D	0.88	0.00	0.00	19.00	1.42	0.00	0.00	0.00	0.00	0.00	$1.8	$4.0 - $8.0	$6.5 - $11.5	MD 132 (APG Rd)	2.32		
14	MD 132 @ MD 462	WB MD 132: New exclusive RT to replace thru-right EB MD 132: New exclusive LT to replace thru-left	F	1.04	E	0.99	C	0.78	D	0.82	0.00	0.00	16.00	0.77	0.00	0.00	0.00	0.00	0.14	$0.5	$2.0 - $4.0	$3.5 - $6.5	MD 132 (APG Rd)	1.59		
15	MD 132 @ US 40	EB US 40: 2 new thru lanes; WB US 40: 1 new thru lane; NB MD 132: 1 new thru lane; SB MD 132: 1 new thru lane	F	1.43	F	1.43	E	0.93	E	0.93	0.00	13.00	43.00	1.35	0.00	0.00	0.00	0.00	0.00	$15.0	$6.0 - $11.0	$22.0 - $27.0	MD 132 (APG Rd)	0.93		
16	MD 22 @ MD 132A (Beards Hill Road)	WB Beards Hill Road: New exclusive LT to create double left; EB Beards Hill Road: New exclusive LT to create double left; SB MD 22: New exclusive LT to create double left and new thru lane; NB MD 22: New thru lane	F	1.06	F	1.30	D	0.84	D	0.90	0.00	0.00	4.00	0.56	0.00	0.00	0.00	0.00	0.00	$0.7	$6.0 - $11.0	$7.5 - $12.5	MD 132 (APG Rd)	2.57		
17	MD 22 @ MD 462	NB MD 22: 1 new thru lane; SB MD 22: 1 new thru lane; WB MD 462: New double LT to replace thru-left; EB MD 462: New exclusive RT to replace thru-right	F	1.59	F	1.31	E	0.98	E	0.93	13.00	0.00	55.00	1.50	0.00	12.00	0.00	0.00	0.00	$4.9	$4.0 - $8.0	$9.5 - $14.5	MD 22	2.02		
18	MD 22 @ US 40 On / Off Ramps	SB MD 22: 1 new thru lane (including bridge) WB US 40 Off-ramp: New LT lane to create double left	F	1.12	F	1.11	D	0.83	E	0.95	0.00	0.00	3.00	1.25	0.00	50.00	0.15	0.00	1.86	$1.0	$41.0 - $51.0	$50.0 - $60.0	MD 22	1.20		
19	MD 22 @ MD 132B (North Post Road)	SB MD 22: 1 new thru lane and new LT lane to create double left NB MD 22: 2 new thru lanes	F	1.21	F	1.53	E	0.95	E	0.93	0.00	0.00	18.00	1.93	0.00	0.00	0.00	0.00	0.88	$1.3	$8.5 - $13.5	$12.0 - $17.0	MD 22	0.81		
20A	MD 155 @ I-95 SB Off Ramp	NB MD 155: 1 new thru lane	B	0.69	F	1.38	B	0.69	D	0.83	0.00	0.00	0.00	0.00	0.00	504.00	0.00	0.00	0.00	$0.0	$3.0 - $6.0	$4.0 - $8.0	MD 22	7.54		Section 300
20B	MD 155 @ I-95 SB On Ramp	NB MD 155: 1 new thru lane	C	0.79	F	1.40	C	0.79	C	0.77	0.00	0.00	0.00	0.00	0.00	392.00	0.00	0.00	0.00	$0.0	$3.0 - $6.0	$3.5 - $6.5	MD 22	7.54		Section 300
20C	MD 155 @ I-95 NB Off Ramp	NB MD 155: 1 new thru lane	C	0.76	F	1.25	C	0.76	C	0.76	0.00	0.00	0.00	0.00	0.00	513.00	0.00	0.00	0.00	$0.0	$1.0 - $3.0	$1.0 - $3.0	MD 22	7.54		Section 300
20D	MD 155 @ I-95 NB On Ramp	NB MD 155: 1 new thru lane	C	0.78	F	1.17	C	0.78	B	0.66	0.00	0.00	0.00	0.00	0.00	690.00	0.00	0.00	0.00	$0.0	$1.0 - $3.0	$1.0 - $3.0	MD 22	7.54		Section 300
21	MD 155 @ MD 763 (Superior Street)	WB MD 763: 1 new thru lane	B	0.70	F	1.24	B	0.70	E	0.97	0.00	0.00	16.00	0.51	0.00	254.00	0.00	0.00	0.00	$0.4	$2.0 - $4.0	$3.0 - $6.0	MD 22	5.62		
22	MD 155 @ US 40 @ MD 7A	EB US 40: 2 new thru lanes and 1 new LT lane to create double left; WB US 40: 1 new thru lane; NB MD 7A: new exclusive RT and LT lanes; SB MD 155: new exclusive LT lane to create double left and one exclusive RT lane	F	1.16	F	1.72	C	0.78	E	0.96	0.00	1.00	28.00	2.10	0.00	230.00	0.29	0.00	0.00	$3.7	$8.5 - $13.5	$14.0 - $19.0	MD 22	5.25	Yes	
23	MD 222 @ US 40	EB US 40: 2 new exclusive LT lanes to create triple left SB MD 222: separate thru and LT lanes	E	0.95	F	1.48	D	0.86	D	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	$0.0	$6.0 - $11.0	$7.0 - $12.0	MD 22	7.34		
24	US 40 @ Otter Creek Ramp to MD 24	WB and EB US 40: new thru lane in each direction	C	0.75	F	1.12	B	0.63	E	0.92	0.00	0.00	1.00	0.81	0.00	0.00	0.80	0.00	0.00	$1.4	$2.0 - $4.0	$4.0 - $8.0	MD 715	8.05		
25	MD 24 @ Trimble Road	NB and SB MD 24: new thru lane in each direction	F	1.08	F	1.03	C	0.74	C	0.74	0.00	0.00	3.00	0.98	0.00	0.00	0.00	0.00	0.00	$1.2	$3.0 - $6.0	$5.0 - $10.0	MD 715	9.89		
26	US 40 @ MD 22 On/Off Ramps	1 new RT lane from MD 22 ramp to WB US 40	D	0.90	F	1.04	D	0.87	E	0.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	$0.0	$1.0 - $3.0	$1.0 - $3.0	MD 22	1.20		

Table 4: Summary of Intersection Priorities

Priority	Intersection	Intersection Number
P1	MD 715 @ US 40/Old Philadelphia Road	11a, 11b,12
P1	MD 159 @ MD 7 @ US 40	10
P1	MD 22 @ MD 132 B (North Post Road)	19
P1	MD 22 @ MD 132A (Beards Hill Road)	16
P1	MD 155 @ US 40 @ MD 7A	22
P1	MD 22 @ MD 462	17
P1	MD 543 @ US 40	9
P1	MD 22 @ US 40	18
P1*	MD 222 @ US 40	23
P2*	MD 152 @ MD 7	1
P2	MD 24 @ MD 7	2
P2	MD 755 @ US 40	3
P2	MD 755 @ MD 24	4
P2	MD 755 @ Hanson Road	5
P2	MD 24 @ Hanson Road	6
P2*	MD 543 @ I-95 SB On/Off Ramps	7a
P2*	MD 543 @ I-95 NB On/Off Ramps	7b
P2*	MD 543 @ MD 7	8
P2	MD 132 @ MD 132A (Beards Hill Road)	13
P2	MD 132 @ MD 462	14
P2	MD 132 @ US 40	15
P2*	MD 155 @ I-95 SB Off Ramp	20a
P2*	MD 155 @ I-95 SB On Ramp	20b
P2*	MD 155 @ I-95 NB Off Ramp	20c
P2*	MD 155 @ I-95 NB On Ramp	20d
P2	MD 155 @ MD 763 (Superior Street)	21
P2	US 40 @ Otter Creek Ramp to MD 24	24
P2	MD 24 @ Trimble Road	25
P2	US 40 @ MD 22 On/Off Ramps	26

BRAC
Aberdeen Proving Ground

Long-Term Analysis

In addition to developing short-term improvements to address the most critical intersections near APG, SHA conducted sketch-level studies of long-term needs to identify corridors that may require improvements to operate at acceptable levels of service in 2030. These studies included investigation of operations of existing intersections and corridors as well as a study of MD 715 Extended. As with the 2015 analyses, the study team used the BMC model with the Round 7.0 demographic data to forecast ADT volumes for the 2030 "With BRAC" condition.

Because of the timing of the BRAC/EUL action, most of the growth is expected to occur by 2015. In fact, the annual growth rate in the study area that is expected from 2006 to 2015 is forecasted to range between four and six percent (substantially higher than the historical growth rate of one half to two percent in this area), while the annual growth rate expected in the study area between 2015 and 2030 is forecasted to range between one-half to two percent, similar to the historical growth rate. The reduction in growth rate after 2015 is important to note because it is likely that many of the intersection improvements recommended for the short-term could continue to function at acceptable levels of service for several years after the implementation of BRAC.

Existing Corridors and Intersections

To understand the corridor and intersection needs in the future, SHA evaluated four conditions for 2030:

- The 2030 With BRAC No Build scenario was studied to determine the anticipated traffic operations at each intersection in 2030 if no geometric improvements were made between 2006 and 2030
- The 2030 With BRAC Build scenario represents the improvements necessary to allow each intersection within the study area to operate at LOS E or better under 2030 "With BRAC" conditions.
- The 2030 No-BRAC No Build scenario was studied as a base case comparison to determine the anticipated affect of BRAC on the intersections within the study area
- The 2030 No-BRAC Build scenario was studied to determine how much of the improvements shown for the 2030 With BRAC Build scenario are due to BRAC at APG.

For this study, SHA has assumed that all three gates serving the Northern Cantonment (the Maryland Gate on MD 715, the Aberdeen Gate on MD 132, and the Harford Gate on MD 22) will be open, although at the time of the studies, no final decisions about gate operations had been made by APG.

To determine the LOS and v/c ratios from the BMC model output, ADTs were extracted from the model for the roads within the study area and put into a spreadsheet that was used to develop turning movement volumes for both the AM and PM peak hours in 2030 for both the No-BRAC and With BRAC conditions. The turning movement volumes were balanced across each region and critical lane analyses were performed on each intersection using the turning movement volumes for each scenario with the existing lane configurations. The study team used this data to develop improvements for each

intersection forecasted to function at LOS F under 2030 With BRAC conditions, and under 2030 No-BRAC conditions.

The study team then analyzed the 2030 link volumes between the intersections and determined the link LOS for both the No-BRAC and With BRAC conditions. Please refer to the Appendix C of the **BRAC Transportation Study, Aberdeen Proving Ground, Harford County, Technical Memorandum No. 2A: Future Conditions (Year 2015 and 2030) Analyses Final Report** (April 2008) for more details on the link volume analysis.

The next step in the study was to analyze all of the corridors in the study area under the No Build scenarios (both 2030 With BRAC and 2030 No BRAC) to determine whether corridor-level improvements, in addition to intersection-level improvements, could be needed to accommodate BRAC growth. The following two factors were used to identify long-term corridor needs:

- Where extra through lanes were recommended at adjacent closely-spaced intersections and widening would provide a consistent cross section between the intersections
- Where corridors are expected to operate at LOS E or F with the existing number of lanes and widening would provide improved operation

When these factors were applied to all of the corridors in the study area under 2030 With BRAC conditions, nearly all of them were found to fall under one or both categories, as shown in the lists below:

Corridors where extra through lanes were recommended at adjacent closely-spaced intersections and widening would provide a consistent cross section between the intersections

- MD 152 from I-95 interchange to US 40
- MD 152 from Hanson Road to Trimble Road
- MD 24 from MD 7 to MD 755
- MD 755 from US 40 to MD 24
- US 40 from MD 755 to MD 24 interchange
- MD 543 from I-95 interchange to MD 7

Corridors expected to operate at LOS E or F under 2030 With BRAC conditions

- US 40 from MD 152 to MD 755
- Hanson Road from MD 152 to MD 24
- Trimble Road west of MD 152
- MD 24 north of I-95 interchange
- MD 24 from Trimble Road to the APG Gate
- MD 7 from MD 24 to US 40
- Old Philadelphia Road from MD 159 to east of MD 715
- MD 132 from I-95 interchange to the APG Gate
- MD 22 from north of I-95 to MD 132A
- MD 132A west of MD 132
- MD 132A east of MD 22
- MD 462 east of MD 22
- MD 763 southeast of MD 155
- MD 222 from north of I-95 to US 40
- US 40 from MD 155 to MD 222

In addition to the corridor-level needs identified above, MD 24 @ I-95 Northbound On/Off ramps would require improvements to operate at LOS E or better in 2030.

The ten corridors listed below fall under both categories; that is, they are projected to operate at LOS E or F under 2030 With BRAC conditions, and would benefit from widening that would provide a consistent cross section between adjacent closely-spaced intersection improvements. These corridors would likely be the highest priorities for further study.

Corridors where both factors apply for the 2030 With BRAC condition

- MD 152 through the I-95 interchange
- MD 152 from US 40 to Hanson Road
- MD 24 from MD 755 to Trimble Road
- MD 755 from MD 24 to Trimble Road

- MD 543 through I-95 interchange
- MD 543 from MD 7 to US 40
- MD 715 from US 40 to the APG Gate
- MD 22 from MD 132A to the APG Gate
- MD 155 from north of I-95 to US 40
- US 40 from MD 24 interchange to MD 155

However, the forecasts for these corridors include BRAC growth as well as other background growth. Therefore, to identify the corridors most affected by BRAC growth in 2030, the study team assembled a similar list of corridors that fall under both categories for the 2030 No-BRAC condition. This list of seven corridors is presented below:

Corridors where both factors apply for the 2030 No-BRAC condition

- MD 152 through the I-95 interchange
- MD 152 from US 40 to Hanson Road
- MD 24 from MD 755 to Trimble Road
- MD 755 from MD 24 to Hanson Road
- MD 543 through I-95 interchange
- MD 543 from MD 7 to US 40
- MD 155 from north of I-95 to US 40

The study team compared the two lists ("With BRAC" to "No-BRAC") to determine which corridors would benefit from widening as a result of BRAC growth. The results of this comparison show that the following three corridors are most affected by BRAC growth and are recommended for further study:

Corridors that would benefit from widening as a result of BRAC growth

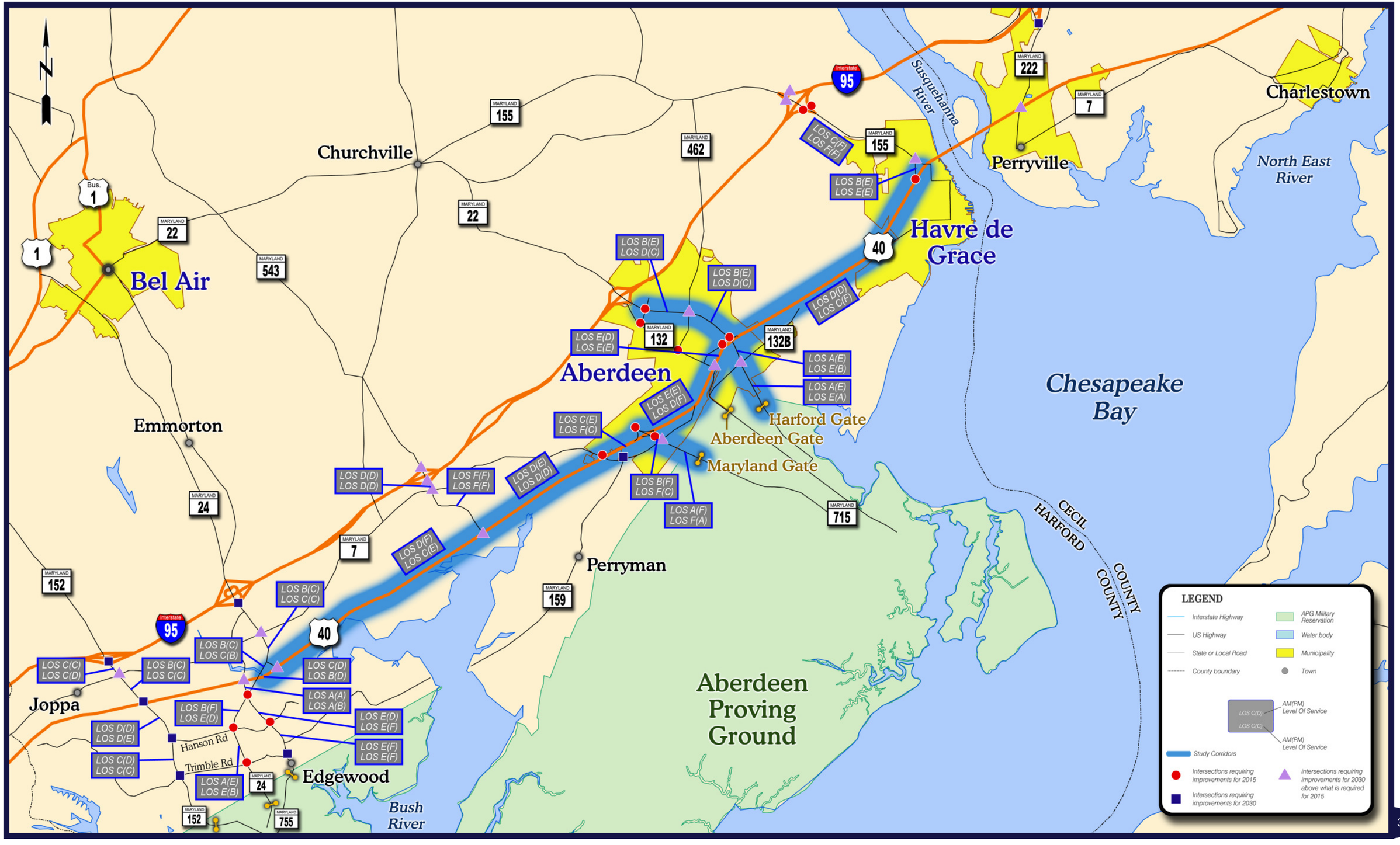
- MD 715 from US 40 to the APG Gate
- MD 22 from MD 132A to the APG Gate
- US 40 from MD 24 to MD 155

Table 5 shows the estimated costs for these proposed corridor improvements.

Figure 4 illustrates the peak hour link volumes on all of the study area corridors evaluated in this study and the additional intersections that would require improvements to operate at LOS E or better in 2030. It should be emphasized that several corridors and intersections could be in need of improvement to accommodate the 2030 traffic volumes that are projected for the study area. However, not all of the growth in the study area by 2030 can be attributed to BRAC growth alone. Therefore, the study team used the comparison of 2030 With BRAC and 2030 No-BRAC volumes to isolate the three corridors that will be in need of improvement because of the projected BRAC growth.

Table 5: Sketch Level Cost Estimates for Recommended Corridor Improvements

Segment	Length (miles)	Cost Estimate (2008 dollars)*
MD 715 from US 40 to the APG Gate	1.0	$20-$25 M
MD 22 from MD 132A to the APG Gate	3.0	$40-$45 M
US 40 from MD 24 to MD 155	7.8	$100-$120 M


N
Churchville
Bel Air
Emmorton
Joppa
Edgewood
Aberdeen
Havre de Grace
Perryville
Charlestown
Perryman
Aberdeen Proving Ground
Chesapeake Bay
North East River
Susquehanna River
Harford Gate
Aberdeen Gate
Maryland Gate
Hanson Rd
Trimble Rd
Bush River
CECIL COUNTY
HARFORD COUNTY
LOS C(F) LOS F(F)
LOS B(E) LOS E(E)
LOS B(E) LOS D(C)
LOS B(E) LOS D(C)
LOS D(D) LOS C(F)
LOS E(D) LOS E(E)
LOS A(E) LOS E(B)
LOS A(E) LOS E(A)
LOS E(E) LOS D(F)
LOS C(E) LOS F(C)
LOS B(F) LOS F(C)
LOS A(F) LOS F(A)
LOS D(D) LOS D(D)
LOS F(F) LOS F(F)
LOS D(E) LOS D(D)
LOS D(F) LOS C(E)
LOS B(C) LOS C(C)
LOS B(C) LOS C(B)
LOS C(C) LOS C(D)
LOS B(C) LOS C(C)
LOS C(D) LOS B(D)
LOS A(A) LOS A(B)
LOS B(F) LOS E(D)
LOS E(D) LOS E(F)
LOS D(D) LOS D(E)
LOS E(F) LOS E(F)
LOS C(D) LOS C(C)
LOS A(E) LOS E(B)
LEGEND
Interstate Highway
US Highway
State or Local Road
County boundary
APG Military Reservation
Water body
Municipality
Town
LOS C(D) LOS C(C)
AM(PM) Level Of Service
AM(PM) Level Of Service
Study Corridors
Intersections requiring improvements for 2015
Intersections requiring improvements for 2030
intersections requiring improvements for 2030 above what is required for 2015

MD 715 Extended Study

In addition to evaluating long-term needs of the existing corridors, the study team conducted a study of MD 715 Extended as part of the comprehensive traffic study (please refer to **BRAC Transportation Study Aberdeen Proving Ground, Harford County, Technical Memorandum No. 2A: Future Conditions (Year 2015 and 2030) Analyses Final Report** (April 2008) for additional data and information). In August 2006, the Harford County Executive's Base Realignment and Closure Planning Advisory Commission (BPAC) Transportation and Infrastructure Subcommittee recommended extending existing MD 715 to provide a more direct route to the MD 715 gate, which is the main access for BRAC-related activities, and possibly alleviate congestion on MD 22 or other parallel roadways. The subcommittee recommended extending MD 715 on a new alignment from US 40 to either an intersection with MD 22 east of the I-95/MD 22 interchange, a new interchange with I-95, or to an overpass of I-95 and then on to an intersection with MD 22 west of the I-95/MD 22 interchange.

To understand the benefits and impacts of a MD 715 Extension to the north, SHA evaluated the transportation effects and potential environmental impacts of a new roadway. Traffic studies have focused on the amount of future (2030) traffic (including BRAC/EUL and non-BRAC growth) that would be diverted onto the MD 715 Extension from existing roadways. For the traffic studies, three alignments were evaluated:

- Option 1: Extend MD 715 to the north and tie into existing Beards Hill Road at MD 132, just south of I-95 (no connection to I-95)
- Option 2: Extend MD 715 to the north and tie into existing Stepney Road south of I-95, cross I-95 (no new access), continue north on a new alignment and terminate at MD 22. Stepney Road would be improved under Option 2
- Option 3: Extend MD 715 to the north and provide a new interchange with I-95 in the vicinity of existing Stepney Road before continuing north to MD 22 along the same new alignment that is described in Option 2. Stepney Road would not be improved under Option 3

The environmental studies were focused on variations of the three options analyzed in the traffic studies. The locations of the three options are shown in **Figure 5**.

Traffic Analysis

The goal of the MD 715 Extended traffic study was to determine, at a sketch level, the extent to which traffic might divert to MD 715 Extended from parallel roadways, including MD 22 and MD 543. Therefore, these traffic studies were not performed to the level of detail that would normally be found in a Project Planning Study. For instance, access to MD 715 Extended was assumed to be provided only at the endpoints (US 40 on the south, MD 22 or Beards Hill Road on the north) and at the I-95 interchange (under Option 3).

For the purposes of this study, MD 715 Extended was assumed to be a 4-lane roadway. It was also assumed that all three APG gates serving the Northern

Table 6: 2030 Average Daily Traffic For No-Build Condition and Option 3

Roadway	2030 ADT Without MD 715 Extended	2030 ADT With MD 715 Extended (Option 3)
MD 715 Extended	N/A	11,300
MD 22	41,900	41,700
MD 543	39,000	31,900

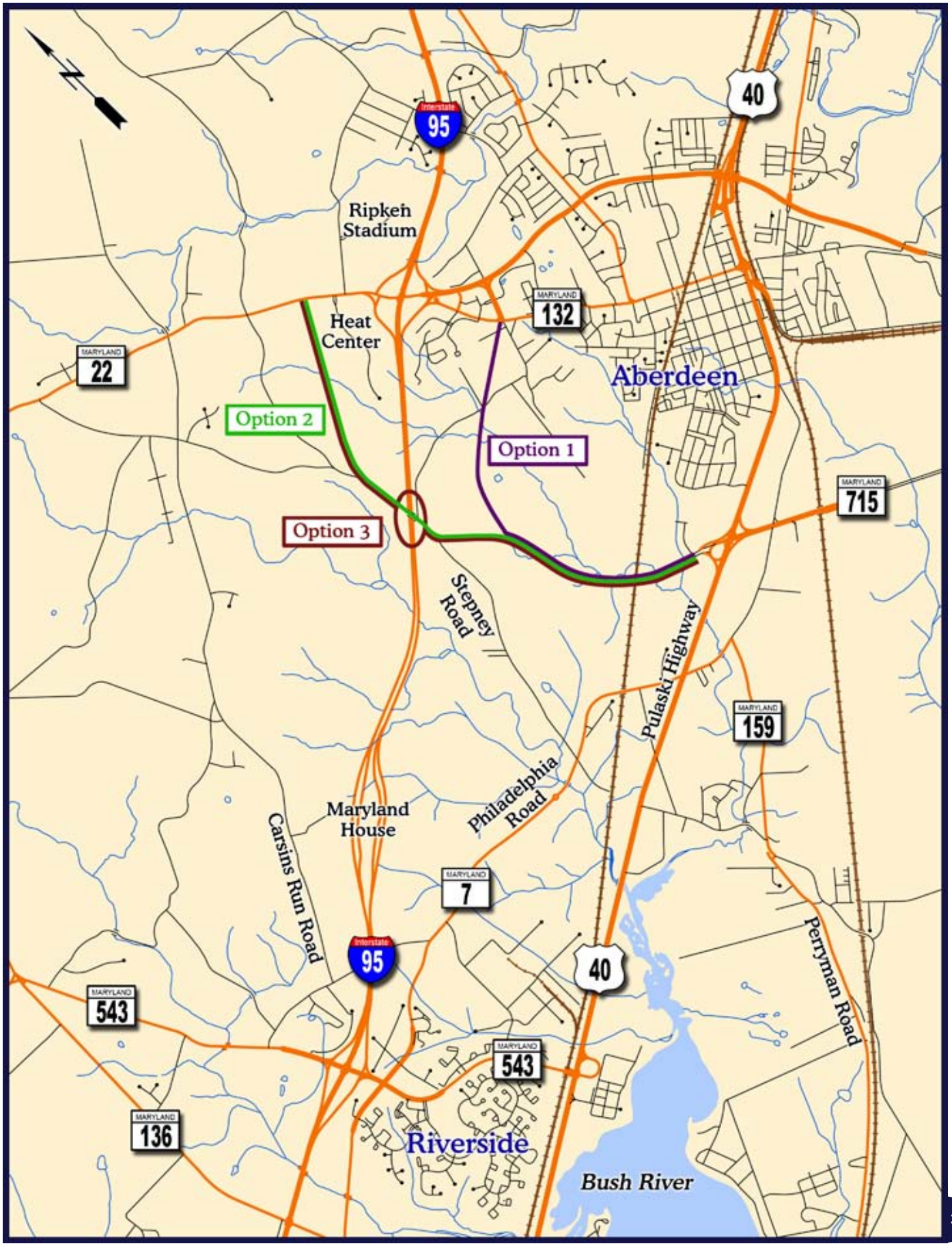
Cantonment (the Maryland Gate on MD 715, the Aberdeen Gate on MD 132, and the Harford Gate on MD 22) would be open.

Future traffic volumes were forecast using Round 7.0 socioeconomic data in conjunction with the Baltimore Metropolitan Council's (BMC) forecasting model. All three options were analyzed, and Option 3, with an interchange with I-95, was the option that had the greatest effect on the existing parallel routes in the traffic network and was thought to best illustrate the potential diversion of traffic. Specifically, Option 3 is expected to divert approximately 7,100 vehicles per day, or 18% of the traffic from the MD 543 corridor, and approximately 200 vehicles per day, or 0.5% of the traffic from the MD 22 corridor. Under this option, MD 715 Extended is projected to carry 11,300 vehicles per day. These traffic volumes indicate that MD 715 Extended would not result in the traffic relief or operational benefits that were expected. The 2030 ADT volumes forecasted for each of these roadways (south of I-95), for both the No-Build condition and Option 3, are summarized in **Table 6**:

Evaluation of the model runs for each of the MD 715 Extended options shows that much of the existing traffic destined to APG from the north is expected to enter APG via the MD 22 gate. Because MD 715 begins at US 40, much of the traffic coming from the south approaches APG via I-95, exits onto MD 543, then accesses MD 715 via US 40. If MD 715 was extended to interchange with I-95, some of this traffic would likely take advantage of a more direct route and exit onto MD 715 rather than MD 543. If traffic is diverted from MD 543 to an extended MD 715 roadway, fewer improvements would be required along MD 543 and US 40 between MD 543 and MD 715 to keep it operating at an acceptable level of service. Conversely, unless MD 22 is highly congested, traffic would not be likely to travel one exit further south along I-95 in order to gain access to APG from the north. Therefore, development of MD 715 Extended would not be expected to provide the level of relief to MD 22 originally anticipated.

Some examples of recommended improvements that may not be necessary if MD 715 Extended were to be constructed include:

- A proposed additional through lane at three intersections: MD 543 @ I-95 On/Off Ramps, MD 543 @ MD 7, and MD 159 @ MD 7 @ US 40
- A proposed additional left turn lane at five locations: MD 132 @ US 40, MD 543 @ I-95 On/Off Ramps, MD 543 @ US 40, and the northbound and southbound approaches of MD 22 / MD 462
- The conversion of an existing free right turn lane from the northbound I-95 Off Ramp onto MD 543 to a signalized triple right turn movement.


N
Interstate 95
40
Ripken Stadium
MARYLAND 132
Heat Center
MARYLAND 22
Aberdeen
Option 2
Option 1
MARYLAND 715
Option 3
Stepney Road
Pulaski Highway
MARYLAND 159
Maryland House
Philadelphia Road
Carsins Run Road
MARYLAND 7
Interstate 95
40
Perryman Road
MARYLAND 543
MARYLAND 543
MARYLAND 136
Riverside
Bush River

However, the addition of a new interchange with I-95 is not being considered at this time. The Maryland Transportation Authority (MdTA) is the owner of I-95 in this area. As part of its I-95 Section 200 studies, MdTA is currently developing mainline and interchange alternatives. All of the alternatives are being developed to accommodate the traffic demand in the design year of 2030 and include all anticipated traffic growth due to BRAC. Without adding any additional interchanges, all anticipated traffic can be accommodated on the proposed mainline I-95 and at the proposed MD 543 and MD 22 interchanges.

The design designation of I-95 throughout Harford County is "rural interstate." The AASTHO 2001 "A Policy on Geometric Design of Highways and Streets" (AASHTO) states that the preferable minimum interchange spacing in rural areas is 2 miles. The Institute of Transportation Engineers "Freeway and Interchange Geometric Design Handbook" (ITE) states that the preferable minimum interchange spacing in rural areas is 5 miles, but that the absolute minimum interchange spacing in rural areas is 2 miles. Furthermore, ITE states that the absolute minimum distance from gore (location where the ramp pavement joins the mainline pavement) to gore along rural interstates is 1.5 miles. The current distance from the Maryland House gore to the MD 22 gore is 2.35 miles.

A proposed interchange with MD 715 would be located between these two points and would encompass a distance along I-95 of approximately 2000 feet or 0.35 miles. Therefore if the proposed interchange were located halfway between the Maryland House and MD 22, then the gore spacing between the Maryland House and MD 715 and between MD 715 and MD 22 would be approximately 1 mile each. This is 0.5 miles less than the absolute minimum recommended by ITE and AASHTO.

A partial interchange between I-95 to the south and MD 715 would eliminate the insufficient gore spacing and weaving distance between MD 715 and MD 22 compared to the full interchange described above, but the other problems described above for the full interchange would still be present with this option. A partial interchange is not a recommended design for I-95 because it eliminates travel continuity for motorists. If a motorist exits to MD 715 from I-95 northbound, they would not be able to return to I-95 northbound from the interchange, but would have to find their way through the local street system to return to I-95 northbound. For these reasons, MdTA would prohibit adding a new full or partial interchange on I-95 between the Maryland House and MD 22.

Environmental Impacts Analysis

The purpose of the environmental impact analysis was to determine, at a sketch level, the potential impacts of a new roadway to the existing environmental features in the study area. Several natural environmental and community resources would likely be impacted by an extension of MD 715. To understand the magnitude of potential impacts, SHA analyzed the impacts to wetlands, forests, historic resources, and properties. These studies assumed that MD 715 Extended would be a four-lane roadway within 150 feet of right-of-way.

Alignment options were developed to meet basic engineering standards, to avoid the most environmentally sensitive areas, and to minimize

Table 7: Potential Impacts to Environmental Resources (Option 3)

Resource	Potential Impact, Alignment 3A	Potential Impact, Alignment 3B
Wetlands	6 acres	4.4 acres
100-year Floodplains	19 acres	3.9 acres
Streams	3,000 feet	1,900 feet
Forests	68 acres	56 acres
Historic Properties	1 property	1 property
Historic-Archaeological Sites	3.9 acres	3.9 acres
Prehistoric-Archaeological Sites	40 acres	26 acres
Residential Properties	5-10 displacements	5-10 displacements
Commercial/Industrial Properties	0 displacements	5 displacements
Hazardous Materials	None	None

the impacts to wetlands, floodplains, forested areas, historic resources, residences and businesses to the extent possible. Two alignments were developed under Option 3; one to avoid as many property impacts as possible (3A), and one to avoid as many environmental impacts as possible (3B). The potential environmental impacts associated with these alignments are summarized in **Table 7** above.

As the traffic studies show, construction of MD 715 Extended would not result in the traffic relief or operational benefits that were expected. Extending MD 715 would divert approximately 18% of the traffic from MD 543 and 0.5% of the traffic away from MD 22. This action could reduce the number of necessary improvements along MD 543 and US 40 between MD 543 and MD 715 to keep it operating at an acceptable level of service in the future, but is not likely to completely eliminate them. Of the three options evaluated, the one that includes an interchange with I-95 would divert the most traffic from existing roads. However, all anticipated traffic can be accommodated on the proposed mainline I-95 and at the proposed MD 543 and MD 22 interchanges, and the MdTA has no plans for a new interchange.

In addition, the potential environmental impacts of a new roadway would be significant. Depending on the alignment, MD 715 Extended would impact up to six acres of wetlands, 19 acres of floodplains, 68 acres of forests, 40 acres of prehistoric archaeological sites, five to 10 residences and five commercial properties. The costs to construct this new roadway would also likely be significant.

Therefore, based on the limited traffic benefits and significant impacts associated with the options evaluated in the MD 715 Extended study presented in this report, the SHA and MdTA do not plan to pursue a MD 715 Extended project at this time.

Long-Term Needs – Next Steps

The purpose of these studies of long-term needs is to provide information about the traffic conditions within the vicinity of Aberdeen Proving Ground in Harford County in a feasibility level of study detail. Any long-term studies or improvements would likely not be implemented until after the short-term improvements have been finalized. As SHA, APG, and the local jurisdictions move further along in the planning process, it is anticipated that additional detailed studies and public outreach may be pursued based on the information presented in this report.

Summary & Conclusions

The results of the study indicate that the existing roadway capacity will be insufficient to accommodate the influx of new traffic due to the BRAC/EUL action at APG. Under existing conditions, two intersections, MD 755 @ MD 24 and MD 155 @ US 40 @ MD 7A are failing during the PM peak hour. Travel forecasts show that a total of 31 of 47 intersections are projected to operate at LOS F for either the AM or PM peak hour (or both) in 2015.

To prepare for this anticipated increase in traffic volumes, the study team has identified improvements at these 31 locations, at a total combined cost of approximately $273 - $407 million. Because the level of available funding is not sufficient to program all of the needed improvements, SHA, in coordination with Harford County and the APG Garrison Commander, developed a list of priority intersections to be implemented, should funding become available.

In addition to developing short-term intersection improvements that have been programmed to address the most critical intersections near APG, SHA conducted studies of long-term needs to identify corridors that may require improvements to operate at acceptable levels of service in 2030. Several corridors that are projected to need improvements to accommodate 2030 traffic volumes were identified, and the study team is recommending that three corridors (MD 715 from US 40 to the APG Gate, MD 22 from MD 132A to the APG Gate, and US 40 from MD 24 to MD 155) be studied further to determine whether corridor-level, in addition to intersection-level improvements, are needed.

A proposed extension of MD 715 to the north was also examined as a possible alternate route for traffic in an attempt to alleviate congestion on MD 22 and other parallel roadways. Three alignment options were analyzed using 2030 traffic data. The alignment that was thought to best illustrate the potential diversion of traffic is expected to divert approximately 18% of the traffic from the MD 543 corridor, and approximately 0.5% of the traffic from the MD 22 corridor in 2030. Depending on the alignment, MD 715 Extended would impact up to six acres of wetlands, 19 acres of floodplains, 68 acres of forests, 40 acres of prehistoric archaeological sites, five to 10 residences and five commercial properties. Therefore, based on the limited traffic benefits and significant impacts associated with the options evaluated in the MD 715 Extended study presented in this report, the SHA and MdTA do not plan to pursue a MD 715 Extended project at this time.






BRAC

Base Realignment and Closure