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TPB Technical Committee
June 27, 2014

2014
CONGESTION MANAGEMENT PROCESS (CMP) TECHNICAL REPORT

FINAL DRAFT

June 20, 2014

National Capital Region Transportation Planning Board
Metropolitan Washington Council of Governments

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AGENCY:

The Metropolitan Washington Council of Governments (COG) is the regional organization of the Washington area's major local governments and their governing officials. COG works toward solutions to such regional problems as growth, transportation, the environment, economic development, and public safety. The National Capital Region Transportation Planning Board (TPB) conducts the continuing, comprehensive transportation planning process for the National Capital Region under the authority of the Federal-Aid Highway Act of 1962, as amended, in cooperation with the states and local governments.

ABSTRACT:

This report provides technical details and documents the Congestion Management Process in the National Capital Region. It contains updated congestion information and congestion management strategies on the region's transportation systems, as well as the process integrating the Congestion Management Process into the region's Financially Constrained Long-Range Transportation Plan.

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ABBREVIATAIONS AND ACRONYMS

AADT	Annual Average Daily Traffic
ACS	American Communities Survey
ART	Arlington Transit
ATIS	Advanced Traveler Information Systems
ATM	Active Traffic Management
ATRI	American Transportation Research Institute
AVL	Automatic Vehicle Location
BRAC	Base Closure and Realignment Commission
BWI	Baltimore/Washington International Thurgood Marshall Airport
CAFE	Corporate Average Fuel Economy
CATT	Center For Advanced Transportation Technology
CCTV	Closed-Circuit Television
CHART	Coordinated Highway Action Response Team
CLRP	Constrained Long-Range Plan
CLV	Critical Lane Volume
CMP	Congestion Management Process
CMS	Congestion Management System
CNG	Compressed Natural Gas
CO	Carbon Monoxide
COC	Commuter Operations Center
CUE	City-University-Energysaver
DASH	Driving Alexandrians Safely Home
DCA	Ronald Reagan Washington National Airport
DMS	Dynamic Message Signs
DOT	Department of Transportation
EPC	Emergency Planning Council
FAF	Freight Analysis Framework
FHWA	Federal Highway Administration
FSCPPE	Federal State Cooperative Program for Population Estimates
MPSTOC	McConnell Public Safety and Transportation Operations Center
MTA	Maryland Transit Administration
MWAA	Metropolitan Washington Airports Authority
MWCOG	Metropolitan Washington Council of Governments
MWRITSA	Metropolitan Washington Regional Intelligent Transportation Systems Architecture
NCHRP	National Cooperative Highway Research Program
NCR	National Capital Region
NEPA	National Environmental Policy Act
NGA	National Geospatial Agency
NHS	National Highway System
NOx	Nitrogen Oxides
NPMRDS	National Performance Management Research Data Set
NPRM	Notice of Proposed Rulemaking
NTOC	National Transportation Operations Coalition
NVRC	Northern Virginia Regional Commission
NVTC	Northern Virginia Transportation Commission
PBPP	Performance-Based Planning and Programming
PM	Particulate Matter
PRTC	Potomac and Rappahannock Transportation Commission
PSTOC	Public Safety Transportation Operations Center
PTI	Planning Time Index
RFC	Region Forward Coalition
RTPP	Regional Transportation Priorities Plan
SAFETEA-LU	Safe Accountable Flexible Efficient Transportation Equity Act - A Legacy for the Users
SIP	State Implementation Plans
SOC	State of the Commute Survey
SOV	Single Occupancy Vehicle
SRTS	Safe Routes to Schools
TARS	Travelers Advisory Radio System

GHG	Greenhouse Gas Emissions
GPS	Geographic Positioning System
GRH	Guaranteed Ride Home
HOT	High Occupancy/Toll
HOV	High Occupancy Vehicle
HPMS	Highway Performance Monitoring System
IAD	Washington Dulles International Airport
ICC	Inter-County Connector
ICM	Integrated Corridor Management
IMR	Incident Management and Response
IS	Interstate System
ITS	Intelligent Transportation Systems
IVR	Interactive Voice Response
LATR	Local Area Transportation Review
LAUS	Local Area Unemployment Statistics
LOS	Level of Service
MAP-21	Moving Ahead for Progress in the 21st Century Act
MARC	Maryland Area Rail Commuter
MAROps	Mid-Atlantic Rail Operations
MATOC	Metropolitan Area Transportation Operations Coordination
MATOps	Mid-Atlantic Truck Operations
MDSHA	Maryland State Highway Administration
MNCPPC	Maryland – National Capital Park and Planning Commission
MOITS	Management, Operations, and Intelligent Transportation Systems
MPO	Metropolitan Planning Organization
TAZ	Traffic Analysis Zone
TCSP	Transportation, Community and System Preservation
TDM	Transportation Demand Management
TE	Transportation Enhancements
TERM	Transportation Emission Reduction Measure
TIGER	Transportation Investment Generating Economic Recovery
TIP	Transportation Improvement Program
TLC	Transportation/Land Use Connections
TMA	Transportation Management Area
TMC	Traffic Management Center; Traffic Message Channel
TOC	Transportation Operations Center
TOD	Transit-Oriented Development
TPB	Transportation Planning Board
TTI	Travel Time Index
TTID	Transportation Technology Innovation and Demonstration
VDRPT	Virginia Department of Rail and Public Transportation
VHD	Vehicle Hours of Delay
VHT	Vehicle Hours of Travel
VMT	Vehicle Miles of Travel
VOC	Volatile Organic Compound
VPL	Variably Priced Lane
VPP	Vehicle Probe Project
VRE	Virginia Railway Express
WMATA	Washington Metropolitan Area Transit Authority

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EXECUTIVE SUMMARY

Background

A Congestion Management Process (CMP) is a requirement stipulated in the 2005 Safe Accountable Flexible Efficient Transportation Equity Act - A Legacy for the Users (SAFETEA-LU), its supporting metropolitan planning regulations, and the 2012 Moving Ahead for Progress in the 21st Century Act (MAP-21). These legislations and regulations were a basis for the CMP component that is wholly incorporated in the region's Constrained Long-Range Plan (CLRP) for transportation. The CMP component of the CLRP constitutes the region's official CMP, and serve to satisfy the federal requirement of having a regional CMP.

This CMP Technical Report serves as a background document to the official CLRP/CMP, providing detailed information on data, strategies, and regional programs involved in congestion management. This 2014 CMP Technical Report is an updated version of the previously published CMP Technical Reports (2012, 2010 and 2008, respectively).

Components of the CMP

The National Capital Region's Congestion Management Process has four components as described in the CLRP:

- Monitor and evaluate transportation system performance
- Define and analyze strategies
- Implement strategies and assess
- Compile project-specific congestion management information

This report documents and provides technical details of the four components of the CMP. It compiles information from a wide range of metropolitan transportation planning activities, as well as providing some additional CMP specific analyses, particularly travel time reliability and non-recurring congestion analyses.

Congestion on Highways

REGIONAL CONGESTION TRENDS, 2010-2013

Based on the results revealed by the I-95 Corridor Coalition Vehicle Probe Project (VPP)/INRIX traffic monitoring[1], the Washington region experienced decreasing congestion during peak periods from 2010 to 2013. The annual average decrease in congestion intensity was 2.6% in the four years from 2010 to 2013, as measured by Travel Time Index[2] from a traveler's perspective (Figure 1). The annual average reduction in spatial extent of congestion was 21% in the same

[1] I-95 Corridor Coalition Vehicle Probe Project, http://i95coalition.net/i95/VehicleProbe/tabid/219/Default.aspx
[2] Travel Time Index (TTI) is an indicator of the intensity of congestion, calculated as the ratio of actual experienced travel time to free flow travel time. A travel time index of 1.00 implies free flow travel without any delays, while a travel time index of 1.30 means one has to spend 30% more time to finish a trip compared to free flow travel.

time period, as measured by Percent of Congested Miles[3] from a system perspective (Figure 2). This trend should be closely monitored to determine whether this is a short-term trend or a long-term change in travel behavior and how this should affect long-range planning.

Figure 1: Annual Average Travel Time Index by Highway Category: Total AM and PM Peaks

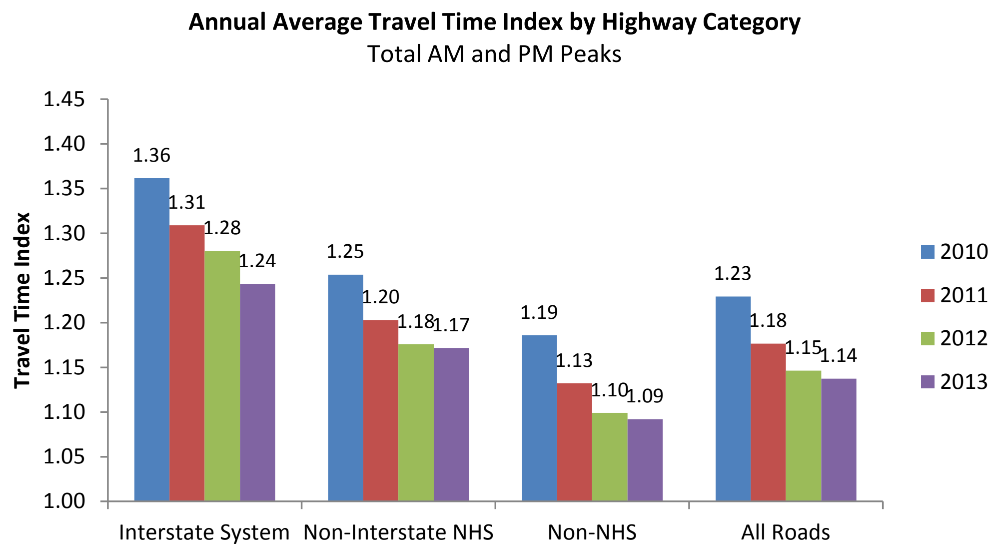
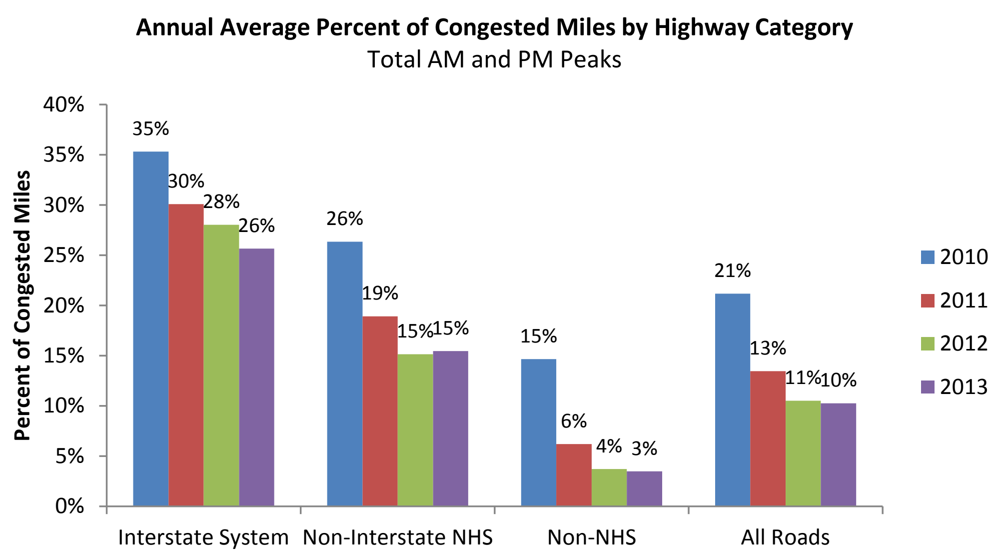


Figure 2: Annual Average Percent of Congested Miles by Highway Category: Total AM and PM Peaks



The pace of decrease had slowed down significantly in 2013. The decrease in Travel Time Index from previous year was 4.3%, 2.6% and 0.8% in 2011, 2012 and 2013, respectively. With regard to the Percent of Congested Miles, the decrease was even more dramatic. The decrease from previous year was 37%, 22% and 3% in 2011, 2012 and 2013.

[3] Percent of Congested (Directional) Miles is a system-wide measure that captures the spatial extent of congestion. Congestion is defined if actual travel time is 30% longer than the free-flow travel time[3], i.e., Travel Time Index > 1.3, based on recommendations made by the National Transportation Operations Coalition in 2005.

While the Interstate System experienced the largest drop (3.0% annually) in congestion intensity from 2010-2013, it had the smallest decrease (10% annually) in the spatial extent of congestion in all the four highway categories (Interstate System, Non-Interstate NHS, Non-NHS, and All Roads) in the same time period. Overall, congestion decreases on the Interstate System were considered “medium”.

The Non-Interstate NHS had the smallest decrease (2.2% annually) in congestion intensity and the second smallest decrease (16% annually) in the spatial extent of congestion from 2010-2013 in all four highway categories. Overall, congestion decreases on the Non-Interstate NHS were considered “small”.

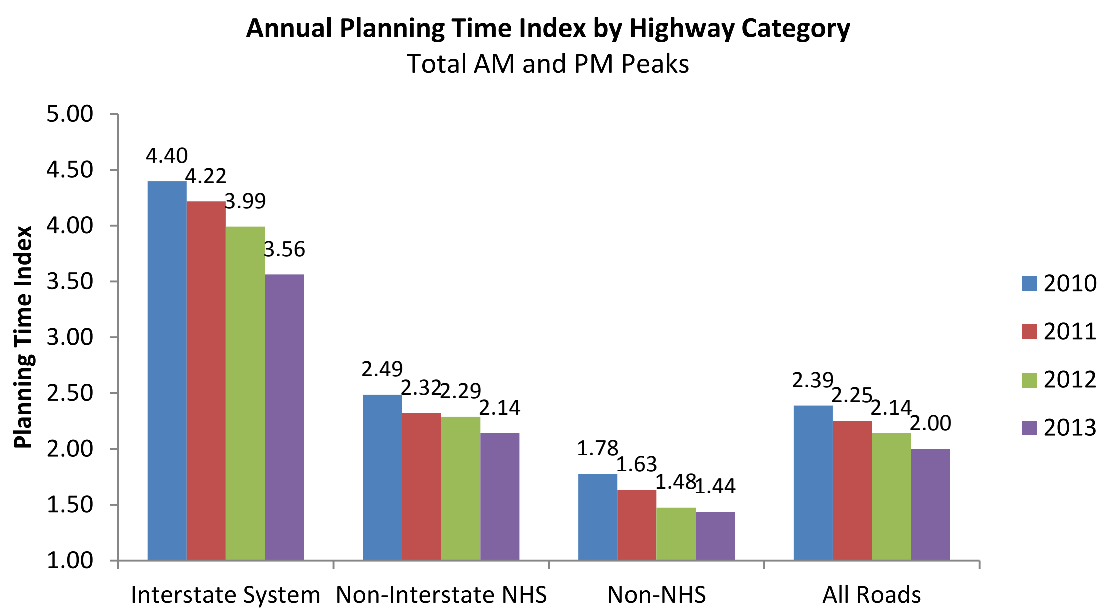
The Non-NHS had the largest decrease (38% annually) in the spatial extent of congestion and the second largest decrease (2.7% annually) in congestion intensity from 2010-2013 in all four highway categories. Overall, congestion decreases on the Non-NHS were considered “large”.

REGIONAL TRAVEL TIME RELIABILITY TRENDS, 2010-2013

Travelers in the Washington region typically will need to budget about two times of the free flow travel time during peak periods to ensure on-time arrivals. These numbers are based on all directions of travel, therefore for those who traveling in the peak direction would need to even budget more.

Similar to the trends observed in traffic congestion, travel time reliability has improved over time from 2010-2013 (Figure 3). The annual average improvement was 5.7%. Different from traffic congestion, reliability improvement kept a constant pace over the years without clear slowing down in 2013.

Figure 3: Annual Average Planning Time Index by Highway Category: Total AM and PM Peaks

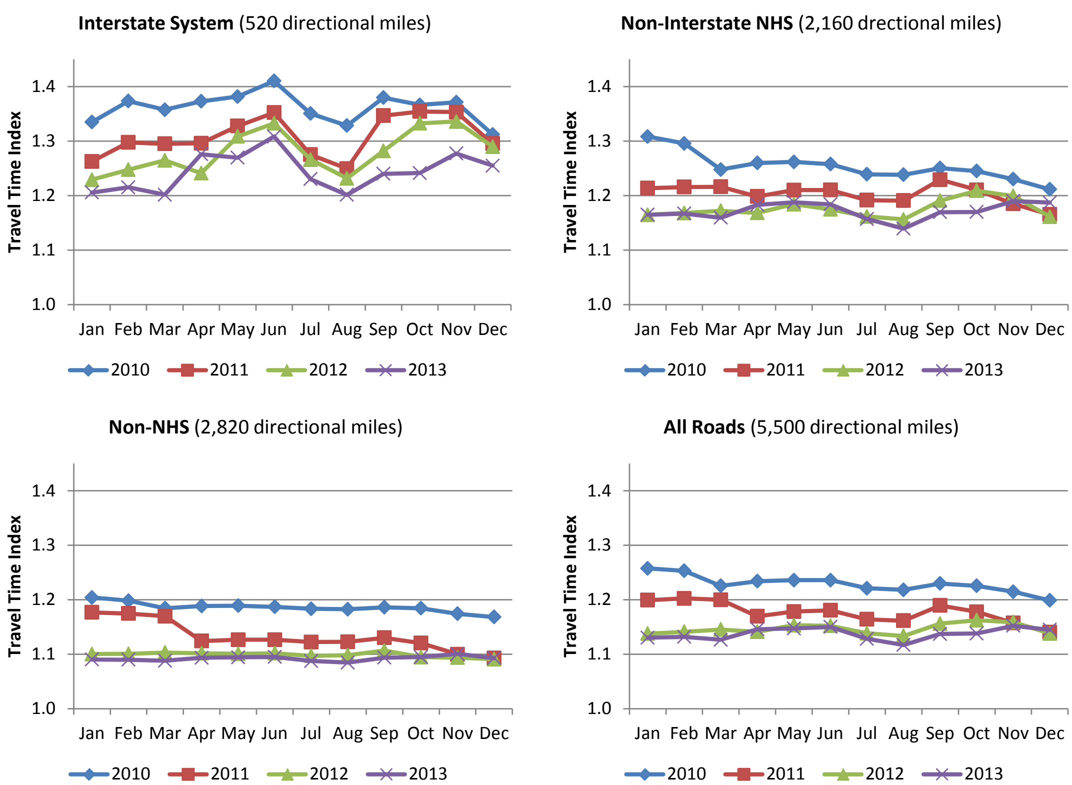


Congestion Monthly Variation

Congestion varies from month to month within a year (Figure 4). Monthly variations of congestion were most noticeable on the Interstate System, followed by the Non-Interstate NHS, and the Non-NHS had the least fluctuations (except in 2011, when a systematic decrease of congestion occurred from the beginning to the end of the year).

Congestion generally had two "lows" and two "highs" within a year on the Interstate System, with one "low-high" pair occurring in the first half of the year and the other in the second half of the year. January was the most frequent "low" month and June was the most likely "high" month on the Interstate System in the first half of the year during both AM and PM peaks. For the second half of the year, August is the "low" month while September, October and November could be the "high" month.

Figure 4: Monthly Variation of Congestion: Total AM and PM Peaks



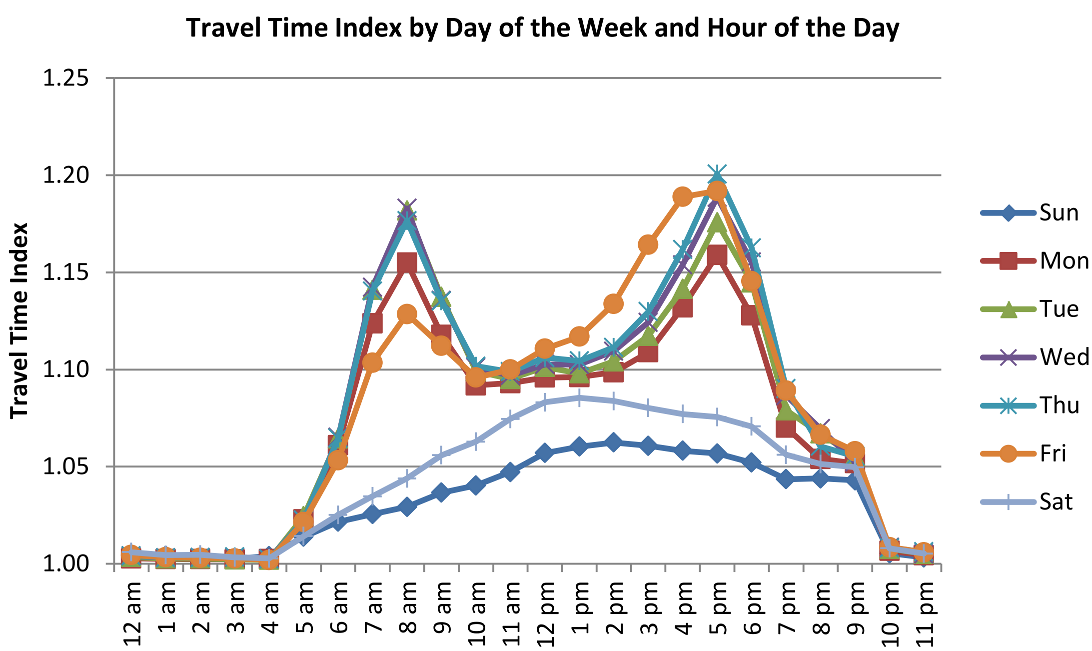
Congestion Day of Week Variation

Congestion also varies within a week (Figure 5). The middle weekdays – Tuesday, Wednesday and Thursday – were the most congested days of a week. During these three weekdays, the AM Peak had almost identical congestion while the most congested PM Peak occurred on Thursday, followed by Wednesday and Tuesday.

Monday and Friday had unique traffic patterns. Monday morning's traffic was lower than that of the middle weekdays but higher than Friday; Monday afternoon had the least congestion in all weekdays. Friday morning had the least congestion in all weekdays; Friday afternoon's congestion was almost as bad as the normal weekdays, but it came about one hour earlier without ending earlier – expanded congested time period.

Weekend days had the lowest traffic in a week and Sunday was even lower than Saturday. During these two days, mid-day traffic (12:00 – 3:00 pm) was the highest.

Figure 5: Day of Week Variation of Congestion in 2013



TOP BOTTLENECKS

This report adopts the VPP Suite[4] to identify the top 10 most significant bottlenecks in the TPB Planning Area and bottlenecks outside the Planning Area but having significant impact on the region in 2013. Based on vehicle speed, the VPP Suite identified 10 top bottlenecks in the TPB Planning Area and additional seven bottlenecks adjacent to the Planning Area with their queues extended into the TPB region, as listed in Table 1 and mapped in Figure 6. Table 2 is a new bottleneck ranking based on speed and annual average daily traffic (AADT), which takes into consideration the number of vehicles and travelers affected by the choke points.

Long queues along southbound I-95 in Virginia, northbound I-95 in Maryland and northbound MD-295 were partially due to bottlenecks outside of the TPB Planning Area. These bottlenecks were far more significant, as measured by the Impact Factor[5], than the TPB Planning Area's No. 1 bottleneck in 2013 – the American Legion Bridge Inner Loop on I-495. In particular, bottlenecks in Fredericksburg and Stafford County, Virginia generated queues as long as 30 miles, with tremendous impact on the southbound travel along I-95 in the region. Addressing these bottlenecks involves coordination with jurisdictions outside the TPB Planning Area.

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[4] The Vehicle Probe Project (VPP) Suite is a web-based tool kit developed by the CATT Lab of the University of Maryland to draw queries from the archived VPP/INRIX data. https://vpp.ritis.org/suite/

[5] The VPP Suite uses the Impact Factor, the product multiplication of Duration (minutes), Queue Length (miles) and the number of Occurrences, to rank bottlenecks.

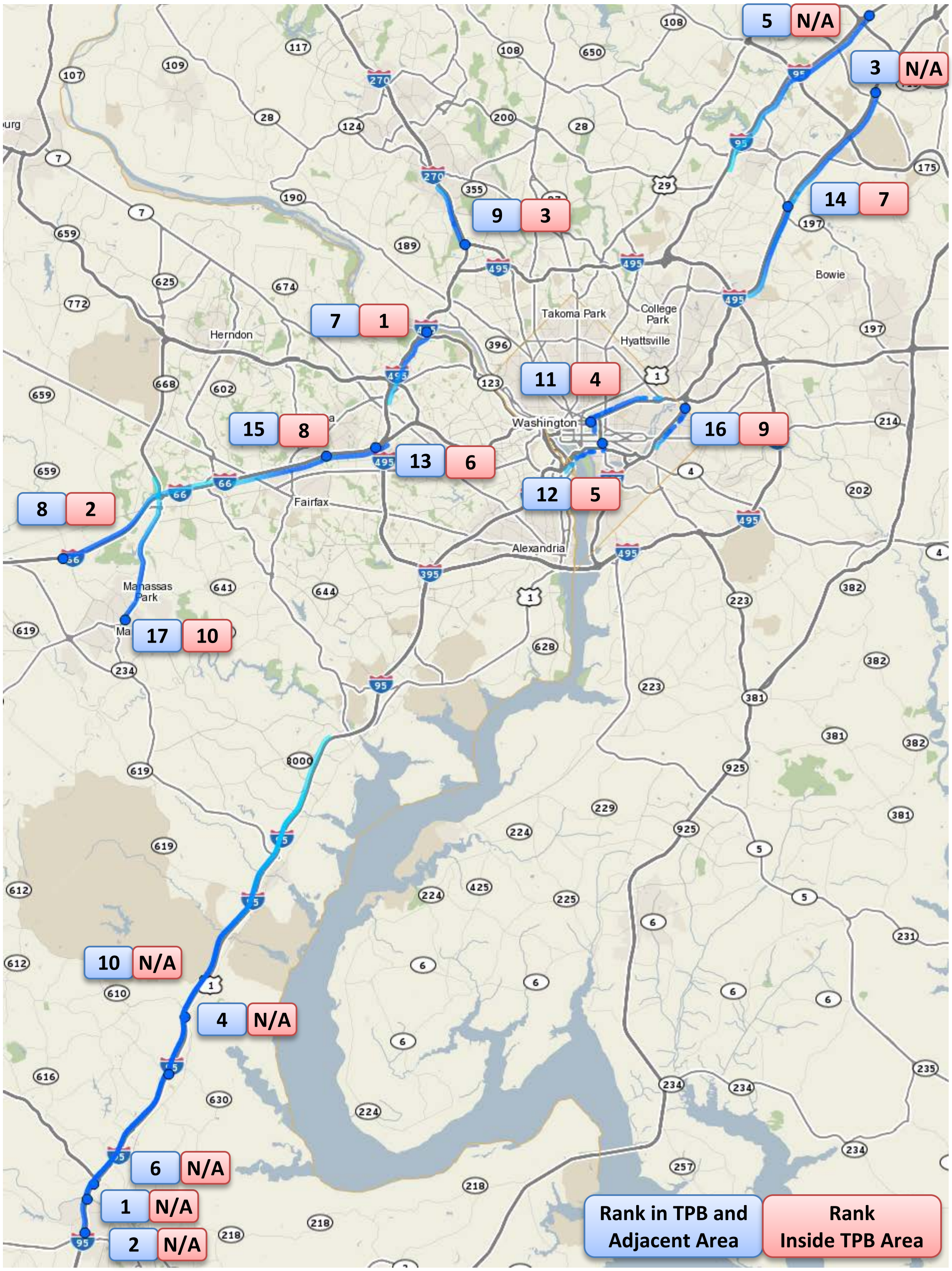
Table 1: 2013 Top Bottlenecks Based on Speed

Rank in TPB and Adjacent Area	Rank Inside TPB Area	Location	Average Duration	Queue Length (miles)	Occurrences	Impact Factor
1	N/A	I-95 S @ Fredericksburg/Stafford Co Line	5 h 6 m	32.0	311	3,055,956
2	N/A	I-95 S @ VA-3/Exit 130	5 h 45 m	32.3	115	1,283,658
3	N/A	MD-295 N @ MD-175	3 h 48 m	13.8	261	823,541
4	N/A	I-95 S @ VA-630/Exit 140	4 h 6 m	20.1	161	795,652
5	N/A	I-95 N @ MD-100/Exit 43	2 h 51 m	14.5	279	756,736
6	N/A	I-95 S @ US-17/Exit 133	5 h 8 m	30.2	60	657,455
7	**1**	**I-495 CW @ American Legion Bridge**	**2 h 47 m**	**4.7**	**800**	**640,474**
8	**2**	**I-66 W @ VA-234/Exit 47**	**2 h 21 m**	**10.9**	**339**	**604,192**
9	**3**	**I-270 Spur S @ I-270**	**1 h 42 m**	**6.4**	**884**	**591,198**
10	N/A	I-95 S @ US-1/VA-610/Exit 143	3 h 9 m	12.0	175	558,193
11	**4**	**US-50 W @ 10th St**	**4 h 19 m**	**13.1**	**145**	**546,624**
12	**5**	**I-395 N @ 2nd St**	**1 h 43 m**	**3.8**	**1388**	**534,048**
13	**6**	**I-66 E @ I-495/Exit 64**	**1 h 53 m**	**4.6**	**968**	**513,693**
14	**7**	**MD-295 N @ MD-197/Exit 11**	**2 h 47 m**	**6.7**	**444**	**505,186**
15	**8**	**I-66 E @ Vaden Dr/Exit 62**	**1 h 58 m**	**6.5**	**567**	**490,498**
16	**9**	**DC-295 N @ Eastern Ave**	**2 h 49 m**	**3.9**	**428**	**334,024**
17	**10**	**VA-28 S @ Prescott Ave/Sudley Rd**	**3 h 23 m**	**8.2**	**196**	**330,540**

Table 2: 2013 Top Bottlenecks Based on Speed and AADT

Rank in TPB and Adjacent Area	Rank Inside TPB Area	Location	Average Duration	Queue Length (miles)	Occurrences	Impact Factor	2011 AADT*
1	N/A	I-95 SB @ Fred./Sta. Co Line	5 h 6 m	32.0	311	3,055,956	70,500
2	**1**	**I-270 Spur SB @ I-270**	**1 h 42 m**	**6.4**	**884**	**591,198**	133,326
3	N/A	I-95 NB @ MD-100/Exit 43	2 h 51 m	14.5	279	756,736	97,667
4	N/A	I-95 SB @ VA-3/Exit 130	5 h 45 m	32.3	115	1,283,658	56,500
5	**2**	**I-495 CW @ American Legion Bridge**	**2 h 47 m**	**4.7**	**800**	**640,474**	107,242
6	N/A	I-95 SB @ VA-630/Exit 140	4 h 6 m	20.1	161	795,652	67,000
7	**3**	**I-66 EB @ Vaden Dr/Exit 62**	**1 h 58 m**	**6.5**	**567**	**490,498**	89,000
8	N/A	I-95 SB @ US-17/Exit 133	5 h 8 m	30.2	60	657,455	65,500
9	**4**	**I-66 EB @ I-495/Exit 64**	**1 h 53 m**	**4.6**	**968**	**513,693**	81,000
10	**5**	**I-395 NB @ 2nd St**	**1 h 43 m**	**3.8**	**1388**	**534,048**	75,716
11	N/A	MD-295 NB @ MD-175	3 h 48 m	13.8	261	823,541	48,225
12	N/A	I-95 SB @ US-1/VA-610/Exit 143	3 h 9 m	12.0	175	558,193	70,500
13	**6**	**I-66 WB @ VA-234/Exit 47**	**2 h 21 m**	**10.9**	**339**	**604,192**	63,500
14	**7**	**MD-295 NB @ MD-197/Exit 11**	**2 h 47 m**	**6.7**	**444**	**505,186**	53,535
15	**8**	**DC-295 NB @ Eastern Ave**	**2 h 49 m**	**3.9**	**428**	**334,024**	56,374
16	**9**	**US-50 WB @ 10th St**	**4 h 19 m**	**13.1**	**145**	**546,624**	12,146
17	**10**	**VA-28 SB @ Prescott Ave/Sudley Rd**	**3 h 23 m**	**8.2**	**196**	**330,540**	14,464

Figure 6: 2013 Top Bottlenecks Based on Speed



MAJOR FREEWAY COMMUTE ROUTES

In addition to the regional summaries as presented by the above performance measures, route- or corridor-specific analysis has also been carried out in this report. A total of 18 major freeway commute routes are defined between major interchanges and/or major points of interest for each peak period. Travel times along the 18 major commute routes in both directions were plotted by the "Performance Charts" tool of the VPP Suite for every Tuesday, Wednesday and Thursday in 2010-2013, as described in Chapter 2 and Appendix C.

CONGESTION ON ARTERIALS

The TPB's arterial monitoring program had been carried out by staff using global positioning system (GPS)-equipped floating vehicles. The last regional survey was conducted in FY[6] 2011, which was summarized in the 2012 CMP Technical Report. In view of emerging data sources such as the VPP/INRIX data, NPMRDS[7] and Bluetooth data, staff has started applying such data in arterial traffic monitoring.

Travel Time Index and Planning Time Index on Non-Interstate NHS are provided in great detail in Appendices A and B. In the near future, staff plans to use the VPP/INRIX data to carry out arterial corridor travel time studies on the routes monitored by the floating car surveys and other routes considered important.

TRAFFIC SIGNAL TIMING

Delays occurred at signalized intersections accounted for a significant portion of overall arterial and urban street delays. Improving traffic signal timing has been identified as a CLRP priority area.

The TPB has conducted three surveys of the status of signal optimization in 2005, 2009 and 2013. The 2013 survey found that between 2009 and 2012, the total 5,400 signalized intersections in the region, 80 percent were computer optimized (56%) or checked or adjusted (24%).

The TPB has conducted three surveys of the status of signal optimization in 2005[8], 2009[9], and 2013[10]. The 2013 survey found that of the total 5,500 signalized intersections in the region, 76 percent were retimed/optimized, 22 percent not retimed/optimized, and no report received for 2 percent. This was a similar but slightly reduced level of optimization compared to the last such survey in 2009, in which 80 percent signals were retimed/optimized.

Since late 2011, the Traffic Signal Subcommittee has conducted five regional surveys on traffic signals power back-up systems[11]. The last survey was conducted by June 30, 2013 and found

[6] A TPB Fiscal Year (FY) starts on July 1 and ends on June 30 of the next year, e.g., FY 2010 is from 7/1/2009 – 6/30/2010.
[7] National Performance Management Research Data Set (NPMRDS), a national data set procured by FHWA from HERE, LLC. http://www.ops.fhwa.dot.gov/freight/freight_analysis/perform_meas/vpds/npmrdsfaqs.htm
[8] COG/TPB, http://www.mwcog.org/uploads/committee-documents/tVtXWlY20051110144208.pdf
[9] COG/TPB, http://www.mwcog.org/uploads/committee-documents/bV5cXFhc20090312161527.pdf
[10] COG/TPB, http://www.mwcog.org/uploads/committee-documents/al1ZXFpb20140212133426.pdf
[11] COG/TPB, http://www.mwcog.org/uploads/committee-documents/ZF1ZXVhW20140204080431.pdf

that about 26% of the region's 5,500+ signals are already equipped with battery-based power back-up systems, and 61% are equipped with generator-ready back-up systems (most battery-based systems also have generator-ready features). These back-up systems are critical in the event of an emergency, particularly if the event involves a lack of power.

Congestion on Transit and Other Systems

TRANSIT

The National Capital Region possesses a multimodal and diverse transit system, including Metrorail, commuter rail and a variety of bus operations. Congestion on the transit system is always one of the concerns of the CMP.

Congestion on the region's roadway network often has an impact on transit systems, such as rail and bus. The identified congested locations, especially those on the Washington Metropolitan Area Transit Authority's (WMATA) Priority Corridor Network, are usually also bottlenecks for bus transit. Relieving roadway congestion will directly have a positive impact on bus operations, such as reducing travelers' delay, reducing bus operations cost, improving bus reliability and increasing ridership.

Congestion can also be an issue within transit. If the demand for buses, rail and train is high and the capacity cannot keep up with that demand, then transit becomes overcrowded. Metrorail crowdedness are often observed during rush hours along certain stations, such as the maximum load stations recorded in the WMATA's Vital Sign Reports[12], e.g., Orange Line Court House station and Red Line Gallery Place station. Congestion also exists within certain transit stations, especially multimodal transit centers, e.g. Union Station. Station congestion is a congestion of different nature, mostly due to limitations in design and circulation as well as ridership growth. The 2008 Metrorail Station Access & Capacity Study found that 19 Metrorail stations need to expand their capacity in order to satisfy the demand imposed by existing large ridership and/or future ridership increases.

CORDON COUNTS

The cordon count program originated from the desire to assess the impact of the construction of the region's Metrorail system stating in the late 1960's. Thus, a cordon line around the Central Business District (the "core") was determined by the inbound point at which there were more destinations (alighting from transit buses) than origins (loadings onto transit buses). The most recent cordon count study is the 2013 Central Employment Core Cordon Count of Vehicular and Passenger Volumes[13]. Data were only collected from 5:00 A.M. to 10:00 A.M. The study found:

- Total inbound travel decreased in the A.M. peak period from about 463,000 person trips in 2009 to 446,000 in 2013. Trips crossing the revised cordon in 2013 were about 435,000.

[12] WMATA, Scorecard, https://wmata.com/about_metro/scorecard/index.cfm
[13] *2013 Central Employment Core Cordon Count of Vehicular and Passenger Volumes*, Draft, December 30, 2013. http://www.mwcog.org/uploads/committee-documents/k11ZXV5e20140127094130.pdf

- Inbound peak period transit trips were about 211,000, little changed from 2009. Transit trips crossing the revised cordon line were about 197,000.

- Person trips by automobile in 2013 were about 236,000, a decrease of about 21,000 from 2009. Most of the decrease in person trips were in multiple occupant vehicles (2 or more persons per vehicles), which declined by about 21,000 trips.

- The number of automobiles entering the Central Employment Core in the A.M. peak period has declined from 203,000 in 2009 to about 192,500 in 2013. For the five-hour monitoring period, the decline was similar in absolute terms, from about 273,000 in 2009 to 263,000 in 2013.

- Traffic volumes crossing the revised cordon line were only slightly higher, but person trips were lower.

- About 3,500 bicycles entered the Central Employment Core in the A.M. peak period. In the full five hour monitoring period, almost 5,000 trips by bike were observed.

HOV FACILITIES

COG/TPB has conducted surveys on the high occupancy vehicle (HOV) freeway facilities in 1997, 1998, 1999, 2004, 2007 and 2010. The most recent survey found that: 1) during Spring 2010, all of the HOV lanes required fewer cars to carry more persons per lane during the HOV restricted periods than adjacent non-HOV lanes making the HOV lanes more efficient at moving people to their destinations; 2) most of the HOV lanes provide travel time savings when compared to non-HOV alternatives, especially the barrier separated HOV lanes in the I-95/I-395 corridor in Northern Virginia; and 3) average auto occupancy in 2010 was little-changed from 2004 and 2007, even though the HOV lanes in Northern Virginia continue to exempt vehicles with "Clean Special Fuel Vehicle" registration plates from the HOV requirement.

PARK-AND-RIDE FACILITIES

There are over 160,000 parking spaces at nearly 400 Park & Ride lots throughout the Washington/Baltimore Metropolitan areas where commuters can conveniently bike, walk or drive to and join up with carpools/vanpools or gain access to public transit. According to the region's Commuter Connections program: two thirds of Park & Ride Lots have bus or rail service available; parking is free at 89% of the Park & Ride Lots; and more than 25% of Park & Ride Lots have bicycle parking facilities.

The 2008 Metrorail Station Access & Capacity Study found Metro presently owns and operates 58,186 parking spaces. On an average weekday, almost all of those spaces are occupied, especially stations at East Falls Church, Van Dorn Street, Naylor Road and Branch Ave. Only a handful of stations—White Flint, Wheaton, College Park-U of MD, Prince George's Plaza, and Minnesota Ave—have a substantial amount of daily unused available capacity.

In 2009, WMATA and VDOT completed the Feasibility Study of Real Time Parking Information at Metrorail Parking Facilities (Virginia Stations)[14], evaluating the feasibility of a real-time parking application for the Metrorail system, with the purpose of improving operations efficiency, reducing operating costs by providing guidance to available parking spaces, encouraging more transit usage and reducing congestion

AIRPORT ACCESS

The transportation linkage between airports and local activities is a critical component of the transportation system. The Washington region has two major airports – Ronald Reagan Washington National Airport (DCA) in Arlington, VA, and Washington Dulles International Airport (IAD) in Loudoun County, VA. The region is also served by the nearby Baltimore/Washington International Thurgood Marshall Airport (BWI). According to the most recent TPB Air Passenger Survey[15], the majority (92%) of those traveling to the region's airports does so via the highway network (i.e. personal cars, rental cars, taxis, buses). Therefore, understanding ground airport access is important to congestion management.

The TPB regularly carries out Regional Airport Ground Access Travel Time Studies (1995, 2003 and 2011) and provides relevant information to congestion management. Comparing the 2011ground access travel time data to that of 2003, it was found travel time overall was increasing.

FREIGHT

The National Capital Region has a responsive freight system to support the vitality of economy and quality of life. This region features a consumer and service-based economy and approximately three quarters of freight traveling to, from, or within the region is transported by truck[16]. The interaction between freight movement and passenger travel is high. The following five worst truck bottlenecks[17] are also among the most congested locations for all traffic.

- I- 95 at VA-7100, Virginia
- I- 95 at VA-234, Virginia
- I-95 at I- 495, Maryland
- I- 495 at American Legion Bridge, Virginia
- I-495 at I-66, Virginia

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[14] Wilbur Smith Associates and Michael Baker Jr., Inc., Feasibility Study of Real Time Parking Information at Metrorail Parking Facilities (Virginia Stations), June 2009. http://www.wmata.com/pdfs/planning/Real_Time_Parking_Study.pdf

[15] *2013 Washington-Baltimore Regional Air Passenger Survey Data Editing Process*, 2014-01-23 Aviation Technical Subcommittee: http://www.mwcog.org/uploads/committee-documents/b11ZXVpf20140131093313.pdf

[16] . *Enhancing Consideration of Freight in Regional Transportation Planning*, Cambridge Systematics, Inc., 2007. http://www.mwcog.org/uploads/committee-documents/bF5fW1pX20080222142629.pdf

[17] I-95 Corridor Coalition, *Mid-Atlantic Truck Operations study – Final Report*. Cambridge Systematics, Inc. October 2009. http://www.i95coalition.net/i95/Portals/0/Public_Files/pm/reports/DFR1_MATOps_Truck%20Operations%20V3.pdf

Future Congestion

The 2013 CLRP Performance Analysis[18] forecasts the outlook for growth in the region. One of the cornerstones of plan performance is the forecasting of future congestion. The plan performance looks at where in the region congestion will occur in the future and compares current congestion to future congestion. It looks at criteria that may affect congestion, such as changes in population, employment, transit work trips, vehicle work trips, lane miles, and lane miles of congestion. The analysis also breaks down lane miles of congestion into core, inner suburbs, and outer suburbs, providing information on where, generally, the most lane miles of congestion can be found in 2040 compared to 2014.

From 2014 to 2040, the region-wide total number of trips taken is expected to increase by 24%. The overall amount of driving in the region (VMT) is expected to grow by 23%, slightly less than population, which means VMT per capita is forecast to drop by 1%. The increase in demand on the roadways (+24% more trips) is forecast to outpace the increase in supply (+7% lane miles), leading to a significant increase in congestion (+71% lane miles of congestion).

Severe stop-and-go congestion during the AM peak is expected to be prevalent throughout the entire region in 2040. Outer suburban jurisdictions are forecast to experience the greatest increase in congestion, while the already congested inner suburbs will experience the worst overall congestion.

Outer suburban jurisdictions in the region will experience the greatest increase in congestion, while the already congested inner suburban jurisdictions will experience the worst overall congestion. Making matters worse, congestion will increasingly not be limited to rush-hour periods, but will also affect off-peak weekday periods and weekends.

Due to a lack of funding for capacity enhancement projects to accommodate all of the projected transit ridership growth in the region, the Metrorail system will likely reach capacity on trips to and through the regional core. According to a WMATA study, without additional railcars beyond those currently funded, all lines entering the core will become congested by 2040, and the Orange/Dulles, Yellow and Green lines are forecast to be highly congested.

Another way to measure the performance of the plan is by residents' accessibility to jobs by transit and auto. The average number of jobs accessible within a 45 minute automobile commute is expected to go down slightly from 919,000 in 2014 to 893,000 in 2040. Average accessibility by transit is forecast to increase from 412,000 in 2014 to 516,000 in 2040, but will remain significantly lower than by automobile.

National Comparison of the Washington Region's Congestion

The Washington region is among the several most congested metropolitan areas in the nation. Based on the ratio of actual travel time over free flow travel time (or Travel Time Index), the region ranked 4th in Texas Transportation Institute's 2012 Urban Mobility Report (for 2011 data), and 10th in INRIX's National Traffic Scorecard (for 2013 data). Different methodologies

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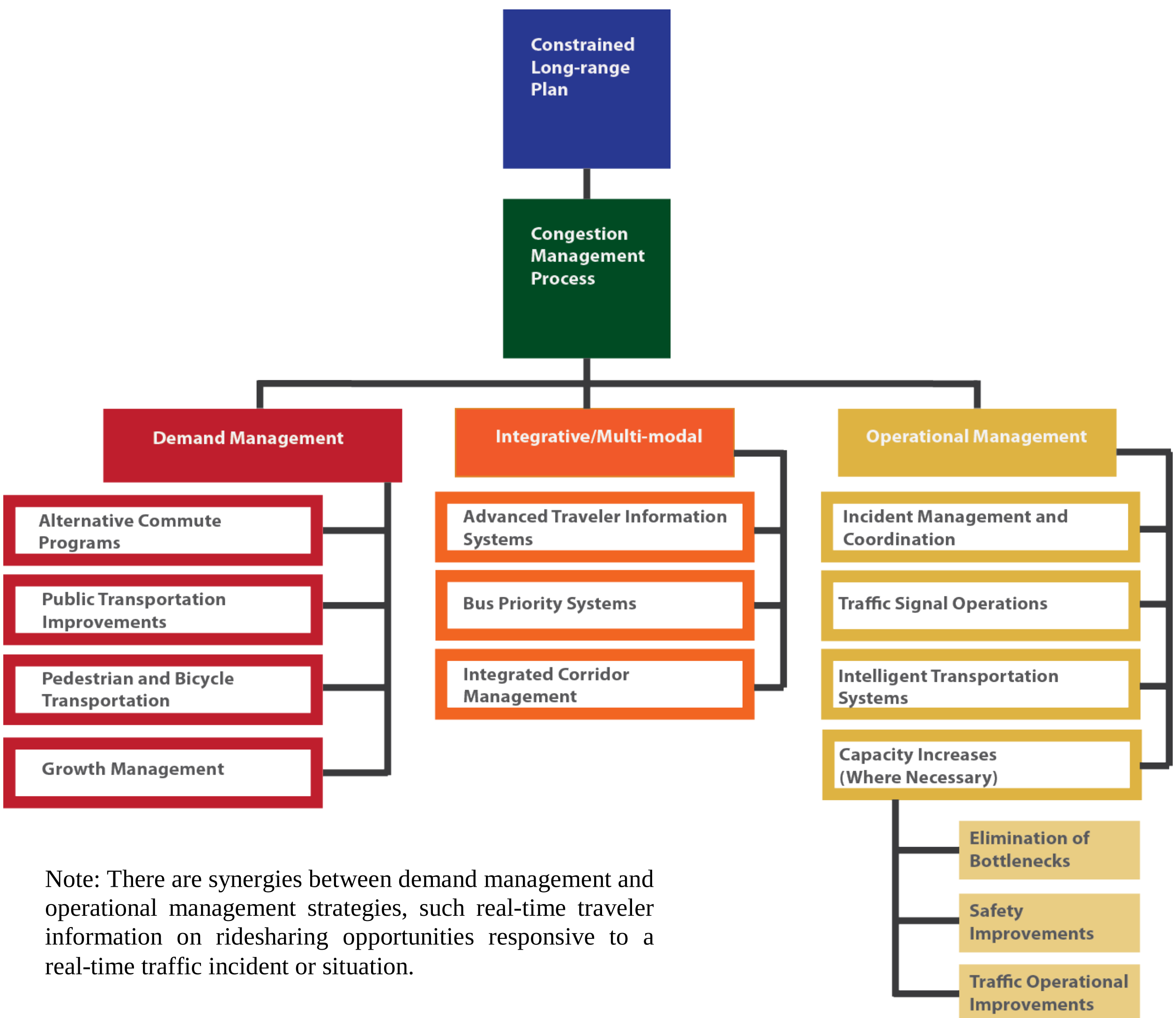
[18] 2013 Performance Analysis of the CLRP, Presentation to the TPB, 2013-12-18: http://www.mwcog.org/uploads/committee-documents/YV1aVlhZ20131218092900.pdf

are the most likely reason for this discrepancy in ranking, such as the different spatial and temporal coverage of the data, and the different weight used to calculate the regional value. Based on annual hours of delay per traveler, this region ranked 1st in 2011 (67 hours) in the Urban Mobility Report.

Congestion Management Strategies

The CMP has been playing an important role in developing strategies, including strategies in association with capacity-expanding projects, to combat congestion or mitigate the impact of congestion. The CLRP and TPB member agencies have pursued many alternatives to capacity increases, with considerations of these strategies informed by the CMP. Implemented or continuing strategies include demand management strategies and operational management strategies, as shown in Figure 7. It should be noted that although strategies are divided into two categories for reporting purposes in this document, demand management and operational management strategies should be designed and implemented to work in cooperation.

Figure 7: Major CMP Strategies



Note: There are synergies between demand management and operational management strategies, such real-time traveler information on ridesharing opportunities responsive to a real-time traffic incident or situation.

DEMAND MANAGEMENT STRATEGIES

Demand Management aims at influencing travelers' behavior for the purpose of redistributing or reducing travel demand. Examples of TPB's demand management strategies include:

- Commuter Connections Program – Including strategies such as Telework, Employer Outreach, Guaranteed Ride Home, Liver Near Your Work, Carpooling, Vanpooling, Ridematching Services, Car Free Day, and Bike To Work Day.
- Promotion of local travel demand management – Local demand management strategies are documented in the main body of the CMP Technical Report.
- Public transportation improvements – The Washington region continues to support a robust transit system as a major alternative to driving alone.
- Pedestrian and bicycle transportation enhancements as promoted and tracked through the Bicycle and Pedestrian Planning program – The number of bicycle and pedestrian facilities in the region has increased in recent years; the regional bikesharing program, Capital Bikeshare can be found in Washington, D.C., Arlington County, the City of Alexandria, and Montgomery County, MD. There are plans and/or studies to expand the network to locations in Prince George's County and Fairfax County
- Car sharing - Local governments work with private companies (e.g., Zipcar, Car2Go, and Enterprise) to make the region's car sharing market viable.
- Land use strategies – Including those promoted by the Transportation-Land Use Connections (TLC) Program.

OPERATIONAL MANAGEMENT STRATEGIES

Operational management focuses on improvements made to the existing transportation system to keep it functioning effectively. Examples of TPB's operational management strategies include:

- High Occupancy Vehicle (HOV) facilities – Existing HOV facilities include I-66, I-95/I-395, I-270, US-50 and the Dulles Toll Road.
- Variably-Priced Lane Facilities – The 18-mile Inter-county Connector (ICC) in Maryland opened from I-270 to I-95 in November 2011; the 495 Express Lanes in Northern Virginia opened in November 2012; and the 95 Express Lane project in Northern Virginia is under construction with an expected a completion date of 2015.
- Incident Management – The region’s state DOTs all pursue strategies for managing their transportation systems, including operation of 24/7 traffic management centers, roadway monitoring, service patrols, and communications interconnections among personnel and systems.
- Regional Transportation Operations Coordination – Notably the Metropolitan Transportation Operations Coordination (MATOC) program, whose development the TPB helped shepherd, uses real-time transportation systems monitoring and information sharing to help mitigate the impacts of non-recurring congestion.
- Intelligent Transportation Systems are considered, particularly through the Management, Operations, and Intelligent Transportation Systems (MOITS) program and committees. Examples include traffic signal optimization, safety service patrols, and traveler information.

INTEGRATED/MULTI-MODAL STRATEGIES

While there is often overlap in demand management and operational management strategies, for example, real-time traveler information on ridesharing opportunities responsive to a real-time traffic incident or situation., there are projects in the region that fully integrate demand and operational management strategies.

- Integrated Corridor Management - VDOT's current ICM project development focuses on I-95 and US-1 corridor from the DC line to Fredericksburg. VDOT launched the first ICM initiative on the corridor in February 2014.
- Advanced Traveler Information Systems – Travelers have more ways than ever for obtaining trip planning information such as traffic, incidents, real-time transit arrivals, and emergency information. The prevalence of internet capable mobile devices and social media provide new means of communication with travelers.
- Bus Priority Systems - There have been three pilot deployments in the region: U.S. 1 (Fairfax County), Columbia Pike (Arlington County), and Georgia Avenue (DC). These are pilot projects intended to provide lessons learned for wider deployments.

ADDITIONAL SYSTEM CAPACITY

Federal law and regulations list capacity increases as another possible component of operational management strategies, for consideration in cases of elimination of bottlenecks, safety improvements and/or traffic operational improvements. These capacity increase projects are documented in CLRP or TIP.

There have been relatively few capacity increase projects in recent years, however. This region has an emphasis on demand and operational management strategies, such us transit improvements, the Commuter Connections program and the Management, Operations and Intelligent Transportation Systems (MOITS) program.

Assessment of Congestion Management Strategies

ASSESSMENT OF IMPLEMENTED STRATEGIES

The TPB assesses the implemented congestion management strategies in a variety of ways. Many strategies have specific assessments and the overall effectiveness of all strategies is repeatedly evaluated by congestion monitoring and analysis.

Specific assessments (of individual or several strategies):

- A variety of surveys within the Commuter Connections Program are regularly conducted to provide firsthand data inputs for the assessments, including the Guaranteed Ride Home Customer Satisfaction Survey, Commuter Connections Applicant Placement Rate Survey, State of the Commute Survey, Employee Commute Surveys, Carshare Survey, Vanpool Driver Survey, Employer Telework Assistance Follow-up Survey, and the Bike-to-Work Day Participant Survey.
- In conjunction with the regional air quality process, vehicle trips reduced, vehicle miles of travel (VMT) reduced and environmental benefits are assessed in the Transportation Emission Reduction Measure (TERM) Evaluations.

- Public transportation improvements, pedestrian and bicycle transportation improvements, and land use strategies are assessed in Regional Household Travel Surveys, Regional Bus Surveys, Regional Activity Centers and Regional Activity Clusters Studies, the Regional Travel Trends Report, and Cordon Counts.
- The region's HOV facilities are monitored by the TPB's HOV monitoring and surveys.
- Status of traffic signal timing is assessed by Management, Operations and Intelligent Transportation Systems (MOITS) program's traffic signal timing surveys. Traffic signal power backup system was surveyed by the Traffic Signal Subcommittee of the MOITS program.
- The Metropolitan Area Transportation Operations Coordination (MATOC) program is assessed by a benefit-cost study.

Overall assessments (of all implemented strategies):

- The TPB's aerial photography survey of the region's freeway system congestion conditions (every three years for AM and PM peak periods and every five years for weekend and off-peak period).
- The TPB's arterial floating car travel time and speed study (every year a sample of major arterials in DC, MD and VA is studied and the same sample was repeated every three years). This study was terminated in FY 2012 and an enhanced arterial monitoring program is under development. COG/TPB has procured a comprehensive historical dataset for calendar year 2010 from INRIX, Inc. to benchmark regional arterial performance.
- In addition to the TPB's monitoring activities, the TPB also utilize other regional and national monitoring activities to complement and enhance the congestion monitoring and analysis in the National Capital Region. These utilized "outside" monitoring activities include:
    a) I-95 Corridor Coalition/INRIX, Inc. probe-vehicle-based traffic monitoring data.
    b) The FHWA Transportation Technology Innovation and Demonstration (TTID) Program/ Traffic.com traffic monitoring.
    c) Maryland, Virginia and the District of Columbia's Highway Performance Monitoring Systems (HPMS).

ASSESSMENT OF POTENTIAL STRATEGIES THROUGH SCENARIO PLANNING

The TPB has a long history of strategy analysis for air quality purposes which focuses on emissions reductions from individual strategies. The two most recent scenario studies, the CLRP Aspirations Scenario and the "What Would it Take?" Scenario looked at groupings of strategies and how they could interact with each other.

The CLRP Aspirations Scenario is an integrated future land use and transportation scenario for building on the key results of previous TPB scenario studies. It includes concentrated land use growth in Regional Activity Centers, a regional network of variably priced lanes, and a high quality bus rapid transit network operating on the VPL network for the current planning horizon year 2040. The most recent version of the CLRP Aspirations Scenario was presented to the TPB in October 2013.

In May 2010, the TPB completed a scenario study examining the role of regional transportation in climate change mitigation in the Washington region, called the "What Would it Take?" scenario. The scenario is a goal-oriented study that specifically asks and tries to answer the question of what it would take in the Washington region to meet aggressive greenhouse gas emissions reduction goals in transportation. The study includes the analysis of over 50 strategies from national level CAFE standards and alternative fuel mandates to regional and local level bicycle plans and congestion reduction strategies to determine their potential to reduce emissions and contribute to the environmental resilience of this region.

In an effort to assist municipalities in implementing strategies suggested by the Scenario Study, the TPB created the Transportation/Land Use Connections (TLC) Program. The TLC Program addresses the "how to" challenges related to improving transportation/land-use coordination and realizing an alternative future for the region, through providing both direct technical assistance and information about best practices and model projects. Through the program, the TPB provides communities with up to $60,000 worth of technical assistance to catalyze or enhance planning efforts. Any local jurisdiction that is a member of the TPB is eligible to apply. The second part of the TLC program is the Clearinghouse, a web-based source of information about transportation/land use coordination, including regional and national experience with transit-oriented development and other key strategies.
Some potential operational congestion management strategies are assessed in the Strategic Plan for the Management, Operations and Intelligent Transportation Systems (MOITS) Planning Program[19].

TPB also assesses special potential strategies on an as-needed basis, such as congestion pricing.

Compiling Project-Specific Congestion Management Information

Pursuant to Federal regulations, the TPB encourages consideration and inclusion of congestion management strategies in all Single Occupancy Vehicle (SOV) capacity-increasing projects. This involves compiling and analyzing information in the Call for Projects documentation forms, which are submitted from regional agencies when the CLRP is developed.

The Call for Projects documentation requests any project-specific information available on congestion that necessitates or impacts the proposed project. Agencies compile this information from various sources, including TPB-published congestion information (if available), internal or other directly measured information, or by conducting engineering estimates of the Level of Service (LOS). TPB compiles and analyzes this submitted information, along with information from other CMP sources.

Specifically for SOV capacity-increasing projects, the TPB requests documentation that the implementing agency considered all appropriate systems and demand management alternatives to the SOV capacity. In the Call for Projects documentation a special set of SOV questions is completed by implementing agencies and the TPB compiles this information.

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[19] *Strategic Plan for the Management, Operations and Intelligent Transportation Systems (MOITS) Planning Program*, June 16, 2010. http://www.mwcog.org/transportation/activities/operations/moits-strategic.asp

Congestion Management as a Process in the CLRP

COMPONENTS OF THE CMP FULLY INTEGRATED IN THE CLRP

The four major components of the CMP as described earlier are fully integrated in the CLRP. More specifically:

In monitoring and evaluating transportation system performance, the TPB uses Skycomp aerial photography freeway monitoring and a number of other travel monitoring activities to support both the CMP and travel demand forecast model calibration, complementing operating agencies' own information, and illustrating locations of existing congestion. CLRP travel demand modeling forecasts, in turn, provide information on future congestion locations. This provides an overall picture of current and future congestion in the region, and helps set the stage for agencies to consider and implement CMP strategies, including those integrated into capacity-increasing roadway projects.

The CMP component of the CLRP defines and analyzes a wide range of potential demand management and operations management strategies for consideration. TPB, through its Technical Committee, Travel Management Subcommittee, Travel Forecasting Subcommittee, and other committees, reviews and considers both the locations of congestion and the potential strategies when developing the CLRP.

For planned (CLRP) or programmed (TIP) projects, cross-referencing the locations of planned or programmed improvements with the locations of congestion helps guide decision makers to prioritize areas for current and future projects and associated CMP strategies. Maps in the 2009 CLRP showed a high correlation between the locations of planned or programmed projects and locations where congestion is being experienced or is expected to occur.

Thus CLRP and TIP project selection is informed by the CMP, and implementation of CMP strategies is encouraged. The region relies particularly on non-capital congestion strategies in the Commuter Connections program of demand management activities, and the Management, Operations, and Intelligent Transportation Systems (MOITS) program of operations management strategies. Assessments of these programs are analyzed, along with regular updates of travel monitoring to look at trends and impacts, to feed back to future CLRP cycles.

The TPB also compiles information pertinent to specific projects in its CMP documentation process (form) within the annual CLRP Call for Projects. This further assures and documents that the planning of federally-funded SOV projects has included considerations of CMP strategy alternatives and integrated components.

REGIONAL TRANSPORTATION PRIORITIES PLAN FACILITATES CMP-CLRP INTEGRATION

The Regional Transportation Priorities Plan (RTPP) , which is a milestone of TPB's Performance-Based Planning approach, facilitates the integration of the CMP and the CLRP. The RTPP was approved by the TPB in January 2014.

Building on the TPB Vision and previous regional transportation planning activities, the RTPP identifies those transportation strategies that offer the greatest potential contributions to addressing continuing regional challenges, and to provide support for efforts to incorporate those strategies into future updates of the CLRP in the form of specific programs and projects. The plan articulates regional priorities for enhancing the performance of the CLRP by advancing six regional goals:

1) Provide a Comprehensive Range of Transportation Options
2) Promote a Strong Regional Economy, Including a Healthy Regional Core and Dynamic Activity Centers
3) Ensure Adequate System Maintenance, Preservation, and Safety
4) Maximize Operational Effectiveness and Safety of the Transportation System
5) Enhance Environmental Quality, and Protect Natural and Cultural Resources
6) Support Inter-Regional and International Travel and Commerce

The RTPP is a policy document to help guide implementing agencies (local, state and regional) in the project development process to consider regional needs when identifying transportation improvements for inclusion in the CLRP. The CMP can help inform that process.

Key Findings of the 2014 CMP Technical Report

1. The Washington region experienced decreasing congestion during peak periods from 2010-2013, but the pace of decrease had slowed down significantly in 2013. The decrease in Travel Time Index from previous year was 4.3%, 2.6% and 0.8% in 2011, 2012 and 2013, respectively; the annual average decrease was 2.6%. With regard to the Percent of Congested Miles, the decrease was even more dramatic. The decrease from previous year was 37%, 22% and 3% in 2011, 2012 and 2013, respectively (Section 2.1.1.1).

2. The Washington region experienced steady improvement in travel time reliability during peak periods from 2010-2013. The improvement in travel time reliability, measured by Planning Time Index, from previous year was 6%, 5% and 7% in 2011, 2012 and 2013, respectively; the annual average improvement was 6% (Section 2.1.1.2).

3. Long queues along southbound I-95 in Virginia, northbound I-95 in Maryland and northbound MD-295 were partially due to bottlenecks outside of the TPB Planning Area. In particular, bottlenecks in Fredericksburg and Stafford County, Virginia generated queues as long as 30 miles, with tremendous impact on the southbound travel along I-95 in the region. Addressing these bottlenecks involves coordination with jurisdictions outside the TPB Planning Area (Section 2.1.1.5).

4. The Commuter Connections program remains the centerpiece to assist and encourage people in the Washington region to use alternatives to the single-occupant automobile. The transit system in the Washington region serves as a major alternative to driving alone – transit mode share is among the highest several metropolitan areas in the country (Section 3.2.1).

5. This region has enhanced efforts in regional transportation operations coordination. The Metropolitan Area Transportation Operations Coordination (MATOC) program was recently enhanced with more staff covering longer time period, and a dedicated MATOC

public website (www.matoc.org) providing real-time traffic and incidents information (Section 3.3.3.4).

6. Congestion management strategies of Management, Operations, and Intelligent Transportation Systems (MOITS) provide essential ways to make most of the existing transportation facilities (Section 3.3.3).

7. Variably Priced Lanes (VPLs) provide options to travelers. Maryland Route 200 (Inter-county Connector (ICC)) was fully opened in November 2011 for the section between I-270 and I-95; a Before-and-After study identified the ICC improved its adjacent area's traffic by 3-4%. The 495 Express Lanes opened on the Virginia side of the Capital Beltway in November 2012 and in the fourth quarter of 2013, there were almost 38,000 average weekday trips and the lines reached a milestone of over one million unique customers. The 95 Express Lanes in Northern Virginia are expected to open in 2015 (Section 3.3.2).

8. Bikesharing and carsharing programs continue to grow providing transportation options to urban residents to wish to remain car-free or car-lite (Sections 3.2.4 and 3.2.5).

9. Mobile devices and social media are changing the way travelers make decisions. Real-time traffic and transit information are available from a number of sources though mobile applications and mobile versions of websites. Social media provides a mutually beneficial direct connection between transportation providers and users. Mobile applications related to non-auto modes, such as bikesharing and carsharing, allow travelers to be flexible with their mode choices (Section 3.4.6).

10. The TPB’s Regional Transportation Priorities Plan (RTPP) takes a performance-based transportation planning approach to identify those transportation strategies that offer the greatest potential contributions to addressing continuing regional challenges, and to provide support for efforts to incorporate those strategies into future updates of the CLRP in the form of specific programs and projects. The MAP-21 legislation strengthens the performance-based approach to planning. The CMP supports the RTPP by monitoring congestion and providing strategies that could improve the mobility of the transportation systems (Section 5.5).

Recommendations for the Congestion Management Process

The 2014 CMP Technical Report documents the updates of the Congestion Management Process in the Washington region from mid-2012 to mid-2014. Looking forward, the report leads to several important recommendations for future improvements.

1. **Refine the Congestion Management Process to help meet the requirements stipulated by MAP-21 and its subsequent federal regulations.** It is anticipated that traffic congestion, system performance of the Interstate System and non-Interstate NHS, and freight movement on the Interstate System will be analyzed and reported by FHWA standards specified in forthcoming rulemakings. The CMP will also improve to help

support performance-based planning and programming processes as mandated by the MAP-21.

2. **Continue the Commuter Connections program.** The Commuter Connections program is a primary key strategy for demand management in the National Capital Region and it is beneficial to have a regional approach. Meanwhile, this program reduces transportation emissions and improves air quality, as identified by the TERMs evaluations.

3. **Continue and enhance the MATOC program and support agency/jurisdictional transportation management activities.** The MATOC program/activities are key strategies of operational management in the National Capital Region. Recent enhancements have including efforts on severe weather mobilization and the construction and coordination. Future enhancements of the MATOC program should be considered when appropriate to expand the function and participation of the program.

4. **Pursue sufficient investment in the existing transportation system, which is important for addressing congestion.** Prioritizing maintenance for the existing transportation system as called for in TPB's Regional Transportation Priorities Plan is critical to congestion management.

5. **Encourage implementation of congestion management for major construction projects.** The construction project-related congestion management has been very successful in the past such as for the 11th Street Bridge and Northern Virginia Megaprojects.

6. **Consider variable pricing and other management strategies in conjunction with capacity increasing projects.** Variably priced lanes (VPLs) provide a new option to avoid congestion for travelers and an effective way to manage congestion for agencies.

7. **Continue to encourage transit in the Washington region and explore transit priority strategies.** The transit system in the Washington region serves as a major alternative to driving alone, and it is an important means of getting more out of existing infrastructure. Local jurisdictions are encouraged to work closely with transit agencies to explore appropriate transit priority strategies that could have positive impacts on travelers by all modes.

8. **Continue to encourage access to non-auto travel modes**. The success of the Capital Bikeshare program and the decrease in automobile registrations in the District of Columbia indicate that there is a shift, at least in the urban areas, to non-automobile transportation.

9. **Pursue increased integration of operations management and travel demand management components of congestion management for more efficient use of the existing transportation network.** State DOTs are encouraged to continue to explore ATM strategies along congested freeways and actively manage arterials along freeways. Transportation agencies (including transit agencies) and stakeholders are encouraged to

work collaboratively along a congested corridor to explore the feasibility of an ICM system. Ongoing projects on I-95/I-395 and I-66 support these concepts.

10. **Continue and enhance providing real-time, historical, and multimodal traveler information.** Providing travelers with information before and during their trips can help them to make decisions to avoid congestion and delays and better utilize the existing road and transit infrastructure. Websites such as MATOC's www.trafficview.org, www.CapitalRegionUpdates.gov, state DOTs' 511 systems, and real-time transit information allow travelers to make more informed decisions for their trips. The value of real-time traveler information can be largely enriched by integrating historical travel information which can provide valuable travel time reliability measures.

11. **Continue to look for ways to safely interface with the public through new technology such as mobile devices and social media.** The increased prevalence of mobile internet-capable devices and social media present a rapidly evolving platform for both disseminating and gathering information.

12. **Encourage connectivity within and between Regional Activity Centers.** The recent refinement of the Regional Activity Centers map, adopted in 2013, helps coordinate transportation and land use planning for future growth. Geographically-focused Household Travel Surveys can collect data which allows planners to see local level travel patterns and behaviors impacting mode shifts.

13. **Continue and enhance the regional congestion monitoring program with multiple data sources.** There are a wealth of sources, both public and private sector, for data related to congestion which have their individual strengths and shortcomings. Private sector probe-based monitoring provides unprecedented spatial and temporal coverage on roadways, but still needs to be supplemented with data from other sources including data on traffic volumes and traffic engineering considerations. There should be continual review of the quality and availability of data provided by different sources and the structuring of a monitoring program in way that is adaptable for potential future changes in data reporting and/or data sources.

14. **Continue to monitor recent trends in congestion**. Recent data show flat or decreasing congestion, in contrast to many years historically of increasing congestion. This trend should be closely monitored to determine whether this is a short-term trend or a long-term change in travel behavior and how this should affect long-range planning.

15. **Monitor trends in freight, specifically truck travel, as the opening of the Panama Canal expansion nears.** This expansion will allow much larger ships from Asia to serve East Coast ports, including the nearby ones in Baltimore and the Hampton Roads area in Virginia. Much of the new cargo arriving at these ports will pass through the Washington region by truck or rail on its way to inland destinations.

MAIN REPORT

1. INTRODUCTION

1.1 Need for a CMP Technical Report

This report presents a technical review of the Congestion Management Process (CMP), as addressed by the Transportation Planning Board (TPB) of the Metropolitan Washington Council of Governments (COG).

The Safe, Accountable, Flexible, Efficient, Transportation Equity Act – A Legacy for Users (SAFETEA-LU) stipulated the requirement for the use of the Congestion Management Process (CMP) in Transportation Management Areas (TMA). The Moving Ahead for Progress in the 21st Century Act (MAP-21) continued the requirement of a CMP. The CMP is similar to the previous requirements for a Congestion Management System (CMS) introduced in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), except that the change in name and acronym of CMS to CMP is intended to place a greater emphasis on the planning process and environmental review process, while maintaining and developing effective management and operation strategies. Federal regulations state that Metropolitan transportation planning areas with a population of 200,000 or more, designated as a TMA, are required to have a CMP, and that long-range transportation plans developed after July 1, 2007 must contain a CMP component. Also, in metropolitan planning areas classified as non-attainment for Ozone and Carbon Monoxide (CO) under the Clean Air Act, no single occupant vehicle (SOV) capacity expanding project can receive federal funds unless it shows that the CMP has been considered.

Federal regulations state that:

> *"The transportation planning process … shall address congestion management through a process that provides for <u>safe and effective integrated management and operation</u> of the multimodal transportation system…*
> *…based on a cooperatively developed and implemented <u>metropolitan-wide</u> strategy…*
> *…of <u>new and existing</u> transportation facilities…*
> *…through the use of <u>travel demand reduction and operational management</u> strategies."*[20]

Additionally, the federal certification of the TPB planning process, dated March 2006, addressed CMS/CMP with the following recommendation:

> *The TPB should develop a comprehensive description of a regional Congestion Management System to demonstrate its application at critical stages of the metropolitan planning process, including the development of the CLRP, TIP, and the development of major projects and policies. The description should be part of the next update to the CLRP or a stand-alone document that is completed in one year from the issuance of this*

[20] "Statewide Transportation Planning; Metropolitan Transportation Planning; Final Rule," *Federal Register*, Vol. 72, No. 30, February 14, 2007, § 450.320 (a) page 7274 – emphasis added.

> *report. The description can build on key elements in place, including monitoring and evaluating alternatives to new capacity (such as for the Mixing Bowl Springfield Exchange and the Woodrow Wilson Bridge) and the range of congestion related strategies (such as the Commuter Connections Program).*[21]

The Congestion Management Process is intended to operate within or in conjunction with the planning process, which is the focal point for consideration of other factors, such as Clean Air Act requirements, transit, funding, land use scenarios, and non-motorized alternatives. The planning process also leads to decisions on which projects are programmed and implemented. The CMP will provide better information to decision-makers, such as the TPB, who consider transportation planning in our region.

This report is a step in the CMP, which is an ongoing activity. Just as there are many causes of congestion, there are also many solutions. While this report documents the region’s recent CMP activities, the concept of addressing congestion and meeting regional goals will continue to be an integral part of the metropolitan planning process.

1.2 The Institutional Context of the CMP in the Washington Region

The federally designated Metropolitan Planning Organization (MPO) for the region is the National Capital Region Transportation Planning Board (TPB) at the Metropolitan Washington Council of Governments (MWCOG). The TPB is charged with producing long-range transportation plans and transportation improvement programs (TIPs) for the region, which includes the District of Columbia as well as portions of the States of Maryland and Virginia. The members of the TPB include representatives from state, county, local government agencies, as well as the Washington Metropolitan Area Transit Authority (WMATA), non-voting members of the Metropolitan Washington Airports Authority, and federal agencies.

The TPB is advised by a standing Technical Committee for transportation. The TPB Technical Committee oversees details of transportation planning and engineering studies and efforts required to support the region’s transportation decision-making process. The Technical Committee has a number of standing subcommittees that focus on particular aspects of the transportation planning process, such as aviation, bicycle and pedestrian planning, regional bus planning, travel forecasting, transportation safety, transportation and land use scenarios, and travel management.

The TPB Technical Committee is the oversight committee for the CMP, as the committee that guides long-range plan activity and oversees interaction of the various subcommittees. The Technical Committee is also advised by a number of the standing subcommittees who have knowledge about particular aspects of the CMP (for example, MOITS, Commuter Connections, and Travel Forecasting).

Previous CMS/CMP activities of the region were steered by a CMS Task Force, developed in the mid-1990s. Congestion Management System reports were developed in FY 1995 and FY 1996.

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[21] *Transportation Planning Certification Summary Report* (March 16, 2006). Prepared by Federal Highway Administration and Federal Transit Administration. Page 10.

However, a decision was then made to fully incorporate congestion management information into the CLRP rather than having a stand-alone document, in order to achieve continuity between the CMS and the CLRP. As such, over the years the CMS/CMP process had included data collection and analysis through compilation of information from implementing agencies associated with projects submitted to the CLRP and TIP, and through consideration of management and operations strategies under the Management, Operations, and Intelligent Transportation Systems (MOITS) Policy Task Force and MOITS Technical Subcommittee. The previously published 2008 CMP Technical Report represented a return to the practice of developing a separate congestion management document.

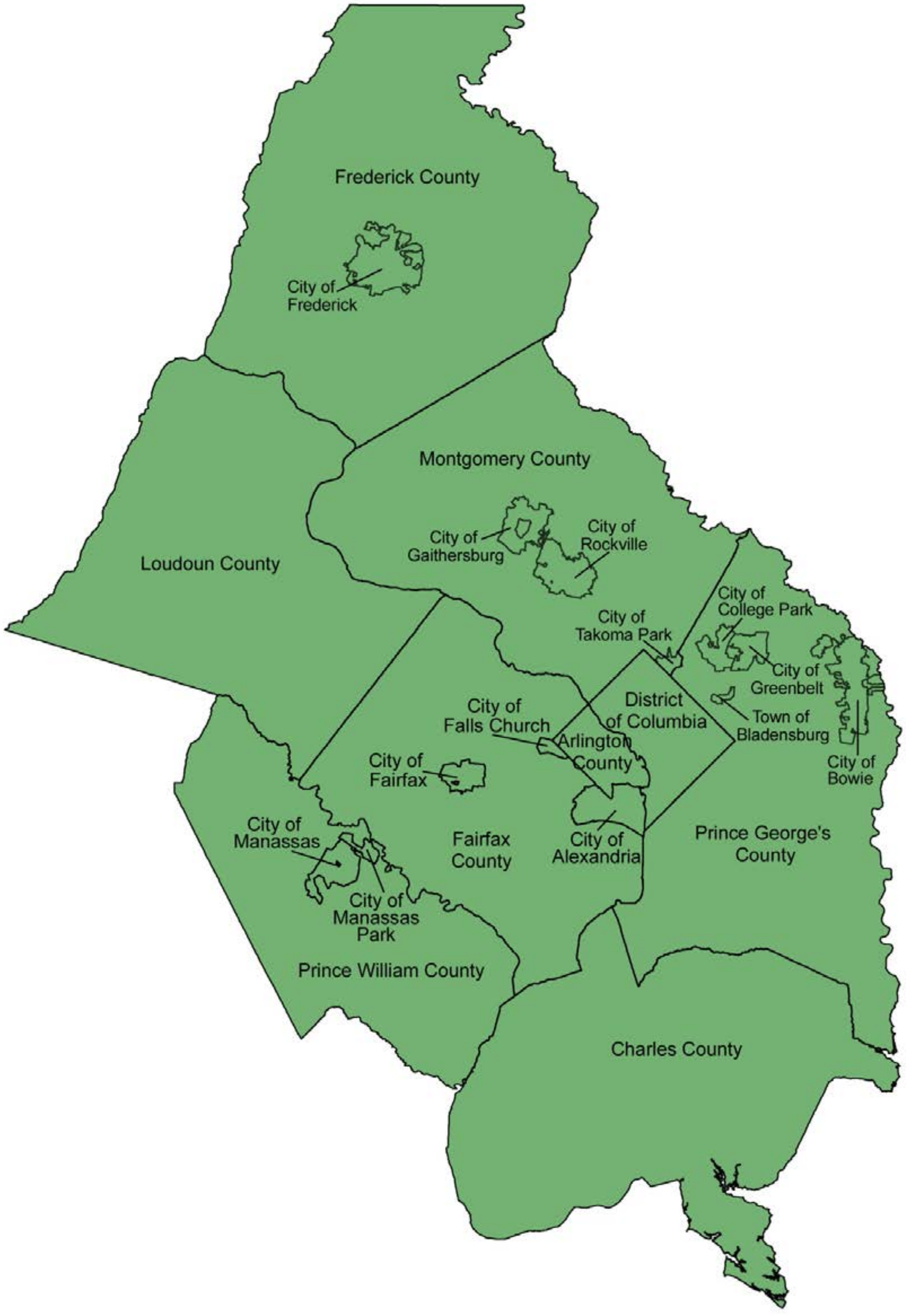
The 2010 CMP Technical Report was the first report incorporated the I-95 Corridor Coalition Vehicle Probe Project (VPP)/INRIX data[22] and developed new performance measures. The 2012 CMP Technical Report utilized even more third-party data than the previous one, including expanded VPP/INRIX data, and traffic volume information from the Transportation Technology Innovation and Demonstration (TTID) Program of the FHWA[23]. The current 2014 CMP Technical Report includes many updates or new initiatives taking place between mid-2012 to mid-2014 and adjusts itself toward meeting MAP-21 requirements. Section 1.5 summarizes the highlights of the 2014 Report.

1.3 Coverage Area of the CMP

The Washington region CMP covers the TPB Planning Area (Figure 8). As of December 31, 2013, the TPB's planning area covered the District of Columbia and surrounding jurisdictions. In Maryland these jurisdictions include Charles County, Frederick County, Montgomery County, and Prince George's County, plus the cities of Bowie, College Park, Frederick, Gaithersburg, Greenbelt, Rockville, and Takoma Park. In Virginia, the planning area includes Alexandria, Arlington County, the City of Fairfax, Fairfax County, Falls Church, Loudoun County, The Cities of Manassas and Manassas Park, and Prince William County.

[22] I-95 Corridor Coalition, http://i95coalition.net/i95/VehicleProbe/tabid/219/Default.aspx
[23] Transportation Technology Innovation and Demonstration (TTID) Program, FHWA, http://ops.fhwa.dot.gov/travelinfo/ttidprogram/ttidprogram.htm

Figure 8: TPB Planning Area



1.4 Components of the CMP

The Congestion Management Process in the National Capital Region consists of the following four components, all of which are wholly integrated into the CLRP:

1. **Monitoring and Evaluating Transportation System Performance.** This TPB effort includes Skycomp freeway aerial photography survey, arterial monitoring program, regional transportation data clearinghouse, special studies, data collections, as well as congestion analyses leveraged by emerging data sources (e.g. I-95 Corridor Coalition/INRIX data).

2. **Defining and Analyzing Strategies.** This component involves identifying existing and potential strategies by the TPB Technical Committee, subcommittees, and staff. The TPB considers a number of demand management and operational management strategies.

3. **Implementing Strategies.** This TPB effort is to focus on compiling information on strategies that have been implemented, particularly on a region-level basis. Also, the TPB is exploring how to assess previously implemented strategies. Feedback from the process is beneficial when it comes to updating the CMP and considering additional strategies and technical methods.

4. **Compiling Project-Specific Congestion Management Information.** Pursuant to Federal regulations, the TPB encourages consideration and inclusion of congestion management strategies in all SOV capacity-increasing projects. This involves compiling and analyzing information in the Call for Projects documentation forms, which are submitted from regional agencies when the CLRP is developed.

1.5 Highlights of the 2014 Update of the CMP Technical Report

The 2014 CMP Technical Report presents more congestion facts and analyses than the previous report while still maintaining a comprehensive and updated documentation of the congestion management strategies that are considered and implemented in the National Capital Region. The highlights of the 2014 update include:

- **MAP-21.** The 2012 MAP-21 legislation calls for the establishment of a National Highway Performance Program and performance-based planning and programming processes. While many rules regarding the implementation of the legislation were as of this writing still to be announced or finalized, this report adjusts itself in a way to better address anticipated future federal requirements, such as separate reporting of the performance of the Interstate System and non-Interstate NHS.

- **VPP/INRIX Expanded Coverage of the Region's Highways.** While the 2010 and 2012 reports included only a subset of highways covered by the VPP/INRIX data, the 2014 report represents an almost full coverage of the region's highways, thanks to the expansions enabled by DDOT, MDOT, VDOT and the I-95 Corridor Coalition. This coverage includes 520 directional miles of Interstate System, 2,160 directional miles of non-Interstate National Highway System (NHS), and 2,820 directional miles of non-NHS, totaling about 5,500 directional miles of roads in the TPB Planning Area.

- **Utilization of the VPP Suite.** The VPP Suite is a web-based tool kit developed by the CATT Lab of the University of Maryland to draw queries and performance measure visualizations from the archived VPP/INRIX data. This report uses the "Bottleneck Ranking", "Trend Map" and "Performance Charts" tools to obtain top bottlenecks, mapping of Travel Time Index and Planning Time Index, and travel times of major freeway commute routes, respectively. The VPP Suite has greatly improved the efficiency of data processing and performance measure visualization, though some upgrades are still desired.

- **Enhanced Regional Transportation Operations Coordination**. The Metropolitan Area Transportation Operations Coordination (MATOC) Program is a coordinated partnership between transportation agencies in D.C., Maryland, and Virginia that aims to improve safety and mobility in the region through information sharing, planning, and coordination. Recent enhancements have including efforts on severe weather mobilization and on construction coordination.

- **Variably Priced Lanes (VPLs) Provide Options to Travelers.** The Intercounty Connector (ICC or MD 200) was fully opened in November 2011 for the section between I-270 and I-95. The 495 Express Lanes will be opened on the Virginia side of the Capital Beltway in November 2012. The 95 Express Lanes in Northern Virginia under construction were scheduled to open in 2015.

- **Continued Growth in Bikesharing and Carsharing Programs.** The number of bicycle and pedestrian facilities in the region has increased in recent years. Capital Bikeshare has over 2,500 bicycles and over 300 stations in the District of Columbia, Arlington County, the City of Alexandria, and Montgomery County. Car sharing continues to grow in the Washington region. The largest company, Zipcar® has over 800 vehicles in the region. In addition to Zipcar®, Car2Go, and Enterprise have moved into the Washington region car sharing market.

- **Periodic updates.** Since the release of the 2012 CMP Technical Report, a variety of planning and program periodic updates and outside data sources have been released. This current report uses these updates to provide the most up-to-date information for the CMP. Some critical updates include, but are not limited to:

    - 2013 CLRP and FY 2013-2018 TIP
    - Round 8.2 Cooperative Forecasts of the region's demographics
    - 2013 Washington-Baltimore Regional Air Passenger Survey
    - 2013 Central Employment Core Cordon Count

2. STATE OF CONGESTION

2.1 Congestion on Highways

The Moving Ahead for Progress in the 21st Century Act (MAP-21) established requirements for Metropolitan Planning Organizations (MPOs) towards performance-based planning and programming. The U.S. Department of Transportation is currently in the process of establishing transportation performance management measures through a rulemaking process. According to the Federal Highway Administration (FHWA) Notice of Proposed Rulemaking (NPRM) regarding the National Performance Management Measures and the Highway Safety Improvement Program[24], the FHWA will assess performance in 12 areas, four of which are relevant to the CMP, including:

1) Traffic congestion,
2) Performance of the Interstate system,
3) Performance of the non-Interstate National Highway System (NHS), and
4) Freight movement on the Interstate system.

The NPRM regarding the above four areas is expected in August 2014. Since the anticipated NPRM will not be in effect as of the publication of this report, it will assess traffic congestion and travel time reliability with previously established measures on the Interstate System, the Non-Interstate NHS, and other roads, respectively and collectively.

The TPB has a multiplicity of traffic monitoring programs on the freeways and arterials in the Washington region. It is advantageous to have monitoring data from a variety of sources and methodologies for the purposes of cross-checking and ensuring resiliency in data sources.

2.1.1 I-95 Corridor Coalition Vehicle Probe Project/INRIX Traffic Monitoring

Since 2010[25], major roadways in the Metropolitan Washington area have been monitored under the I-95 Corridor Coalition Vehicle Probe Project (VPP)[26]. This project is a groundbreaking initiative and collaborative effort among the Coalition, University of Maryland and INRIX, Inc. providing comprehensive and continuous real-time and historical traffic information to members. The objective of this project is to acquire travel times and speeds on freeways and arterials using probe technology. While the dominant source of data is obtained from fleet systems that use GPS to monitor vehicle location, speed, and trajectory, other data sources such as sensors may also be used. The INRIX system fuses data from various sources to present a comprehensive picture of traffic, including vehicle speed and travel time at 5-minute granularity for each road segments[27].

As an affiliate member of the coalition, the TPB was granted gratis access to the historical archive data in 2009. The initial effort to utilize this third-party data for freeway congestion monitoring was summarized in the *2010 Congestion Management Process (CMP) Technical*

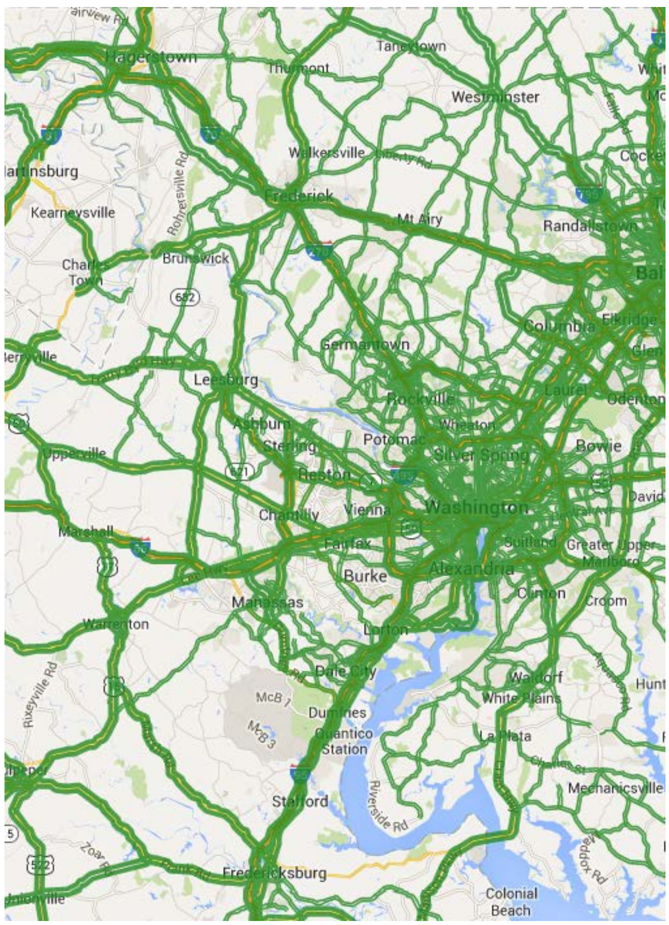
[24] Federal Register, Vol. 79, No.47, March 11, 2014.
[25] Data for some roadways are available back to July 1, 2008.
[26] I-95 Corridor Coalition, http://i95coalition.net/i95/VehicleProbe/tabid/219/Default.aspx
[27] In 2014, the I-95 Corridor Coalition was in the process of re-competing the VPP data contract; companies involved and the nature of the data supplied may change after this re-competition is complete.

Report[28]. An enhanced effort that included expanded full coverage of the freeways in the Washington region and a speed-volume data fusion was reported in the *2012 Congestion Management Process (CMP) Technical Report*[29].

As of December 31, 2013, the VPP/INRIX data covers about 5,500 directional miles of roads in the TPB Planning Area (Figure 9), including 520 miles of the Interstate System, 2,160 miles of Non-Interstate NHS, and 2,820 miles of Non-NHS; if categorized by freeway/arterial, this coverage includes 680 miles of freeways and 4,820 miles of arterials.

This VPP/INRIX data source has become the major source of traffic monitoring for both freeways and arterials in the Washington region, transforming the way by which highway congestion and travel time reliability are analyzed and presented.

Figure 9: The I-95 Vehicle Probe Project/INRIX Data Coverage in the Washington Region



(Screenshot was captured on the I-95 Traffic Monitoring website http://i95.inrix.com/.)

[28] COG/TPB, http://www.mwcog.org/clrp/elements/cmp/files/CMP_Tech_Report_2010%20FINAL_09032010.pdf
[29] COG/TPB, http://www.mwcog.org/clrp/elements/cmp/files/2012%20CMP%20Tech%20Report_FINAL%202012-11-02%20for%20post.pdf

2.1.1.1 Regional Congestion Trends

The annual average congestion, measured by Travel Time Index and the Percent of Congested Miles, in the four years from 2010-2013 is summarized as follows.

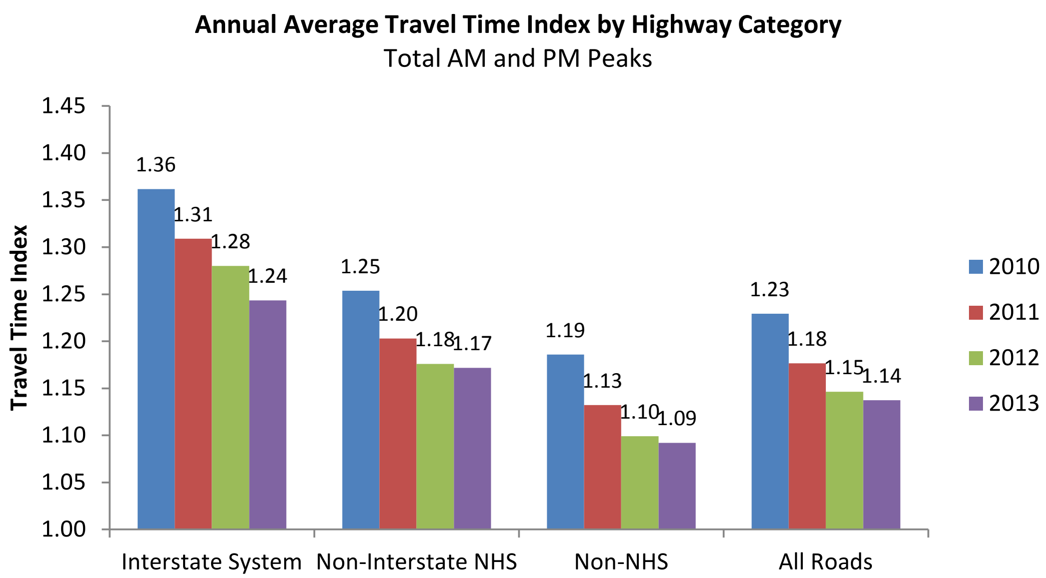
Travel Time Index

Travel Time Index (TTI) is an indicator of the intensity of congestion, calculated as the ratio of actual experienced travel time to free flow travel time. A travel time index of 1.00 implies free flow travel without any delays, while a travel time index of 1.30 means one has to spend 30% more time to finish a trip compared to free flow travel. More information about TTI and its calculation can be found in Chapter 4.1.

The annual average Travel Time Index on monitored highways in the TPB Planning Area is shown below. Figure 10 is the average TTI of total AM Peak (6:00-10:00 am) and PM Peak (3:00-7:00 pm) on all weekdays in a year, Federal holidays excluded, Figure 11 is the TTI for the AM Peak, and Figure 12 is the TTI for the PM Peak. The TTI is reported by four highway categories:

1) Interstate System, about 520 directional miles.
2) Non-Interstate NHS, about 2,160 directional miles. The NHS designation used in this report was defined on October 1, 2012. The MAP-21 NHS includes all principal arterials[30].
3) Non-NHS, about 2,820 directional miles. This category mainly includes minor arterials covered by the VPP/INRIX data.
4) All Roads, about 5,500 directional miles. All roads covered by the VPP/INRIX data in the TPB Planning Area.

Figure 10: Annual Average Travel Time Index by Highway Category: Total AM and PM Peaks



[30] FHWA, National Highway System, http://www.fhwa.dot.gov/planning/national_highway_system/nhs_maps/

2013 weekday (Monday through Friday) peak hour (8:00-9:00 am; 5:00-6:00 pm) Travel Time Index on the Interstate System and the Non-Interstate NHS were visualized by the "Trend Map" tool of the I-95 Vehicle Probe Project (VPP) Suite Developed by the CATT Lab of the University of Maryland[31], as provided in Appendix A.

Figure 11: Annual Average Travel Time Index by Highway Category: AM Peak

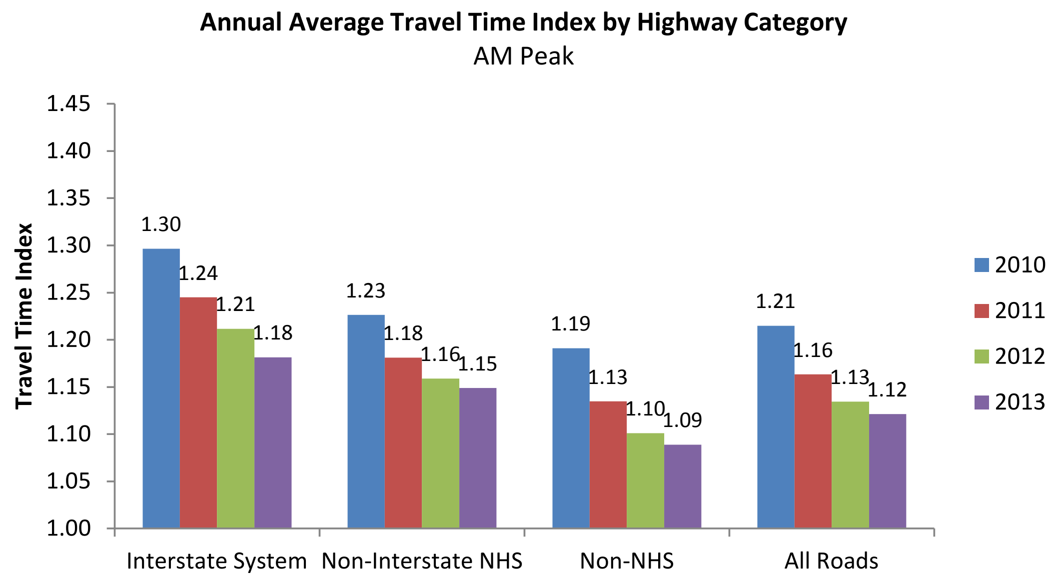
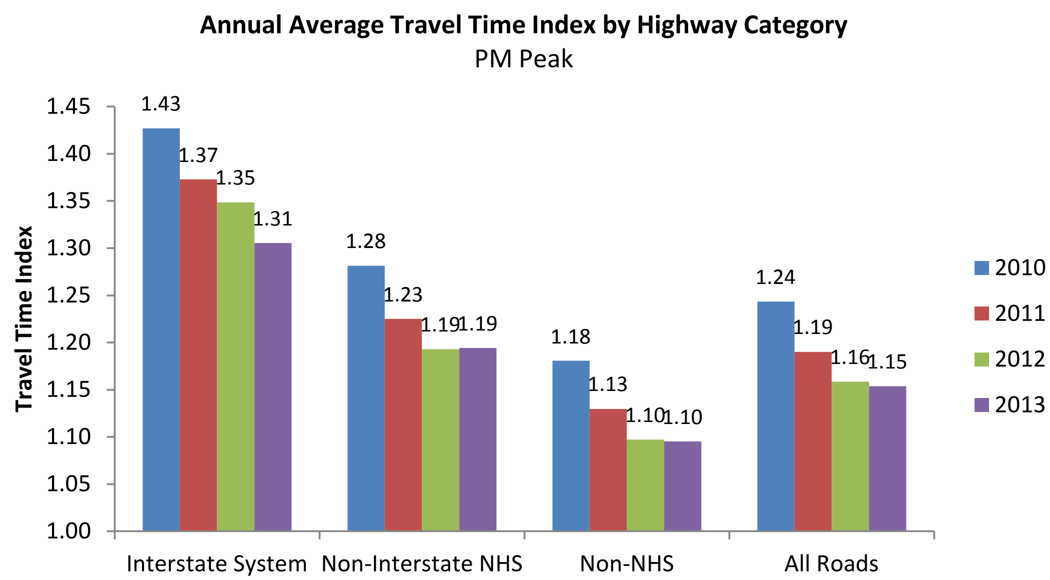


Figure 12: Annual Average Travel Time Index by Highway Category: PM Peak



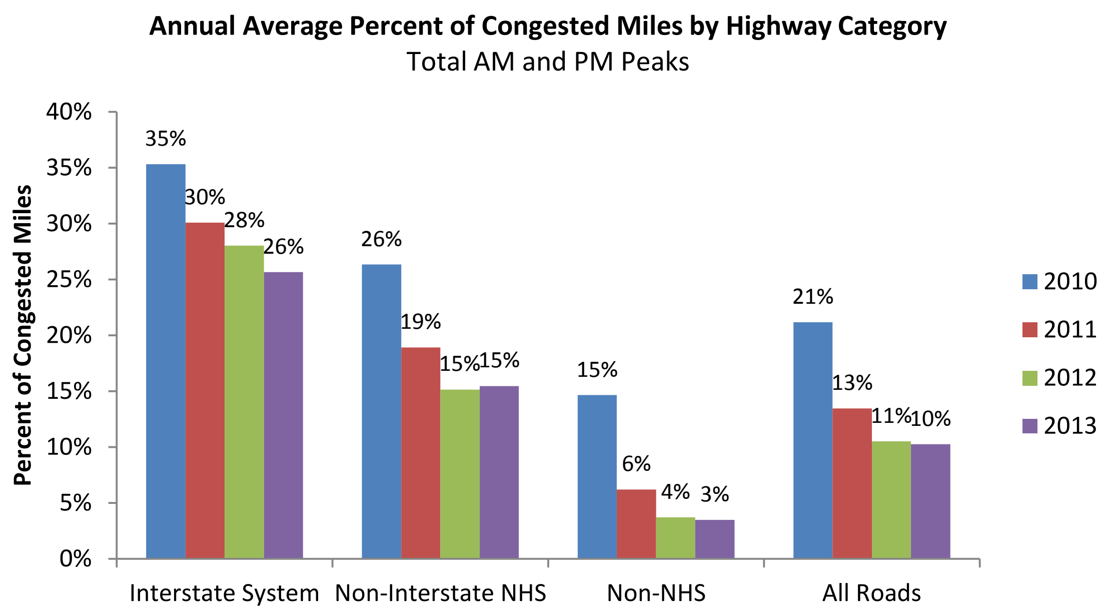
[31] Center for Advanced Transportation Technology Laboratory (CATT Lab), University of Maryland, Vehicle Probe Project Suite, https://vpp.ritis.org.

Percent of Congested Miles

Percent of Congested (Directional) Miles is a system-wide measure that captures the spatial extent of congestion. According to the National Transportation Operations Coalition, if actual travel time is 30% longer than the free-flow travel time, i.e., Travel Time Index > 1.3, congestion is defined[32].

The annual average Percent of Congested Miles on monitored highways in the TPB Planning Area is shown below. Figure 13 is the average percentage of both AM Peak (6:00-10:00 am) and PM Peak (3:00-7:00 pm) on all weekdays in a year, Federal holidays excluded, Figure 14 is the percentage for the AM Peak, and Figure 15 is the percentage for the PM Peak. The percentage is reported by four highway categories as described earlier.

Figure 13: Annual Average Percent of Congested Miles by Highway Category: Total AM and PM Peaks



[32] National Transportation Operations Coalition, National Transportation Operations Coalition (NTOC) Performance Measures Initiative, 2005. http://www.ntoctalks.com/action_teams/ntoc_final_report.pdf.

Figure 14: Annual Average Percent of Congested Miles by Highway Category: AM Peak

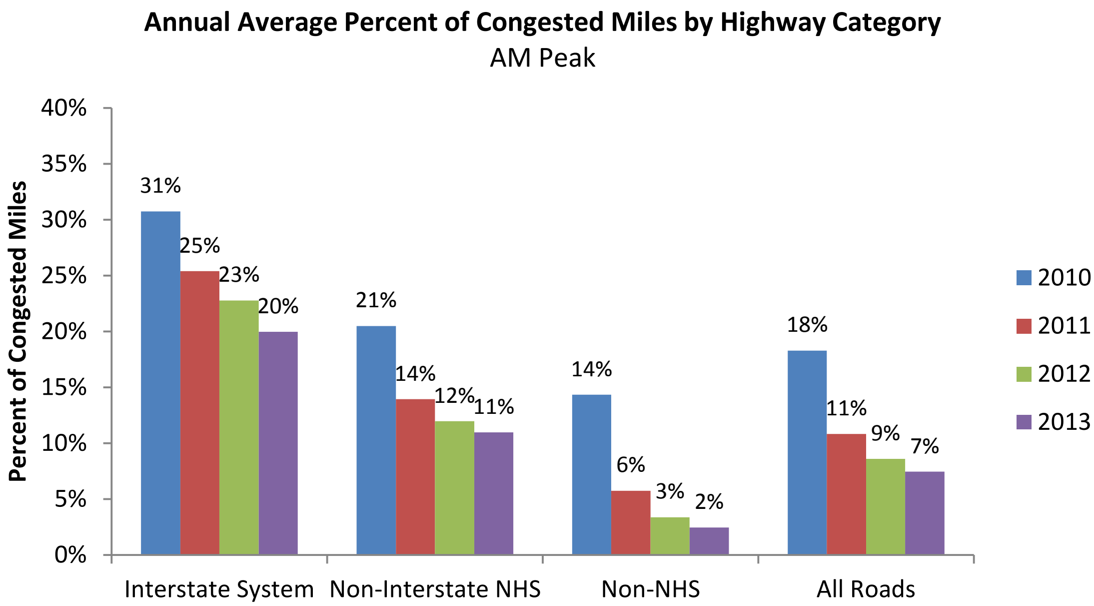
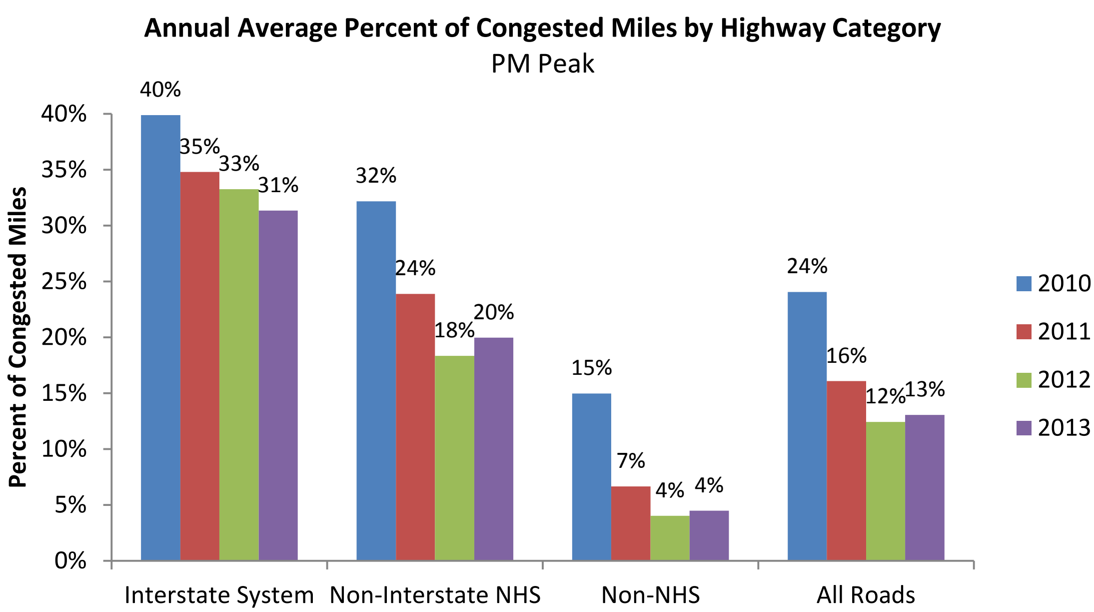


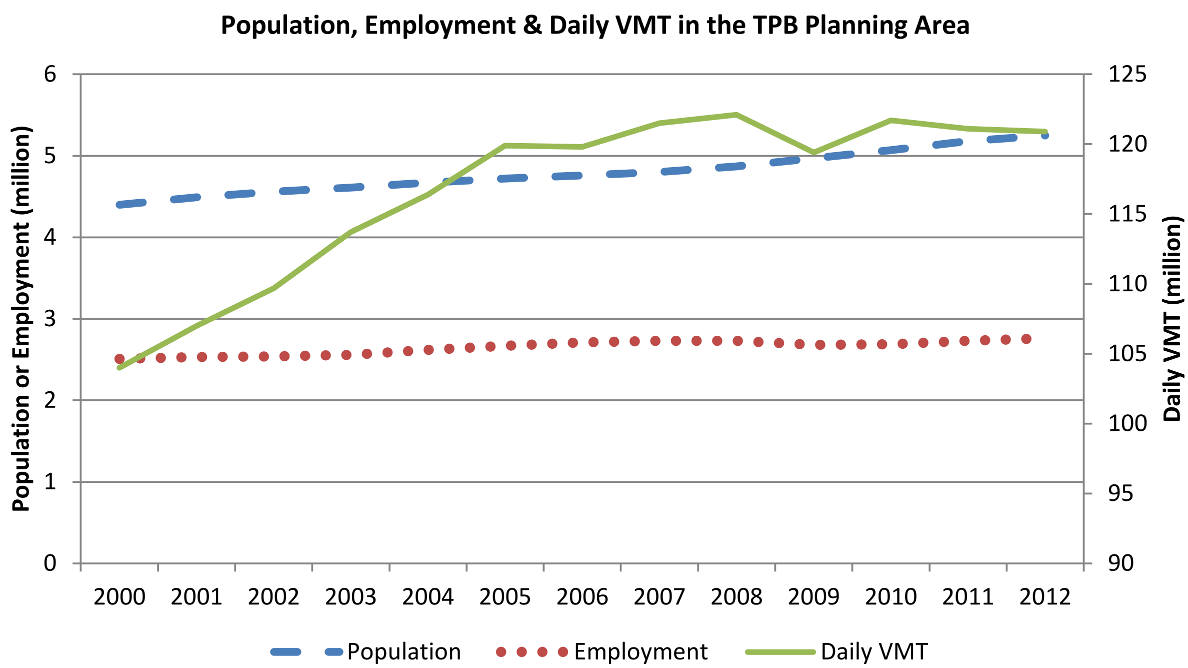
Figure 15: Annual Average Percent of Congested Miles by Highway Category: PM Peak



Population, Employment and Daily VMT

In order to put the above congestion trends into perspective, Figure 16 below provides the TPB Planning Area's population, employment and daily VMT for the period from 2000 to 2012[33]. Focusing only on the three-year period from 2010 to 2012, the region's population increased from 5.07 million to 5.25 million, and employment increased from 2.69 million to 2.76 million. However, the daily VMT decreased from 121.7 million to 120.9 million vehicle-miles. Such a VMT reduction is consistent with the congestion reduction as indicated by the Travel Time Index and Percent of Congested Miles[34].

Figure 16: Population, Employment and Daily VMT in the TPB Planning Area, 2000-2012



Findings

Based on the VPP/INRIX data, the following 2010-2013 congestion trends can be identified. Note that the Travel Time Index and Percent of Congested Miles are based on speeds and travel times provided by the VPP/INRIX data, not weighted by roadway capacity or vehicle volumes.

1) The Washington region experienced decreasing congestion during peak periods from 2010 to 2013. The annual average decrease in congestion intensity was 2.6% in the four years from 2010 to 2013, as measured by Travel Time Index from a traveler's

[33] Population and daily VMT are provided by the TPB's Regional Transportation Data Clearinghouse (https://gis.mwcog.org/webmaps/rtdc/); employment data are provided by the Bureau of Labor Statistics' Quarterly Census of Employment and Wages.
[34] Reasons proposed by participants in the TPB planning process for this drop in VMT include the recent economic recession; an increasing proportion of the region's population living in walkable neighborhoods; telework; e-commerce; and high fuel prices. Continued monitoring over a longer period of years may help clarify the reasons behind the trend.

perspective. The annual average reduction in spatial extent of congestion was 21% in the same period, as measured by Percent of Congested Miles from a system perspective.

2) The pace of congestion decrease slowed down significantly in 2013. The decrease in Travel Time Index from previous year was 4.3%, 2.6% and 0.8% in 2011, 2012 and 2013, respectively. With regard to the Percent of Congested Miles, the decrease was even more dramatic. The decrease from previous year was 37%, 22% and 3% in 2011, 2012 and 2013, respectively.

3) Slight increases in congestion were observed from 2012-2013 in the PM Peak period for Non-Interstate NHS (both intensity and spatial extent), Non-NHS (spatial extent only), and All Roads (spatial extent only).

4) While the Interstate System experienced the largest drop (3.0% annually) in congestion intensity from 2010-2013, it had the smallest decrease (10% annually) in the spatial extent of congestion in all the four highway categories (Interstate System, Non-Interstate NHS, Non-NHS, and All Roads) in the same time period. Overall, congestion decreases on the Interstate System were considered "medium".

5) The Non-Interstate NHS had the smallest decrease (2.2% annually) in congestion intensity and the second smallest decrease (16% annually) in the spatial extent of congestion from 2010-2013 in all four highway categories. Overall, congestion decreases on the Non-Interstate NHS were considered "small".

6) The Non-NHS had the largest decrease (38% annually) in the spatial extent of congestion and the second largest decrease (2.7% annually) in congestion intensity from 2010-2013 in all four highway categories. Overall, congestion decreases on the Non-NHS were considered "large".

7) PM Peak (3:00-7:00 pm) congestion, in terms of both intensity and spatial extent, was more severe than AM Peak (6:00-10:00 am) in the four years of 2010-2013 across all highway categories.

2.1.1.2 Regional Travel Time Reliability Trends

To most travelers, everyday congestion, particularly peak period congestion, is common and they often adjust their schedules or plan extra time to allow for the expected delays; what troubles travelers most are unexpected or much-worse-than-expected delays, which can be caused by incidents, inclement weather, work zones, and the like. Travelers thus want travel time reliability - a consistency or dependability in travel times, as measured from day to day or across different times of day[35] - to avoid being late.

To quantify travel time reliability, this report adopts Planning Time Index (PTI), the ratio (also able to be expressed as a percentage) of 95th percentile travel time over free flow travel time. It

[35] Federal Highway Administration, *Travel Time Reliability Measures*, http://ops.fhwa.dot.gov/perf_measurement/reliability_measures/index.htm

expresses the extra time a traveler should budget in addition to free flow travel time in order to arrive on time 95 percent of the time. The difference between 95th percentile travel time and free flow travel time is called Planning Time. For example, a 30-minute free flow travel with a Planning Time Index of 2.00 requires 60 minutes in budget to ensure on-time arrival, and thus the Planning Time is 30 minutes.

The annual Planning Time Index on monitored highways in the TPB Planning Area is shown below. Figure 17 is the average PTI of total AM Peak (6:00-10:00 am) and PM Peak (3:00-7:00 pm) on all weekdays in a year, Federal holidays excluded. Figure 18 is the PTI for the AM Peak, and Figure 19 is the PTI for the PM Peak. The PTI is reported by the four highway categories described above in the Travel Time Index section.

The 2013 weekday (Monday through Friday) peak hour (8:00-9:00 am; 5:00-6:00 pm) Planning Time Index on the Interstate System and the Non-Interstate NHS were visualized by the "Trend Map" tool in the VPP Suite, as provided in Appendix B.

Observations from examining travel time reliability in the region for 2010-2013 include:

1) Travelers typically will need to budget about two times of the free flow travel time during peak periods to ensure on-time arrivals. These numbers are based on all directions of travel, therefore for those who traveling in the peak direction would need to even budget more.

2) Similar to the trends observed in traffic congestion, travel time reliability has improved over time from 2010-2013. The annual average improvement was 5.7%. Different from traffic congestion, reliability improvement kept a constant pace over the years without clear slowing down in 2013.

Figure 17: Annual Average Planning Time Index by Highway Category: Total AM and PM Peaks

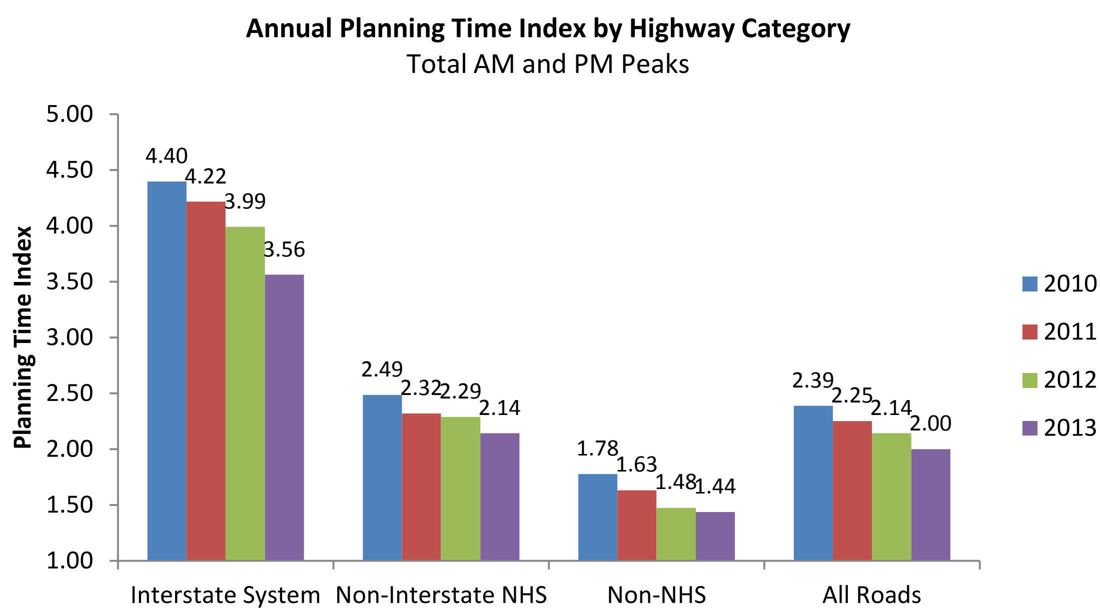


Figure 18: Annual Average Planning Time Index by Highway Category: AM Peak

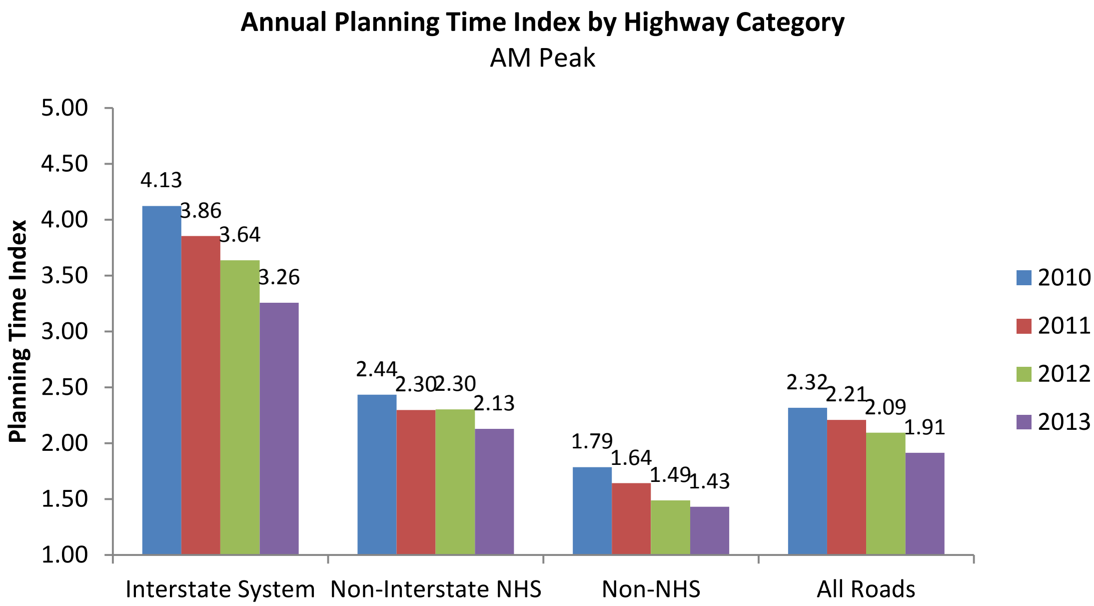
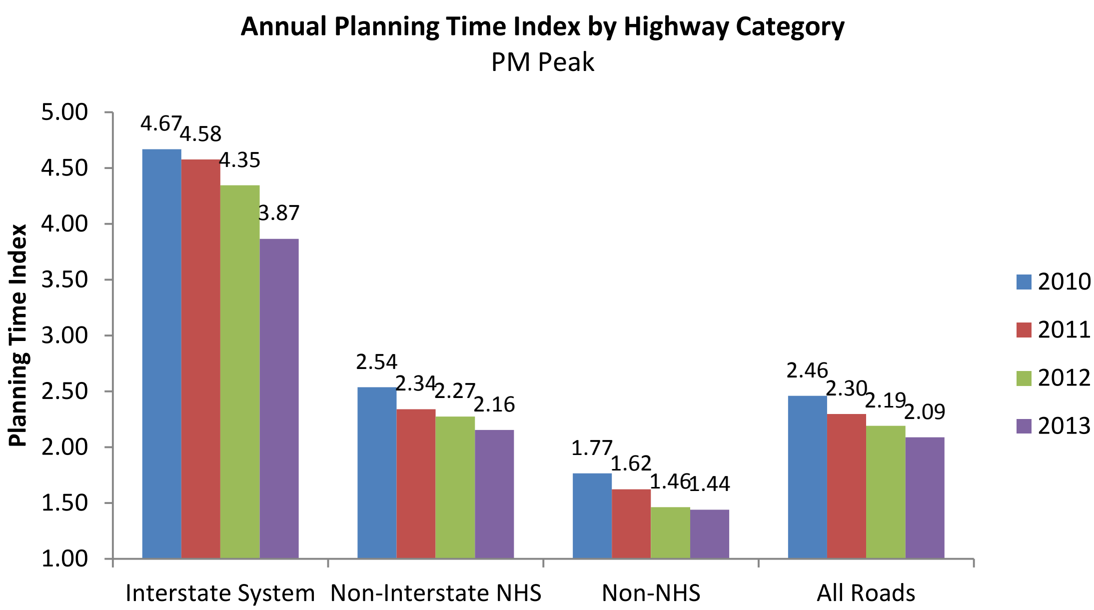


Figure 19: Annual Average Planning Time Index by Highway Category: PM Peak



2.1.1.3 Congestion Monthly Variation

Congestion varies from month to month within a year, as shown in Figure 20 (total AM and PM peaks), Figure 21 (AM Peak), and Figure 22 (PM Peak). Monthly variation of congestion had the following characteristics in the Washington region:

1) Monthly variations of congestion were most noticeable on the Interstate System, followed by the Non-Interstate NHS, and the Non-NHS had the least fluctuations (except in 2011,

when a systematic decrease of congestion occurred from the beginning to the end of the year).

2) Congestion generally had two "lows" and two "highs" within a year on the Interstate System, with one "low-high" pair occurring in the first half of the year and the other in the second half of the year.

3) January was the most frequent "low" month and June was the most likely "high" month on the Interstate System in the first half of the year during both AM and PM peaks. While the congestion fluctuated from January to June in the AM Peak, it almost kept straight increase during the same time period.

4) Congestion showed a great deal of variation between the AM Peak and PM Peak on the Interstate System during the second half of the year. For the AM Peak, August represented the undoubtedly "low" month (even lower than January) and September or October could be the "high" month; for the PM Peak, the "low" month was generally September and the "high" was November.

Figure 20: Monthly Variation of Congestion: Total AM and PM Peaks

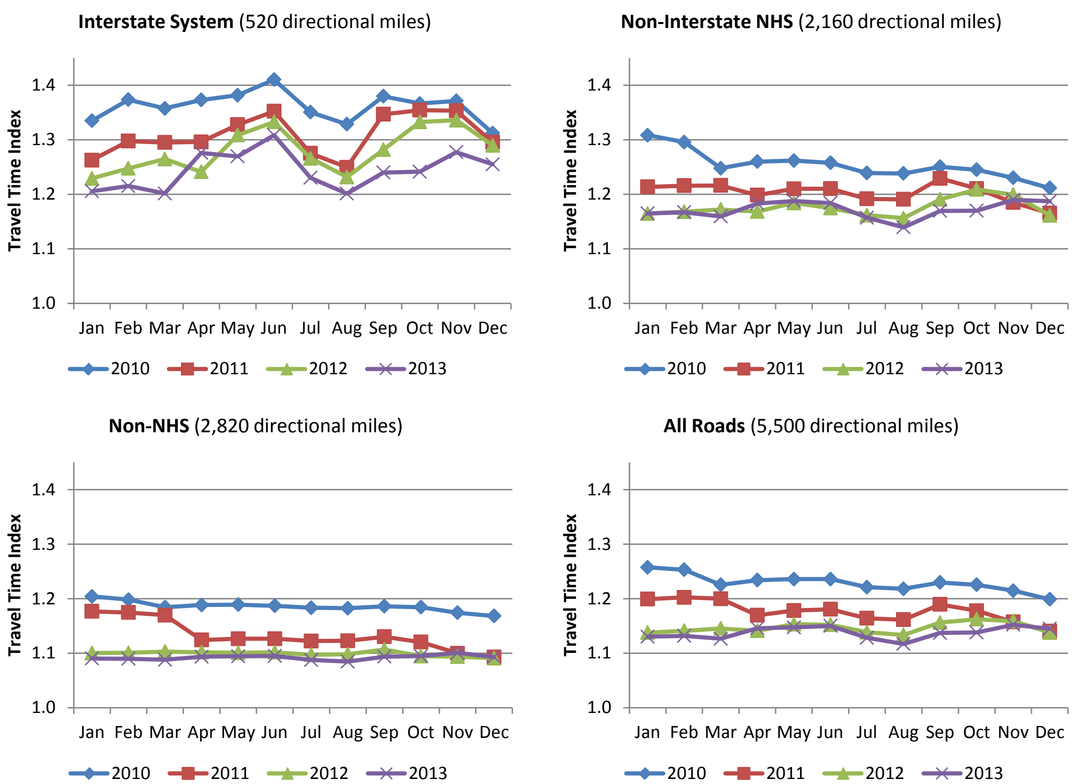


Figure 21: Monthly Variation of Congestion: AM Peak

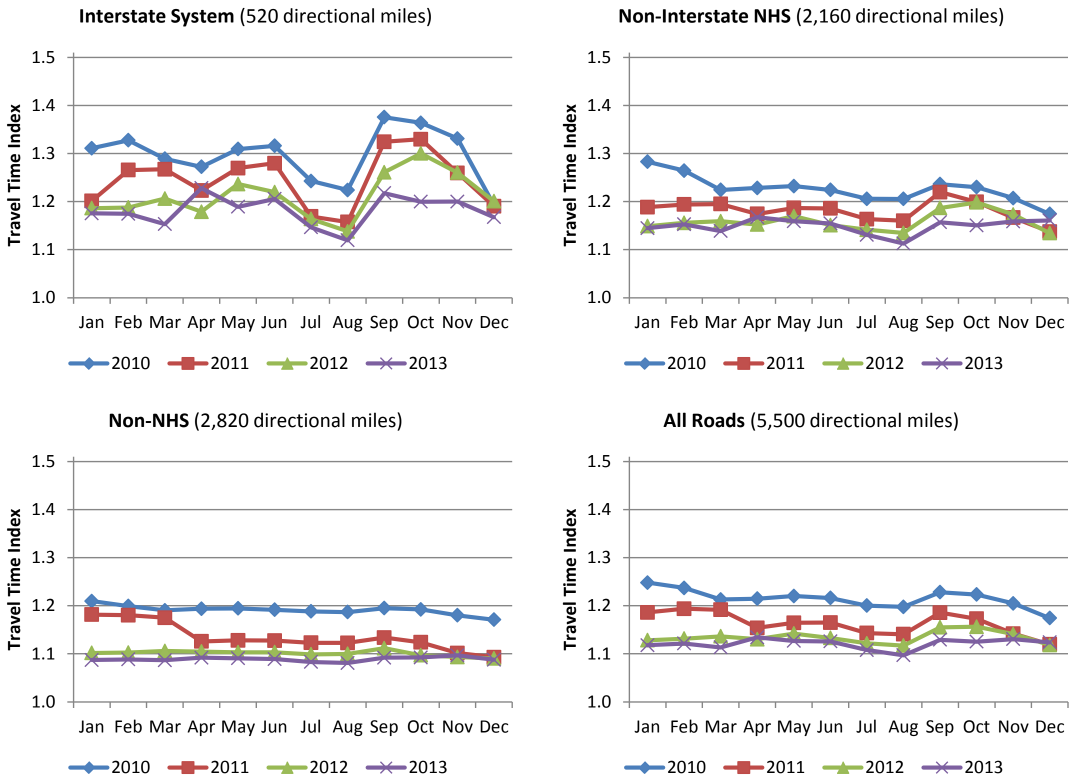
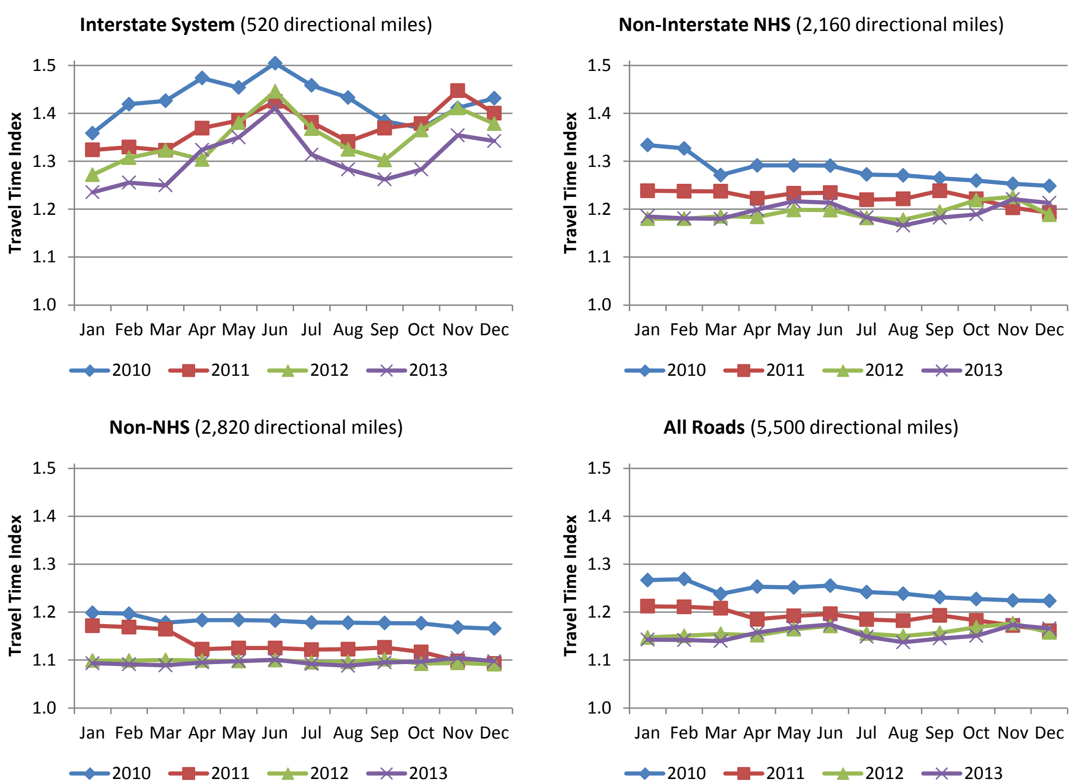


Figure 22: Monthly Variation of Congestion: PM Peak



2.1.1.4 Congestion Day of Week Variation

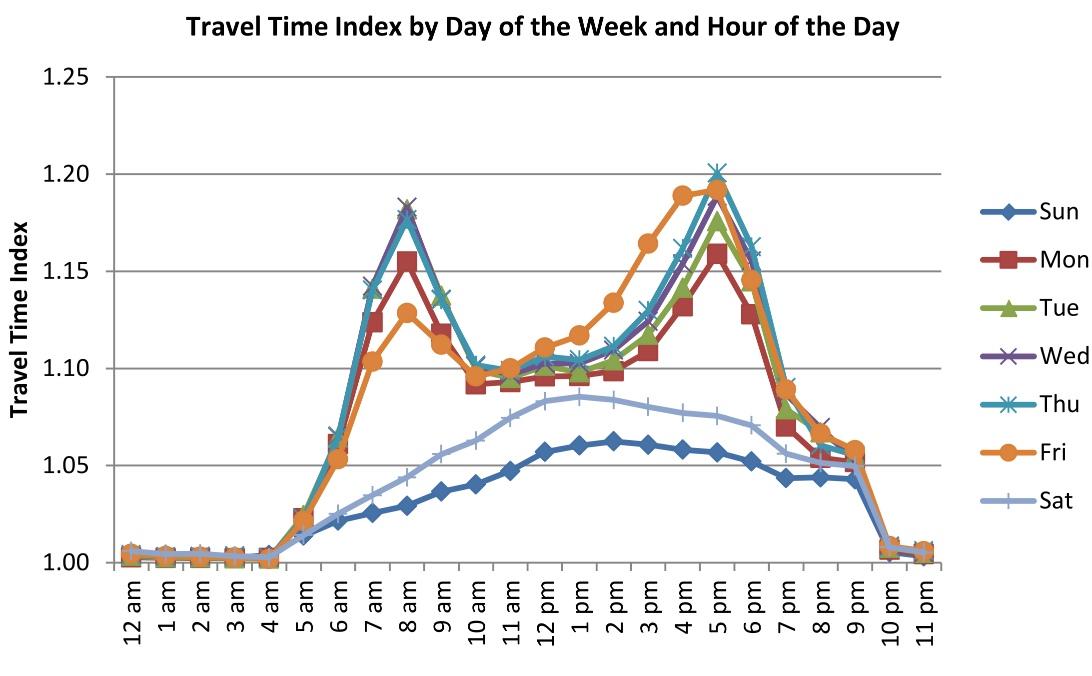
Congestion also varies within a week, as shown in Figure 23. The day of week variation of congestion on the Washington region in 2013 had the following trends. Note that these trends are a summary of all the 5,500 directional miles of roads in the region; different areas, highway facilities and routes may vary differently.

1) Middle weekdays – Tuesday, Wednesday and Thursday – were the most congested days of a week. During these three weekdays, the AM Peak had almost identical congestion while the most congested PM Peak occurred on Thursday, followed by Wednesday and Tuesday.

2) Monday and Friday had unique traffic patterns. Monday morning's traffic was lower than that of the middle weekdays but higher than Friday; Monday afternoon had the least congestion in all weekdays. Friday morning had the least congestion in all weekdays; Friday afternoon's congestion was almost as bad as the middle weekdays, but it came about one hour earlier without ending earlier – expanded congested time period.

3) Weekend days had the lowest traffic in a week and Sunday was even lower than Saturday with no pronounced AM and PM peaks. During these two days, mid-day traffic (12:00 – 3:00 pm) was the highest.

Figure 23: Day of Week Variation of Congestion in 2013



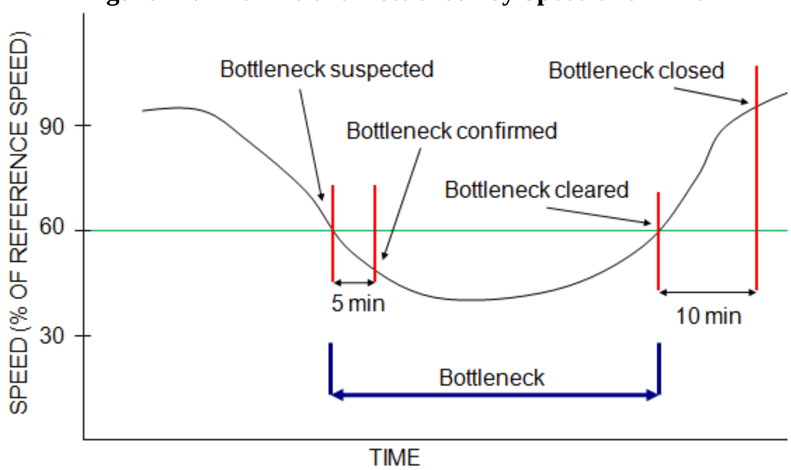
2.1.1.5 Top Bottlenecks

Methodology

This report adopts the VPP Suite to identify the top 10 most significant bottlenecks in the TPB Planning Area and bottlenecks outside the Planning Area but having significant impact on the region in 2013. The VPP Suite uses the following methodology to track bottlenecks:

Bottleneck conditions are determined by comparing the current reported speed to the reference speed for each segment of road. Reference speed values are provided by INRIX, Inc. for each segment and represent the 85th percentile observed speed for all time periods with a maximum value of 65 mph. If the reported speed falls below 60% of the reference, the road segment is flagged as a potential bottleneck. If the reported speed stays below 60% for five minutes, the segment is confirmed as a bottleneck location. Adjacent road segments meeting this condition are joined together to form the bottleneck queue. When reported speeds on every segment associated with a bottleneck queue have returned to values greater than 60% of their reference values and remained that way for 10 minutes, the bottleneck is considered cleared. The total duration of a bottleneck is the difference between the time when the congestion condition was first noticed (prior to the 5 minute lead in) and the time when the congestion condition recovered (prior to the 10 minute lead out). Bottlenecks whose total queue length, determined by adding the length of each road segment associated with the bottleneck, is less than 0.3 miles are ignored.

Figure 24: The Life of a Bottleneck by Speed and Time



The VPP Suite currently only allows users to rank bottlenecks within an up to three months period. When the number of road segments increases, the time period of analysis could be further shortened. In the analysis for this report, a total of six two-month queries were drawn for the region's freeways in 2013. A post-VPP Suite analysis was conducted to consolidate all the queries to obtain the top bottlenecks for the full year. In each of the six queries, a bottleneck comes with its Average Duration, Average Maximum Queue Length, number of Occurrences in the two-month period, and Impact Factor – the product of multiplying Duration (minutes), Queue Length (miles) and Occurrences. In the post-VPP Suite analysis, a consolidated full-year top bottleneck has the following relationship with its constituent two-month bottlenecks, and the full-year bottlenecks are ranked by its Impact Factor:

Full-Year Bottleneck		*Two-Month Bottleneck*
Average Duration	=	Average of the Durations of the two-month bottlenecks, weighted by the number of occurrences
Queue Length	=	Average of the Queue Lengths of the two-month bottlenecks, weighted by the number of occurrences
Occurrences	=	Sum of the Occurrences of the two-month bottlenecks
Impact Factor	=	Sum of the Impact Factors of the two-month bottlenecks

Top Bottlenecks

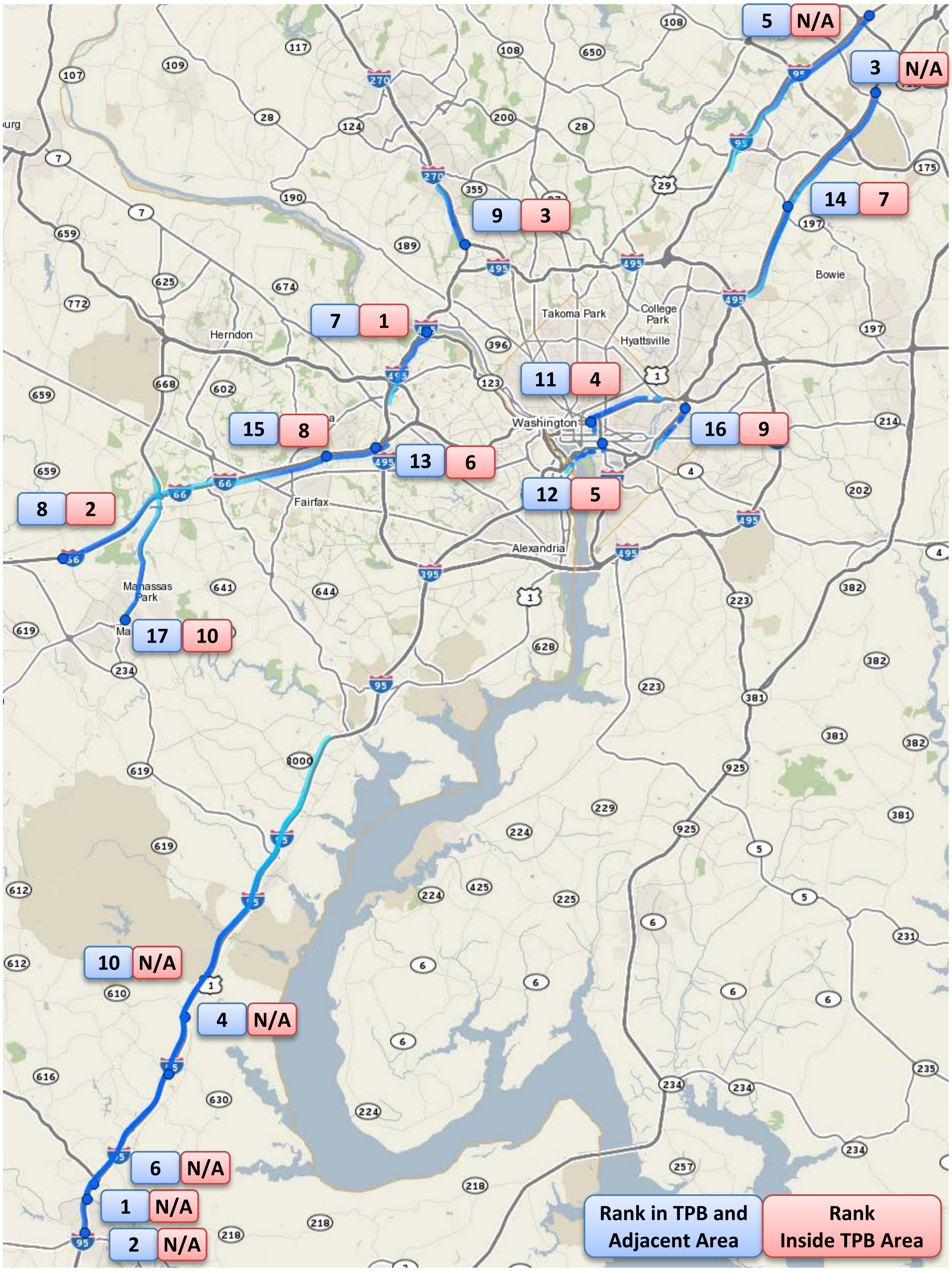
This post-VPP Suite analysis yielded the following top 10 bottlenecks in the TPB Planning Area and additional seven bottlenecks adjacent to the Planning Area with their queues extended well into the Area (Table 3 and Figure 25).

Table 3: 2013 Top Bottlenecks Based on Speed

Rank in TPB and Adjacent Area	Rank Inside TPB Area	Location	Average Duration	Average Queue Length (miles)	Occurrences	Impact Factor
1	N/A	I-95 SB @ Fredericksburg/Stafford Co Line	5 h 6 m	32.0	311	3,055,956
2	N/A	I-95 SB @ VA-3/Exit 130	5 h 45 m	32.3	115	1,283,658
3	N/A	MD-295 NB @ MD-175	3 h 48 m	13.8	261	823,541
4	N/A	I-95 SB @ VA-630/Exit 140	4 h 6 m	20.1	161	795,652
5	N/A	I-95 NB @ MD-100/Exit 43	2 h 51 m	14.5	279	756,736
6	N/A	I-95 SB @ US-17/Exit 133	5 h 8 m	30.2	60	657,455
7	**1**	**I-495 CW @ American Legion Bridge**	**2 h 47 m**	**4.7**	**800**	**640,474**
8	**2**	**I-66 WB @ VA-234/Exit 47**	**2 h 21 m**	**10.9**	**339**	**604,192**
9	**3**	**I-270 Spur SB @ I-270**	**1 h 42 m**	**6.4**	**884**	**591,198**
10	N/A	I-95 SB @ US-1/VA-610/Exit 143	3 h 9 m	12.0	175	558,193
11	**4**	**US-50 WB @ 10th St**	**4 h 19 m**	**13.1**	**145**	**546,624**
12	**5**	**I-395 NB @ 2nd St**	**1 h 43 m**	**3.8**	**1388**	**534,048**
13	**6**	**I-66 EB @ I-495/Exit 64**	**1 h 53 m**	**4.6**	**968**	**513,693**
14	**7**	**MD-295 NB @ MD-197/Exit 11**	**2 h 47 m**	**6.7**	**444**	**505,186**
15	**8**	**I-66 EB @ Nutley St/Exit 62**	**1 h 58 m**	**6.5**	**567**	**490,498**
16	**9**	**DC-295 NB @ Eastern Ave**	**2 h 49 m**	**3.9**	**428**	**334,024**
17	**10**	**VA-28 SB @ Prescott Ave/Sudley Rd**	**3 h 23 m**	**8.2**	**196**	**330,540**

Note: Bold texts indicate bottlenecks inside the TPB Planning Area.

Figure 25: 2013 Top Bottlenecks Based on Speed



Long queues along southbound I-95 in Virginia, northbound I-95 in Maryland and northbound MD-295 were partially due to the bottlenecks outside of the TPB Planning Area. These bottlenecks were far more significant, as measured by the Impact Factor, than the Planning Area's No. 1 bottleneck –American Legion Bridge Inner Loop on the Capital Beltway. In particular, bottlenecks in Fredericksburg and Stafford County, Virginia generated queues as long as 30 miles with tremendous impact on the southbound travel along I-95 in the region. Addressing these bottlenecks involves coordination with jurisdictions outside the TPB Planning Area.

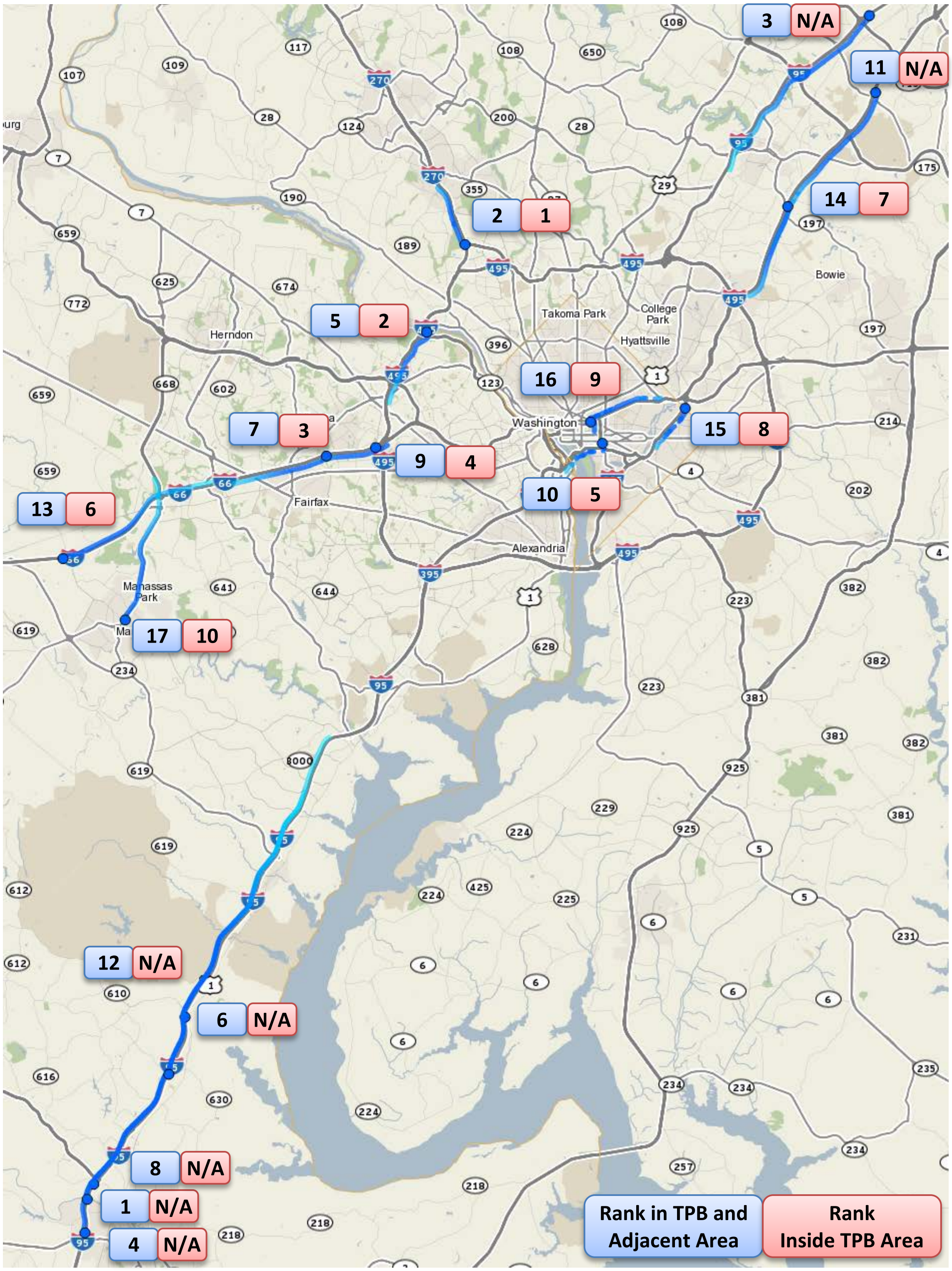
Another important factor in ranking the bottlenecks is the number of vehicles or people affected by the bottlenecks. Therefore the 2011 annual average daily traffic (AADT) was obtained from the TPB's Regional Transportation Data Clearinghouse, and a new bottleneck ranking is produced based on the product of the Impact Factor and the AADT, as shown in Table 4 and Figure 26. Under this new ranking, the I-270 Spur SB @ I-270 bottleneck became the No. 1 in the region and No. 2 in the bigger area, underlining the severity of this bottleneck; at the same time, several bottlenecks within the TPB advanced their rankings in the bigger area, such as I-495 CW @ American Legion Bridge (from 7th to 5th), I-66 EB @ Vaden Dr/Exit 62 (from 8th to 7th), I-66 EB @ I-495/Exit 64 (from 13th to 9th), I-395 NB @ 2nd St (from 12th to 10th).

Table 4: 2013 Top Bottlenecks Based on Speed and AADT

Rank in TPB and Adjacent Area	Rank Inside TPB Area	Location	Average Duration	Queue Length (miles)	Occurrences	Impact Factor	2011 AADT*
1	N/A	I-95 SB @ Fred./Sta. Co Line	5 h 6 m	32.0	311	3,055,956	70,500
2	**1**	**I-270 Spur SB @ I-270**	**1 h 42 m**	**6.4**	**884**	**591,198**	133,326
3	N/A	I-95 NB @ MD-100/Exit 43	2 h 51 m	14.5	279	756,736	97,667
4	N/A	I-95 SB @ VA-3/Exit 130	5 h 45 m	32.3	115	1,283,658	56,500
5	**2**	**I-495 CW @ American Legion Bridge**	**2 h 47 m**	**4.7**	**800**	**640,474**	107,242
6	N/A	I-95 SB @ VA-630/Exit 140	4 h 6 m	20.1	161	795,652	67,000
7	**3**	**I-66 EB @ Nutley St/Exit 62**	**1 h 58 m**	**6.5**	**567**	**490,498**	89,000
8	N/A	I-95 SB @ US-17/Exit 133	5 h 8 m	30.2	60	657,455	65,500
9	**4**	**I-66 EB @ I-495/Exit 64**	**1 h 53 m**	**4.6**	**968**	**513,693**	81,000
10	**5**	**I-395 NB @ 2nd St**	**1 h 43 m**	**3.8**	**1388**	**534,048**	75,716
11	N/A	MD-295 NB @ MD-175	3 h 48 m	13.8	261	823,541	48,225
12	N/A	I-95 SB @ US-1/VA-610/Exit 143	3 h 9 m	12.0	175	558,193	70,500
13	**6**	**I-66 WB @ VA-234/Exit 47**	**2 h 21 m**	**10.9**	**339**	**604,192**	63,500
14	**7**	**MD-295 NB @ MD-197/Exit 11**	**2 h 47 m**	**6.7**	**444**	**505,186**	53,535
15	**8**	**DC-295 NB @ Eastern Ave**	**2 h 49 m**	**3.9**	**428**	**334,024**	56,374
16	**9**	**US-50 WB @ 10th St**	**4 h 19 m**	**13.1**	**145**	**546,624**	12,146
17	**10**	**VA-28 SB @ Prescott Ave/Sudley Rd**	**3 h 23 m**	**8.2**	**196**	**330,540**	14,464

Bold texts indicate bottlenecks inside the TPB Planning Area.
*2011 AADT Source: TPB Regional Transportation Data Clearinghouse, https://gis.mwcog.org/webmaps/rtdc/ .

Figure 26: 2013 Top Bottlenecks Based on Speed and AADT



2.1.1.6 Quarterly National Capital Region Congestion Report

Inspired by various agency and jurisdictional dashboard efforts around the country (e.g., the Virginia Department of Transportation Dashboard), driven by the MAP-21 legislation and the emerging probe-based traffic speed data from the I-95 Corridor Coalition Vehicle Probe Project, this quarterly updated National Capital Region Congestion Report takes advantage of the availability of rich data and analytical tools to produce customized, easy-to-communicate, and quarterly updated traffic congestion and travel time reliability performance measures for the Transportation Planning Board (TPB) Planning Area. The goal of this effort is to timely summarize the region's congestion and the programs of the TPB and its member jurisdictions that would have an impact on congestion, to examine reliability and non-recurring congestion for recent incidents/occurrences, in association with relevant congestion management strategies, and to prepare for the MAP-21 performance reporting.

This quarterly report includes congestion and travel time reliability analysis, top 10 bottlenecks in a quarter, congestion maps, quarterly spotlight focusing on notable event(s) and its transportation impacts during that quarter, background and methodology information. This repot can be accessed via www.mwcog.cog/congestion. A screenshot of the first page of the 4th Quarter 2013 Report is shown in Figure 27.

Figure 27: National Capital Region Congestion Report (First Page)

Congestion – Travel Time Index (TTI)

Interstate System

TTI 4th Quarter 2013:	1.26	↓4.7% or 0.06[1]
TTI 2013:	1.24	↓2.9% or 0.04[2]

Non-Interstate NHS[3]

TTI 4th Quarter 2013:	1.18	↓0.6% or 0.01
TTI 2013:	1.17	↓0.4% or 0.004

Non-NHS

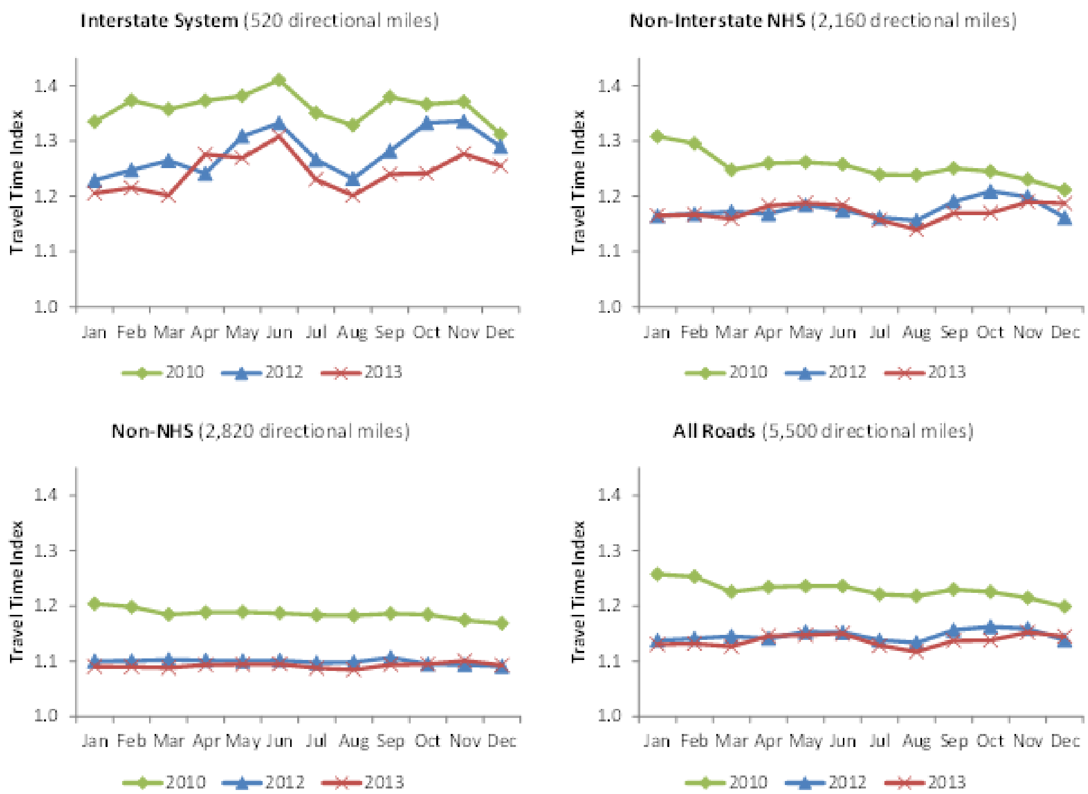
TTI 4th Quarter 2013:	1.10	↑0.3% or 0.003
TTI 2013:	1.09	↓0.6% or 0.01

All Roads

TTI 4th Quarter 2013:	1.15	↓0.7% or 0.01
TTI 2013:	1.14	↓0.8% or 0.01

[1] Compared to 4th quarter 2012; [2] Compared to 2012; [3] NHS: National Highway System.

Figure 1. Monthly average Travel Time Index for Total AM peak (6:00-10:00 am) and PM peak (3:00-7:00 pm)



Travel Time Index

Travel Time Index (TTI), defined as the ratio of actual travel time to free-flow travel time, measures the intensity of congestion. The higher the index, the more congested traffic conditions it represents, e.g., TTI = 1.00 means free flow conditions, while TTI = 1.30 indicates the actual travel time is 30% longer than the free-flow travel time.

2.1.1.7 Travel Times along Major Freeway Commute Routes

In addition to the regional summaries as presented by the above performance measures, route- or corridor-specific analysis has also been carried out in this report. A total of 18 major freeway commute routes are defined between major interchanges and/or major points of interest, as shown in Table 5 and Figure 28:

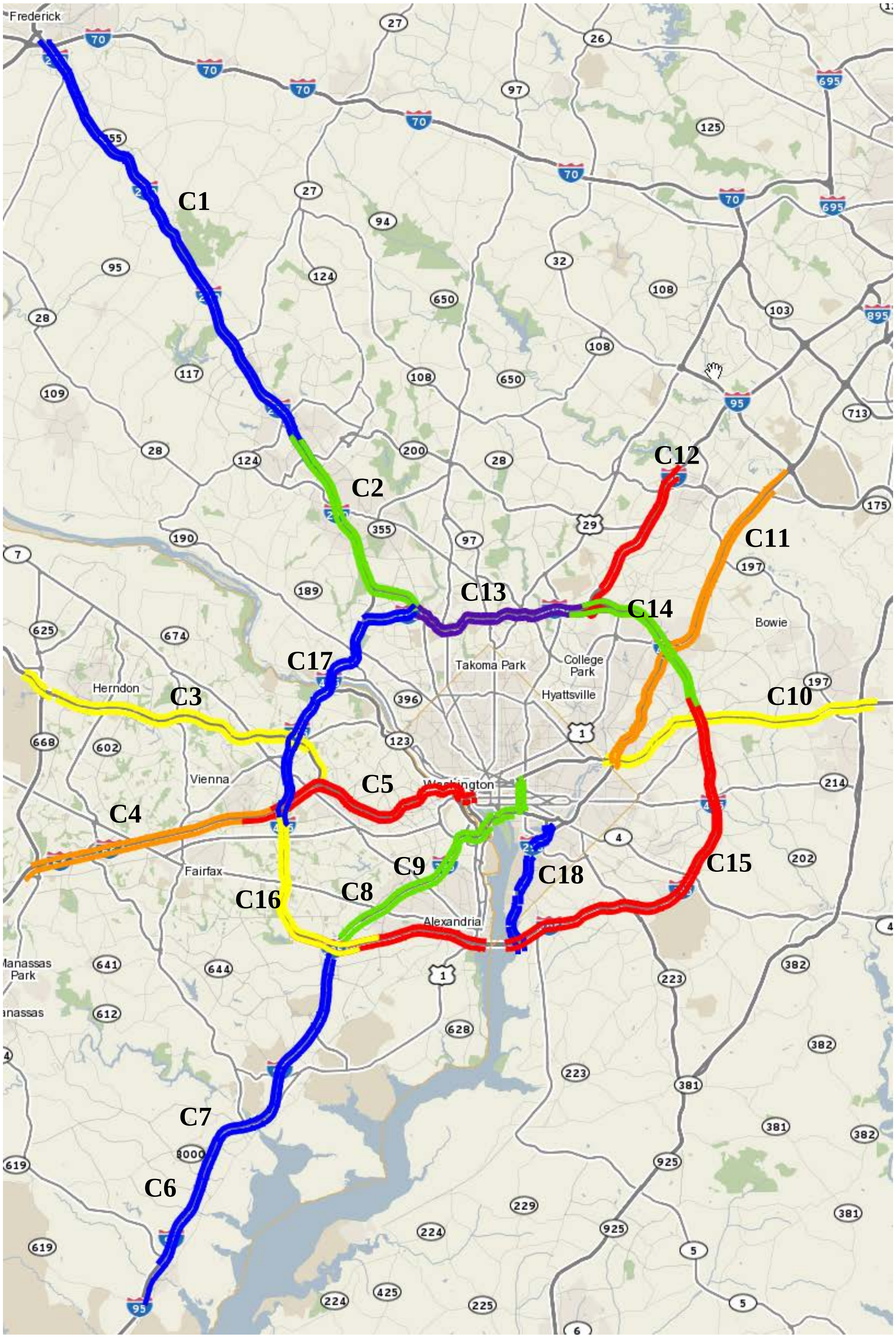
Table 5: Major Freeway Commute Routes

Route Code	Description
C1	I-270 between I-370/Sam Eig Hwy/Exit 9 and I-70/US-40
C2	I-270 between I-370/Sam Eig Hwy/Exit 9 and I-495/MD-355
C3	VA-267 between VA-28/Exit 9a and VA-123/Exit 19
C4	I-66 between VA-28/Exit 53 and I-495/Exit 64
C5	I-66 between I-495/Exit 64 and Theodore Roosevelt Memorial Bridge
C6	I-95 between VA-234/Exit 152 and Franconia Rd/Exit 169
C7	I-95 HOV between VA-234/Exit 152 and Franconia Rd/Exit 169
C8	I-395 between I-95 and H St
C9	I-395 HOV between I-95 and US-1
C10	US-50 between MD-295/Kenilworth Ave and US-301/Exit 13
C11	MD-295 between US-50/MD-201/Kenilworth Ave and MD-198
C12	I-95 between I-495/Exit 27-25 and MD-198/Exit 33
C13	I-495 between I-270/Exit 35 and I-95/Exit 27
C14	I-495 between I-95/Exit 27 and US-50/Exit 19
C15	I-495 between US-50/Exit 19 and I-95/I-395/Exit 57
C16	I-495 between I-95/I-395/Exit 57 and I-66/Exit 9
C17	I-495 between I-66/Exit 9 and I-270/Exit 35
C18	I-295 between I-495 and 11th St. Bridge

Travel times along the 18 major commute routes in both directions were plotted by the "Performance Charts" tool of the VPP Suite for every Tuesday, Wednesday and Thursday in 2010-2013, as shown in Figure 29 below (one example) and Appendix C (all 18 corridors). The travel times and planning times (95th percentile travel times) during AM Peak (6:00-10:00 am) and PM Peak (3:00-7:00 pm) are also provided in Table 6 and Table 7.

One caveat of the method employed in the major commute route analysis is that the route travel time is calculated as *instantaneous travel time* other than *experienced travel time*. Instantaneous travel time is the travel time that would result if prevailing traffic conditions remained unchanged; in other words, the instantaneous route travel time is simply the sum of all segment travel times. The experienced travel time is the travel time of the user who has just completed the considered trip, and is generally not equal to the sum of segment travel times, especially during unstable traffic conditions. This caveat in the methodology merits future improvements.

Figure 28: Major Freeway Commute Routes



(Screenshot was captured from vpp.ritis.org)

Figure 29: Sample of Travel Times along Major Freeway Commute Routes

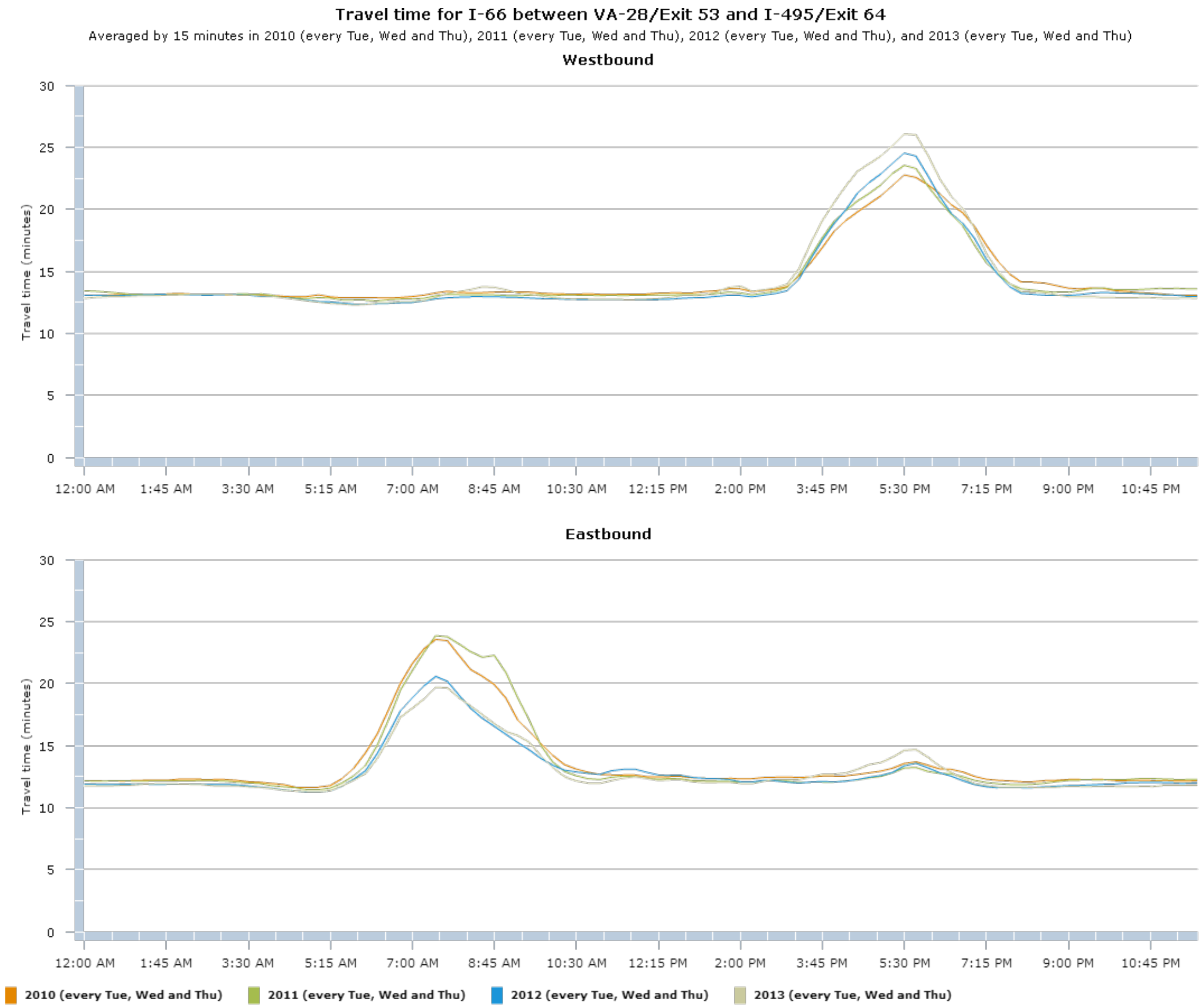


Table 6: Travel Time on Major Freeway Commute Routes in AM Peak Period (6:00-10:00 am)

Route	Length (miles)	Average Travel Time in Peak Period (min)				Reliable (95th) Travel Time* in Peak Period (min)				2013 Change in Average Travel Time in Peak Period (min)			2013 Change in 95th Travel Time in Peak Period (min)		
		2010	2011	2012	2013	2010	2011	2012	2013	vs. 2010	vs. 2011	vs. 2012	vs. 2010	vs. 2011	vs. 2012
C1: I-270 SB from I-70 to I-370	24	33	29	29	29	81	65	60	58	-4	0	0	-23	-7	-2
C2: I-270 SB from I-370 to I-495	10	16	14	13	14	35	34	29	29	-2	-1	0	-7	-5	0
C3: VA-267 EB from VA-28 to VA-123	14	18	18	15	15	43	39	29	29	-3	-2	0	-14	-10	0
C4: I-66 EB from VA-28 to I-495	12	19	20	17	17	48	41	35	32	-3	-3	0	-16	-9	-2
C5: I-66 EB from I-495 to TR Bridge	13	20	19	16	17	43	42	34	34	-3	-3	0	-9	-8	-1
C6: I-95 NB from VA-234 to Exit 169	20	25	24	24	24	61	61	59	56	-1	0	-1	-5	-5	-3
C7: I-95 NB HOV from VA-234 to Exit 169	18	18	17	17	17	28	27	24	23	-1	-1	0	-5	-4	-1
C8: I-395 NB from I-95 to H St.	13	24	24	23	23	66	68	65	62	-1	-2	-1	-3	-6	-2
C9: I-395 NB HOV from I-495 to US-1	11	14	14	13	13	31	30	29	27	-1	-1	0	-5	-3	-2
C10: US-50 WB from US-301 to MD-295	14	17	16	16	16	32	31	28	28	-1	0	0	-4	-3	0
C11: MD-295 SB from MD-198 to US-50	16	21	20	19	19	50	47	42	40	-2	-1	0	-10	-6	-2
C12: I-95 SB from MD-198 to I-495	8	11	10	9	9	28	28	20	19	-2	-1	0	-9	-9	-1
C13: I-495 IL from I-270 to I-95	10	12	11	11	11	18	18	18	16	-1	0	0	-3	-2	-2
C14: I-495 IL from I-95 to US-50	9	10	10	9	9	12	12	12	12	0	0	0	0	-1	0
C15: I-495 IL from US-50 to I-95	28	28	28	27	29	41	38	41	46	1	1	2	5	8	5
C16: I-495 IL from I-95 to I-66	10	17	17	14	11	39	36	34	16	-7	-6	-3	-22	-20	-18
C17: I-495 IL from I-66 to I-270	14	16	16	15	15	25	24	25	26	-1	-1	0	1	2	1
C13: I-495 OL from I-95 to I-270	10	20	19	17	18	43	44	38	38	-2	-1	1	-5	-6	0
C14: I-495 OL from US-50 to I-95	10	12	12	11	11	24	25	22	20	-1	0	0	-4	-5	-2
C15: I-495 OL from I-95 to US-50	29	31	30	29	28	46	46	43	39	-3	-2	-1	-7	-7	-5
C16: I-495 OL from I-66 to I-95	11	10	10	10	10	12	12	11	10	-1	-1	0	-2	-1	0
C17: I-495 OL from I-270 to I-66	14	15	15	15	14	23	23	20	18	-1	-2	-1	-5	-5	-2
C18: I-295 NB from I-495 to 11th St. Brdg.	6	10	9	10	9	28	25	30	25	0	0	0	-3	-1	-5

* The majority (95%) of trips spent equal to or less than the reliable (95^{th}) travel time on the specified route. On average, a traveler could successfully complete the travel on the specified route within the reliable travel time during 19 out of 20 trips (only 1 trip could exceed the reliable travel time).

Table 7: Travel Time on Major Freeway Commute Routes in PM Peak Period (3:00-7:00 pm)

Route	Length (miles)	Average Travel Time in Peak Period (min)				Reliable (95th) Travel Time* in Peak Period (min)				2013 Change in Average Travel Time in Peak Period (min)			2013 Change in 95th Travel Time in Peak Period (min)		
		2010	2011	2012	2013	2010	2011	2012	2013	vs. 2010	vs. 2011	vs. 2012	vs. 2010	vs. 2011	vs. 2012
C1: I-270 NB from I-370 to I-70	24	30	29	29	28	63	55	54	52	-2	-1	-1	-11	-3	-2
C2: I-270 NB from I-495 to I-370	9	12	12	12	12	23	25	24	24	0	0	0	1	-1	0
C3: VA-267 WB from I-66 to VA-28	15	17	16	15	15	25	22	22	21	-1	-1	0	-4	-1	-1
C4: I-66 WB from I-495 to VA-28	13	19	20	20	22	38	43	43	45	2	2	1	7	2	1
C5: I-66 WB from TR Bridge to I-495	11	15	14	13	14	31	33	28	29	-1	0	1	-1	-4	1
C6: I-95 SB from Exit 169 to VA-234	18	30	28	29	29	89	77	82	83	-1	1	0	-6	6	0
C7: I-95 SB HOV from Exit 169 to VA-234	17	18	17	17	18	30	28	27	34	-1	0	1	4	6	6
C8: I-395 SB from H St. to I-95	14	20	22	22	21	39	45	44	45	1	-1	0	6	0	1
C9: I-395 SB HOV from US-1 to I-495	11	12	12	11	11	20	17	17	17	-1	0	0	-2	0	0
C10: US-50 EB from MD-295 to US-301	13	15	14	14	14	21	20	19	19	-1	0	0	-2	-1	-1
C11: MD-295 NB from US-50 to MD-198	15	24	23	21	22	51	53	48	51	-3	-1	0	0	-2	3
C12: I-95 NB from I-495 to MD-198	7	9	8	8	8	15	16	15	18	0	0	1	3	2	3
C13: I-495 IL from I-270 to I-95	10	18	17	16	15	43	44	41	39	-3	-3	-1	-4	-5	-2
C14: I-495 IL from I-95 to US-50	9	12	12	12	12	24	27	26	25	0	0	0	1	-2	-1
C15: I-495 IL from US-50 to I-95	28	30	29	28	28	45	44	42	36	-3	-1	0	-9	-8	-6
C16: I-495 IL from I-95 to I-66	10	11	11	10	9	25	24	15	11	-2	-1	0	-14	-13	-4
C17: I-495 IL from I-66 to I-270	14	25	23	24	24	83	84	81	72	-1	1	0	-11	-12	-9
C13: I-495 OL from I-95 to I-270	10	14	12	11	11	40	34	23	26	-3	-1	0	-14	-8	3
C14: I-495 OL from US-50 to I-95	10	12	11	11	12	24	24	19	22	0	0	0	-2	-2	3
C15: I-495 OL from I-95 to US-50	29	31	30	30	31	54	61	59	61	0	0	1	6	0	1
C16: I-495 OL from I-66 to I-95	11	13	12	12	11	23	23	19	16	-3	-2	-1	-7	-8	-3
C17: I-495 OL from I-270 to I-66	14	23	23	20	16	65	66	62	33	-7	-6	-4	-31	-33	-29
C18: I-295 SB from 11th St. Brdg. to I-495	6	10	10	10	10	21	22	22	21	0	0	0	0	-2	-1

* The majority (95%) of trips spent equal to or less than the reliable (95^{th}) travel time on the specified route. On average, a traveler could successfully complete the travel on the specified route within the reliable travel time during 19 out of 20 trips (only 1 trip could exceed the reliable travel time).

2.1.1.8 Congestion on Arterials

Congestion Characteristics on Arterials

An arterial highway is defined as an interrupted flow roadway. Arterials are different than freeways in that they tend to have multiple ingress and egress points, intersections, fewer lanes, and lower speeds. Due to these characteristics, the congestion on arterials can be caused from reasons different from that of freeways.

As mentioned earlier, the TPB had carried out Arterial Floating Car Travel Time Studies from 2000 – 2011 on selected NHS arterial highways in the region. These studies had identified some common themes and trends about general arterial congestion:

- There are competing demands of traveler mobility and accessibility to adjacent land uses affecting arterial operations.
- Growth and development can contribute to rapid worsening of congestion at specific locations.
- Intersections and driveways can cause slow-downs and backups along arterials.
- Arterials often experience spillover from freeways.
- Arterials tend to be heavily traveled in densely developed corridors.
- Traffic engineering improvements, such as extending a turn lane or traffic signal timing, can help soften the impacts of growth.
- By nature of design and other factors, arterials can be a mix of speeds, depending on things such as number of traffic signals, intersections, and lanes.
- Since the Washington region has a limited number of freeway lane miles, the region is especially dependent upon its arterial highways for mobility.
- Cars share the road with transit and delivery vehicles with frequent stops.

Although congestion occurs on arterials throughout the region, there are also common trends that are generally associated with the land use and urban form surrounding the arterial. For the purposes of this report, we will classify these as metro core, inner suburban and outer suburban arterials.

Arterials in the Inner Core

The characteristics of the inner core of a region, by their urban nature, can greatly impact the flow of traffic on the core's arterials:

- Pedestrian and transit access to densely populated land uses are a major focus of inner core roadways. Traffic speeds must be at a level that ensures pedestrian safety.
- The flow of traffic is more frequently interrupted by a higher concentration of signaled intersections and driveways/alleyways in the inner core.

- Intersections tend to be close together. If traffic is stopped at an intersection, sometimes backups can occur through the intersection behind it. In addition, traffic blocking an intersection could impact the flow of traffic on the cross street.
- There are not always turn lanes present, so drivers may have to wait while a car in front of them makes a turn.
- On-street parking necessitates slower traffic speeds. In addition, some inner core arterials experience worse congestion in the off-peak period because two lanes of capacity are lost due to on-street parking during the day.
- In many older areas, a grid pattern of streets allows for multiple travel routes at moderate speeds.

For example, many of these inner core characteristics play a role in the congestion on Connecticut Ave NW, between K Street NW and Nebraska Ave NW. This segment of Connecticut Ave is a dense corridor of retail and commercial activity which attracts a large number of pedestrians and drivers searching for on-street parking.

Congestion management strategies that can help manage congestion on core arterials include operations management strategies such as optimized traffic signal timing and traffic engineering improvements. Relevant demand management strategies include robust transit services in these densely populated areas, employer outreach of alternative commute programs, as well as improved pedestrian and bicycle facilities.

Arterials in the Inner Suburbs

Arterials in the inner suburbs have characteristics combined from that of the inner core and outer suburban arterials.

- Signalized intersections, especially the intersections of major arterial roadways, have capacity limitations, especially when there are high percentages of turning movements at those intersections.
- Traffic from both nearby offices and residences can cause congestion.
- There can be spillover from adjacent congested freeways.
- Strip retail and other “destination” retail activities are often located along arterials. In the inner suburbs the density of these uses is likely higher than that of the outer suburbs, and ingress/egress points are closer together. This could cause disruptions in traffic flow during peak times.
- Inner suburban areas have been experiencing welcome increases in pedestrians and transit usage in recent years, which must be considered in operations planning for arterials in these areas.

For example, these inner suburban arterial qualities are true of US 29, which extends from Arlington, VA to Centreville, VA. The segment between M Street NW in DC and Harrison Street in Arlington is lined with several strip retail areas.

US 29 is also a major alternative commuting route of I-66, and it provides access to I-66 at several different locations. US 29 experienced spillover from several major freeways in the vicinity, including I-66 and the Beltway.

Georgia Ave, between Eastern Ave NW (DC boundary) and MD 28 also experiences situations typical of inner suburban arterials. Georgia Ave links Aspen Hill area to Silver Spring, serving as one of the major commuting routes to and from DC for the communities between I-270 and I-95 in Montgomery County in Maryland. The southern part of the corridor connects to US 29 in Silver Spring, a major arterial cross the region. Georgia Ave also experienced spillover from the Beltway in Silver Spring.

Congestion management strategies that can help inner suburban arterials include operational management strategies such as optimized traffic signals, operational management improvements on nearby freeways, and traffic engineering improvements. Often off-peak signal timing in inner suburban arterials can be worse than the peak hours, as a high number of people are moving in all directions and not with peak flow movement. Relevant demand management strategies include transit services, bus rapid transit, and Commuter Connections programs (especially employer-based programs).

Arterials in the Outer Suburbs

Arterials in the outer suburbs have their own unique characteristics:

- New development in the outer suburbs may quickly overwhelm the capacities of what were until recently lightly traveled rural roads.
- Because commute distances in the outer suburbs tend to be longer, peaking characteristics of traffic are much sharper.
- Transit services and pedestrian facilities are limited.
- Not unlike the inner suburbs, strip retail and other “destination” retail activities are likely to be located along outer suburban arterials. This could cause disruptions in traffic flow during peak times.
- Outer suburban arterials can also experience spillover from major freeways. This is especially expected during the morning and evening peak period when commuters drive to and from the inner core for work.

For example, MD144 between Waverly Road and Monocacy Boulevard in Frederick County experiences spillover from two major roadways that bypass in Frederick: I-70/I-270 and US 340/US 15 (Catoctin Mountain Highway).

The northern section of VA 7 between Georgetown Pike and VA 653 links Fairfax County to Leesburg. It is a major commuting route which connects to VA 28. The stretch of arterial from the Loudoun County line to Sterling has seen much commercial and retail development over the past several years.

Congestion management strategies that can help outer suburban arterials include operational management strategies such as bottleneck removal, dedicated turn lanes, and other traffic engineering improvements. Relevant demand management strategies include park-and-ride lots, commuter bus and rail services and Commuter Connections programs (especially employee-focused programs).

Congestion on Selected Arterials

Given the availability of the I-95 VPP/INRIX data, the TPB has adopted this third-party probe-based data for arterial travel time monitoring. This new data source enabled more detailed analysis of travels along arterials including travel time reliability. Appendices A and B provide the peak hour Travel Time Index and Planning Time Index on most of the region's NHS arterials for 2013.

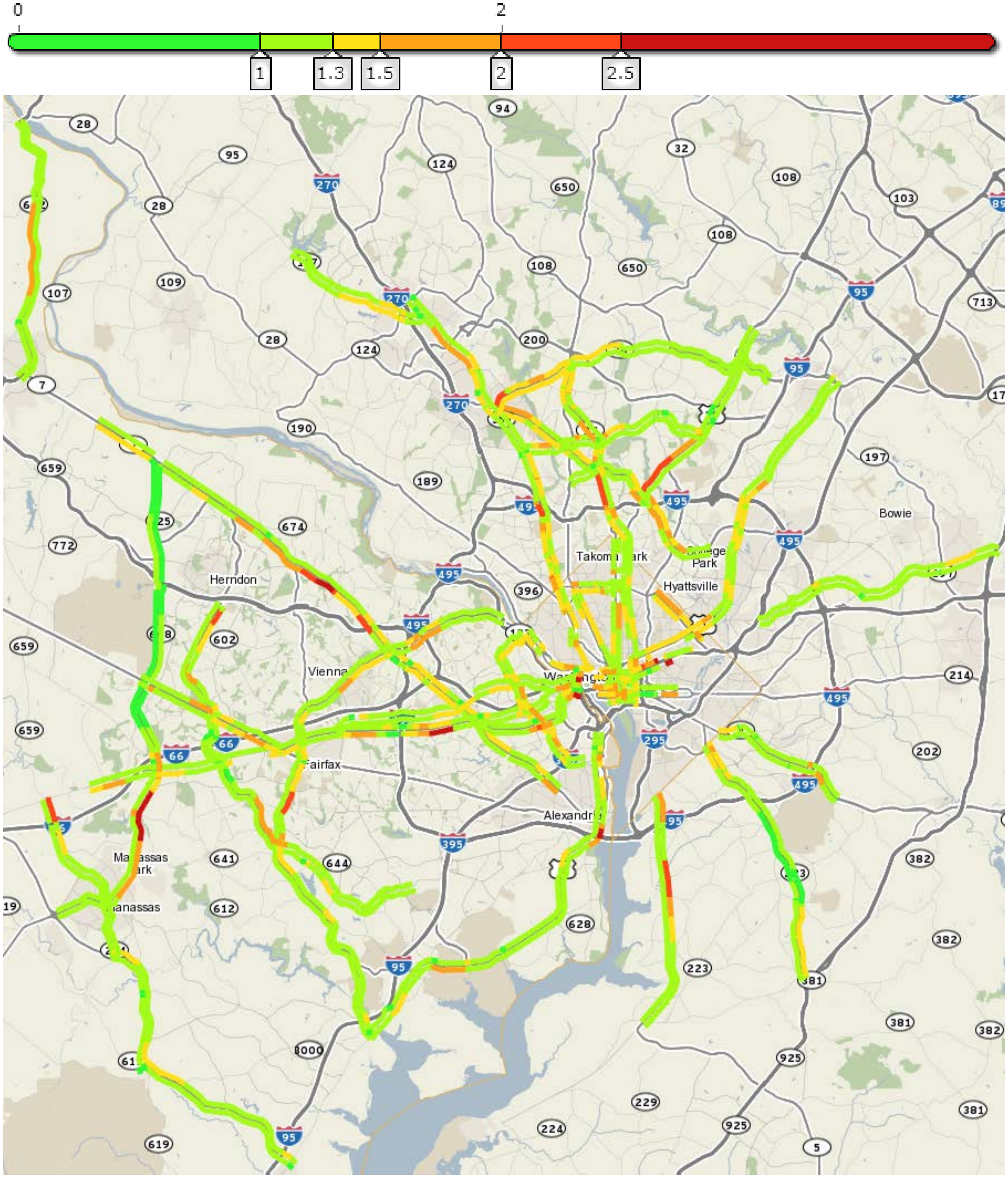
In addition to the regional summaries and congestion mapping on arterials that have been presented earlier in this chapter, this report also investigates the travel times along the study routes under the historical floating car surveys. This includes 58 routes shown in Table 8 below. Travel Time Index of the studied routes for middle weekday peak hours (8:00-9:00 am and 5:00-6:00 pm on Tuesdays, Wednesdays, and Thursdays) are mapped in Figure 30 and Figure 31.

Table 8: Arterial Travel Time Study Routes

State	Route	From/To	To/From	Length (miles)
DC	14th St	Independence Ave	K St	1.0
DC	16th St	K St	Eastern Ave	6.1
DC	17th St	Pennsylvania Ave	Independence Ave	0.5
DC	7th St/Georgia Ave Sec. 1	Independence Ave	New Hampshire Ave	2.8
DC	7th St/Georgia Ave Sec. 2	New Hampshire Ave	Eastern Ave	3.5
DC	Canal Rd/M St	30th St	Chain Bridge	3.7
DC	Connecticut Ave	K St	Nebraska Ave	4.0
DC	Constitution Ave	Louisiana Ave	14th St NE	1.5
DC	H St	Pennsylvania Ave	14th St NW	0.6
DC	Independence Ave	17th St	2nd St SE	1.9
DC	K St/New York Ave	21st St NW	Bladensburg Rd	4.2
DC	L St	Pennsylvania Ave	14th St NW	1.1
DC	Military Rd	Connecticut Ave	Georgia Ave	2.5
DC	Pennsylvania Ave	Constitution Ave	15th St NW	0.8
DC	Rhode Island Ave	7th St	Eastern Ave	3.5
DC	South Dakota Ave	Bladensburg Rd	Riggs Rd	3.0
DC	US 50	17th St	T. R. Bridge	0.9
DC	US 29	M St	Whitehurst Fwy	0.5
DC	Wisconsin Ave	M St	Western Ave	4.1
MD	MD 117	Muddy Branch Rd	Clarksburg Rd	6.8
MD	MD 193	Colesville Rd	Adelphi Rd	4.6
MD	MD 198	MD 650	Old Gunpowder Rd	5.2
MD	MD 210	Southern Ave	Livingston Rd	10.5
MD	MD 355 Sec. 1	MD 124	MD 547	10.1

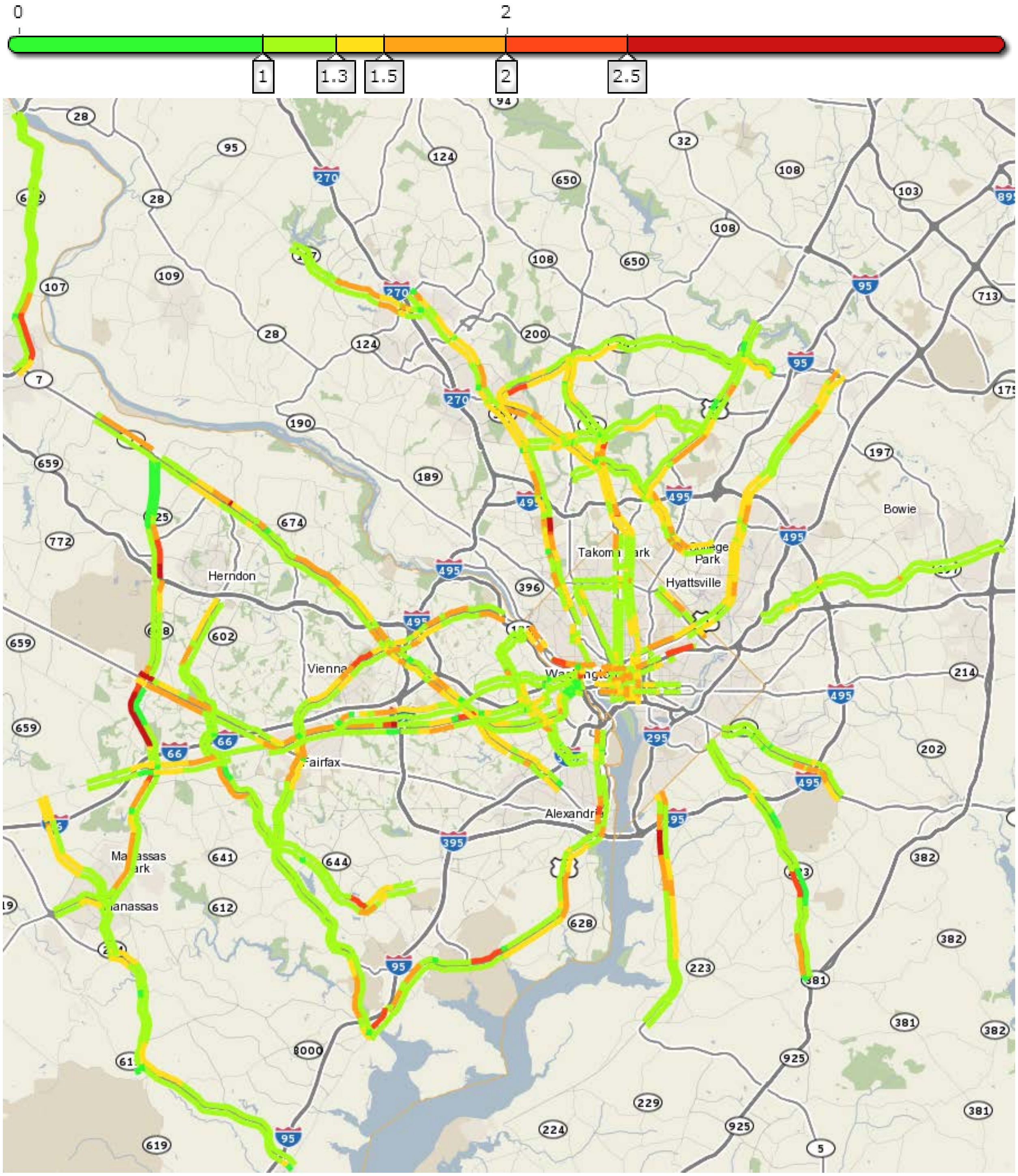
MD	MD 355 Sec. 2	MD 547	Western Ave	5.3
MD	MD 4	Southern Ave	Dowerhouse Rd	7.0
MD	MD 450	US 301	B. W. Pkwy	12.1
MD	MD 586	MD 28	MD 193	5.0
MD	MD 193	US 29	MD 185	4.2
MD	MD 28	Veirs Mill Rd	New Hampshire Ave	9.0
MD	MD 5	Suitland Pkwy	Accokeek Rd	12.2
MD	MD 97 Sec. 1	Eastern Ave	University Blvd	4.2
MD	MD 97 Sec. 2	University Blvd	MD 28	5.3
MD	Randolph Rd	MD 355	Columbia Pike	9.1
MD	US 1 Sec. 1	MD 198	MD 193	8.1
MD	US 1 Sec. 2	MD 193	Eastern Ave	5.3
MD	US 29	East-West Hwy	Fairland Rd	7.1
VA	US 15	VA 7	Lovettsville Rd	12.6
VA	US 50 Sec. 1	VA 28	Nutley St	13.4
VA	US 50 Sec. 2	Nutley St	Fort Myer Dr	12.3
VA	US 1	15th St	VA 123	20.0
VA	US 29 Sec. 1	G.W. Pkwy	Gallows Rd	9.0
VA	US 29 Sec. 2	Gallows Rd	VA 236	8.8
VA	US 29 Sec. 3	VA 236	Bull Run PO Rd	7.5
VA	VA 120	I 395	Chain Bridge	8.3
VA	VA 123 Sec. 1	VA 193	VA 7	5.8
VA	VA 123 Sec. 2	VA 7	VA 236	7.1
VA	VA 123 Sec. 3	VA 236	US 1	14.8
VA	VA 234 Sec. 1	US 1	Hoadley Rd	10.2
VA	VA 234 Sec. 2	Hoadley Rd	US 29	13.2
VA	VA 28 Sec. 1	Wellington Road	Compton Rd	7.0
VA	VA 28 Sec. 2	Compton Rd	VA 7	17.0
VA	VA 7 Sec. 1	Braddock Rd	Gallows Rd	9.5
VA	VA 7 Sec. 2	Gallows Rd	VA 193	10.0
VA	VA 7 Sec. 3	VA 193	VA 28	8.0
VA	VA 286 Sec. 1	Sunrise Valley	US 50	6.2
VA	VA 286 Sec. 2	US 50	Rolling Rd	20.0
VA	Wilson Blvd	Roosevelt Blvd	Fort Myer Dr	4.7
	Total			402.7

Figure 30: Travel Time Index on Selected Arterials during 8:00-9:00 am on Middle Weekdays in 2013



Note: Congestion levels are categorized by the value of TTI: TTI = 1.0: Free flow
1.0<TTI<=1.3: Minimal
1.3<TTI<=1.5: Minor
1.5<TTI<=2.0: Moderate
2.0<TTI<=2.5: Heavy
2.5<TTI: Severe

Figure 31: Travel Time Index on Selected Arterials during 5:00-6:00 pm on Middle Weekdays in 2013



Note: Congestion levels are categorized by the value of TTI: TTI = 1.0: Free flow
1.0<TTI<=1.3: Minimal
1.3<TTI<=1.5: Minor
1.5<TTI<=2.0: Moderate
2.0<TTI<=2.5: Heavy
2.5<TTI: Severe

Future Arterial Congestion Analysis

Using the VPP/INRIX data for arterial congestion monitoring is considered by many practitioners a challenging task. One major concern is the validity of the data, especially on arterials on which traffic volumes were much less than that of freeways. Unlike the freeways, the VPP currently has no on-going third-party data validation tests to ensure data quality on arterials. The segmentation, based on which the probe data is reported, on arterials is also less straightforward than on freeways. In order to better utilize the data for arterial monitoring, staff plans to carry out two studies in the near future:

- Compare the VPP/INRIX data to Bluetooth data and other available data sources on selected arterials.
- Conduct arterial corridor travel time studies on all of the routes monitored by the previous floating car surveys.
- Conduct arterial congestion and reliability analysis on additional routes.

Improving Congestion on Arterials

Adding capacity on arterials to reduce congestion is seldom feasible, as many arterials are already built to capacity with development on either side. However, there are demand management and operational management strategies that could offer solutions. The addition of express bus or other types of public transportation along an arterial could decrease the amount of cars on the road. Pedestrian and bicycle improvements, such as the implementation of a new bike facility along the arterial can provide an alternative option for travelers. Operational improvements can include the addition of turn lanes, to reduce the amount of back-ups at an intersection, or the creation of additional lanes. Traffic signal timing optimization is also important in ensuring the appropriate movement of vehicles at intersections.

2.1.2 FREEWAY AERIAL PHOTOGRAPHY SURVEY

The TPB has contracted with Skycomp, Inc. to conduct a systematic aerial study of regional freeway congestion since 1993. The last survey was completed in Spring 2011 and the final report, *Traffic Quality on the Metropolitan Washington Area Freeway System*: *Spring 2011 Report*, can be downloaded from www.mwcog.org[36]. The last survey's highlights can be found in the *2012 Congestion Management Process (CMP) Technical Report.* A new survey was being carried out as of the writing of this report in 2014, and will be summarized in subsequent documents.

In the aerial photography survey, peak period freeway congestion is monitored on a once-every-three-years cycle during the AM and PM peak periods. It provides a wealth of information on the region's freeways, including the overall conditions of the freeways, specific congested locations, trends over time, and identification of factors associated with the congested conditions.

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[36] *Traffic Quality on the Metropolitan Washington Area Freeway System*: *Spring 20011 Report*. Prepared by: Skycomp, Inc. (Columbia, Maryland). http://www.mwcog.org/store/item.asp?PUBLICATION_ID=436

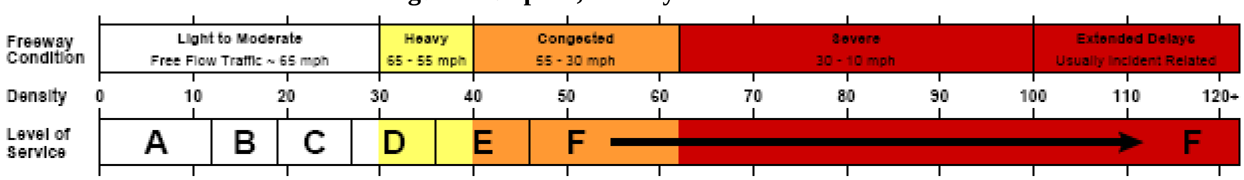
During a survey period, aircraft follow designated flight patterns along the region's approximately 300 centerline miles of limited-access highways. Survey flights were conducted on weekdays, excluding Monday mornings, Friday evenings, and mornings after holidays, during the following time periods:

- Morning surveying times:
  - 6:00 AM – 9:00 AM outside the Capital Beltway;
  - 6:30 AM – 9:30 AM inside the Capital Beltway.
- Evening surveying times:
  - 4:00 – 7:00 PM inside the Capital Beltway
  - 4:30 – 7:30 PM outside the Capital Beltway

During the survey flights, overlapping photographic coverage was obtained of each designated highway, repeated once an hour over four morning and four evening commuter periods (this means that, altogether, there were 12 morning and 12 evening observations[37] of each highway segment).

Data were then extracted from the aerial photographs to measure average traffic flow density by link and by time period. The density was further converted to level of service (LOS) [38] using methods presented in the *Highway Capacity Manual 2000*. LOS "A" reflects generally free-flow conditions, and levels "E" and "F" reflect the most severe congestion with extended delays, as illustrated in the following diagram (Figure 32).

Figure 32: Speed, Density and LOS Chart



The most recent peak period survey was conducted in Spring 2011 and the following summarizes the highlights of the survey results.

[37] In the 2014 survey, the total number of observations will be reduced from 12 to 9. Given the vast availability of the private-sector probe-based traffic data, e.g., the I-95 Vehicle Probe Project/INRIX data and the National Performance Management Research Data Set (NPMRDS)/HERE data (introduced later), the role of the aerial photography survey has transformed from being the major source of freeway congestion information to being an independent source that can be used to validate and supplement probe data; more importantly, it can provide unique visual imagery of congestion.

[38] There are generally six levels of service, A through F. Level of service "A" is the best, describing primarily free-flow conditions, while level of service "F" is the worst, describing flow as unstable and significant traffic delay.

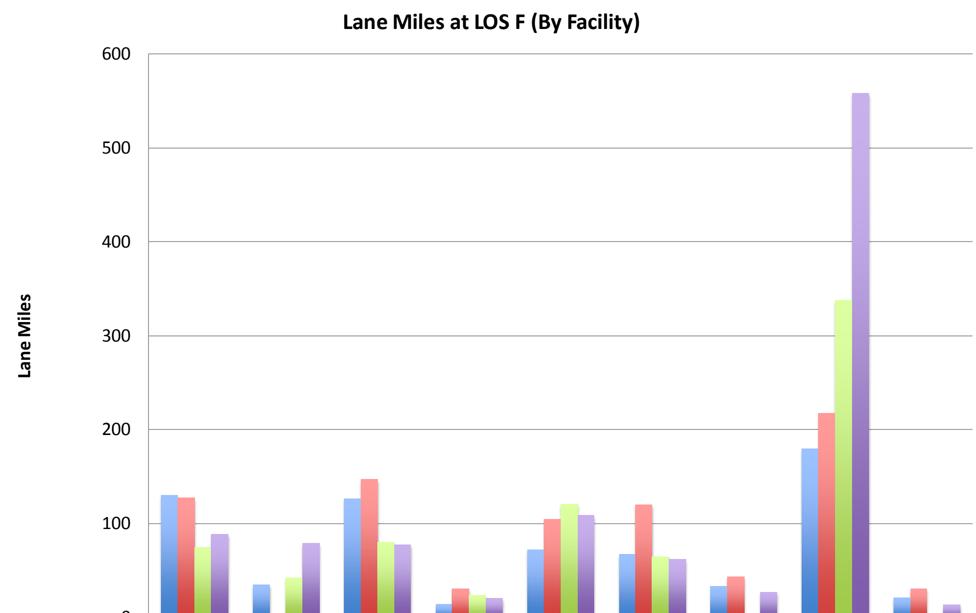
2.1.2.1 Highlighted Findings of the Spring 2011 Survey

Lane miles of congestion continue to grow in the region. Regionally lane miles under congested conditions (LOS F) which experienced a dip in 2008 due to the downturn in economy has increased by 50% over 2008 conditions but only 10% over the 2005 conditions. Note that the lane miles were calculated as the *total* of the three-hour peak period (i.e., total = sum of each hour's lane miles at LOS F).

Reviewing the 3-hour AM and PM peak period conditions, Skycomp also observed the peak spreading occurring in the region.

The lane miles at LOS F by facility are given in Figure 33. I-495 had the highest number of lane miles at LOS F in all time, and it also had the largest increase from 2008 to 2011 in the peak period (260 lane miles).

Figure 33: Lane Miles at LOS F



	I-270	I-295(Inside Beltway)	I-66 (Outside Beltway)	I-66 (Inside Beltway)	I-395	I-95 VA	I-95 MD	I-495 (Capital Beltway)	G/W Parkway
2008 (6-9AM)	130	35	126	14	72	67	33	180	21
2011 (6-9AM)	127	4	147	30	105	120	43	218	30
2008 (4-7PM)	75	42	79	23	121	64	0	337	1
2011 (4-7PM)	88	79	77	20	108	62	27	558	14

2.1.2.2 Improvements Observed in the Spring 2011 Survey

Figure 34 and Figure 35 provide overview maps of significant changes in traffic congestion from 2008 to 2011.

The biggest positive impact on congestion in the region was caused by the opening of the Wilson Bridge on May 30th, 2008. What used to be routine 3 hours of AM peak period congestion on the inner loop of the Capital Beltway (I-95) extending from St Barnabas Road in Prince George's County to Telegraph Road in Virginia has been completely eliminated. Additionally far away from the bridge AM peak period congestion on SB I-395 from the 11th street Bridge to the 14th Street Bridge and congestion on NB I-395 at the 14th Street Bridge in the District has been substantially reduced.

Another route with performance improvements was southbound Baltimore Washington Parkway due to geometric improvements, and bridge repair work. Congestion that existed since 2005 on SB B/W Parkway from I-495 to Pennsylvania has been substantially reduced.

Another route with improvement was eastbound VA 267 during the am peak between Fairfax County Parkway and International Drive. Skycomp could not identify any specific improvement that contributed to this change in congestion.

2.1.2.3 Degradation Observed in the Spring 2011 Survey

The following routes experienced more congestion as compared to 2008 and 2005 surveys. The cause appears to be increase in volume of traffic.

Eastbound I-66 during the AM peak period has deteriorated on both the general purpose lanes and HOV lanes between VA 234 bypass and VA 28.

Eastbound I-66 inside the beltway during the am peak period between VA 267 and Fairfax Drive even though this part of I-66 is limited to HOV 2+.

Northbound I-395 (general purpose lanes) during the AM peak period extending from the construction zone at the 14th Street Bridge to the Capital Beltway. The ramp from the HOV 3+ facility to the Pentagon also experienced congestion. The cause appears to be narrowing of lanes and short merge lanes due to the construction.

The right lane of southbound I-295 in Maryland during the pm peak period between Suitland Parkway and westbound Capital Beltway towards the Wilson Bridge. This bottleneck location could potentially be fixed by studying possible alternatives similar to the fix at the Beltway exit ramp to the Dulles Toll Road.

Figure 34: Significant Changes (2008-2011) – Morning Peak Period

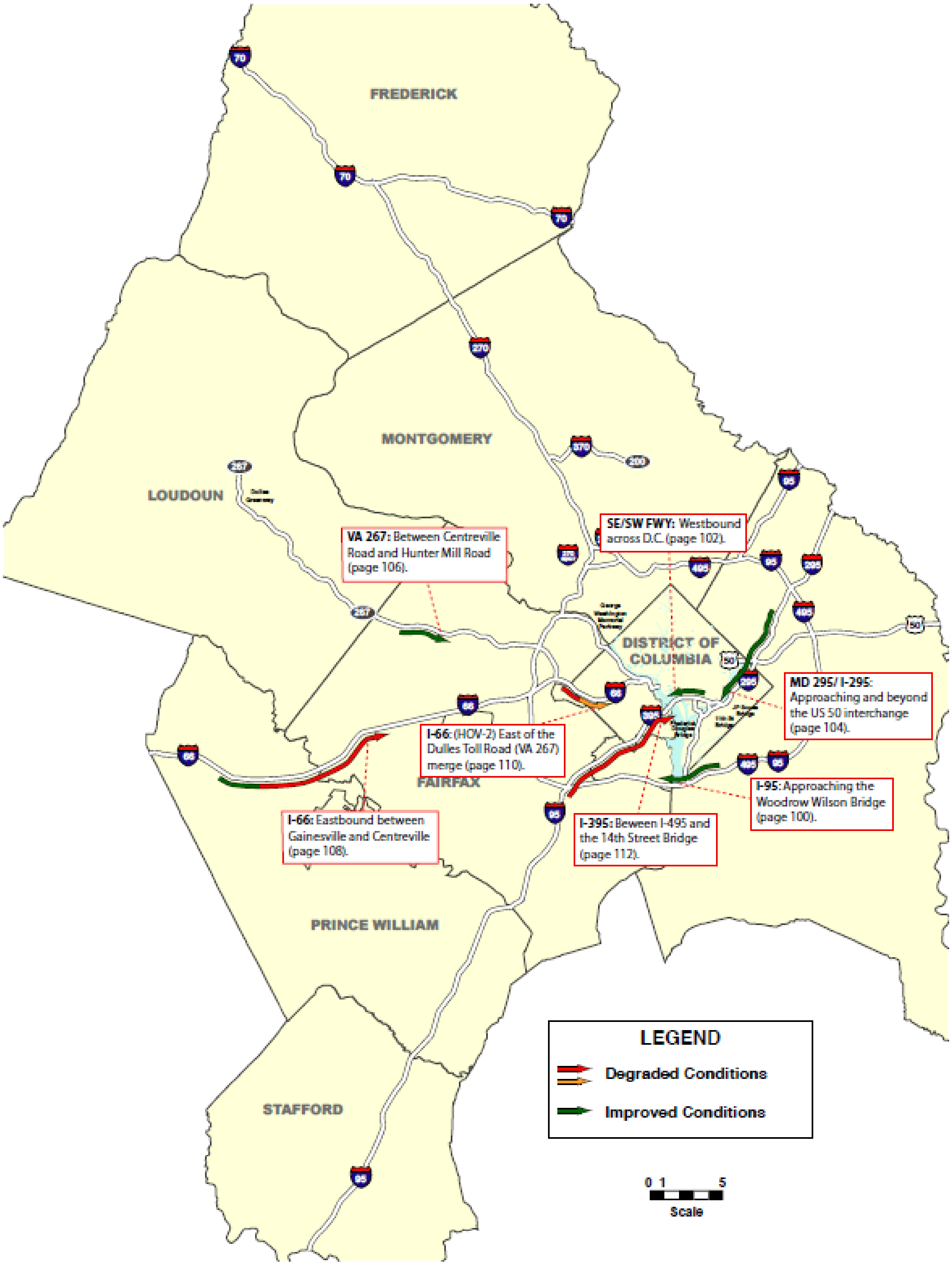
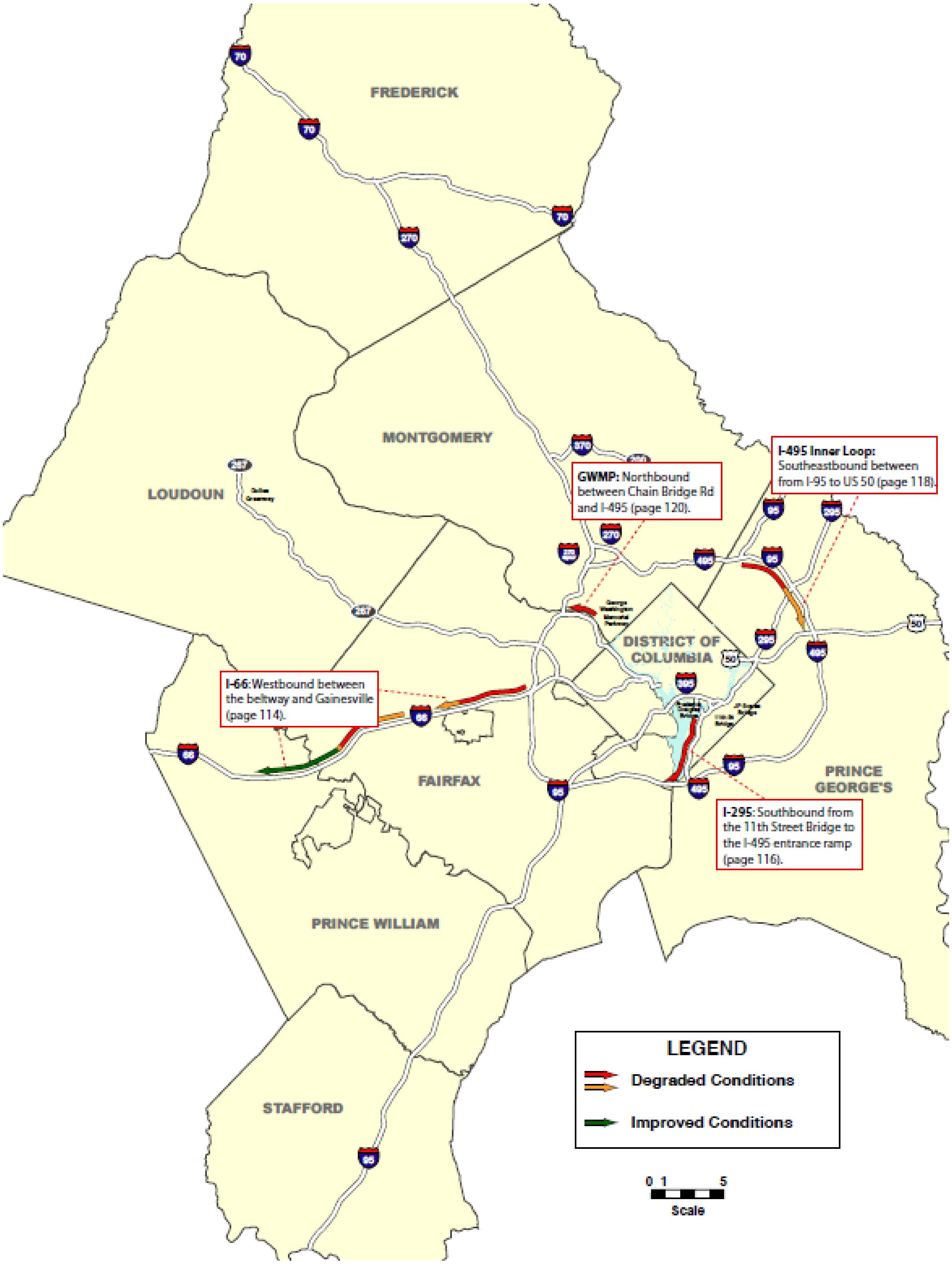


Figure 35: Significant Changes (2008-2011) – Evening Peak Period



2.1.2.4 Summary Congestion Maps of the Spring 2011 Survey

The summary maps of the AM and PM congestion of the Spring 2011 Survey are provided in Figure 36 and Figure 37.

Figure 36: Morning Peak Period Regional Congestion - Spring 2011

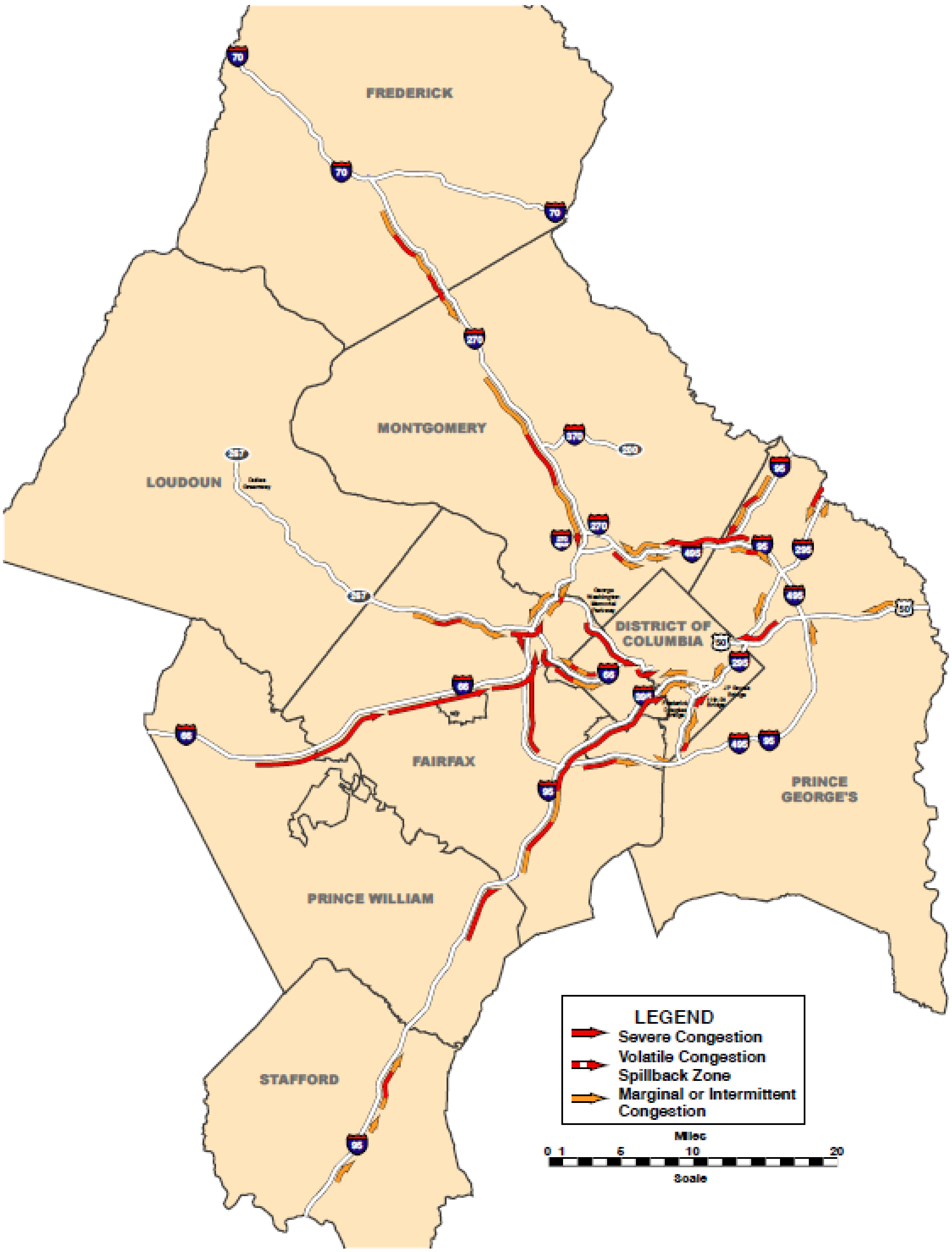
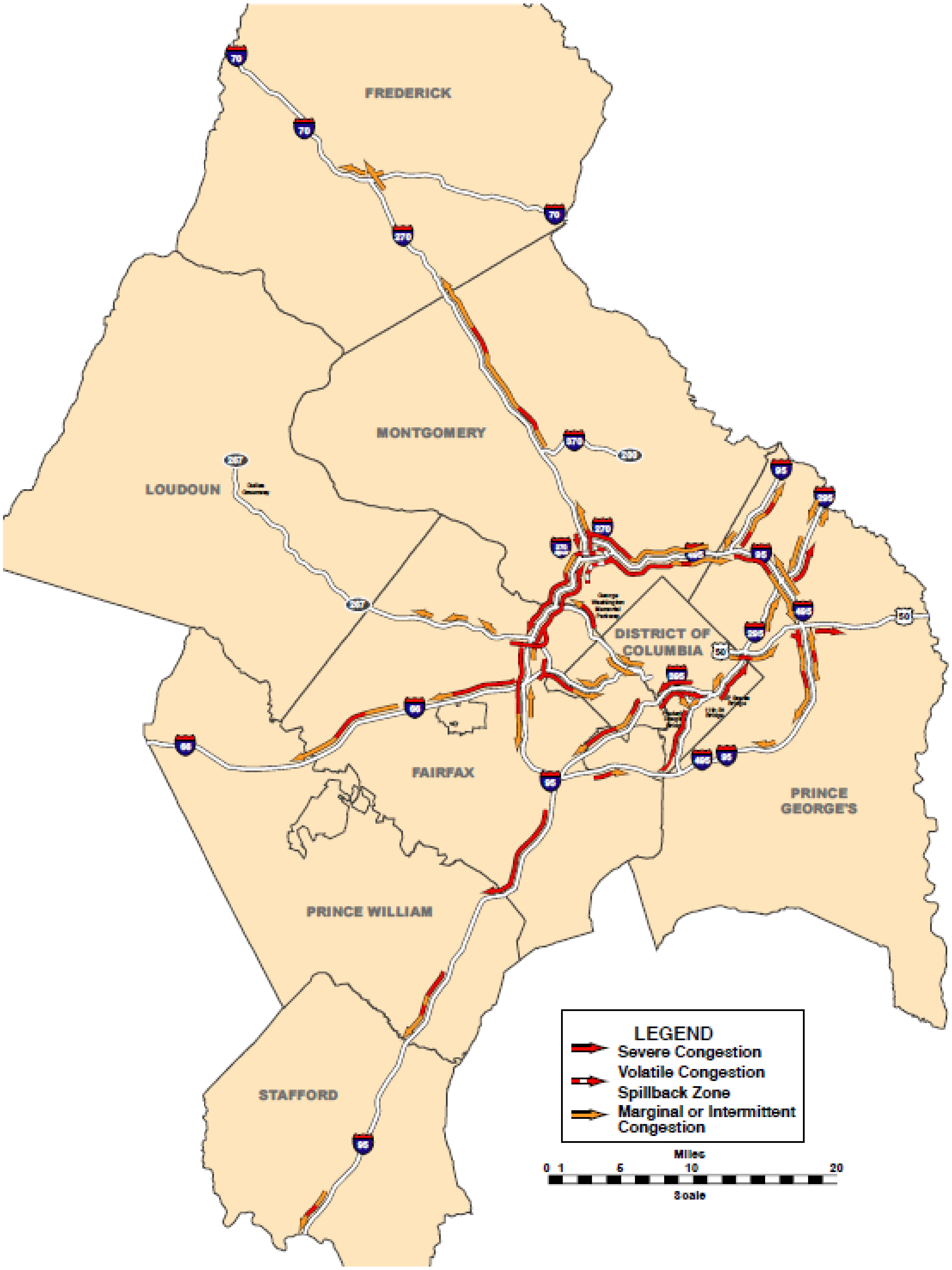


Figure 37: Evening Peak Period Regional Congestion – Spring 2011



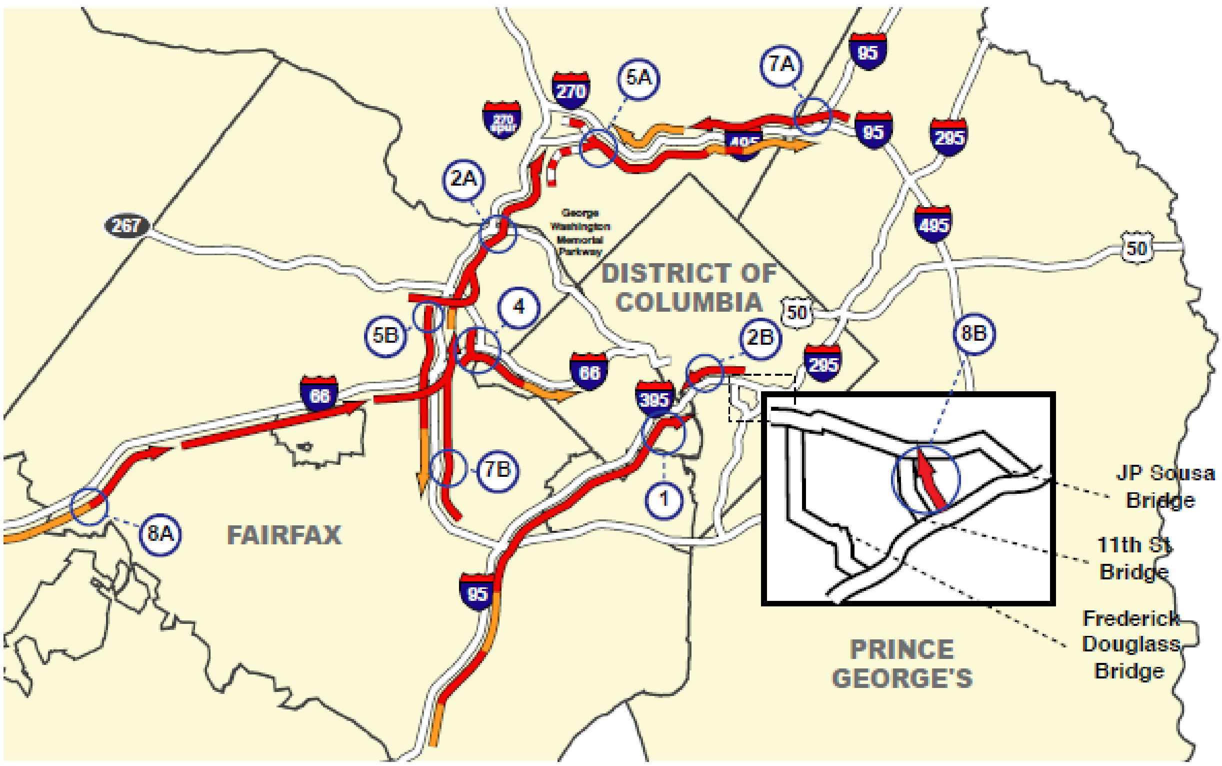
2.1.2.5 Top Ten Congested Locations in the Spring 2011 Survey

Figure 38 maps and lists the most congested locations on the region's freeway system. These locations were obtained by ranking the densities of all segments and picking the top ten irrespective of whether they are congested during the AM or PM peak period.

Figure 38: Top Ten Congested Locations – Spring 2011

Criteria for the top ten congested locations are as follows:

- A location is defined as a congested freeway segment, by direction, between interchanges; this congested location is typically within a larger queue.
- Rankings for the top ten are based on the average hourly density value which corresponds to a speed (see table below).
- Construction-related congestion was not included in the rankings unless the location was historically congested in the absence of construction.
- Congestion caused by traffic signals was not included in the rankings.



Top Ten Congested Segments on the Freeway System (2011)

Rank	Route	From	To	Density	Speed Range
1*	NB I-395 (8:30 to 9:30 AM)	VA 27 (Washington Blvd)	VA 110 (Jefferson Davis Hwy)	145	5 MPH
2A	IL I-495 (5:30 to 6:30 PM)	VA 193 (Georgetown Pike)	George Washington Mem Pkwy	125	5 to 10 MPH
2B	SB I-395/SW Fwy (6:00 to 7:00 PM)	4th St	12th St	125	5 to 10 MPH
4	EB I-66 (6:00 to 7:00 PM)	VA 7 (Leesburg Pike)	Dulles Access	115	7 to 12 MPH
5A	IL I-495 (4:30 to 5:30 PM)	MD 355 / I-270	MD 185 (Connecticut Ave)	110	10 to 15 MPH
5B*	OL I-495 (5:30 to 6:30 PM)	VA 267 (Dulles Toll Rd)	VA 123 (Chain Bridge Rd)	110	10 to 15 MPH
7A	OL I-495 (8:00 to 9:00 AM)	I-95	MD 650 (New Hampshire Ave)	105	12 to 20 MPH
7B*	IL I-495 (8:00 to 9:00 AM)	Gallows Rd	US 50 (Arlington Blvd)	105	12 to 20 MPH
8A	EB I-66 (7:00 to 8:00 AM)	VA 234 Bypass	VA 234 (Sudley Rd)	95	15 to 25 MPH
8B*	WB 11th St Bridge (7:30 to 8:30 AM)	I-295	Southeast Fwy	95	15 to 25 MPH

* While impacted by construction, these links are historically congested

2.1.2.6 Longest Delay Corridors in the Spring 2011 Survey

Beginning in 2008, the freeway aerial survey introduced a new metric – Longest Delay Corridors. The purpose of this metric was to identify corridors which might not have bottlenecks in the "Top Ten Congested Locations" but were long congested corridors. Delay was calculated by estimating the additional travel time during congested conditions over the free flow travel time. Free flow speed was assumed to be 60 mph. Figure 39 and Figure 40 present the top five congested corridors in the AM and PM peak period.

Figure 39: Longest Delay Corridors - Morning Peak Period (Spring 2011)

Site Name	Road Name	Time	Direction	From	To	Queue Length (miles)	Estimated Travel Time (minutes)	Estimated Speed (mph)	Estimated Delay (minutes)
Site #1	I-95/I-395	7:30 – 8:30	Northbound	US 1	GWMP	18.3	62.8	18	44.4
Site #2	I-66	7:00 – 8:00	Eastbound	VA 234 Bypass	I-495	19.4	48.0	24	28.6
Site #3	I-495	7:00 – 8:00	Outerloop	US 1	I-270	10.0	28.7	21	18.7
Site #4	I-495	8:00 – 9:00	Innerloop	I-95	I-66	8.0	24.9	19	16.9
Site #5	GWMP	7:30 – 8:30	Eastbound	Chain Bridge Rd	I-66	5.3	16.5	19	11.2

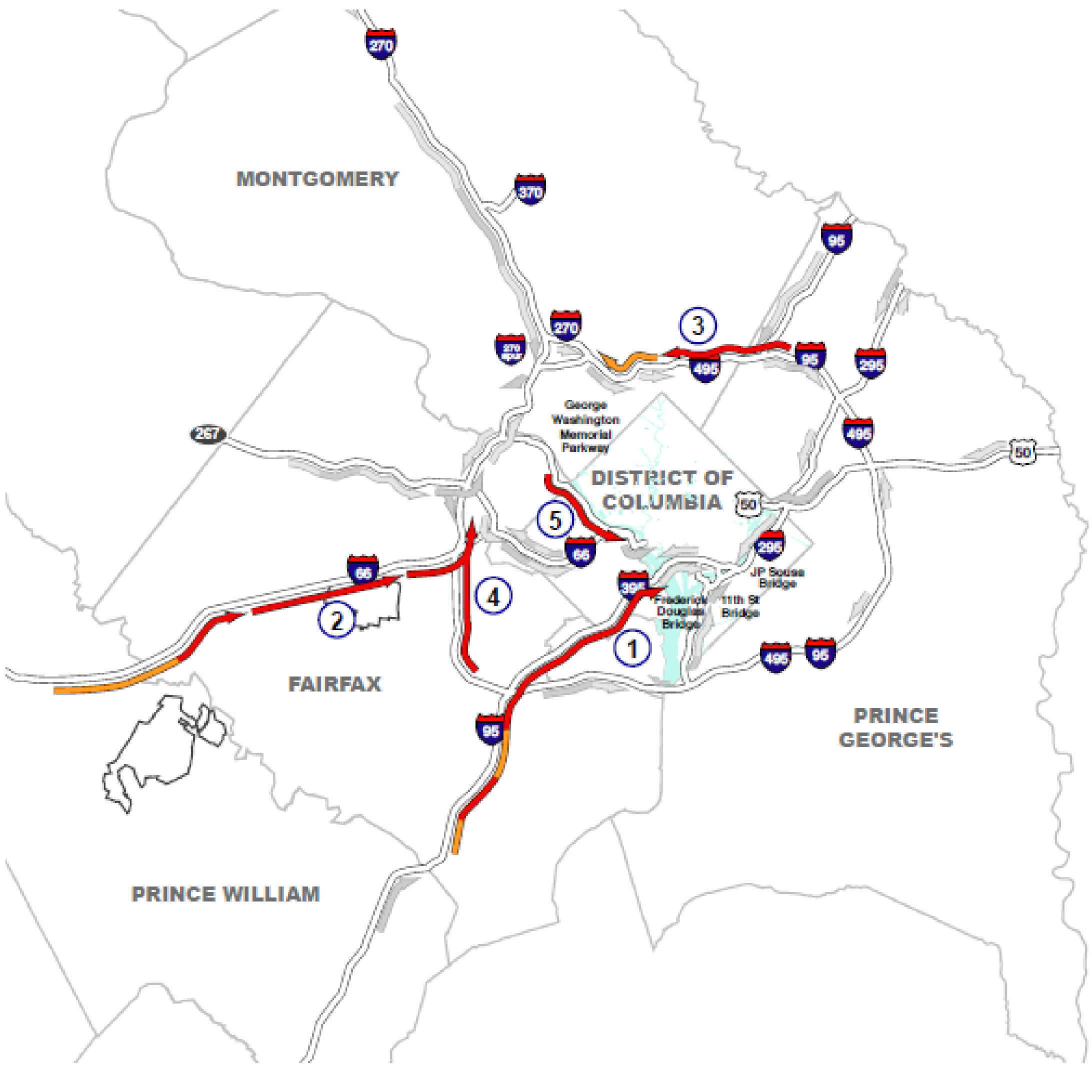
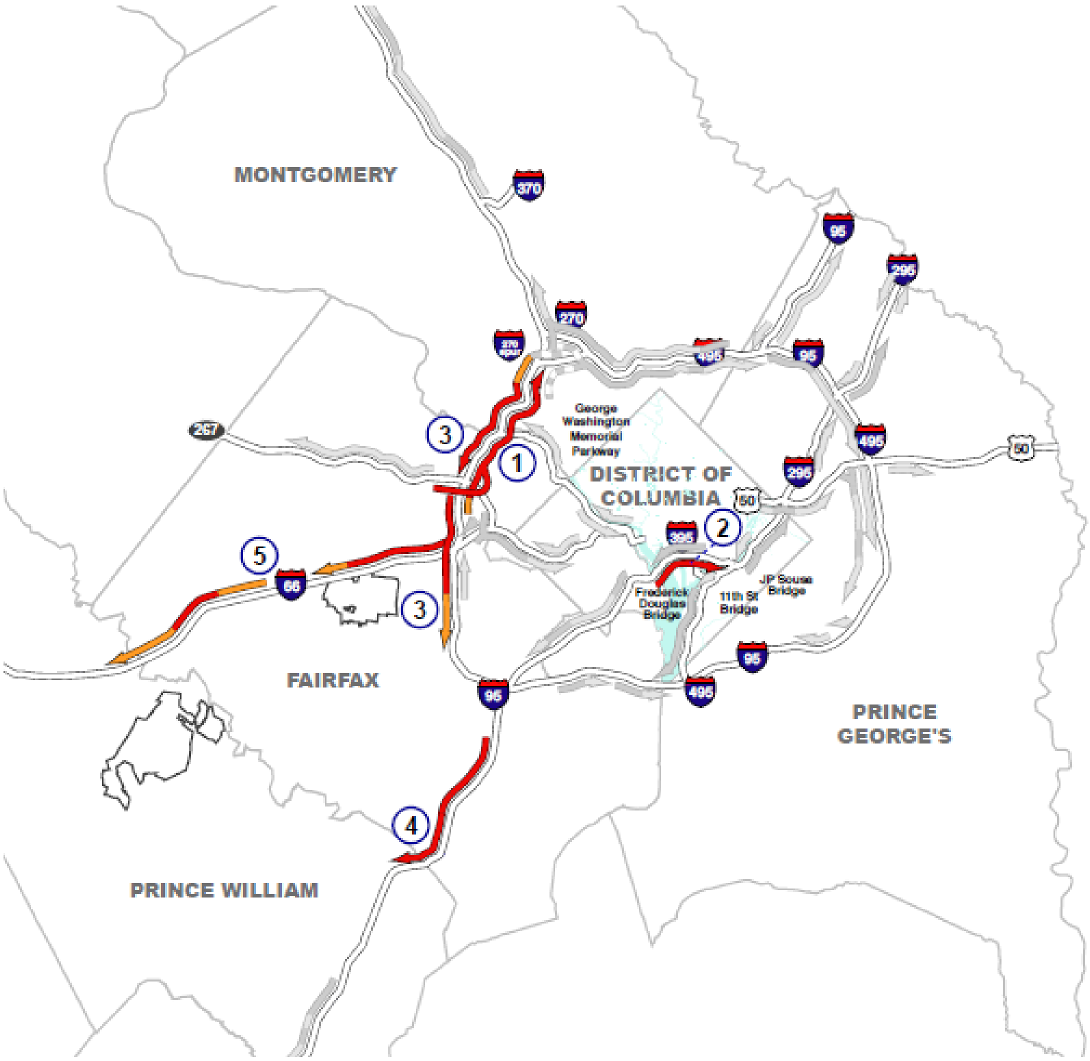


Figure 40: Longest Delay Corridors - Evening Peak Period (Spring 2011)

Site Name	Road Name	Time	Direction	From	To	Queue Length (miles)	Estimated Travel Time (minutes)	Estimated Speed (mph)	Estimated Delay (minutes)
Site #1	I-495	5:30 – 6:30	Innerloop	VA 7(Leesburg Pike)	I-270 Spur	10.3	41.8	15	31.5
Site #2	I-395	5:00 – 6:00	Northbound	VA 110 (Jeff. Davis Hwy)	Pennsylvania Ave	4.3	19.2	13	14.9
Site #3	I-495	4:30 – 5:30	Outerloop	MD 187 (Old Georgetonwn Rd)	VA 236 (Lttle River Turnpike)	8.8	22.6	23	13.8
Site #4	I-95	4:30 – 5:30	Southbound	I-495	VA 123 (Gordon Blvd)	9.7	22.4	26	12.8
Site #5	I-66	4:30 – 5:30	Westbound	I-495	VA 234 (Sudley Rd)	16.8	28.3	36	11.5



2.1.3 Arterial Floating Car Travel Time Study

Before the existence of private sector probe-based traffic data, the TPB carried out Arterial Floating Car Travel Time Studies from 2000 – 2011 on selected NHS arterial highways in the region. Staff gathered data regarding travel time, speed, and delay using Geographic Positioning System (GPS) technology, with data collection occurring in three-year cycles (e.g., 2005 routes repeated in 2008 and 2011, etc.). Data were collected between the hours of 1:00 PM and 8:00 PM, on Tuesdays, Wednesdays and Thursdays, avoiding public holidays or the day after a public holiday. By 2011 the last year of this type of survey, 57 major arterial highway routes in the

District of Columbia, Maryland, and Virginia, totaling 430 centerline miles were monitored. The level of service (LOS) was used to characterize the extent of congestion during the PM peak hour, PM peak period and PM off-peak period of travel[39]. Summary of the 2008-2011 studies can be found in the *2010 Congestion Management Process (CMP) Technical Report* and the *2012 Congestion Management Process (CMP) Technical Report.*

There are no plans to repeat or continue the Arterial Floating Car Travel Time Study as the I-95 VPP/INRIX traffic monitoring covers the vast majority of arterials in the region with unprecedented spatial and temporal granularity.

2.1.4 Traffic Signal Timing

Delays occurred at signalized intersections accounted for a significant portion of overall arterial and urban street delays. Improving traffic signal timing has been identified as a CLRP priority area.

The TPB has conducted three surveys of the status of signal optimization in 2005[40], 2009[41], and 2013[42]. The 2013 survey found that of the total 5,500 signalized intersections in the region, 76 percent were retimed/optimized, 22 percent not retimed/optimized, and no report received for 2 percent. This was a similar but slightly reduced level of optimization compared to the last such survey in 2009, in which 80 percent signals were retimed/optimized. This result, however, should be interpreted within the context of the comments below:

- Regional results overall held to a similar albeit lower level to that of three years ago, in the context of widespread budgetary belt-tightening by involved transportation agencies; it was anticipated that some upcoming anticipated investments will improve the regional picture.

- DDOT currently has a five-year signal re-timing project. This includes a phased approach, with the intent to touch all signals based on areas of concern. DDOT has also identified three corridors for possible deployment of an adaptive system.

- Signal optimization can help get an arterial closer to its design capacity but cannot increase capacity.

- Techniques are often combined; signals can be optimized using computer software followed by active field management for validation purposes.

- Active management is particularly useful to address non-recurring congestion caused by incidents and special events.

[39] PM peak hour is 5:00 – 6:00 PM, PM peak period is 4:00 PM – 7:00 PM, and PM off-peak period is 1:00 – 4:00 PM and 7:00 – 8:00 PM.
[40] COG/TPB, http://www.mwcog.org/uploads/committee-documents/tVtXWlY20051110144208.pdf
[41] COG/TPB, http://www.mwcog.org/uploads/committee-documents/bV5cXFhc20090312161527.pdf
[42] COG/TPB, http://www.mwcog.org/uploads/committee-documents/al1ZXFpb20140212133426.pdf

- Signal equipment must be properly maintained for signal timing to be effective.

Since late 2011, the Traffic Signal Subcommittee has conducted five regional surveys on traffic signals power back-up systems[43]. The last survey was conducted by June 30, 2013 and found that about 26% of the region's 5,500+ signals are already equipped with battery-based power back-up systems, and 61% are equipped with generator-ready back-up systems (most battery-based systems also have generator-ready features). These back-up systems are critical in the event of an emergency, particularly if the event involves a lack of power.

2.1.5 Safety and Congestion

2.1.5.1 Overview

Transportation safety is a serious concern in the Washington region. There is shown to be a strong correlation between traffic safety and traffic congestion. Incidents, including those in work zones, secondary incidents, involve adverse weather events, or bicycle and pedestrian incidents, all can contribute to non-recurring congestion. Sources indicate that approximately half of all congestion is caused by non-recurring congestion.[44] Raising awareness about such things as transportation safety can help address an issue at the root of incident management.

Engineering and operational management activities can help improve safety and therefore lessen the impact of crashes and other safety problems on congestion. Many transportation agencies in the region have active incident management programs that quickly respond to incidents, help reduce their duration, and lessen the likelihood of secondary accidents in traffic backups. These programs are further integrated into the Metropolitan Area Transportation Operations Coordination (MATOC) program[45], to undertake day-to-day, real-time multi-agency coordination and information sharing regarding transportation systems conditions during major incidents in the Washington region. Furthermore, transportation agencies look for ways to improve the safety of the physical roadway infrastructure, again to improve safety and therefore lessening its impacts on congestion. Such engineering improvements may include turn lanes, improvements of site lines, lighting, guardrails, and pedestrian enhancements.

The TPB is addressing transportation safety through a variety of programs and activities:

- Transportation safety is encouraged and tracked by TPB member agencies through the ***Transportation Improvement Program (TIP)***, which provides information on projects to be completed over the next six years. The TIP contains projects whose primary purpose is to enhance safety, and explains how other projects will support transportation safety.

- The ***TPB's transportation safety planning activities*** helps facilitate regional traffic data compilation, sharing this data among member agencies, and identifying regional safety problems.

[43] COG/TPB, http://www.mwcog.org/uploads/committee-documents/ZF1ZXVhW20140204080431.pdf
[44] Describing the Congestion Problem, Federal Highway Administration: http://www.fhwa.dot.gov/congestion/describing_problem.htm.
[45] See www.matoc.org for more information.

- The ***Transportation Safety Subcommittee,*** a subcommittee of the TPB Technical Committee, focuses on advising staff on the federally-required transportation safety portion of the long-range transportation plan. The diversity of the Subcommittee, which is comprised of stakeholders from the State Departments of Transportation Planning, planning staff of the TPB member agencies, law enforcement officials, and public health representatives, is essential to providing a wide-range of safety perspectives. Another key objective of the Subcommittee is exchanging information on ongoing safety activities and best practices.

- The ***Street Smart Pedestrian and Bicycle Safety*** campaign is an annual region-wide campaign to raise public awareness on pedestrian and bicycle safety.[46] The campaign, created by the TPB's Bicycle and Pedestrian Subcommittee in 2002, uses methods such as radio, newspaper, and transit advertising, public awareness efforts, and law enforcement with an overall goal of changing motorist and pedestrian behavior and reducing pedestrian and bicycle deaths and injuries.

Transportation Safety remains a key focus of transportation planning in the region. The TPB's transportation safety work program acts as a home for facilitating discussion of transportation safety issues in our region, and raising awareness about those issues. Continuing safety planning activities in the Washington region will continue to be important to the CMP.

2.1.5.2 Traffic Safety Facts

The TPB Transportation Safety Subcommittee compiles, summarizes, and reports safety and other information about the region's transportation system. Some of these traffic safety facts observed may help in illustrating the relationship of safety and congestion.[47]

- Total traffic fatalities in the Washington region had significantly gone down from 426 in 2005 to 270 in 2012;
- The fatality rate per 100 million VMT for the Washington Metropolitan Statistical Area deceased from 1.20 in 2005 to 0.76 in 2012.
- Traffic deaths per 100,000 population in the Washington region had also significantly gone down from 8.94 in 2005 to 5.14 in 2012, the lowest level since 2002;
- Total traffic injuries in the Washington region decreased consistently from 49,781 in 2012 to 36,985 in 2011, and then slightly increased to 38,403 in 2012;
- Traffic injuries per 100,000 population declined from 1090.13 in 2002 to 716.76 in 2011, and then slightly increased to 724.63 in 2012;
- Decline in overall injuries over the past ten years has slowed;
- Rise in pedestrian and cyclist injuries – both in absolute numbers and as a percentage of total – has been observed in recent years.

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[46] http://www.bestreetsmart.net/
[47] The Regional Transportation Safety Picture, presentation to the Transportation Safety Subcommittee meeting, 2013-12-16: http://www.mwcog.org/uploads/committee-documents/YV1aVlpX20131216093705.pdf

The above facts reveal that traffic safety is something that needs to be taken very seriously. The incident-related and non-recurring strategies our region undertakes not only manage congestion that commonly occurs after an incident happens, but these strategies can also prevent subsequent incidents from occurring. Our region's strategies aim at improving safety on our roadways, and ultimately contribute to making a nationwide difference.

2.1.5.3 Incident-Related and Non-Recurring Congestion

Fifty percent of congestion is said to be non-recurring, which is congestion due to incidents such as crashes, disabled vehicles and special events, work zones and bad weather.[48] Typically, there are more than 200 traffic related incidents on the region's roadways every day, the most severe of which can disrupt traffic for hours, cause secondary incidents, and overall cause major disruptions to the transportation system. Heavily-trafficked areas and construction areas are especially prone to incidents. Nonrecurring events dramatically reduce the available capacity and reliability of the entire transportation system. Travelers and shippers are especially sensitive to the unanticipated disruptions to tightly scheduled personal activities and manufacturing distribution procedures.

The Federal Highway Administration breaks down non-recurring congestion into three primary causes: 1) incidents ranging from a flat tire to an overturned hazardous material truck (25%), work zones (10%), and weather (15%).

A number of TPB's member agencies, including DDOT, MDOT, VDOT, and some local jurisdictions operate incident-management programs. These programs are further coordinated and facilitated by the Metropolitan Area Transportation Operations Coordination (MATOC) program, which has more emphasis on regional-significant incidents. The MATOC program and the local jurisdictional programs help minimize the impact the events have on the transportation network and traveler safety. If an incident disrupts traffic, it is important for congestion that normal flow resumes quickly. The TPB compiles and analyzes data associated with these incident management programs.

2.2 Congestion on Transit Systems

2.2.1 Impacts of Highway Congestion on Transit Systems

Often the region's highway congestion will have an impact on transit systems, such as rail and bus. To some extent, transit operations are concentrated in areas of high-density land uses, where traffic congestion may be expected. Bus schedules generally are designed to anticipate and accommodate highway congestion whenever possible. However, there are instances when congestion is unpredictable and can not only impact the timing of one bus, but of the entire bus system and other transit systems the bus connects to (such as commuter rail).

One way to analyze the performance of one mode's impact on another is to identify key linkages between one or more modes of transportation. In 2008 the TPB conducted a Regional Bus

[48] Describing the Congestion Problem, Federal Highway Administration: http://www.fhwa.dot.gov/congestion/describing_problem.htm.

Survey[49] throughout our region. This survey found about 23% of the region's bus passengers accessed bus system via buses or autos and about 67% of all passengers had one or more transfers to reach their final destinations. These passengers were subjected to the impact of highway congestion if it occurs on pertinent routes.

Another way to assess the impacts of highway congestion on transit is to investigate bus travel speed along roads carrying both buses and other vehicles. Figure 41, Figure 42, and Figure 43 show regionwide bus speeds observed in the TPB's Multimodal Coordination for Bus Priority Hot Spots Study[50] carried out in 2011-2012. These maps report average bus travel speeds for 28,172 roadway segments in the region (2,330 miles of roadway). The lines shown on the maps indicate the slower of the two directions during the given period. With few exceptions, this represents "outbound" buses during the PM peak (3:00-6:00 pm) and "inbound" buses during the AM peak (6:00-9:00 am).

The results of this study show that there are numerous roadway segments within the region with average transit operating speeds of less than 10 mph and several with speeds of under 5 mph. The vast majority of these locations are within the District, but some fall in Maryland and Virginia suburban areas (particularly around Silver Spring and several Arlington County locations). The analysis, as shown on the maps, also shows that PM speeds are generally lower than AM speeds, though the differences are small in most cases. For instance, the bridges over the Anacostia River in the District all show a noticeable decline in travel speed during the PM peak. The differences between the peak periods and the all-day speeds are smaller than might typically be expected. This indicates that mid-day congestion is heavy on many routes in the service areas. In addition, because most bus trips occur during the peak periods the all-day averages are naturally weighted toward the peaks.

In general, the results of the analysis show that bus operating conditions vary greatly by location throughout the region. Many locations, particularly in the downtown core, have operating speeds below 10 mph, indicating high amounts of bus delay. Moreover, many of the slowest corridors shown on the map carry very high bus volumes (e.g., I Street in downtown DC has 493 daily WMATA buses with a total ridership of 55,070) suggesting that priority improvements on these corridors could provide significant transportation benefits. In particular, WMATA's work to develop a network of priority bus routes, and the recent federal Transportation Investment Generating Economic Recovery (TIGER) grant award to implement much of this network, provides a unique opportunity to address the challenges of congestion-related bus delay. In such efforts, support and collaboration from state DOTs and local agencies are vital.

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[49] 2008 Regional Bus Survey, Final Technical Report, http://www.mwcog.org/uploads/committee-documents/a15aXldb20091029142551.pdf. The 2014 Metrobus Survey was being carried out as of the writing of this report: http://www.mwcog.org/uploads/committee-documents/a11ZWFtf20140325100202.pdf

[50] COG/TPB, Publications, http://www.mwcog.org/store/item.asp?PUBLICATION_ID=445

Figure 41: Regionwide Bus Speeds – All Day

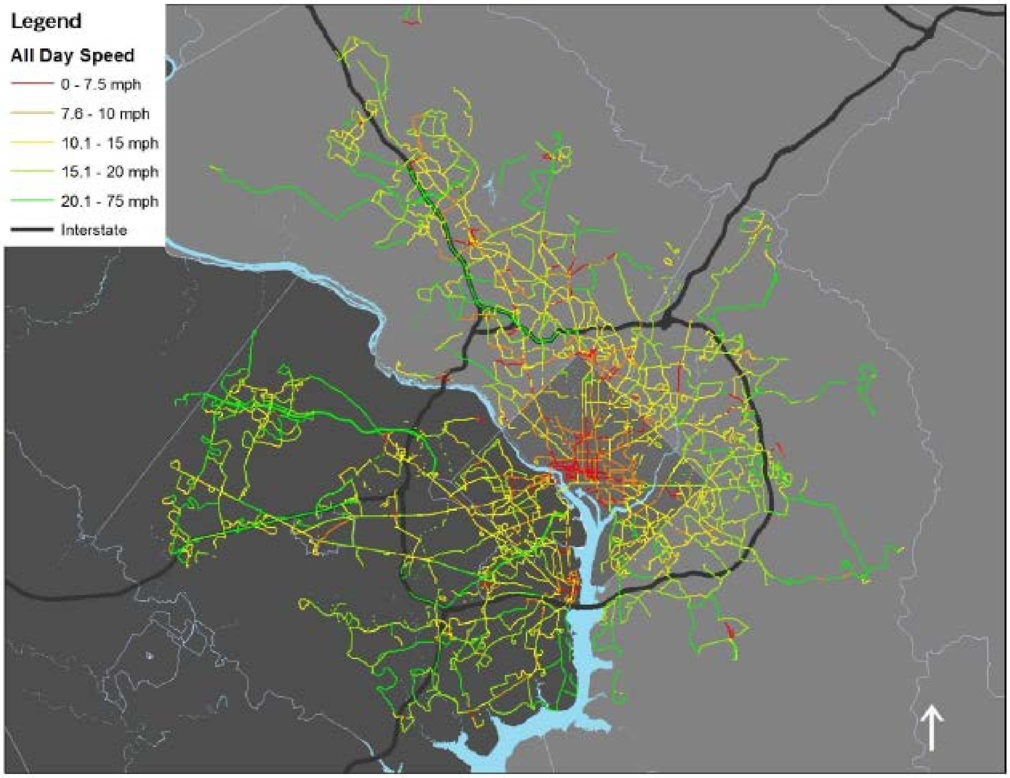


Figure 42: Regionwide Bus Speeds – AM Peak

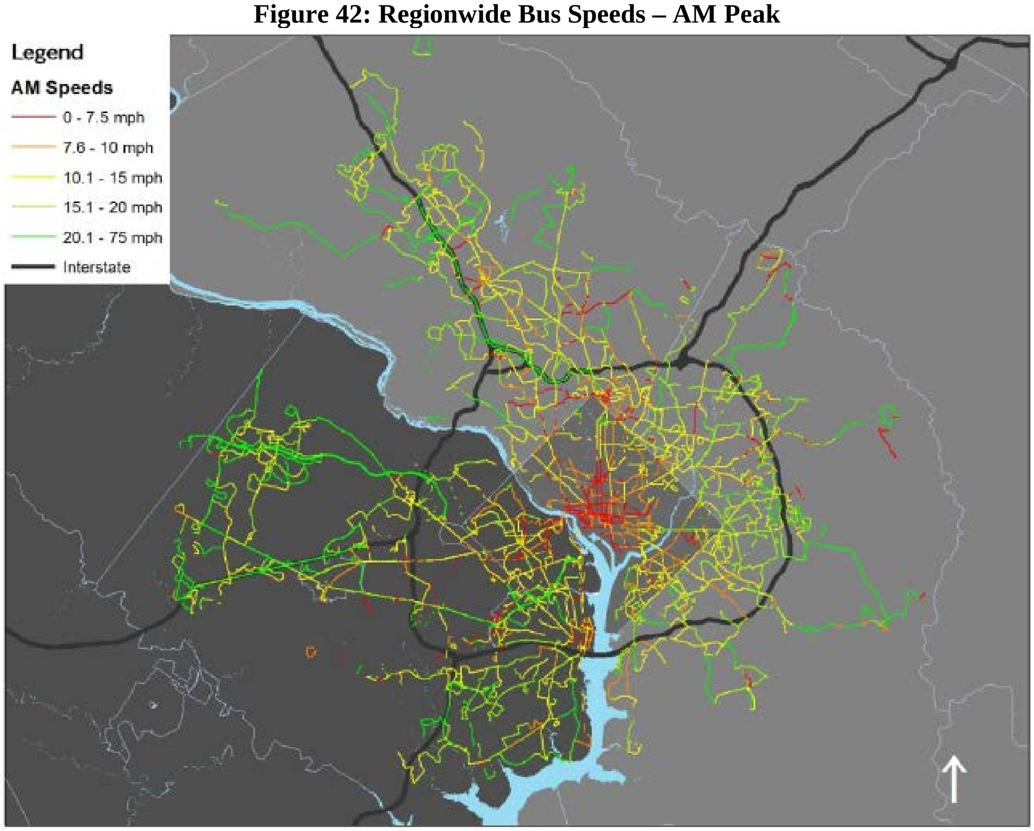
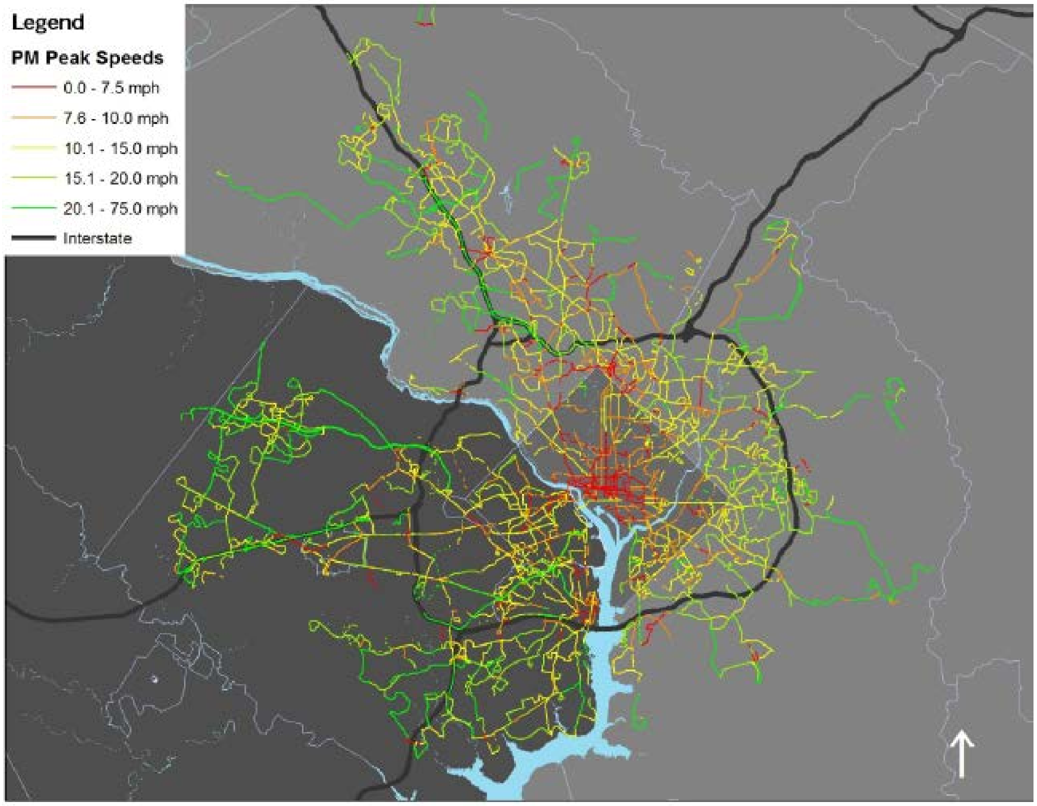


Figure 43: Regionwide Bus Speeds – PM Peak



2.2.2 CONGESTION WITHIN TRANSIT FACILITIES OR SYSTEMS

Congestion can also be an issue within transit. If the demand for rail and buses is high and the capacity cannot keep up with that demand, then transit becomes too crowded. Just as incidents can cause non-recurring incidents on roadways, the same can occur on transit facilities. Even a minor bus or train incident can cause back-ups and delays.

In addition, certain transit facilities may experience more congestion that others. Union Station in the District of Columbia is a station that accommodates Metrorail, Metrobus, DC Circulator buses, Maryland Area Rail Commuter (MARC) trains, Virginia Railway Express (VRE) trains, and AMTRAK. With these various transit options, Union Station has become a primary connection point for commuters/visitors, and the busiest station in the Metrorail system, with 70,000 passengers entering and exiting daily (a passenger congestion simulation can be found on http://planitmetro.com/data)[51]. In response, WMATA and DDOT jointly completed the Union Station Access and Capacity Improvement Study in early 2011[52], and identified improvements that would fit compatibly with Union Station and benefit all transportation service providers and customers.

[51] Washington Metropolitan Area Transit Authority, Data Visualization, Union Station Simulation http://planitmetro.com/data

[52] WMATA and DDOT, Union Station Access and Capacity Improvement Study Project Report, February 18, 2011. http://www.wmata.com/about_metro/docs/Final%20Union%20Station%20Project%20Report%20Feb182011.pdf

The TPB's Central Employment Core Cordon Count of Vehicular and Passenger Volumes[53] could be used to measure transit crowding at count stations. Section 2.6.1 will provide more information about the cordon count.

Congestion can not only result on the transit system itself, but on station platforms and around the station. In 2008, WMATA released their findings of the Metrorail Station Access & Capacity Study[54]. This study found that a number of stations need to expand their capacity in order to satisfy the demand imposed by existing large ridership and/or future ridership increases, as listed in Table 9.

Table 9: Existing and Future Station Capacity Issues

Station	Mezz	Vertical		Faregate	
		2005	2030	2005	2030
Archives-Navy Memorial-Penn Quarter		⊙	⊙		
Bethesda			⊙		
Branch Ave		⊙	⊙		
Cleveland Park					⊙
Court House			⊙		⊙
Farragut North	SE	◎	◎		
Farragut West	W	⊙	⊙		
Foggy Bottom-GWU		⊙	⊙		
Franconia-Springfield			⊙		
Gallery Pl-Chinatown	N	⊙	◎	⊙	◎
	W				⊙
Judiciary Square	E		⊙		
L'Enfant Plaza	E	⊙	◎		
	W		◎		
Metro Center	N	⊙	◎		⊙
	S	◎	◎		
	W		⊙		
Navy Yard*	E				⊙
Shady Grove		⊙	◎		
Takoma				⊙	⊙
Twinbrook					⊙
White Flint					⊙
Union Station	S	⊙	⊙		
	W	⊙	⊙		

Legend
⊙ Needs study (0.5≤v/c<0.75)
◎ Needs improvement (v/c≥0.75)

**Note: Both Navy Yard mezzanines will have unique future needs, which may not be reflected in this analysis, due to the opening of the Washington Nationals Ballpark in 2008.*

Source: WMATA, 2008, Metrorail Station Access & Capacity Study.

According to Metro's Office of Long Range Planning, more than two-thirds of Metrorail daily ridership occurs during the morning and evening peak periods[55]. The graphic (Figure 44) provided by this Office shows the AM peak hour (8AM-9AM) passenger volumes by travel

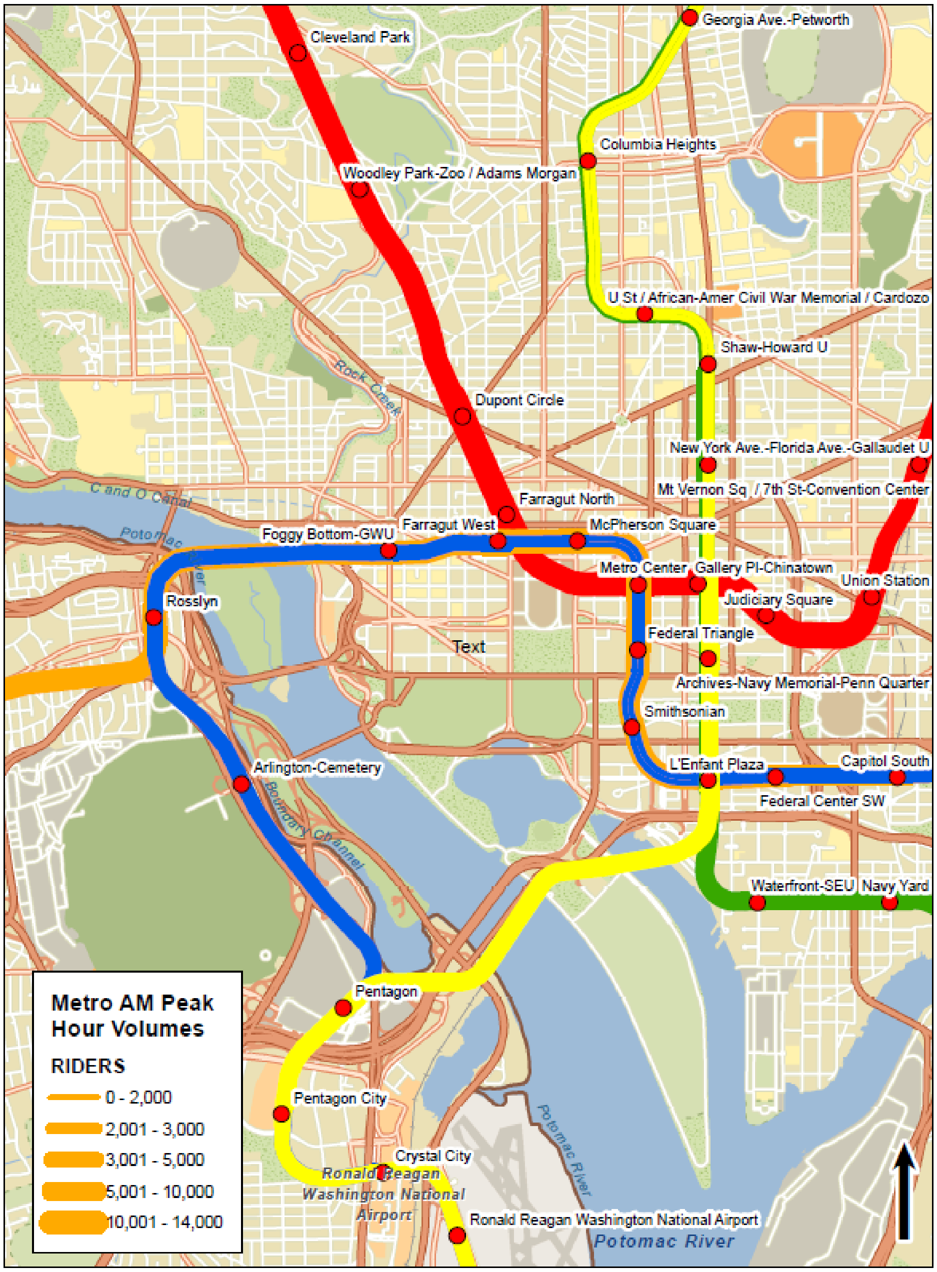
[53] *2013 Central Employment Core Cordon Count of Vehicular and Passenger Volumes*, Draft, December 30, 2013. http://www.mwcog.org/uploads/committee-documents/k11ZXV5e20140127094130.pdf

[54] Metrorail Station Access & Capacity Study, Washington Metropolitan Area Transit Authority (WMATA), http://www.wmata.com/pdfs/planning/Final%20Report_Station%20Access%20&%20Capacity%20Study%202008%20Apr.pdf.

[55] Washington Metropolitan Area Transit Authority, Data Visualization, Peak Hour Passenger Ridership on Metrorail. http://planitmetro.com/data

direction. Red and Orange/Blue Lines carry the highest passenger volumes in the system morning peak hour, on segments from Woodley Park to Farragut North (eastbound), Gallery Place to Metro Center (westbound), and Rosslyn to Farragut West (eastbound). Please note the 8AM-9AM system graphic does not reflect true max-loads on the Green Line. Unlike the other lines, the Green Line actually reaches peak loads between 7:30 AM and 8:30 AM, ahead of the other lines, with hourly passenger loads exceeding 7,000 from Anacostia to L'Enfant Plaza.

Figure 44: AM Peak Hour (8:00-9:00 AM) Metrorail Link Passenger Volumes



Source: WMATA; data based on an average of six weekdays in October 2012.

In 2007, an analysis was conducted by TranSystems to gauge the effect traffic congestion and passenger crowding has on WMATA bus operations.[56] The analysis found evidence that traffic congestion imposes a cost on WMATA, as the peak vehicle requirement needs to be increased to maintain a sufficient level of service on certain routes. In addition, growth in passenger demand has the same effect, since additional bus trips need to be added to certain routes to avoid overcrowding.

In 2013, WMATA announced Momentum, Metro's strategic plan for 2013-2025[57]. As shown in Table 10 below from the plan, there are crowded conditions at peak periods today; without rail fleet expansion, most rail lines will be even more congested by 2025. The plan lays out seven Metro 2025 initiatives, including running eight-car trains during peak periods and core station improvements. For riders, Momentum will mean more trains, reduced crowding, faster buses, brighter, safer, easier-to-navigate Metrorail stations, and information when and where you want it. For the region, Momentum will increase capacity throughout the system, enable future expansion, and remove vehicles from our already-crowded roadways.

Table 10: Metrorail System Peak Period Capacity by Line without Fleet Expansion

	2012	2020	2025	2040
Red	✔	—	—	✘
Yellow	✔	✔	✔	—
Green	✔	—	—	✘
Blue	✔	—	—	✘
Orange/Silver	—	✘	✘	✘

✔ Acceptable (average passengers per car (PPC <100)
— Crowded (PPC between 100 and 120)
✘ Extremely crowded (PPC >120)

Source: WMATA, 2013, Momentum, Strategic Plan 2013-2025.

The CMP recognizes the growing concern of congestion within our regional transit systems. As the region's population grows and "goging green" trends advances, there would be more comuters and residents looking to transit options instead of driving. While increase in transit use is overall a positive trend, it is important that the concern of transit congestion throughout the region be examined further.

Congestion management will benefit from continuing to encourage transit in the Washington region and explore transit priority strategies. The transit system in the Washington region serves as a major alternative to driving alone, and it is an important means of getting more out of existing infrastructure. Additional work with appropriate committees and transit agencies to address related data and performance measure issues would help further support the CMP.

[56] Memo: Impact of Congestion on Metrobus Operations. March 12, 2007. http://www.mwcog.org/uploads/committee-documents/t1daVl020070509095750.pdf
[57] WMATA, Momentum, http://www.wmata.com/Momentum/

2.3 Park-and-Ride Facilities

There are over 160,000 parking spaces at nearly 400 Park & Ride lots throughout the Washington/Baltimore Metropolitan areas where commuters can conveniently bike, walk or drive to and join up with carpools/vanpools or gain access to public transit. The following statistics provide an idea of why park-and-ride lots play such a popular role in the region's transportation system[58]:

- Two thirds of Park & Ride Lots have bus or rail service available.
- Parking is free at 89% of the Park & Ride Lots.
- More than 25% of Park & Ride Lots have bicycle parking facilities.

In addition to the above statistics, Intelligent Transportation Systems (ITS) strategies such as traveler information systems and electronic payment systems can add to the convenience of park-and-ride lots. In 2009, WMATA and VDOT completed the Feasibility Study of Real Time Parking Information at Metrorail Parking Facilities (Virginia Stations)[59], evaluating the feasibility of a real-time parking application for the Metrorail system, with the purpose of improving operations efficiency, reducing operating costs by providing guidance to available parking spaces, encouraging more transit usage and reducing congestion.

Commuter Connections also displays a park-and-ride map on their website, which provides users with the location of lots, transit stations in the vicinity, and the location of Telework centers.

Due to the popularity of park-and-ride lots, some are experiencing overcrowding, where demand exceeds supply. This tends to happen at lots at or near Metrorail and commuter rail service. Over the past several years, Maryland State Highway Administration (MDSHA) has taken inventory of the SHA owned and maintained ridesharing facilities in the state[60]. Maryland has 103 park and ride lots located in 20 counties throughout the State providing a total of 12,572 spaces. In 2012, approximately 7,300 spaces were utilized on a given day which accounts for about 60% usage of the total spaces. It is estimated that providing the park and ride lot facilities resulted in 108 million fewer vehicle miles of travel in 2012.

The most recent TPB study on the usage of park-and-ride lots was conducted in 1996. As the region continues to grow and the demand for park-and-ride lots increases, this is an area that may need to be examined more closely. Remove this.

According to the 2008 WMATA Metrorail Station Access & Capacity Study, Metro presently owns and operates 58,186 parking spaces. On an average weekday, almost all of those spaces are occupied. Only a handful of stations—White Flint, Wheaton, College Park-U of MD, Prince George's Plaza, and Minnesota Ave—have a substantial amount of available capacity. Table 11 shows parking lot utilization as of October 2006.

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[58] Source: Commuter Connections http://76.227.210.32/commuters/transit/park-ride-locations/

[59] Wilbur Smith Associates and Michael Baker Jr., Inc., Feasibility Study of Real Time Parking Information at Metrorail Parking Facilities (Virginia Stations), June 2009. http://www.wmata.com/pdfs/planning/Real_Time_Parking_Study.pdf

[60] Maryland State Highway Administration, 2013 Maryland State Highway Mobility Report, Sep. 2013. Available: http://sha.maryland.gov/OPPEN/2013_Maryland__Mobility.pdf

Table 11: Metro Parking Lot Utilization, October 2006

Station and Region	Lot Capacity	Average Utilization[12] Mon-Thurs	Average Utilization Fri
MONTGOMERY COUNTY			
Grosvenor	1,894	103%	92%
White Flint	1,158	41%	31%
Twinbrook	1,097	84%	70%
Rockville	524	104%	101%
Shady Grove	5,467	83%	78%
Glenmont	1,781	103%	102%
Wheaton	977	63%	40%
Forest Glen	596	101%	96%
PRINCE GEORGE'S COUNTY			
New Carrollton	3,519	98%	88%
Landover	1,866	76%	49%
Cheverly	530	97%	84%
Addison Road-Seat Pleasant	1,268	91%	71%
Capitol Heights	372	88%	82%
Greenbelt	3,399	99%	85%
College Park-U of MD	1,870	68%	64%
Prince George's Plaza	1,068	67%	60%
West Hyattsville	453	101%	102%
Southern Ave	1,980	98%	89%
Naylor Road	368	110%	107%
Suitland	1,890	100%	91%
Branch Ave	3,072	108%	106%
Morgan Boulevard	635	95%	87%
Largo Town Center	2,200	97%	87%
DISTRICT OF COLUMBIA			
Deanwood	194	95%	82%
Minnesota Ave.	333	52%	44%
Rhode Island Ave.	340	95%	94%
Fort Totten	408	88%	86%
Anacostia	808	89%	71%
NORTHERN VIRGINIA			
Huntington	3,090	99%	93%
West Falls Church-VT/UVA	2,009	103%	89%
Dunn Loring-Merrifield	1,319	107%	105%
Vienna/Fairfax-GMU	5,849	100%	91%
Franconia-Springfield	5,069	96%	88%
Van Dorn Street	361	110%	118%
East Falls Church	422	117%	129%
System Total	**58,186**	**94%**	**85%**

Source: WMATA

2.4 Airport Access

The transportation linkage between airports and local activities is a critical component of the transportation system. The Washington region has two major airports – Ronald Reagan Washington National Airport (DCA) in Arlington, VA, and Washington Dulles International Airport (IAD) in Loudoun County, VA. The region is also served by the nearby Baltimore/Washington International Thurgood Marshall Airport (BWI). The majority (92%) of those traveling to the region's airports does so via the highway network (i.e. personal cars, rental cars, taxis, buses)[61]. Therefore, understanding ground airport access is important to congestion management for two primary reasons:

- Choice of airport to use and even the decision to fly in general can be based on the quality, cost, and travel time associated with the ground journey to the airport. Traffic conditions can have an impact on these decisions.

- Understanding airport ground access provides a basis for understanding overall congestion on major roadways at peak travel times.

    - Studying airport ground access can provide information on traffic patterns that may have not otherwise been considered, in particular the relationship between travel times and distances. For example, a study can examine and compare trips across the region (e.g. from Maryland to IAD), or shorter trips where the origin and destination are close together.

    - Passengers using the airports may be non-residents of the Washington region, so this airport access information can give us information on trips originating elsewhere.

In the spring of 2011, COG staff conducted the third Airport Ground Access Travel Time survey[62], during the time periods of 6:00-10:00 AM (for the AM peak period), 10:00 AM - 2:00 PM (for the mid-day period), and 3:30 – 7:00 PM (for the PM peak period). Travel time, speed and delays were collected using Geographical Positioning System (GPS) technology. The findings and evaluation of the data are based on the observed travel time and speed compared with the posted speed limit on the facility. Congested areas and bottlenecks for travel to the three airports are identified, as well as any notable changes in conditions since the 2003 report.

For travel between nearly all activity centers and all three airports for all time periods, travel times have increased between 2003 and 2011. Bottlenecks that impede ground access to the airports, identified when travel speeds along a route are less than 50% of the posted speed limit, occur during the peak periods largely along freeways with recurring regional congestion, such as I-270 between MD 28 and the "split," I-495 between I-395 and I-66 (in the AM peak period), the entire length of I-395 from the Beltway to the Pentagon, and the Beltway between Tysons Corner and the I-270 split (in the PM peak period).

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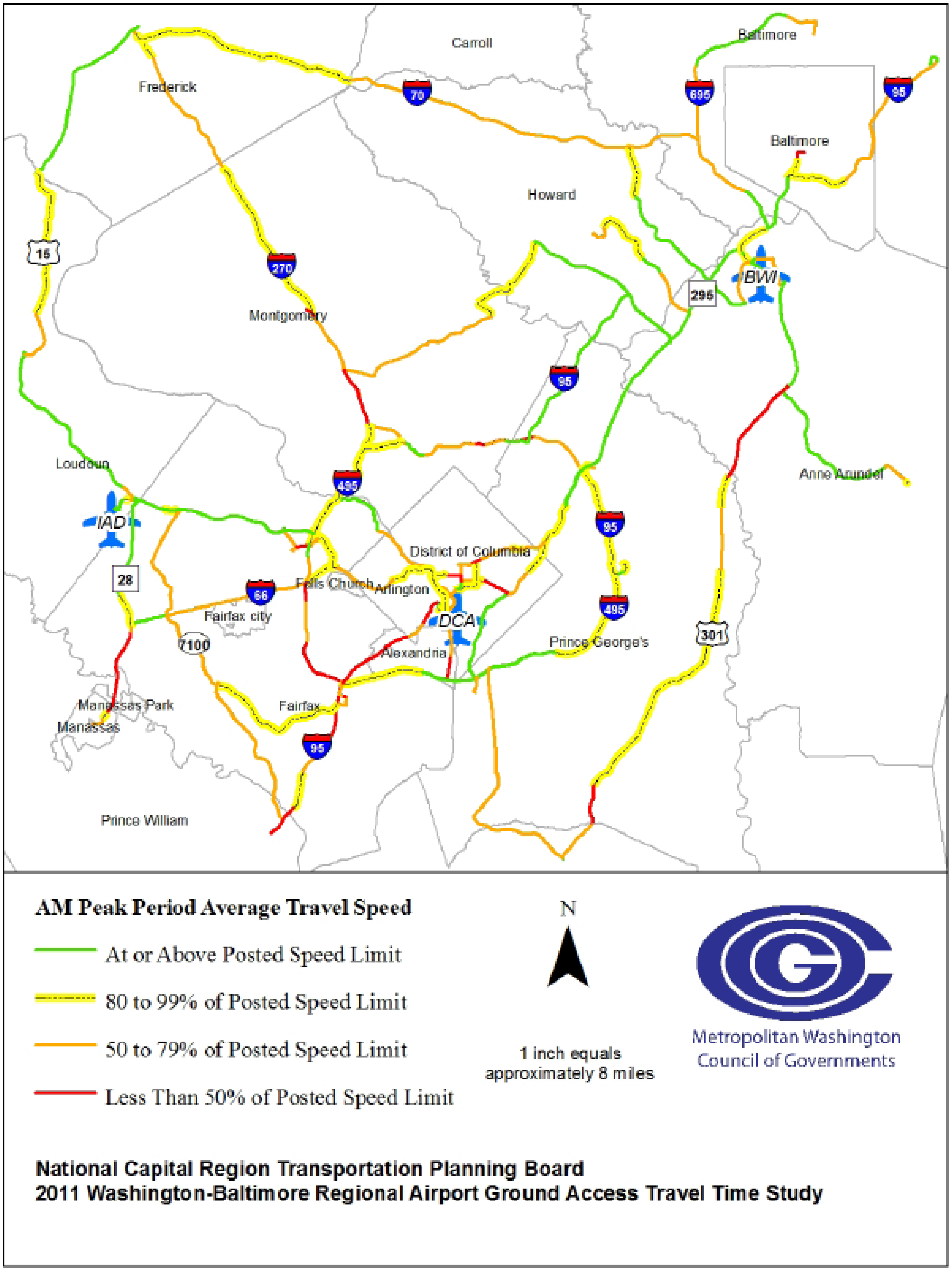
[61] *2013 Washington-Baltimore Regional Air Passenger Survey Data Editing Process*, 2014-01-23 Aviation Technical Subcommittee: http://www.mwcog.org/uploads/committee-documents/b11ZXVpf20140131093313.pdf

[62] *2011 Washington-Baltimore Regional Airport Ground Access Travel Time Study*, December 2011. http://www.mwcog.org/uploads/committee-documents/aF1eXlZW20120113141801.pdf

During the mid-day period, the bottlenecks are mostly limited to a few arterial segments where delays are caused by regular signal cycles and increased cross traffic on streets with mid-day destinations such as restaurants and other retail destinations. Arterial roadway bottlenecks from the mid-day period increase in severity during the AM and PM peak periods, particularly in downtown Washington and across Montgomery County. With a few exceptions, automobile travel times to the airports are much shorter than comparable scheduled times for transit. Those exceptions are activity centers with good access to the Metrorail system for connections to direct bus or rail service to an airport, particularly the core areas of the District of Columbia.

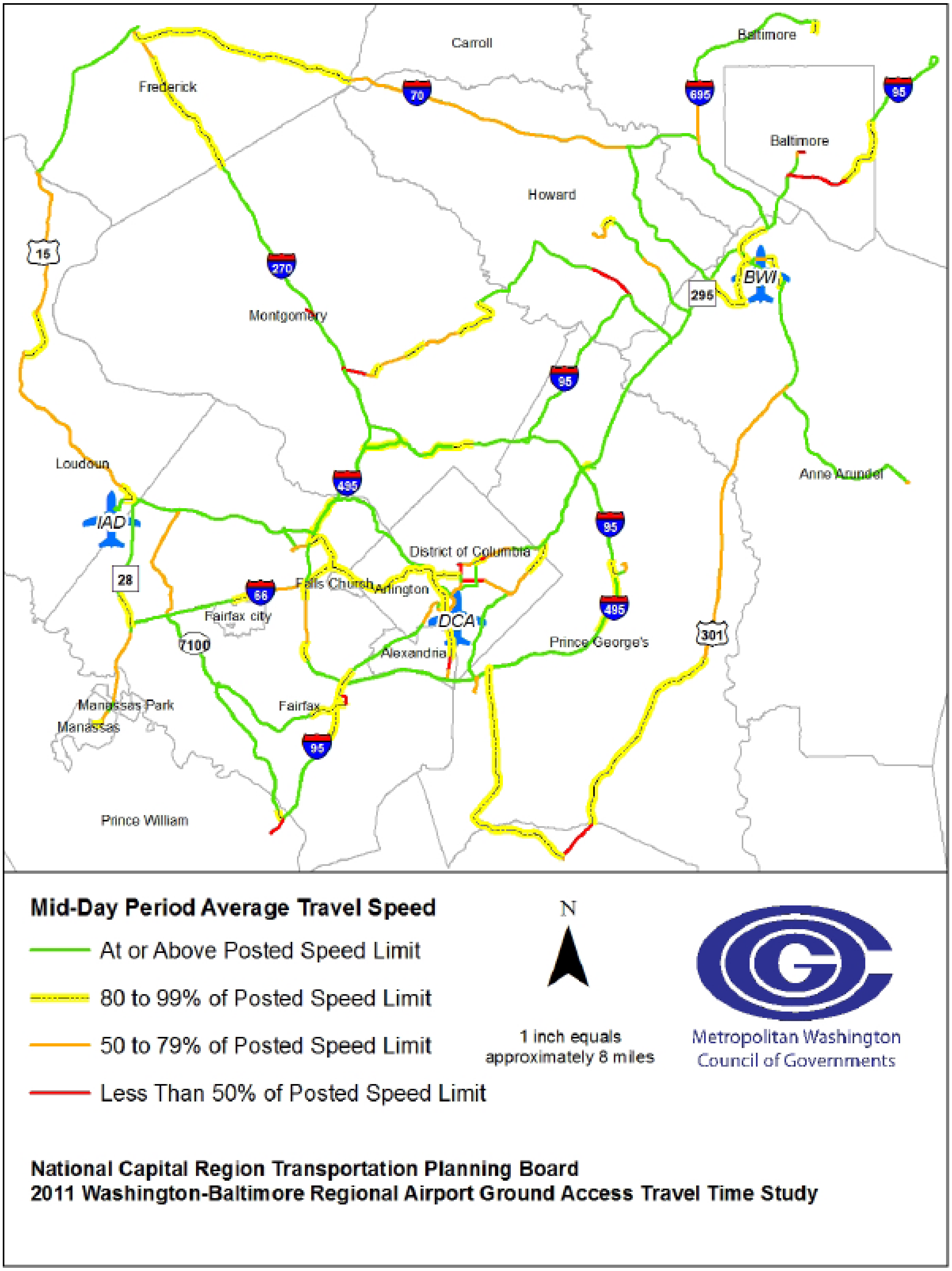
Figure 45, Figure 46 and Figure 47 below show average travel speeds for AM peak period, mid-day, and PM peak period conditions for travel from the activity centers to the three airports. Regionally, the AM peak period has the worst travel conditions. However, travel conditions do vary depending on the destination airport. Travel conditions to DCA in both peak periods are worse than travel to the other two airports; however, since DCA is much closer to the DC core than BWI and IAD, overall travel time from the core areas is less.

Figure 45: AM Peak Period Average Travel Speeds (mph) From Activity Centers to Airports



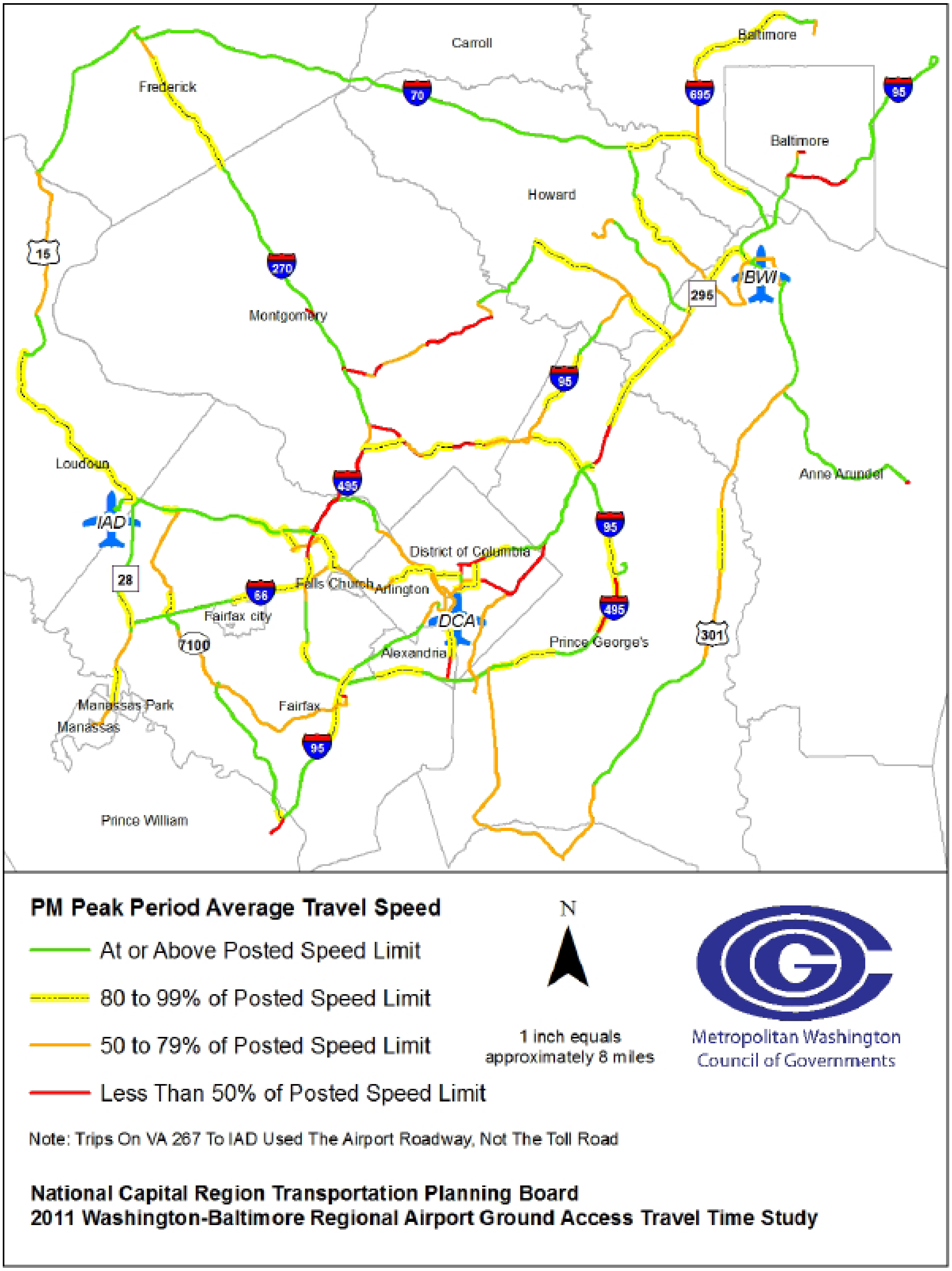
Source: 2011 Washington-Baltimore Regional Airport Ground Access Travel Time Study, December 2011.

Figure 46: Mid-Day Average Travel Speeds (mph) From Activity Centers to Airports



Source: 2011 Washington-Baltimore Regional Airport Ground Access Travel Time Study, December 2011.

Figure 47: PM Peak Period Average Travel Speeds (mph) From Activity Centers to Airports



Source: 2011 Washington-Baltimore Regional Airport Ground Access Travel Time Study, December 2011.

2.5 Freight Movement and Congestion

In addition to surface transportation congestion around airports and congestion's impacts on person movement, congestion in and around major metropolitan regions such as Washington significantly impacts freight movements. Though freight movements by rail, water, and pipeline are not impacted as much as trucks are by surface transportation congestion, rail freight is also subject to bottlenecks and congestion in the Washington region.

Traffic congestion on the region's highways and arterials increasingly slows freight deliveries and impacts both shippers and consumers. Shippers are already adjusting their operations in response to congested conditions. Impacts of increased congestion to the freight industry include:

- A shrinking of the delivery area that one driver and vehicle can serve, causing firms to add smaller and more numerous trucks to their fleets to serve existing customers;
- A decrease in the size of the area that can be served from any given distribution facility, impacting the size, number, and dispersion of distribution facilities in the region;
- An increase in the proportion of deliveries scheduled for the very early morning due to increasing afternoon congestion;
- A decrease in delivery reliability, causing firms to increase "on hand" or "just in case" inventory, thereby eroding the economic efficiencies associated with just-in-time inventory systems; and
- An increase in shipper operating costs (time and fuel) which are eventually passed on to consumers.

In 2007, a freight study was conducted on behalf of the Transportation Planning Board and the region by a team of expert consultants. According to the study, approximately 222 million tons of goods worth over $200 billion are transported to, from, or within the Washington region annually.[63] Approximately three-quarters of this freight movement (by weight) is by truck. An additional 314 million tons of goods were estimated to pass through the region annually. Freight movement in the Washington region is significant across the major modes (by both truck and rail) as well as both local freight movement and through movement. It is therefore critical for freight movement to have an efficient surface transportation network to move traffic in, about, and through the region.

Employment in the professional and business services, trade and transportation, federal government, and state and local government sectors drives the economy of the Washington region. Because the regional economy is service-based, the region is primarily a consumer of goods, not a producer of goods. Consumers depend upon trucks to deliver needed goods into the National Capital Region. This demand puts pressure on the regional surface transportation system as trucks maneuver the highway and arterial transportation network to make their deliveries on time. In order to make just-in-time deliveries, shippers need a transportation network they can depend upon.

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[63] . *Enhancing Consideration of Freight in Regional Transportation Planning*, Cambridge Systematics, Inc., May 2007, p2-1 (GWI Analysis of Bureau of Labor Statistics and Maryland Department of Labor, Licensing, and Regulation 2005, data). http://www.mwcog.org/uploads/committee-documents/bF5fW1pX20080222142629.pdf

Future trends predict a significant growth in freight movements across all transportation modes. Trucks are more flexible than trains, ships, or airplanes; operate on a broader transportation network than any other mode; and are usually required to haul goods shipped by other modes to their final destination. Because of this, trucks will continue to capture much of the projected growth in the freight market. By 2030 rail tonnage is projected to grow by 50% while the truck tonnage is projected to grow by 106%. According to the Federal Highway Administration's (FHWA) Freight Analysis Framework (FAF), the Washington metropolitan region is projected to see the amount of total tonnage moving to, from, and within the region to increase 110% and the value to increase by 145% by 2030.[64] These rates are higher than those projected for the country as a whole.

The Panama Canal Expansion is anticipated to be complete in late 2105. This expansion will allow much larger "Post-Panamax" ships from Asia to serve East Coast ports, including the nearby ones in Baltimore and the Hampton Roads area in Virginia. Much of the new cargo arriving at these ports will pass through the Washington region by truck or rail on its way to inland destinations..

COG/TPB has established a Freight Program with a Freight Subcommittee as a major component of this program. The Freight Subcommittee has five objectives:

1) To provide a voice for freight in transportation planning;
2) To recognize freight's role in economic development;
3) To recognize freight's integrated role in the multimodal system;
4) To coordinate transportation and land use planning; and
5) To recognize how freight can reduce air quality impacts.

The Freight Subcommittee provides a forum for discussion of freight issues and concerns within the Metropolitan Washington Region. This gives freight stakeholders the opportunity to share concerns and information with the TPB and other decision-makers. The Freight Subcommittee meets regularly and interacts with special guest speakers, visits distribution facilities and other locations important to goods movement, and shares information. The first *National Capital Region Freight Plan*[65] was completed in 2010. It examined freight movements in the region, identified important freight-related issues, and provided information about the National Capital Region Freight Project Database which contains information about projects beneficial to freight movement within and through the region.

Through the Freight Program, COG/TPB supports efforts to share information and identify solutions for multi-regional issues such as congestion. Two examples of such efforts include support of the I-95 Corridor Coalition's Mid-Atlantic Truck Operations study (MATOps) to identify truck bottlenecks in the Mid-Atlantic region and assess the cost of delay, and the similar Mid-Atlantic Rail Operations study (MAROps), to identify projects to improve rail movement along the I-95 corridor.

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[64] Ibid., May 2007, p2-30 (2002 FAF data).
[65] *National Capital Region Freight Plan*, July 21, 2009 http://www.mwcog.org/store/item.asp?PUBLICATION_ID=381

Trucks impact congestion and compete for limited space on roadways in congested corridors. Similarly, competition for curb space along streets in urban environments for goods delivery is also a challenge. Discussions with freight movement stakeholders revealed that they are already going to great lengths to schedule deliveries at off-peak hours or to move goods by rail where practicable and economically feasible. Full consideration of non-highway means of freight movement will be continued. However, the projected robust growth in all modes ensures that trucks will remain a major presence on the region's roadways.

The I-95 Corridor Coalition's MATOps study identified the following five worst truck bottlenecks in the region based on observed delay in 2006[66]:

1) I- 95 at VA-7100, Virginia
2) I- 95 at VA-234, Virginia
3) I-95 at I- 495, Maryland
4) I- 495 at American Legion Bridge, Virginia
5) I-495 at I-66, Virginia

The #3 bottleneck, I-95 at I- 495 in Maryland, was also identified as the 25th worst freight bottleneck in the nation[67] according to a study conducted by the American Transportation Research Institute (ATRI).

Several of these bottlenecks were also identified by the Virginia and Maryland Departments of Transportation through traffic count data (Maryland 2008 data and Virginia 2007 data). Figure 48 shows truck percentages of total Annual Average Daily Traffic (AADT) on the region's freeway network[68]. The percentages are truck counts averaged from both directions. The congestion on the freeways is for the morning peak period conditions from the spring 2008 TPB aerial survey.

In 2013, the FHWA procured the National Performance Management Research Data Set (NPMRDS) from HERE, LLC[69]and the data can be used by MPOs and state DOTs to conduct performance analysis on the NHS. This data source contains valuable truck speeds information and could be a source for future freight movement analysis for this region.

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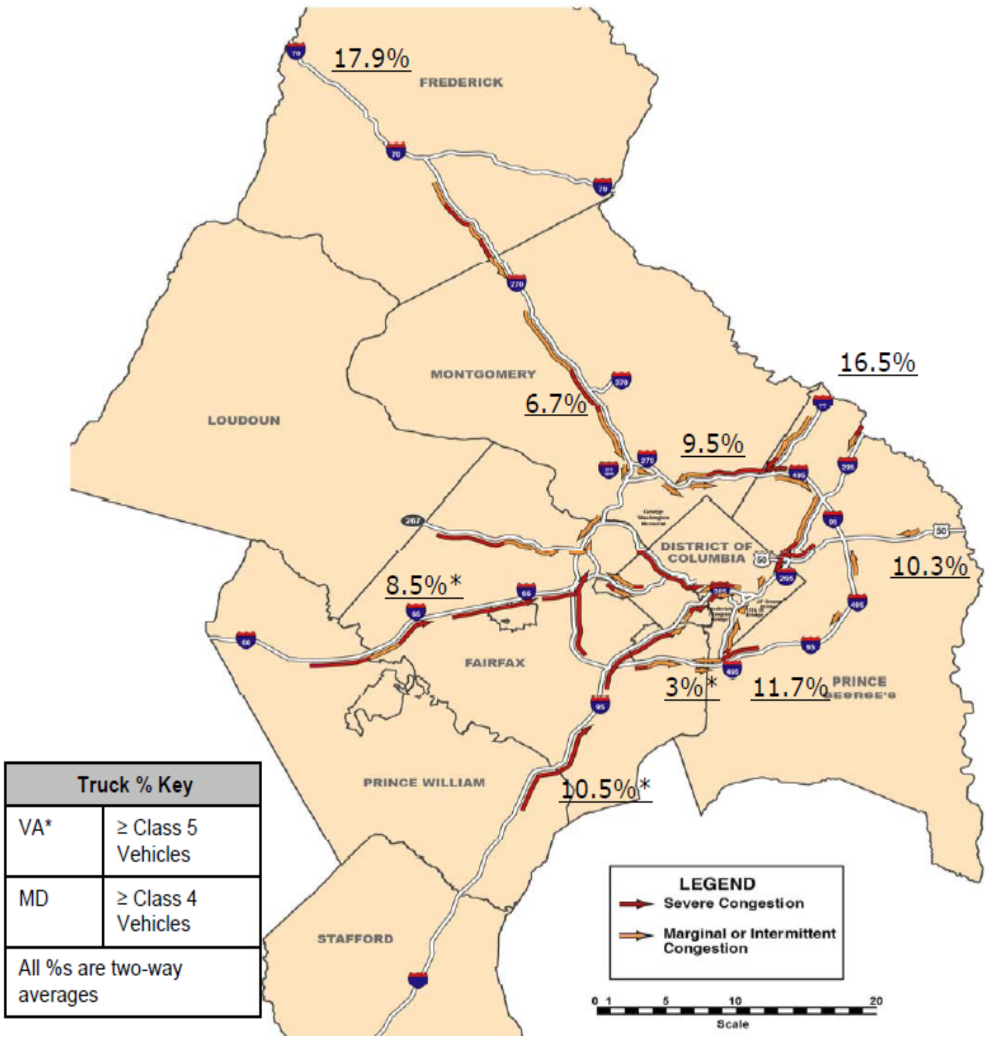
[66] I-95 Corridor Coalition, *Mid-Atlantic Truck Operations study – Final Report*. Cambridge Systematics, Inc. October 2009. http://www.i95coalition.net/i95/Portals/0/Public_Files/pm/reports/DFR1_MATOps_Truck%20Operations%20V3.pdf

[67] American Transportation Research Institute. *Freight Performance Measures Analysis of 30 Freight Bottlenecks.* March 2009.

[68] *Integrated Freight Report*, July 2009. http://www.mwcog.org/uploads/committee-documents/kV5aXl1a20091020140842.pdf

[69] FHWA, National Performance Management Research Data Set (NPMRDS) Technical Frequently Asked Questions. http://www.ops.fhwa.dot.gov/freight/freight_analysis/perform_meas/vpds/npmrdsfaqs.htm

Figure 48: Percentages of Truck Counts on the Region's Morning Peak Period Network



2.6 Other Congestion Monitoring and Data Consolidation Activities

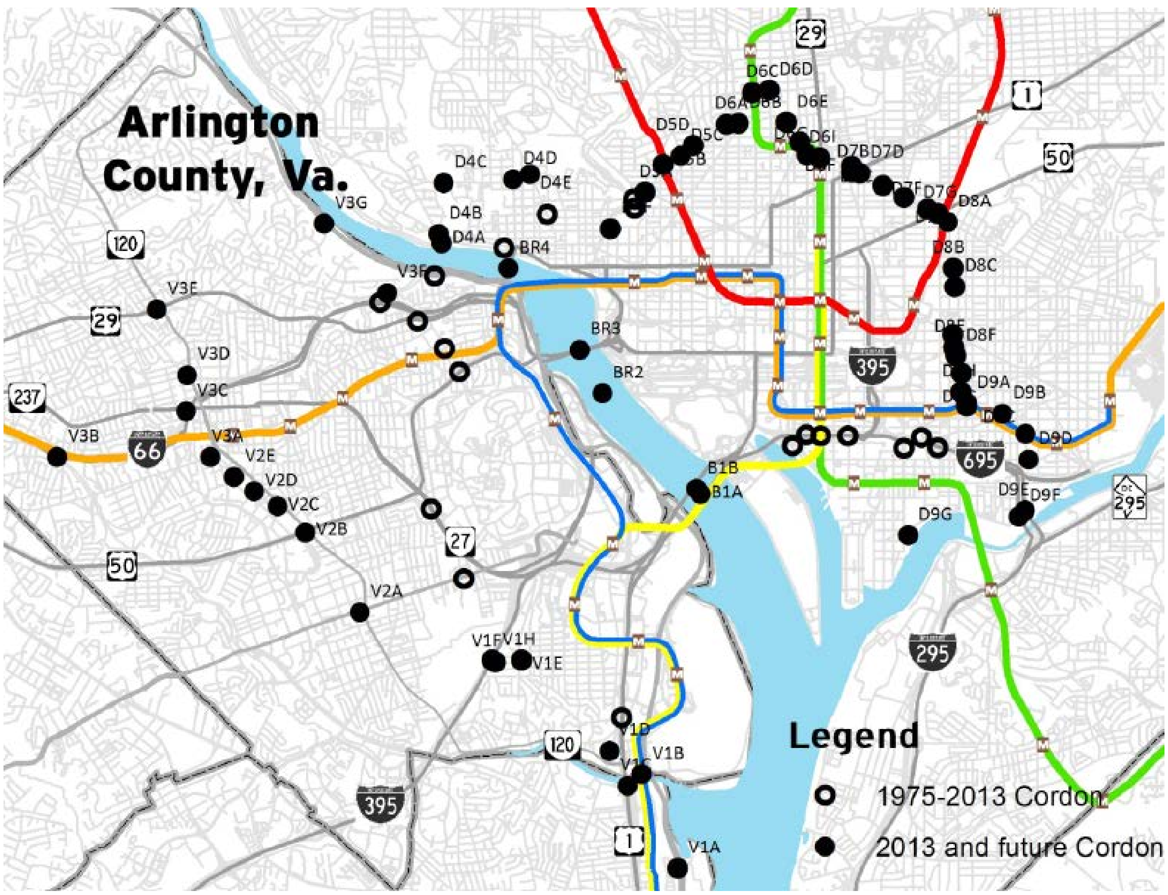
In addition to the congestion monitoring activities presented above in this chapter, the following monitoring and data consolidation activities are also carried out in the Washington region.

2.6.1 Cordon Counts

The cordon count program originated from the desire to assess the impact of the construction of the region's Metrorail system stating in the late 1960's. Thus, a cordon line around the Central Business District (the "core") was determined by the inbound point at which there were more destinations (alighting from transit buses) than origins (loadings onto transit buses). The central business district includes the downtown area of the District of Columbia, Georgetown south of "Q" Street, N.W., the U.S. Capitol, and the nearby sections of Arlington County, Virginia, including Rosslyn, the Pentagon, Pentagon City, Crystal City and Reagan National Airport. In later years, additional cordon counts were added to the program, including:

- Vehicle counts, classification, and occupancy were taken on facilities that cross the region's center core cordon.
- Monitoring of freeway routes in the region with HOV lanes.
- Other data collection projects, including counts of commercial vehicles and roadside truck surveys.
- In 2013, a revised cordon line was used in the count and the expanded cordon include "new" employment that has and will happen between 1975 and 2020, as shown in Figure 49 below.

Figure 49: Cordon Count Stations



These projects help to inform the development of regional travel forecasting computer models and provide an opportunity for trend analysis.

The most recent cordon count study is the 2013 Central Employment Core Cordon Count of Vehicular and Passenger Volumes[70]. This study collected data for the Spring 2013 Central

[70] *2013 Central Employment Core Cordon Count of Vehicular and Passenger Volumes*, Draft, December 30, 2013. http://www.mwcog.org/uploads/committee-documents/k11ZXV5e20140127094130.pdf

Employment Core Cordon Count of peak period person and vehicle volumes entering the downtown employment area of the District of Columbia and Arlington County, Virginia, designated the Central Employment Core (formerly Metro Employment Core), the largest activity center in the Washington metropolitan region. Data were collected from 5 A.M. to 10 A.M. inbound along two cordon lines, the "traditional" cordon line which dates to the opening of the initial segment of the Metrorail system in 1976, and an revised or expanded cordon.

Most comparisons are made with results obtained from the previous Central Employment Core Cordon Count conducted in Spring 2009, though some are with the Spring 2006 Cordon Count. Between the 2009 and 2013 counts, some demographic and transportation system changes have occurred that may have influenced the numbers of people and how they have commuted into the regional core. Data were not collected during the P.M. peak period for this effort.

Trends and changes in person and vehicle trips by mode are emphasized for the 6:30 - 9:30 A.M. peak period inbound. The following changes were observed:

1) Total inbound travel decreased in the A.M. peak period from about 463,000 person trips in 2009 to 446,000 in 2013. Trips crossing the revised cordon in 2013 were about 435,000.

2) Inbound peak period transit trips were about 211,000, little changed from 2009. Transit trips crossing the revised cordon line were about 197,000.

3) Person trips by automobile in 2013 were about 236,000, a decrease of about 21,000 from 2009. Most of the decrease in person trips were in multiple occupant vehicles (2 or more persons per vehicles), which declined by about 21,000 trips.

4) The number of automobiles entering the Central Employment Core in the A.M. peak period has declined from 203,000 in 2009 to about 192,500 in 2013. For the five-hour monitoring period, the decline was similar in absolute terms, from about 273,000 in 2009 to 263,000 in 2013.

5) Traffic volumes crossing the revised cordon line were only slightly higher, but person trips were lower.

6) About 3,500 bicycles entered the Central Employment Core in the A.M. peak period. In the full five hour monitoring period, almost 5,000 trips by bike were observed.

Figure 50 and Figure 51 below contain charts that depict the trends in person trips from 1999 to 2013, in the inbound peak period.

Figure 50: 2013 Cordon Count Trends in Person Trips: 1999-2013, Inbound 6:30-9:30 am

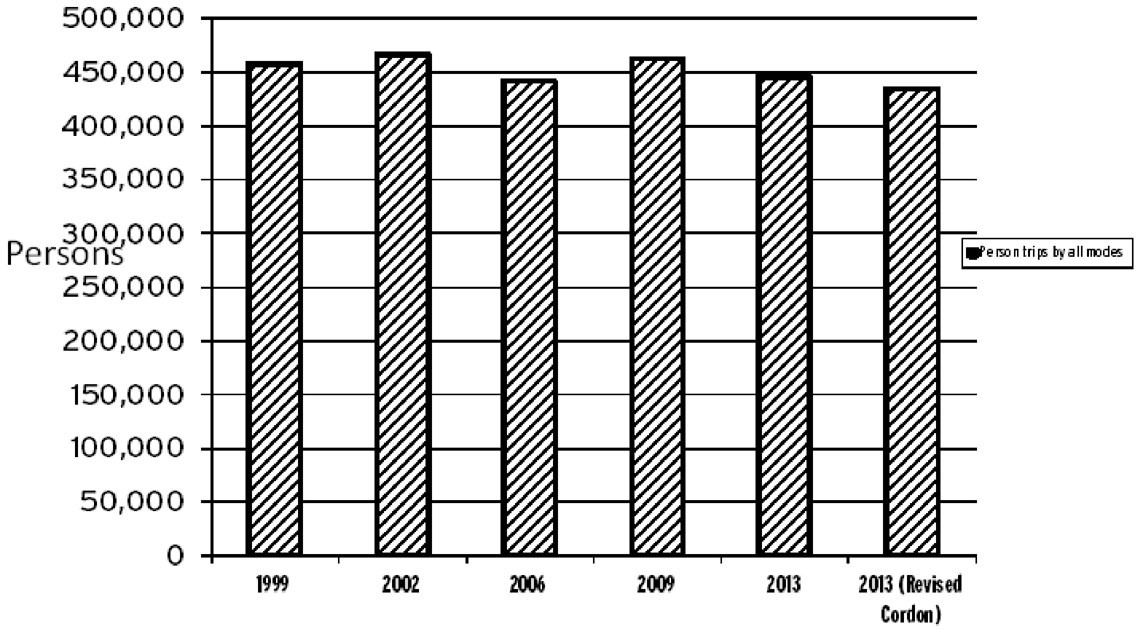
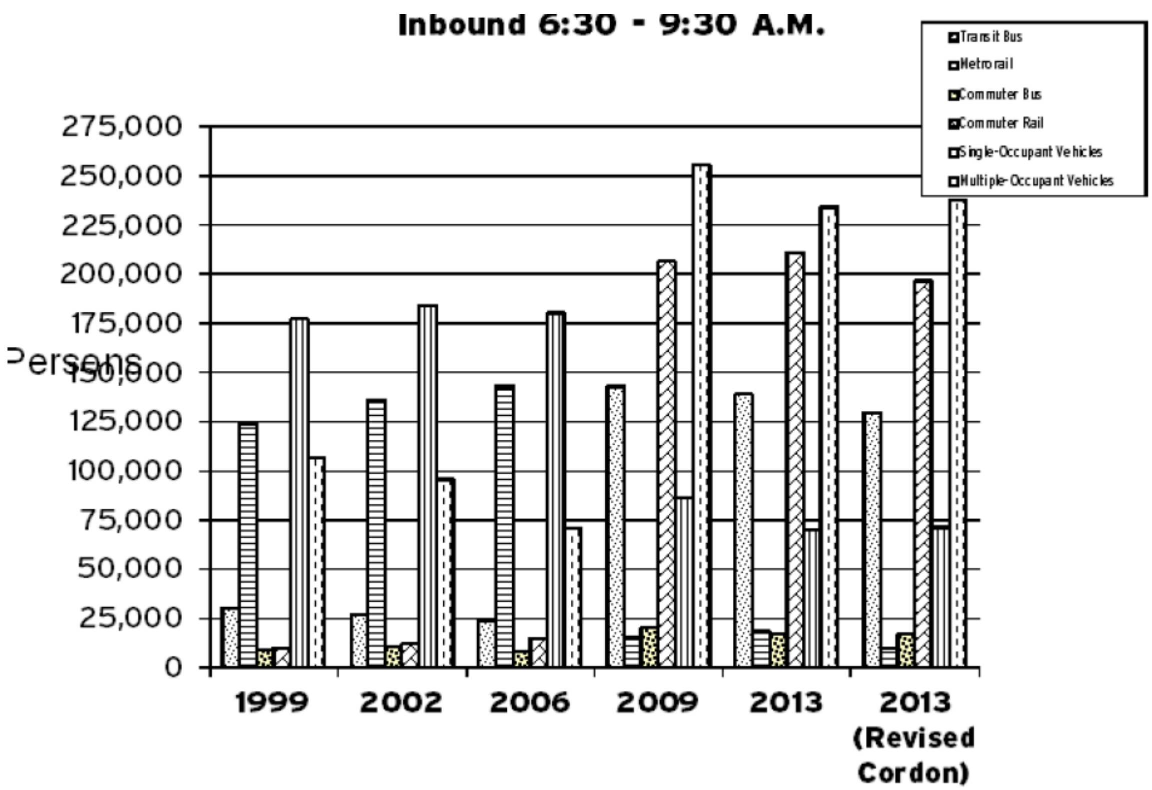


Figure 51: 2013 Cordon Count Trends in Person Trips by Mode: 1999-2013, Inbound 6:30-9:30 am



2.6.2 HOV FACILITY SURVEYS

High occupancy vehicle (HOV) facilities are designed to offer several advantages over conventional lanes and roads, including the increase of person throughput during peak periods.

In the Washington area, there are five high occupancy vehicle (HOV) facilities on highways functionally classified as freeways. These are:

- I-95/I-395 in the Northern Virginia counties of Prince William, Fairfax and Arlington, and the City of Alexandria;
- I-66, also in the Virginia counties of Prince William, Fairfax and Arlington (this HOV system includes a section of the Dulles Connector in McLean, connecting to VA 267's HOV lanes (see below));
- I-270 and the I-270 Spur in Montgomery County, Maryland;
- VA 267, connecting to I-66 via the Dulles Connector; and
- U.S. 50 in Prince George's County, Maryland.

The I-95/I-395 and I-66 HOV facilities provide direct access to core employment centers of the region in Arlington County and the District of Columbia. I-270 and the I-270 Spur end at the Capital Beltway (I-495) and the U.S. 50 HOV lanes end just prior to the Beltway. VA 267's HOV system connects directly to I-66, providing access to the regional core from the Dulles Toll Road Corridor. There are arterial HOV lanes and bus only shoulder treatments in the region, but these facilities are beyond the scope of this study.

COG/TPB has conducted surveys on the HOV system in 1997, 1998, 1999, 2004, 2007 and 2010. Some highlights of the most recent 2010 survey[71] were summarized below; more information can be found in Appendix D.

The following major trends were observed by comparing the 2010 survey to previous surveys:

- During Spring 2010, all of the HOV lanes required fewer cars to carry more persons per lane during the HOV restricted periods than adjacent non-HOV lanes making the HOV lanes more efficient at moving people to their destinations;

- Most of the HOV lanes provide travel time savings when compared to non-HOV alternatives, especially the barrier separated HOV lanes in the I-95/I-395 corridor in Northern Virginia; and

- Average auto occupancy in 2010 was little-changed from 2004 and 2007, even though the HOV lanes in Northern Virginia continue to exempt vehicles with "Clean Special Fuel Vehicle" registration plates from the HOV requirement.

The 2010 survey results showed that in all corridors, HOV routes saved time and operated at higher than average speeds than parallel non-HOV routes. The time savings during the AM restricted periods in 2010 are greater than those observed in 2007 for the I-66 and Dulles Toll Road corridors and have declined slightly in the I-95/I-395 and the I-270 corridors. The travel time advantage of HOV over non-HOV in the U.S. 50 corridor is negligible. In 2010, the areas with the greatest time savings are I-395 and I-66 inside the Beltway. All other segments save

[71] *2010 Performance of High-Occupancy Vehicle Facilities on Freeways in the Washington Region,* September 7, 2011. http://www.mwcog.org/uploads/committee-documents/ll1fXl1b20110908082403.pdf

less than a minute per mile, but on I-395 inside the Beltway time savings are 2.9 minutes per mile and I-66 sees 2.4 minutes per mile time savings. The PM restricted period showed similar results: improved travel time advantages for HOV in the I-95/I-395 and I-66 corridors, some rebound travel time savings in the Dulles Toll Road and U.S. 50 corridors over 2007, and I-270 held steady on the west side of the spur while experiencing a three minute increase in travel time savings from the east spur.

HOV facilities are designed to provide faster travel times and more predictable speeds than parallel non-HOV facilities, which was the general conclusion of this study. It is clear that while HOV facilities aid in improving the operation of the region's roadways, they can also influence traveler behavior and manage the demand of single-occupant travel.

In addition to the HOV facilities, the Washington region also operates two other managed facilities: the Inter-County Connector (MD 200) in Maryland and the I-495 Express Lanes on the Virginia side of the Capital Beltway. The 29-mile I-95 Express Lanes[72] in Virginia were under construction as of the writing of this report and will be open in 2015. Future congestion monitoring activities should also include these facilities.

2.6.3 Household Travel Surveys

The TPB conducts Household Travel Surveys of households in the Washington region and adjacent areas to gather updated information on area wide travel patterns. These surveys provide information on such important determinants of travel as household demographics, income, employment destinations, and number of vehicles available. This data helps guide future transportation planning as the area continues to grow.

The latest comprehensive regional Household Travel Survey was conducted by TPB staff in 2007-2008, updating the last such survey which was undertaken in 1994. Data is being collected from households across the region and some preliminary results of survey data analysis include:

- The significant increase in the proportion of single person households in the region had a dramatic impact on the average number of daily trips per household.
- Per person daily trip rates decreased moderately for persons from 5 to 34.
- Per person daily trip rates increased significantly for persons 65+.
- The share of daily trips by auto driver vehicle trips decreased 2.2 percentage points, the walk share increased by 1.6 percentage points, and the transit share increased by 0.7 percentage points.
- The biggest modal shifts between auto driver vehicle trips and the transit and walk modes were seen in the 16 to 34 and the 55 to 64 age groups.
- Persons 25 to 34 more likely to live in Regional Activity Centers.

Following the 2007-2008 TPB Regional Household Travel Survey that was primarily conducted for the development of the new travel demand model, geographically-focused house hold travel surveys have been conducted from 2010 to 2013. The objective of the surveys are threefold: (1)

[72] Virginia Mega Projects, 95 Express Lanes, http://www.vamegaprojects.com/about-megaprojects/i-95-hov-hot-lanes/

analyzing daily travel behavior in communities with different densities, physical characteristics and transportation options, (2) assisting local planners with current local land use and transportation planning efforts, and (3) building a household travel survey database that can measure changes in local community travel behavior over a period of time (Before and After comparisons).

The TPB's first phase of Geographically-Focused Household Travel Surveys was conducted in spring 2010, fall 2011 and spring 2012. Surveys were conducted at five high-density developments (14th St NW/Logan Circle, Crystal City, Friendship Heights, and Shirlington), two planned high-density development areas (White Flint and National Harbor), three areas experiencing growth (New York Avenue Corridor area, St, Charles Urbanized Area, and the Dulles North Area) three areas with emerging transportation options (Woodbridge, VA, Beauregard Avenue Corridor, and Frederick, MD), and five study areas with recent or planned rail transit options (Columbia Pike Corridor; Reston, VA; the University Boulevard corridor in Maryland; and the area around the Largo Metrorail Station, and the Falls Church Area[73]. Initial results for the first ten locations were presented to the TPB at its May 2012 meeting[74]. Additional phases of focused surveys are underway as of the time of this report and more are planned for the future.

2.6.4 Special Surveys and Studies

The TPB and its member agencies undertake special studies or data collection efforts, on both one-time and recurring bases. Examples include compiling data to form a regional travel trends report, as well as monitoring transit usage, and cordon counts of traffic on specified areas of the region.

2.6.4.1 Regional Bus Survey

A major regional bus survey was conducted in Spring 2008 on behalf of the TPB[75]. The purposes of this survey were to: 1) collect the jurisdiction of residence data of Washington Metropolitan Transit Authority's (WMATA) weekday bus passengers in support of WMATA's bus subsidy allocation formula; 2) collect origin and destination trip patterns of the local jurisdiction bus systems for local bus route planning and regional travel demand model validation; and 3) collect other travel-related and demographic data to update the regional profile of WMATA and local bus system riders and their related bus trips.

Transit systems surveyed were ART (Arlington Transit), The Bus (Prince George's County), CUE (Fairfax, VA), DASH (Alexandria Transit Co.), TransIT (Frederick County Transit), OmniRide/OmniLink (PRTC), Ride On (Montgomery Co.) and Metro Bus (D.C, Virginia, Maryland). Some key findings of this survey include:

[73] TPB Weekly Report (5/29/12): In-Depth Surveys Provide New Understanding of Neighborhood-Level Travel Patterns in Regio, http://www.mwcog.org/transportation/weeklyreport/2012/05-29.asp
[74] TPB Presentation (5/16/12): 2011 TPB Geographically-Focused Household Travel Survey Initial Results, http://www.mwcog.org/uploads/committee-documents/k11dXlle20120517145044.pdf
[75] NuStats, *2008 Regional Bus Survey Technical Report*, June 2009.

- Except for Metrobus, most systems primarily served residents of a particular geographic subarea of the region.
- Except for PTRC and TheBus, more than half the riders access their bus by walking to it.
- The PRTC and TheBus systems have large percentages of riders who park-and-ride, at 22% and 15% respectively.
- Commuting to work accounts for one-half to two-thirds of the trips on each bus system.
- SmarTrip was the predominant payment method used by PRTC (57%) and Metrobus (42%).
- Overall 24% of the surveyed bus riders reported receiving a transit benefit from their employer.
- Choice riders are riders who had a vehicle available to them to make the trip they were making, but "chose" to make the trip by bus instead. The PRTC ART and DASH systems had the greatest percentages of "choice" riders.

As of the writing of this report, the 2014 Metrobus Survey[76] was underway. In this survey, all Metrobus lines will be surveyed in the spring and fall of 2014.

2.6.4.2 Regional Travel Trends Report

The Regional Travel Trends Report summarized major travel trends in the metropolitan region from 2000 – 2006[77]. The rate and spatial pattern of population growth are key to the underlying changes in travel trends. The metropolitan Washington region has seen a fast increase in growth over the last several decades, and with that come major changes in how and why people travel. This is important to congestion management, in that it is important in understanding why congestion may be occurring in particular areas. In addition, travel trends can help predict, and prepare for, future congestion.

The data for the Regional Travel Trends report is not compiled from just one survey or study. Rather, the data is drawn from a variety of different sources. These sources include:

- Population and worker characteristic data from the 2000 Decennial Census and the new American Communities Survey (ACS)
- Population, group quarter, and housing unit estimates from the Federal State Cooperative Program for Population Estimates (FSCPE)
- Employment and labor force data from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages (QCEW)
- Local Area Unemployment Statistics (LAUS) program
- Highway Performance Monitoring System (HPMS)
- Travel monitoring data from:
    - DDOT
    - MDOT
    - VDOT

[76] Regional Bus Subcommittee presentation (3/25/14): 2014 Metrobus Survey, http://www.mwcog.org/uploads/committee-documents/a11ZWFtf20140325100202.pdf
[77] *DRAFT Regional Travel Trends Report*, December 28, 2007

  - TPB Regional Transportation Data Clearinghouse
- Transit ridership statistics from the Washington Metropolitan Area Transit Authority (WMATA)
- Northern Virginia Transportation Commission (NVTC)
- Montgomery County
- Prince George's County

The Travel Trends report looks at the 2000 – 2006 trends and compares that to the trends of the previous decade, from 1990 – 2000. During the 1990s, the outer suburbs experienced the greatest population changes, with Loudoun County having the largest population increase at 97%. However, both Fairfax County and Montgomery County added more population in absolute terms than Loudoun. During the 1990's there was virtually no net increase in population in the region's Center Area jurisdictions.

Some key findings of the regional travel trends during the 2000 – 2006 time period include:

- The outer suburbs continue to grow. The greatest amount of population increase in this decade so far have been in the Outer Suburban jurisdictions of Loudoun, Prince William, and Stafford Counties in Virginia, and in Frederick, Charles, and Calvert Counties in Maryland. Loudoun and Prince William counties have already added more population in the first six years of this decade than they did in the entire ten years of the previous decade.
- If the annual growth rates observed in the Outer Suburbs from 2000 – 2006 continue, they will have added almost 500,000 people between 2000 and 2010. This would be significantly more than the 340,000 added in the Inner Suburbs between 1990 and 2000.
- A significant turnaround in the District of Columbia's population growth was seen from 2000 – 2006. Whereas the District lost population between 1990 and 2000, the city experienced a net gain of more than 10,000 residents between 2000 and 2006.
- Similar to the gain in population growth, the Outer Suburbs also experienced the greatest increase in civilian labor force between 2000 and 2006.
- The latest statistics show household vehicle availability growing at the same rate as total population increase. This is different from the 1990's statistics, which show that at that time the number of household vehicles was increasing faster than the total population.
- Weekday Vehicle Miles of Travel (VMT) in the region grew by an average annual rate of 2.4% between 2000 and 2006. This is faster than the increase in population, employment, and vehicle availability.

2.6.4.3 Local Studies

Sometimes member state and local jurisdictions will conduct studies to analyze and evaluate their own programs, and these studies can be important to congestion management.

An example of one such effort is the Montgomery County Mobility Assessment Report (MAR) produced by the Maryland – National Capital Park and Planning Commission (MNCPPC)[78]. The report is updated annually (with exceptions) with the latest information regarding the status of congestion in Montgomery County, Maryland.

Intersections and arterials are two main focuses of the report. For intersections, observed Critical Lane Volumes (CLVs) is the performance measure and the ratio of CLVs over Local Area Transportation Review (LATR) standard is used to quantify intersection congestion. The report also ranks the most congested intersections in the county for more detailed analysis. For arterials, the VPP/INRIX data and the VPP Suite were used to analyze traffic congestion. Travel Time Index was the main performance measure and a color scheme of congestion severity was developed.

2.6.5 The Regional Transportation Data Clearinghouse

Over the years, staff at the TPB has collected transportation data from various sources, primarily member jurisdictions, state agencies, and transit authorities. The Regional Transportation Data Clearinghouse program transforms these data into a format associated with the region's travel demand forecasting model. In late 2012, the TPB launched a Web Map Application for the Regional Transportation Data Clearinghouse[79], offering easy-to-access, web-based tools for users to draw queries and download raw data. As of the end of 2013, the Web Map Application provides eight data layers:

1) Hourly traffic counts
2) Annualized traffic volumes
3) Transit counts (Transit route description and 2011 average weekday ridership)
4) WMATA Metrorail facilities – stations and lines
5) Round 8.2 Cooperative Forecast by TAZ
6) Activity Centers
7) Screenlines location and ID number for TPB travel demand model version 2.3
8) Metropolitan Washington Boundaries

In the future, the Clearinghouse plans to add more data and more functionality into the Web Map Application.

2.7 National Comparison of the Washington Region's Congestion

Regularly since 1982, the Texas Transportation Institute releases an *Urban Mobility Report*[80], which outlines and compares urban congestion and mobility in all 439 urban areas across the

[78] Maryland – National Capital Park and Planning Commission (MNCPPC), Mobility Assessment Report (MAR), Draft, April, 2014. http://www.montgomeryplanning.org/transportation/documents/Mobility%20Assessment%20Report%202014%20-%20DRAFT%20(4-9-2014).pdf
[79] User Guide, TPB Regional Transportation Data Clearinghouse Web Map Application, revised September 2013. https://gis.mwcog.org/downloads/RTDC_UsersGuide.pdf
[80] Texas Transportation Institute (TTI) and the Texas A&M University System. *The 2012Urban Mobility Report*. February 2013. http://mobility.tamu.edu/ums/

United States. The most recent report was released in February 2013 and was based on 2010 data from the National Highway Performance Monitoring System (HPMS) and INRIX, Inc.

Since 2007, INRIX, Inc., an independent live traffic information provider based primarily on GPS units equipped on commercial fleets, releases a *National Traffic Scorecard*[81] for the largest 100 metropolitan areas in the U.S. Started in mid-2012, INRIX provides monthly updates to the Scorecard.

Both national reports use several different performance measures, which greatly impacts the rankings of cities (Table 12). For example, the TTI study concludes that the Washington region is ranked as the most congested metro area in the nation, the ranking of the report often cited in the local press. This particular ranking uses travel delay per person as the performance measure. If a different measure, travel time index (the ratio of travel time in the peak period to travel time under free flow conditions) is used, the Washington region is ranked second. The INRIX report only uses peak period (6:00-10:00 am and 3:00-7:00 pm) Travel Time Index[82] as the ranking measure.

Table 12: National Comparison of the Washington Region's Congestion

Measures	Texas Transportation Institute (2011 data)		INRIX National Traffic Scorecard (2013 data)	
	Value	Rank	Value	Rank
Travel time index	1.32	4	1.162	10
Annul delay per traveler	67 hours	1	/	/
Total Travel delay	179,331,000 person- hours	4	/	/
Excess fuel consumed	85,103,000 gallons	5	/	/
Congestion cost	$ 3,771 million	4	/	/

There are some limitations to the Texas Transportation Institute's report. it provides average conditions across the region, not location-specific information that only a regional congestion monitoring program, such as that done for freeways and arterials in our region, can provide. In addition, even though the methodology has improved over time and attempts to include the impacts of transit, HOV lanes, demand management, and some operational improvements, it tends to apply national average parameters to particular metropolitan areas. For INRIX report, the regional measures are summarized based on segment length rather than vehicle miles of travel (VMT) of the segment (the way Texas Transportation Institute does), due mainly to lack of traffic volume information in their data source.

The primary value of the Texas Transportation Institute report is not in identifying rankings, but rather in studying how urban areas across the county are doing over time. It also mentions the benefits of congestion management strategies that many cities, such as the Washington, DC area, are considering. Operational and demand management strategies, such as providing more travel

[81] INRIX, Inc., National Traffic Scorecard, http://scorecard.inrix.com/scorecard/

[82] A term "INRIX Index" is used in the monthly updated INRIX Traffic Scorecard. According to the "Methodology", the INRIX Index represents a percentage point increase in the average travel time of a commute above free-flow conditions during peak hours, i.e., INRIX Index = (Travel Time Index – 1)*100%.

options, adding capacity, managing the demand, increasing efficiency of the system, and managing construction and maintenance projects, all noted in the report, are all robust strategies that will continue to be pursued by TPB member agencies.

2.8 Performance and Forecasting Analysis of the 2013 Financially Constrained Long-Range Transportation Plan (CLRP)

The CLRP includes all regionally significant transportation projects and programs planned in the Metropolitan Washington region over the next 25-30 years. Each year the CLRP is updated to include new projects and programs. TPB produces a performance analysis of every CLRP, which examines trends and assesses future levels of congestion and other performance measures. The 2013 CLRP Performance Analysis[83] provides both an overall assessment of the anticipated impacts of the CLRP, as well as an indication of future levels of congestion relevant to the CMP.

Plan performance analyzes the outlook for growth in the region. One of the cornerstones of plan performance is the forecasting of future congestion. The plan performance looks at where in the region congestion will occur in the future and compares current congestion to future congestion. It looks at criteria that may affect congestion, such as changes in population, employment, transit work trips, vehicle work trips, lane miles, and lane miles of congestion. The analysis also breaks down lane miles of congestion into core, inner suburbs, and outer suburbs, providing information on where, generally, the most lane miles of congestion can be found in 2040 compared to 2014.

From 2014 to 2040, the region-wide total number of trips taken is expected to increase by 24% (Figure 52). The overall amount of driving in the region (VMT) is expected to grow by 23%, slightly less than population, which means VMT per capita is forecast to drop by 1%. The increase in demand on the roadways (+24% more trips) is forecast to outpace the increase in supply (+7% lane miles), leading to a significant increase in congestion (+71% lane miles of congestion).

Severe stop-and-go congestion during the AM peak is expected to be prevalent throughout the entire region in 2040. Outer suburban jurisdictions are forecast to experience the greatest increase in congestion, while the already congested inner suburbs will experience the worst overall congestion (Figure 53).

AM congestion is expected to increase throughout most of the region in 2040, particularly in the following outer jurisdiction locations (Figure 54):

- I-70 East toward Frederick
- The Beltway both directions between I-270 and the American Legion Bridge
- Parts of VA-267 East in Fairfax County
- Parts of I-66 East in Prince William and Fairfax Counties
- I-95 North in Prince William County
- The Wilson Bridge on the inner loop of the beltway

[83] 2013 Performance Analysis of the CLRP, Presentation to the TPB, 2013-12-18: http://www.mwcog.org/uploads/committee-documents/YV1aVlhZ20131218092900.pdf

Congestion reductions are forecast in the following locations:

- I-70 East at the I-270 interchange (widening)
- Along parts of I-270 South (Corridor Cities Transitway, HOV, and widening)
- VA-267 East (collector/distributor roads and Silver Line to Loudoun)
- And I-66 East inside the beltway (spot improvements and increase to HOV3+)

Figure 52: Changes in Land Use and Travel Forecast, 2014-2040

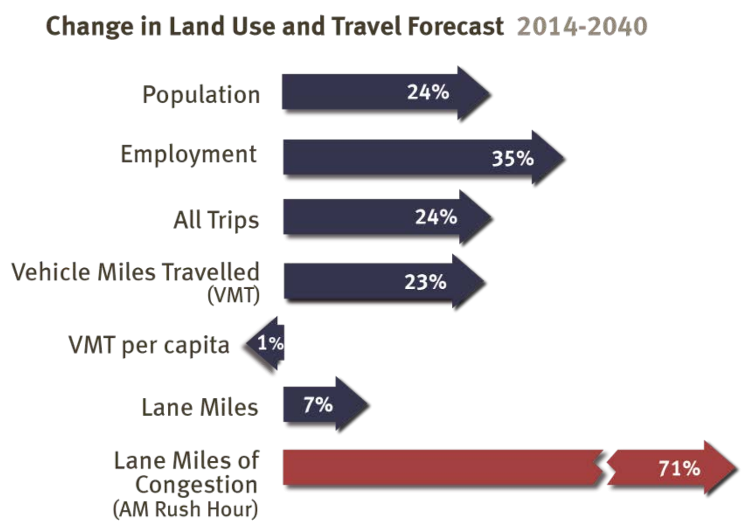


Figure 53: Lane Miles of Congestion, AM Rush Hour, 2014-2040

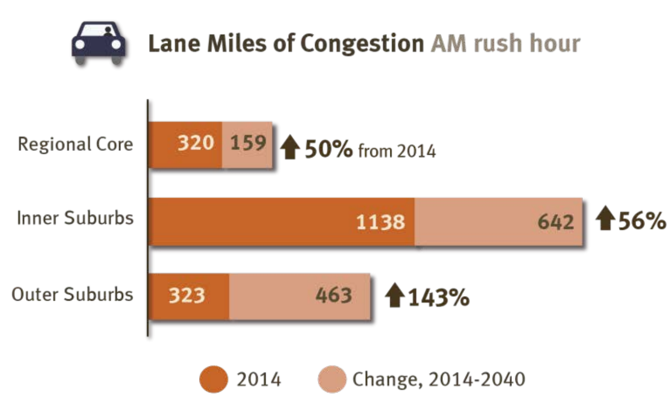
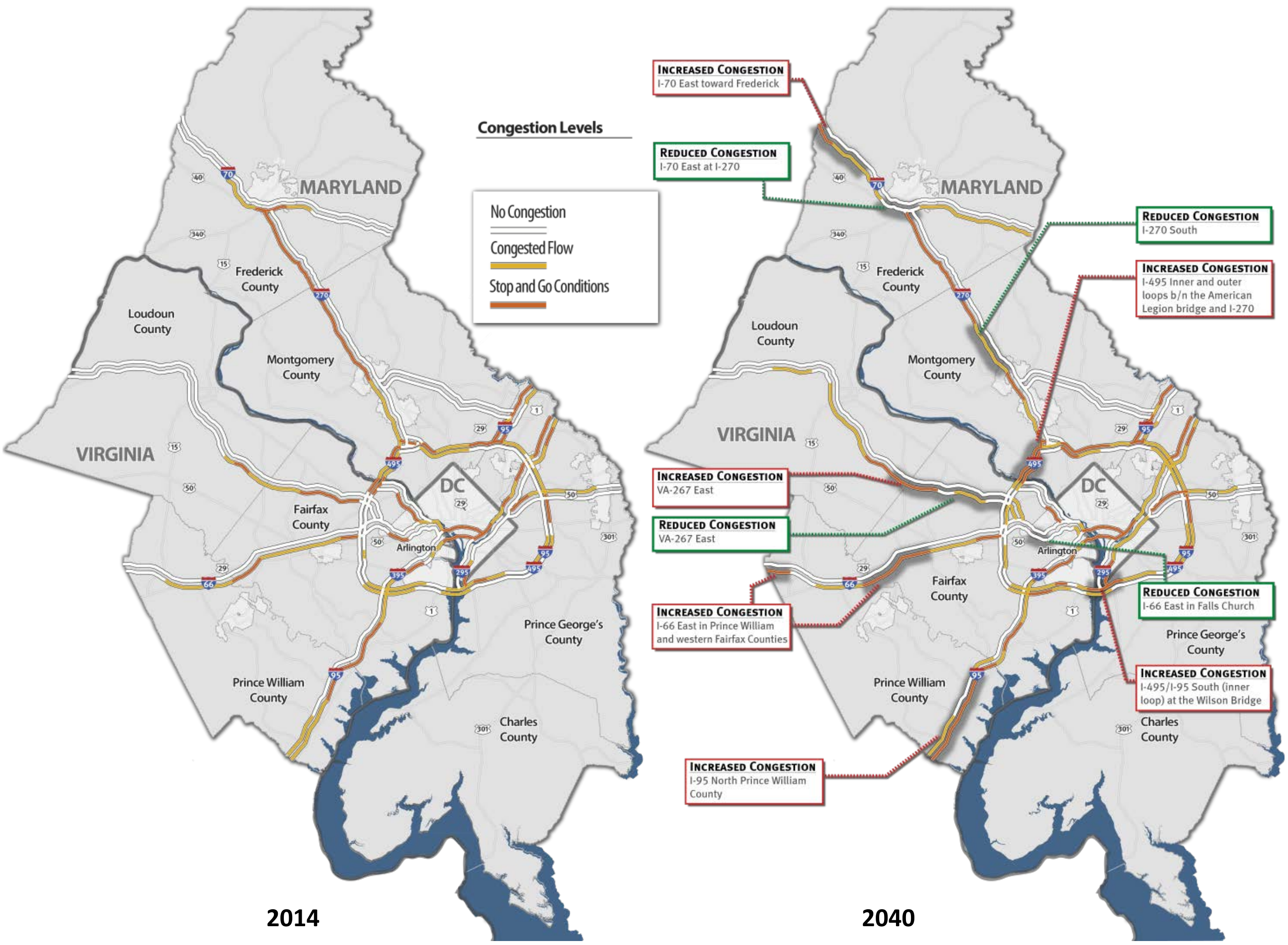
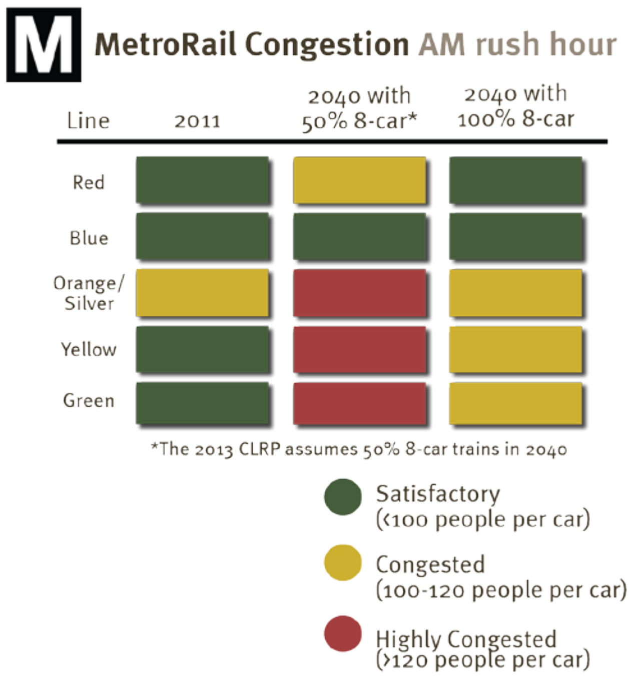


Figure 54: Highway Congestion, AM Rush Hour, 2014-2040



Due to a lack of funding for capacity enhancement projects to accommodate all of the projected transit ridership growth in the region, the Metrorail system will likely reach capacity on trips to and through the regional core. According to a WMATA study (Figure 55), without additional railcars beyond those currently funded, all lines entering the core will become congested by 2040, and the Orange/Dulles, Yellow and Green lines are forecast to be highly congested.

Figure 55: Metrorail Congestion in AM Rush Hour



Another way to measure the performance of the plan is by residents' accessibility to jobs by auto and transit. The average number of jobs accessible within a 45 minute automobile commute is expected to go down slightly from 919,000 in 2014 to 893,000 in 2040 (Figure 56). The greatest reductions in job accessibility are expected to be on the eastern side of the region, due to increases in congestion system-wide and a higher concentration of future jobs on the west side. Average accessibility by transit is forecast to increase from 412,000 in 2014 to 516,000 in 2040, but will remain significantly lower than by automobile (Figure 57).

Figure 56: Job Accessibility by Auto, 2014-2040

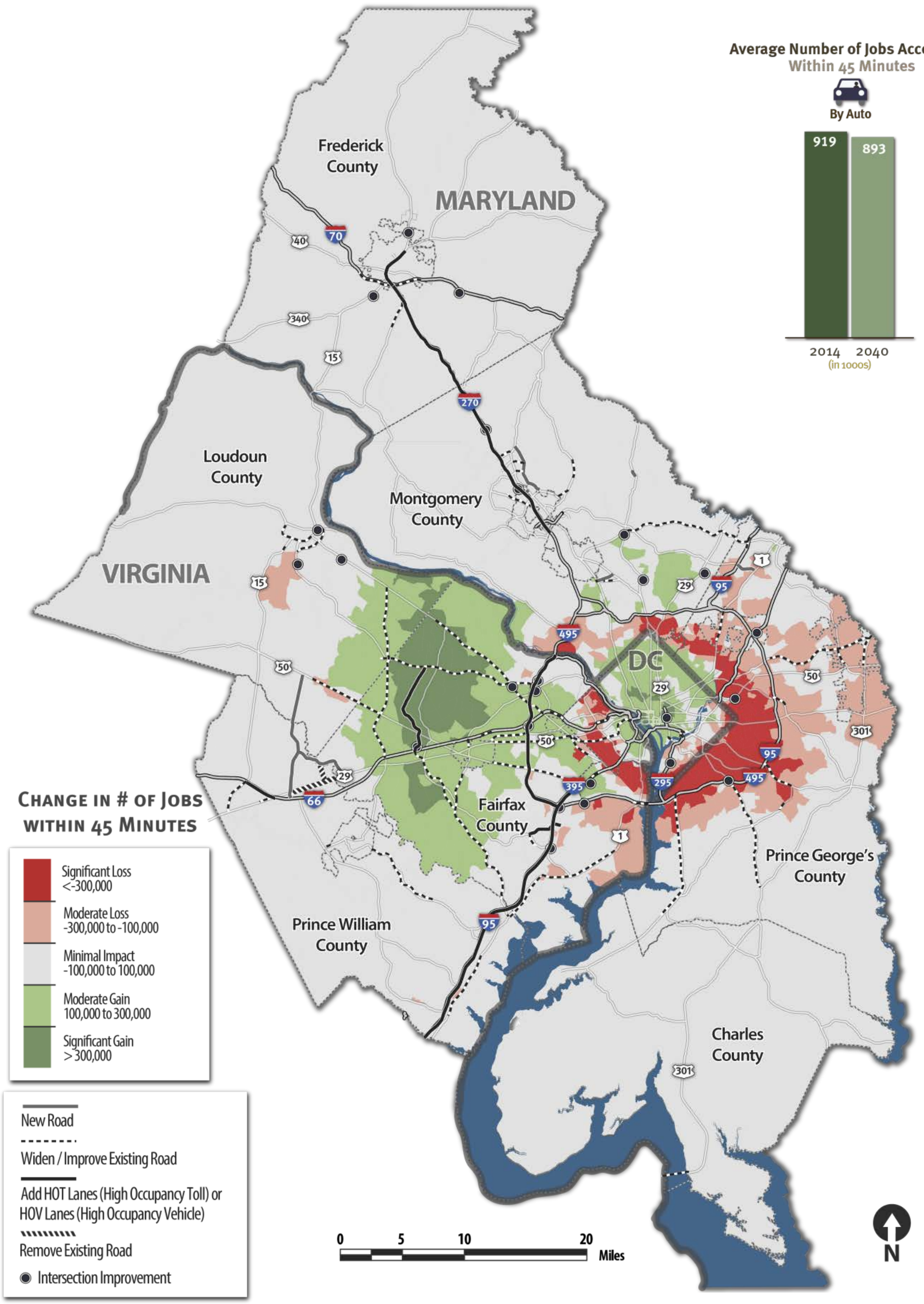
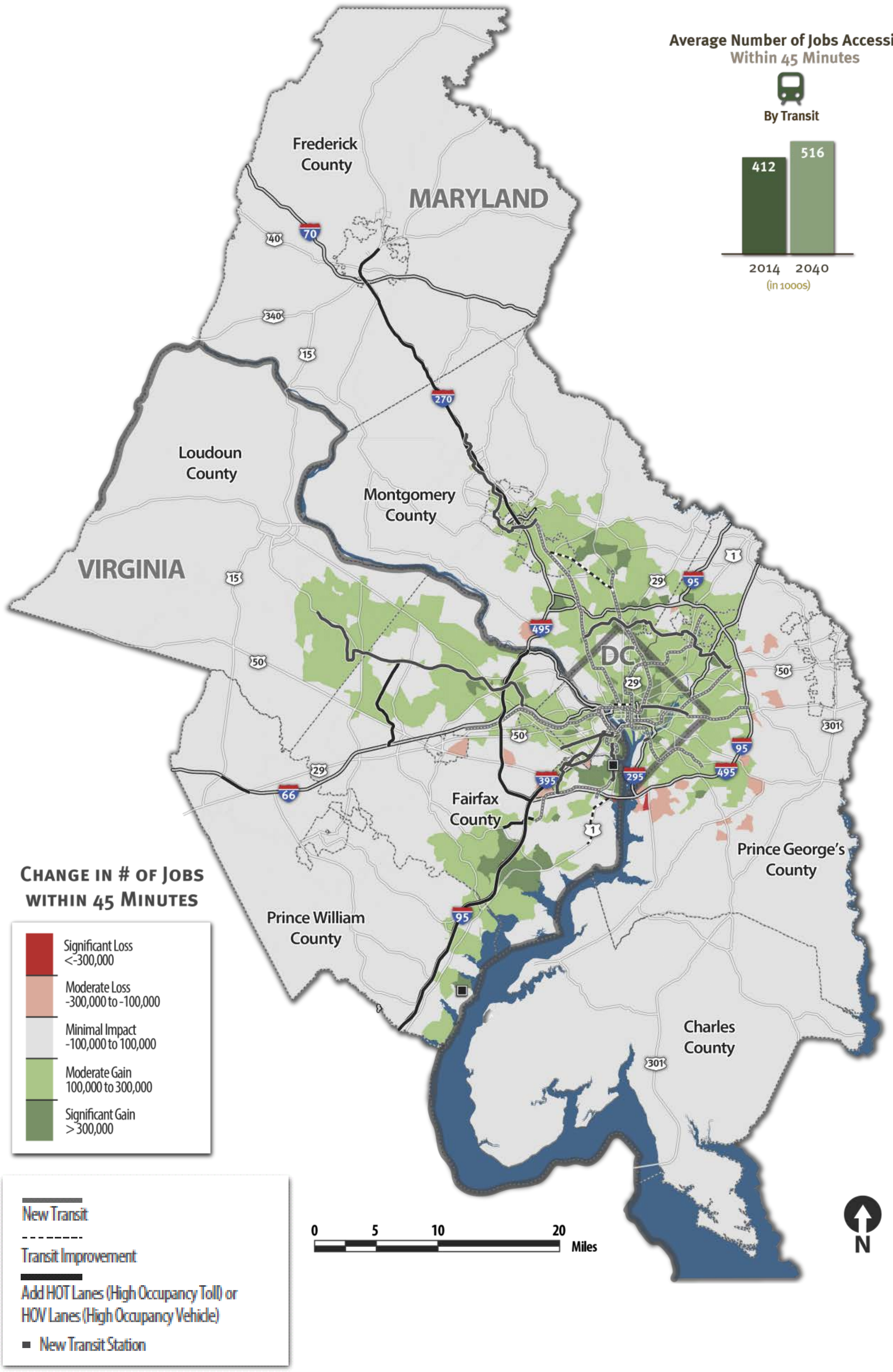


Figure 57: Job Accessibility by Transit, 2014-2040

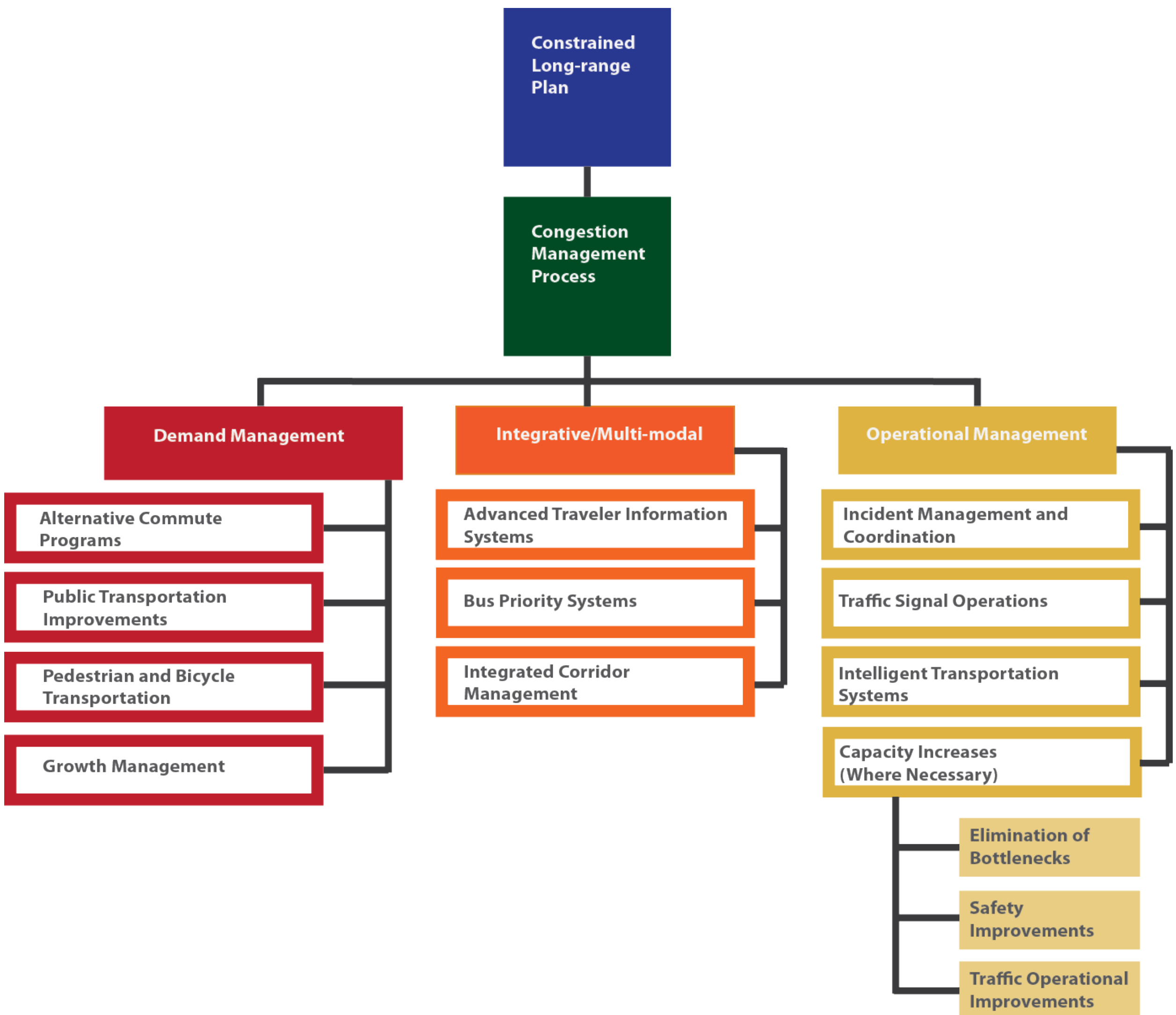


3. CONSIDERATION AND IMPLEMENTATION OF CONGESTION MANAGEMENT STRATEGIES

3.1 Overview of Congestion Management Strategies

Congestion Management Strategies generally can be divided into two types – Demand Management strategies and Operational, or Supply Management strategies. For purposes of this report, a third category, Integrative/Multi-modal, was added to better reflect the integration of demand and operation management in different projects in the region. Figure 58 shows examples of congestion management strategies.

Figure 58: Major CMP Strategies



Note: There are synergies between strategies categorized as demand management or operational management strategies, such as real-time traveler information on ridesharing opportunities responsive to a real-time traffic incident or situation.

Demand Management is aimed at reducing the demand for travel and influencing travelers behavior; either overall or by targeted modes. Demand Management strategies can include carpooling, vanpooling, telework programs that allow people to work from home to reduce the amount of cars on the road, and living near your work as a means of reducing commute travel.

Supply or operational management, on the other hand, is managing and making better use of existing transportation network in order to meet the region's transportation goals and ultimately reduce congestion. Example supply management strategies are High-Occupancy Vehicle (HOV) lanes, variably priced lanes, and traffic management.

Often strategies categorized as either demand management or operational management have components of the other. There are strategies in place the region that take that combination a step further and integrate demand and operational management strategies into larger projects. In this report, these strategies have been categorized in this report as Integrative/Multi-modal strategies. Examples of these strategies include advanced traveler information systems and integrated corridor management.

These strategies, and how they are implemented throughout the Washington region, are explained in further detail below.

3.2 Demand Management Strategies

3.2.1 Commuter Connections Program

Commuter Connections is a regional network, coordinated by COG/TPB, which provides commuter information and commuting assistance services to those living and working in the Washington, DC region. This program has been in existence since the 1970's under different names and has implemented a number of demand management strategies in the region. The Commuter Connections program is designed to inform commuters of the availability and benefits of alternatives to driving alone, and to assist them in finding alternatives to fit their commuting needs. The program is funded by the District of Columbia, Maryland, and Virginia Departments of Transportation, as well as the U.S. Department of Transportation, and all services are provided free to the public and employers. Continuing the Commuter Connections Program is one of the key recommendations of the 2014 CMP Technical Report.

Commuter Connections evaluates the impacts of their programs through the Commuter Connections Transportation Demand Management Evaluation Project. The evaluation process allows for both on-going estimation of program effectiveness and for annual and triennial evaluations. The most recent Transportation Emission Reduction Measure (TERM) Analysis Report covered FY2009-2011. [84] The next report will cover FY2012-2014[85].

[84] *Transportation Emission Reduction Measure (TERM) Analysis Report FY 2009-2011*, January 17, 2011. http://www.mwcog.org/commuter2/pdf/publication/2011-TERMAnalysisFinalReport01-17-12.pdf

Both qualitative and quantitative types of performance measures are included in the evaluation process to assess effectiveness. First, measures reflecting commuters' and users' awareness, participation, utilization, and satisfaction with the program, and their attitudes related to transportation options are used to track recognition, output, and service quality. Some of the important performance measures are:

- Vehicle trips reduced
- Vehicle miles of travel (VMT) reduced
- Emissions reduced: Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC), Particulate Matter (PM2.5), PM 2.5 pre-cursor NOx, and CO_2 emissions (Greenhouse Gas Emissions - GHG)

Particularly of interest to congestion management is the impact on vehicle trips reduced, vehicle miles of travel (VMT) reduced, and cost effectiveness. Appendix E shows the summary of results for individual terms (i.e., how many daily vehicle trips were reduced and the daily VMT reduced compared to the goals set by Commuter Connections).

Commuter Connections also operates the Commuter Operations Center (COC), providing direct commute assistance services, such as carpool and vanpool matching through telephone and internet assistance to commuters. The Commuter Operations Center also provides transit, bicycling, park and ride lot, and telecommuting information to commuters in the region.

In addition, a variety of surveys (the following lists a subset of them) are conducted by Commuter Connections to follow-up with program applicants and assess user satisfaction on TERMs. These surveys provide data used to estimate program impacts. Some of the surveys, such as the Applicant Placement survey and Guaranteed Ride Home (GRH) Survey, also provide information used by Commuter Connections staff to fine tune program operations and policies.

- ***Commuter Connections Applicant Placement Rate Survey*** **–** Since May 1997 Commuter Connections has conducted commuter applicant placement surveys to assess the effectiveness of the Commuter Operations Center and other program components. The surveys assess users' perceptions of and satisfaction with the services provided.
- ***GRH Applicant Survey*** **–** Commuters who register with the GRH program or use a one-time exception trip will be surveyed to establish how the availability and use of GRH influenced their decision to use an alternative mode and to maintain that mode. Satisfaction with GRH services also will be polled.
- ***State of the Commute Survey (SOC)*** – The SOC survey, a random sample survey of employed adults in the Washington metropolitan region, serves several purposes. First, it establishes trends in commuting behavior, such as commute mode and distance, and awareness and attitudes about commuting, and awareness and use of transportation services, such as HOV lanes and public transportation, available to commuters in the region.

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[85] *Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework FY 2012-FY2014, Preliminary Draft, May 21, 2013.* http://www.mwcog.org/uploads/committee-documents/Z11bWVdc20130510085456.pdf

- ***Employee Commute Surveys* –** Some employers conduct baseline surveys of employees' commute patterns, before they develop commuter assistance programs and follow-up surveys after the programs are in place.
- ***Employer Telework Assistance Follow-up Survey* –** Sent to employers that received telework assistance from Commuter Connections to determine if and how they used the information they received.
- ***Bike-to-Work Day Participant Survey* –** A survey among registered participants in the Bike-to-Work Day event is undertaken to assess travel behavior before and after the Bike-to-Work Day, as well as commute distance and travel on non-bike days.
- ***Carshare Survey* –** A survey about the experiences of carshare users and the impact carsharing has on travel patterns in the region. The survey examines characteristics of carshare trips, travel changes made in response to carshare availability, and auto ownership and use changes in response to carshare availability.
- ***Vanpool Driver Survey* –** a survey that collects data on van ownership and operation, vanpool use and travel patterns, availability and use of vanpool assistance and support services, and issues of potential concern to vanpool drivers.

Transportation Emission Reduction Measures (TERMs) Evaluation

With the introduction of Clean Air Amendments in the 1990's reducing vehicle emissions became important in the region. Analysis showed that enhancing existing and introducing new demand management strategies will have a two-fold impact; reducing congestion and at the same time reducing emissions and clearing the air of ozone causing pollutants. These programs were called Transportation Emissions Reduction Measures (TERMs) and the regional programs were implemented through the Commuter Connections Program, in concert with program partners to meet air quality conformity and federal clean air mandates. Commuter Connections sets goals on TERM programs that impact commute trips[86], and evaluates the TERMs to determine the impact they are having on reducing congestion and vehicle emissions. These TERMs include:

- ***Guaranteed Ride Home (GRH)* –** Eliminates a barrier to use of alternative modes by providing free rides home in the event of an unexpected personal emergency or unscheduled overtime to commuters who use alternative modes.

- ***Employer Outreach* –** Provides regional outreach services to encourage large, private-sector and non-profit employers voluntarily to implement commuter assistance strategies that will contribute to reducing vehicle trips to worksites, including the efforts of jurisdiction sales representatives to foster new and expanded trip reduction programs.

- ***Mass Marketing* –** Involves a large-scale, comprehensive media campaign to inform the region's commuters of services available from Commuter Connections as one way to address commuters' frustration about the commute. Projects associated with this program include a

[86] The region has adopted and implemented TERMs other than those in the Commuter Connections program. Some other TERMs, such as for Signal Timing Optimization, may also impact congestion. Others, such as for emissions control equipment on heavy-duty diesel vehicles, impact only emissions.

regional Bike to Work Day event, Car free day event, and the 'Pool Rewards rideshare incentive program.

- ***'Pool Rewards*** - 'Pool Rewards is a special incentive program available through Commuter Connections designed to encourage current drive alone commuters to start ridesharing in the Washington Metropolitan region. Commuters who currently drive alone to work may be eligible for a cash payment through 'Pool Rewards when they start or join a new carpool.[87] If eligible, each carpool member can earn $2 per day ($1 each way) for each day they carpool to work over a consecutive 90-day period. The maximum incentive for the 90-day trial period is $130. Carpools may consist of two or more people. For commuters who drive alone to work and can get at least seven people together to form a vanpool, they may qualify for a $200 monthly 'Pool Rewards subsidy for the new vanpool.[88]

Both the TERM evaluation and associated surveys are keys to assessing the impact these programs have on congestion management and air quality. Following is a more detailed analysis on the above TERMs and other Commuter Connections demand management strategies in the region.

3.2.1.1 Telework

Teleworking, or telecommuting, can be described as a means of using telecommunications and information technology to replace work-related travel. This can be done by working at one's home, or at a designated telework center one or more days a week. There are designated telework centers throughout the region, in the District, Maryland, and Virginia. Phones, wireless communications, fax machines, and computers make teleworking an easy alternative to getting in a car and driving long distances to an office. Teleworking has shown to boost the quality of life, have economic benefits, reduce air pollution, and ease traffic congestion.

Telework is a TERM evaluated by Commuter Connections. Telework Outreach is a resource service to help employers, commuters, and program partners initiate telework programs. In evaluating teleworking, several travel changes need to be assessed, including: trip reduction due to teleworking, the mode on non-telework days, and mode and travel distance to telework centers.

Telework impacts are primarily estimated from the State of the Commute survey (SOC) and by surveys conducted of employers directly requesting information from Commuter Connections. The 2013 State of the Commute Technical Report (draft)[89] concluded the following regarding teleworking:

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[87] http://www.commuterconnections.org/commuters/ridesharing/pool-rewards/
[88] http://www.mwcog.org/commuter2/commuter/ridesharing/PoolRewardsLandingpage.html
[89] *Commuter Connections State of the Commute Survey 2013 Technical Survey Report (draft)*. Prepared for Metropolitan Washington Council of Governments. Prepared by: LDA Consulting, Washington, DC. In conjunction with: CIC Research, San Diego, CA. November 19, 2013.
http://www.mwcog.org/uploads/committee-documents/YV1aWFdY20131108123033.pdf

- Teleworkers accounted for 27% of all regional commuters. That is, workers who travel to a main work location on non-telework days.[90]
- An additional 18% of commuters, all who do not currently telework, said they "would and could" telework either regularly or occasionally, that is, they have job responsibilities that could be done while teleworking and would be interested in teleworking, if given the opportunity.
- The remaining respondents said they either were not interested in teleworking (11%) or that their jobs could only be performed at their main workplace (44%)
- Over half (57%) of the teleworkers surveyed said they teleworked at least one day a week.

The *TERM Analysis Report for FY 2009-2011* estimated the impacts of teleworking. It is estimated that the Maryland and Virginia Telework TERM reduced 12,500 daily vehicle trips and 241,000 daily VMT.

3.2.1.2 Employer Outreach

Employer Outreach is aimed at increasing the number of private and non-profit employers implementing worksite commuter assistance programs, and is ultimately designed to encourage employees of client employers to shift from driving alone to alternative modes.

In this TERM, jurisdiction-based sales representatives contact employers, educate them about the benefits commuter assistance programs offer to employers, employees, and the region and assist them to develop, implement, and monitor worksite commuter assistance programs.

The *TERM Analysis Report for FY 2009-2011* estimated the impacts of employer outreach. The following are some noteworthy statistics from that report:

- Employers participating in Employer Outreach substantially exceeded the goal, with 1,119 participating employers compared to the goal of 581.

- Estimated daily vehicle trip (90,000) and VMT (1.65 million) reduction exceeded the goals for this TERM.

3.2.1.3 Live Near Your Work

Population and employment growth can be considered beneficial for the region, but with it comes the potential for increased congestion. The trend of employees living further from their job is worsening, creating longer commutes. 'Live Near Your Work' is a program to help bridge the gap between the workplace and home. The program is primarily geared towards employers in an attempt to improve their employees' work-life balance. In turn, the results of employees living closer to where they work can reduce the number of cars on the road, which ultimately can ease congestion and have positive environmental impacts.

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[90] Using this base of commuters excludes workers who are self-employed and for whom home is their only workplace.

To promote the ‘Live Near Your Work’ initiative, Commuter Connections provides housing information in an online Employer’s Resource Guide. The tool highlights various housing programs and resources available for the Washington area workforce and aims to assist employees with moving closer to where they work. This guide also provides a list of flexible commuter options available through Commuter Connections. Used in tandem, employers have a number of ways to provide the information workers need to make living near and getting to work a reality. Employers can work with their internal staff to find and execute the right fit for their employees, and ultimately help everyone feel “more connected.” Employers can find that this can have a true impact on their bottom line.

3.2.1.4 Carpooling, Vanpooling, Ridesharing and other Commuter Resources

Commuter Connections provides information on carpooling, vanpooling, and Ridesharing. These alternative commute methods reduce the amount of single occupant vehicles (SOVs) on the road, which is important to congestion management.

- ***Carpooling*** is two or more people traveling together in one vehicle, on a continuing basis.

- ***Vanpooling*** is when a group of individuals (usually long-distance commuters) travel together by van, which is sometimes provided by employers. There are typically three kinds of vanpool arrangements:

    - *Owner-operated vans* — An individual leases or purchases a van and operates the van independently. Riders generally meet at a central location and pay the owner a set monthly fee.

    - *Third-party vans* — A vanpool "vendor" leases the vanpool vehicle for a monthly fee that includes the vehicle operating cost, insurance, and maintenance. The vendor can contract directly with one or more employees. The monthly lease fee is paid by the group of riders.

    - *Employer-provided vans* — The employer (or a group of employers) buys or leases vans for employees’ commute use. The employer organizes the vanpool riders and insures and maintains the vehicles. The employer may charge a fee to ride in the van or subsidize the service.

- ***Ridematching Services*** enables commuters to find other individuals that share the same commute route and can carpool/vanpool together. This provides carpooling options for people who may not know of someone to carpool with, thus broadening the carpooling options

3.2.1.5 Bike To Work Day

Each May thousands of area commuters participate in Bike to Work Day, sponsored by Commuter Connections and the Washington Area Bicyclist Association.[91] The TPB has a Bike

[91] http://www.biketoworkmetrodc.org

to Work Day Steering Committee which coordinates the event each year.

Bike to Work Day encourages commuters to try bicycling to work as an alternative to solo driving. The program has grown enormously attracting over 14,000 bicyclists in 2013.

Biking and other nontraditional modes are expanded upon in Section 3.2.4.

3.2.1.6 Car Free Day

Each year, Commuter Connections implements a regional Car Free Day[92] campaign that encourages residents to leave their cars behind or to take alternative forms of transportation such as public transit, carpools, vanpools, telework, bicycling or walking.

Car Free Day was first held in FY 2009. In FY 2012, evaluation results showed that there were over 11,700 individuals that pledged to go "car-free" for this event, a 70% increase over the previous year. In addition, there were approximately 5,500 vehicle trips reduced and 272,000 vehicle miles of travel reduced as a result of participation in this event. This event will is held on September 22nd each year and is in tandem with the World Car Free Day event. A marketing campaign along with public outreach efforts will be developed to coincide with this worldwide celebrated event.

3.2.2 Local and Other Transportation Demand Management and Traffic Management Activities

Local agencies and organizations, such as local governments and Transportation Management Areas (TMAs) are doing their part to promote alternative commute methods and other demand management strategies. Table 13 provides detailed information on specific ongoing demand management strategies in the Washington region.

[92] http://www.carfreemetrodc.org/

Table 13: Ongoing State Local Jurisdictional Transportation Demand Management (TDM) Strategies

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
Region-wide	Region-wide	WMATA	Public Transportation Improvements	Demand	Metrobus transit	Public bus service available throughout the region. Connects to other modes: Metrorail, commuter rail, park-and-ride lots, etc.	http://wmata.com/bus/
Region-wide	Region-wide	WMATA	Public Transportation Improvements	Demand	Metrorail transit	Public rail services DC, MD, and VA. Connects to commuter rail, Metrobus and local bus systems.	http://wmata.com/rail/
Region-wide	Region-wide	WMATA	Park-and-ride lot improvements	Demand	Metrorail station park-and-ride lots	Parking offered at 42 Metrorail stations.	http://wmata.com/rail/parking/
State/Multi-jurisdictional	Maryland State-wide	MDOT	Pedestrian, Bicycle, and Multimodal Improvements	Demand	Maryland Bicycle and Pedestrian Advisory Committee (MBPAC)	Provides information on biking, walking. Master Plan guides bike/ped planning in the State.	http://www.mdot.state.md.us/Planning/Bicycle/BikePedPlanIndex
State/Multi-jurisdictional	Maryland State-wide	MDOT	Telecommuting	Demand	MDOT's Telework Partnership with Employers/TeleworkBaltimore.com program	Offers free teleworking consulting services to Maryland employers. Promotes teleworking.	http://www.mdot.state.md.us/Planning/Telework%20Partnership%20Web%20Page/Telework%20Partnership%20with%20Employers
State/Multi-jurisdictional	Maryland State-wide	MTA	Employer outreach / mass marketing	Demand	MDOT's Commuter Choice Maryland	Reaches out to Maryland employers and offers incentives to implement a commuter program.	http://www.commuterchoicemaryland.com/

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
State/Multi-jurisdictional	Maryland State-wide	MTA	Public Transportation Improvements	Demand	MDOT's MARC train	Maryland MTAPublic commuter rail serving Montgomery County, Prince William County, Frederick County, and into DC.	https://www.mtamaryland.com/services/marc/index.cfm
State/Multi-jurisdictional	Maryland State-wide	MTA	Public Transportation Improvements	Demand	Local bus	Maryland MTA Public bus service throughout Maryland, primarily around the Baltimore-DC area.	https://www.mtamaryland.com/services/bus/routes/bus/
State/Multi-jurisdictional	Maryland State-wide	MTA	Public Transportation Improvements	Demand	Commuter Bus	Maryland MTA Commuter bus service in Maryland and DC's inner-ring suburbs.	https://www.mtamaryland.com/services/commuterbus/
State/Multi-jurisdictional	District-wide	DDOT	Pedestrian, Bicycle and Multimodal Improvements	Demand	Bicycle and Pedestrian Programs	Committed to providing safe and convenient bicycle and pedestrian access throughout the City.	http://ddot.dc.gov/DC/DDOT/On+Your+Street/Bicycles+and+Pedestrians
State/Multi-jurisdictional	District of Columbia, Arlington County, City of Alexandria, Montgomery County	Partnership of DDOT, Arlington County, City of Alexandria, Montgomery County	Bicycle Programs	Demand	Capital Bikeshare	A bikesharing program to encourge the use of bicyles.	http://capitalbikeshare.com/
State/Multi-jurisdictional	District-wide	DDOT	Carsharing Programs	Demand	DDOT Carsharing Initiative	A network of vehicles offered for rent to the public. Allows mobility of a car without owning one.	http://ddot.dc.gov/DC/DDOT/On+Your+Street/Car+Sharing?nav=1&vgnextrefresh=1

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
State/Multi-jurisdictional	District-wide	DDOT	Public Transportation Improvements	Demand	DDOT Mass transit	DDOT helps coordinate mass transit with agencies and WMATA.	http://ddot.dc.gov/ddot/cwp/view,a,1250,q,638123,ddotNav_GID,1586,ddotNav,%7C32399%7C.asp
State/Multi-jurisdictional	Takoma Park and Takoma Park, MD	DDOT	Growth Management	Demand	DDOT's Takoma Transportation Study	A study done for Takoma area of DC and adjacent Takoma Park, MD. Study recommends pedestrian, bicycle, transit, and road improvements.	http://ddot.washingtondc.gov/ddot/cwp/view,a,1249,q,561963.asp
State/Multi-jurisdictional	District-wide	DDOT	District TDM Program	Demand	goDCgo	goDCgo is an initiative of DDOT that is designed to help reduce congestion and improve air quality in the District through the promotion of sustainable transportation modes.	http://godcgo.com/
State/Multi-jurisdictional	Downtown DC	Partnership of DDOT, WMATA, and DC Surface Transit	Public Transportation Improvements	Demand	DC Circulator	A public bus system serving the District.	http://www.dccirculator.com/DCCirculator.html#home
State/Multi-jurisdictional	Virginia-statewide	VDRPT	Telecommuting	Demand	Telework!VA	Primary resource for Virginia's employers to start a telework program in VA, promotes teleworking.	http://www.teleworkva.org/
State/Multi-jurisdictional	Northern Virginia	VDOT	Variably Priced HOT Lanes	Demand/Operational	495 Express Lanes	High occupancy toll (HOT) lanes that use congestion pricing to manage contgestion on the Beltway in Virginia	https://www.495expresslanes.com/

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
State/Multi-jurisdictional	Northern Virginia	VDOT	Variably Priced HOT Lanes	Demand/Operational	95 Express Lanes	Construction of high occupancy toll (HOT) lanes that use congestion pricing to manage contgestion on the Beltway in Virginia	http://www.vamegaprojects.com
State/Multi-jurisdictional	Virginia - Statewide	Virginia TAX and VDRPT	Telecommuting	Demand	Virginia Telework Tax Credit	Qualifying businesses in Virginia can claim a tax credit up to $50,000 to offset expenses for equipment for new teleworkers and telework assessment	http://www.teleworkva.org/
State/Multi-jurisdictional	Northern Virginia	VDOT and VDRPT	Transportation Management Program	Demand/ operational	Virginia Megaprojects Regional, Dulles Rail, and 495 and 95 Express Lanes TMP's	Various targeted TDM and transit improvements to mitigate impacts and delays caused by construction of large scale projects in Northern Virginia	http://www.vamegaprojects.com
State/Multi-jurisdictional	Northern Virginia	VDOT, VDRPT, Loudoun County, and PRTC	Public Transportation Improvements	Demand	Tysons Express Bus Service	Regional bus services to Tysons Corner during Megaprojects construction. Service funded by Loudoun County to the Wiehle Avenue and Spring Hill Metrorail Stations and limited service to Tysons Corner will operate after the opening of the Silver Line	http://www.drpt.virginia.gov/news/details.aspx?id=452
State/Multi-jurisdictional	Northern Virginia	NVRC	Laws and Safety Tips Booklet	Demand	Safety/Outreach	Pocket Booklet	www.bikewalkvirginia.org

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
State/Multi-jurisdictional	Fairfax and Loudoun Co. VA	VDRPT and MWAA	Public Transportation Improvements	Demand	Dulles Corridor Metrorail Project	In cooperation with WMATA and local governments. Construct an extension of Metrorail to Dulles Airport.	http://www.dullesmetro.com
State/Multi-jurisdictional	I-66, I-95/395 HOV lanes	VDOT/NOVA	HOV Lanes	Demand	I-66 HOV Lanes, Shirley Highway HOV	Lanes available to ridesharers, those carpooling and vanpooling, and transit vehicles	www.VDOT.Virginia.gov
State/Multi-jurisdictional	Virginia Statewide	VDRPT and AMTRAK	Public Outreach	Demand	AMTRAK Virginia	Promotes AMTRAK passenger rail service in Virginia	http://www.amtrakvirginia.com
State/Multi-jurisdictional	Virginia Statewide	VDOT	Traffic Management	Operational	I-66 ATM	Promote safety and congestion management	none
State/Multi-jurisdictional	Virginia Statewide	VDOT	TDM and Traffic management	Operational	I-95 ICM	Promote safety and congestion management	none
State/Multi-jurisdictional	Loudoun, Fairfax, Arlington, and Prince William Counties	Northern Virginia Transportation Authority	Public Transportation Improvements	Demand	NVTA's TransAction 2040 Regional Transportation Plan	Identifies a number of public transit improvements, including new park-and-ride lots throughtout Northern VA.	http://www.thenovaauthority.org/projects.html
State/Multi-jurisdictional	Loudoun, Fairfax, Arlington, and Prince William Counties	Northern Virginia Transportation Authority	Alternative Commute Programs	Demand	NVTA's Mission of the Authority	Responsibilities include a general oversight of regional congestion mitigation, including carpooling, vanpooling, and other commute programs	http://www.thenovaauthority.org/mission.html
State/Multi-jurisdictional	Northern VA and the District of Columbia	VRE	Public Transportation Improvements	Demand	VRE	Commuter rail serving Northern VA and two stations in the District. Connects to local transit.	http://www.vre.org/index.html

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
State/Multi-jurisdictional	Prince William Co., Manassas, and several locations in VA & DC	PRTC	Public Transportation Improvements	Demand	PRTC's OmniRide	Commuter bus service along I-95 and I-66 corridor in Prince William Co., Manassas, and to several locations in VA & DC, including Metrorail stations.	http://www.prtctransit.org/omniride/index.php
State/Multi-jurisdictional	Eastern Prince William Co. and Manassas	PRTC	Public Transportation Improvements	Demand	PRTC's OmniLink	A local bus service in Eastern Prince William Co. and Manassas	http://www.prtctransit.org/omnilink/index.php
State/Multi-jurisdictional	Prince William Co. and Manassas	PRTC	Ridematching Services	Demand	PRTC's OmniMatch	A free ridematching service for carpooler and vanpoolers originating in Prince William Co and Manassas.	http://www.prtctransit.org/omnimatch/index.php
State/Multi-jurisdictional	I-66, I-95/395 HOV lanes	VDOT/NOVA	HOV Lanes	Demand	I-66 HOV Lanes, Shirley Highway HOV	Lanes available to ridesharers, those carpooling and vanpooling, and transit vehicles	http://www.VDOT.Virginia.gov
State/Multi-jurisdictional	Fairfax, Loudoun, and Prince William Counties	VDOT/NOVA	Park-and-Ride Lots	Demand/ operational	Commuter Park-and-Ride lots	Provides and maintains numerous park-and-ride lots	www.virginiadot.org/travel/pnrlots.asp
State/Multi-jurisdictional	Fairfax, Loudoun, and Prince William Counties	VDOT/NOVA	Bicycle Lockers	Demand/ operational	Bicycle Locker Rental Program	Provides reserved bicycle lockers at several Park-and-Ride lots for an annual rental fee	http://www.virginiadot.org/travel/nova-mainBicycle.asp
State/Multi-jurisdictional	Northern Virginia	MWAA	HOV Lanes	Demand	Dulles Toll Road HOV Lanes	Lanes available to rideshares, Those carpooling and vanpooling, And transit vehicles	www.mwaa.com

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
State/Multi-jurisdictional	NOVA	DRPT	Transit and TDM	Demand	SuperNOVA Transit and TDM	Transit/TDM vision planning	none
Multi-jurisdictional	Northern Virginia	PRTC in cooperation with NVTC and GWRC	Vanpool Programs	Demand	Vanpool Alliance	Organizes private vanpool providers for NTD reporting. Provides support, ridematching, and general marketing for vanpools in the region.	www.vanpoolalliance.org
Multi-jurisdictional	Prince William County, Cities of Manassas and Manassas Park	PRTC	Employer Outreach	Demand	Omni SmartCommute	Provides outreach and support to area employers seeking to implement employee commute assistance programs.	http://www.prtctransit.org/special-programs/employer-services.php
State/Local	NOVA	VDOT/Local	Bike Lanes	Demand	Road Diet	Improve safety and mobility	none
County	Throughout Montgomery County	Montgomery County, MD	Park-&-Ride lots: Provision, maintenance & improvements	Demand	Montgomery County Park-and-Ride Lots	Provide park-and-ride lots information in the County.	http://www.montgomerycountymd.gov/tsvtmpl.asp?url=/content/DOT/transit/routesandschedules/brochures/parklots.asp
County	Throughout Montgomery County	Montgomery County, MD	Public Transportation	Demand	Ride On	Provides public bus service in Montgomery County. Connects to Metrorail and Metrobus	http://www.montgomerycountymd.gov/dot-transit/
County	Throughout Montgomery County MD	MCDOT/Commuter Services Section	Alternative Commute Programs	Demand	MCDOT TDM Programs & Services - available throughout the	Provides information on alternative commute options: carpooling, biking, employer incentives, all other TDM services &	http://www.montgomerycountymd.gov/commute

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
County	Throughout Montgomery County MD	MCDOT/Commuter Services Section & other offices within MCDOT; M-NCPPC	Growth Management	Demand	TDM for Development Review	Coordinates TDM strategies required in new developments	http://www.montgomerycountymd.gov/commute
County	Throughout Montgomery County MD	MCDOT/Commuter Services Section & Traffic	Alternative Commute Programs – Bicycling	Demand	Bicycling Resources	Bike/transit maps for County and individual service areas. Bike resources	http://www.montgomerycountymd.gov/commute http://www2.montgomerycountymd.gov/DOT-DTE/BikeWays/BWHome.aspx
County	Throughout Montgomery County MD	MCDOT/Commuter Services Section	Telework Incentive Program	Demand	Telework Resources	Laptops and consulting services available to employers exploring or adopting telework	http://www.montgomerycountymd.gov/commute
County	Throughout Prince George's County	Prince George's County Dept. of Public Works and Transportation	Alternative Commute Programs	Demand	Prince George's County Ride Smart Commuter Solutions	Provides information on commuter services available in Prince George's County.	http://www.ridesmartsolutions.com/
County	Throughout Prince George's County	Prince George's County Dept. of Public Works and Transportation	Park-and-ride lot improvements	Demand	Prince George's County Park-and-Ride Lots	There are 15 free park-and-ride lots available in Prince George's County.	http://www.goprincegeorgescounty.com/Government/AgencyIndex/DPW&T/Transit/park_ride.asp?nivel=foldmenu(2)
County	Throughout Prince George's County	Prince George's County Dept. of Public Works and Transportation	Improving accessibility to multimodal options	Demand	Prince George's County Call-A-Bus	Bus service available to all residents of Prince George's County who are not served by existing bus or rail.	http://www.goprincegeorgescounty.com/Government/AgencyIndex/DPW&T/Transit/bus.asp?nivel=foldmenu(2)
County	Throughout Frederick County	Frederick County, MD	Public Transportation Improvements	Demand	Frederick County TransIt	Public bus and paratransit services.	http://frederickcountymd.gov/index.aspx?nid=105

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
County	Throughout Frederick County	Frederick County, MD	Alternative Commute Programs	Demand	Frederick CountyTransIt	TransIt also offers information on alternative commute programs.	http://www.co.frederick.md.us/index.asp?NID=208
County	Throughout Frederick County	Frederick County, MD	Alternative Commute Programs	Demand	TransIT Services of Frederick County	Help business and employees find best transportation solutions	http://www.frederickcountymd.gov/index.aspx?NID=4609
County	Throughout Frederick County	Frederick County, MD	Alternative Commute Programs	Demand	Frederick County Rideshare and Employer Outreach	Provides information on alternative commute programs, and local and regional public transit. Work with Employers to develop commute strategies at their locations.	http://frederickcountymd.gov/index.aspx?NID=208
County	Throughout Fairfax County	Fairfax County, VA	Public Transportation Improvements	Demand	Fairfax Connector	Public bus system in Fairfax County. Connects to Metrorail and bus.	http://www.fairfaxcounty.gov/connector/
County	Throughout Fairfax County	Fairfax County, VA	Alternative Commute Programs	Demand	Fairfax County RideSources Program	Provides information on alternative commute programs.	http://www.fairfaxcounty.gov/fcdot/sources.htm
County	Throughout Fairfax County	Fairfax County, VA	Alternative Commute Programs	Demand	Fairfax County Employer Services Program	Help business and employees find best transportation solutions	http://www.fairfaxcounty.gov/fcdot/employer.htm
County	Throughout Fairfax County	Fairfax County, VA	Alternative Commute Programs	Demand	Fairfax County Bike Program	A comprehensive bicycle initiative and program committed to making Fairfax County bicycle friendly	http://www.fairfaxcounty.gov/fcdot/bike/
County	Throughout Fairfax County	Fairfax County, VA	Alternative Commute Programs	Demand	Fairfax County Pedestrian Program	A comprehensive Pedestrian Program to provide dedicated resources to meet specific goals	http://www.fairfaxcounty.gov/fcdot/pedestrian/

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
County	Throughout Fairfax County	Fairfax County, VA	Alternative Commute Programs	Demand	Bicycling Resources	Bike / Transit Maps for County and individual service areas. Bike resources	http://www.fairfaxcounty.gov/fcdot/bike/
County	Throughout Fairfax County	Fairfax County, VA	Alternative Commute Programs	Demand	Shuttlepool program	High occupancy shuttle service offered to employers with staff that commute more that 20 miles away	http://www.fairfaxcounty.gov/fcdot/employer.htm
County	Throughout Fairfax County	Fairfax County, VA	Alternative Commute Programs	Demand	Commuter-Friendly Communities	Program that works with residential properties to implement TDM programs that are tailored for that location	http://www.fairfaxcounty.gov/fcdot/tdm/cfc.htm
County	Throughout Fairfax County	Fairfax County, VA	Alternative Commute Programs	Demand	Buspool Program	Commuter bus service offered to employers with staff that commute more that 20 miles away	http://www.fairfaxcounty.gov/fcdot/employer.htm
County	Throughout Fairfax County	Fairfax County, VA	Bicycle Programs	Demand	Bike Benefit Match Program	Fairfax employers can receiv	http://www.fairfaxcounty.gov/fcdot/bike/bikebenefit.htm
County	Throughout Fairfax County	Fairfax County, VA	Vanpool Assistance	Demand	Van Start Van Save	Vanpool funding assistance used to temporarily fill empty seats for start up and vans that are losing ridership	http://www.fairfaxcounty.gov/fcdot/vanassist.htm
County	Throughout Fairfax County	Fairfax County, VA	Rideshare Matching	Demand	Employee Density Plots	GIS density maps that are used to promote ridesharing by identifying staff within a close proximity	http://www.fairfaxcounty.gov/fcdot/employer.htm

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
County	Throughout Fairfax County	Fairfax County, VA	Employer Outreach	Demand	Transportation Services Group	Reaches out to Fairfax employers and offers incentives to implement a commuter program	http://www.fairfaxcounty.gov/fcdot/employer.htm
County	Throughout Fairfax County	Fairfax County, VA	Employer Outreach	Demand	Employer Lunch and Learn Session	Lunchtime presentations to promote TDM programs to employer staff members.	http://www.fairfaxcounty.gov/fcdot/employer.htm
County	Throughout Fairfax County	Fairfax County, VA	Parking Management	Demand	Rideshare Preferred Parking	Employer assistance in creating preferred parking for staff members that rideshare to work	http://www.fairfaxcounty.gov/fcdot/employer.htm
County	Throughout Fairfax County	Fairfax County, VA	Residential Commuter Site Awards	Demand	Commuter-Friendly Communities Awards	Bronze, Silver, Gold and Platinum award status for residential sites that have reached specific TDM level status	http://www.fairfaxcounty.gov/fcdot/tdm/cfc.htm
County	Throughout Fairfax County	Fairfax County, VA	Employer Awards	Demand	Fairfax County Best Workplaces for Commuters Awards	National & local recognition awards for Fairfax County employers who have established level 3 or 4 TDM programs	http://www.bestworkplaces.org/employers/fairfax/
County	Throughout Fairfax County	Fairfax County, VA	Transit	Demand	Fairfax Transit	Study countywide transit needs	http://www.fairfaxcounty.gov/FCDOT/2050Transit Study
County	Throughout Arlington County	Arlington County, VA	Public Transportation Improvements	Demand	Arlington Transit (ART)	Public bus service in Arlington. Connects to Metrorail and bus.	http://www.commuterpage.com/art/
County	Throughout Arlington County	Arlington County, VA	Alternative Commute Programs	Demand	Getting Around Arlingon	Provides information on alternative commute programs, and public transit.	http://www.commuterpage.com/art/villages/arl_tran.htm

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
County	Throughout Arlington County	Arlington County, VA	Pedestrian, Bicycle and Multimodal Improvements	Demand	Arlington's BikeArlington	Initiative to encourage more people to bike often.	http://www.bikearlington.com/about.cfm
County	Throughout Arlington County	Arlington County, VA	Alternative Commute Programs	Demand	Arlington's Car-Free Diet	Promotes alternative commute methods.	http://www.carfreediet.com/
County	Throughout Arlington County	Arlington County, VA	Promote Alternate Modes	Demand	WALKArlington	Promotes walking as an alternative mode.	http://www.walkarlington.com/about/index.html
County	Throughout Arlington County	Arlington County, VA	Alternative Commute Programs	Demand	Arlington County's CommuterPage.com	Provides information on transportation options in Arlington and the DC area.	http://www.commuterpage.com/
County	Throughout Arlington County	Arlington County, VA	Growth Management	Demand	Arlington County's TDM Management for Site Plan Developmetn	Coordinates site plan development (proposed land use) with commuter and transit services.	http://www.commuterpage.com/TDM/
County	Throughout Loudoun and from Loudoun to DC	Loudoun County, VA	Public Transportation	Demand	Loudoun County Transit	Commuter bus service from Loudoun Co. to Arlington and downtown DC.	http://inter4.loudoun.gov/Default.aspx?tabid=969
County	Throughout Loudoun County	Loudoun County, VA	Park-and-ride lot improvements	Demand	Loudoun's Free Park-and-Ride lots	Free park-and-ride lots are available throughout the County.	http://inter4.loudoun.gov/Default.aspx?tabid=959
County	Throughout Loudoun County	Loudoun County, VA	Alternative Commute Programs	Demand	Loudoun's Commuting options	Provides information on alternative commute programs and transit options.	http://inter4.loudoun.gov/Default.aspx?tabid=789

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
County	Throughout Loudound County	Loudoun County, VA		Demand	Loudoun's Employer Services	Helps businesses identify commuting solutions for employees in Loudoun County	http://inter4.loudoun.gov/Default.aspx?tabid=984
County	Throughout Southern Loudoun and in Northern Loudoun to Purcellville	Virginia Regional Transit (in cooperation with Loudoun Co.)	Local Fixed Route Bus Service	Demand	Loudoun County	Public bus service within Loudoun County.	http://inter4.loudoun.gov/Default.aspx?tabid=898
County	Throughout Prince William County	Prince William County, VA	Park-and-ride lot improvements	Demand	Prince William County Commuter Parking Lots	Goal is to work with VDOT and provide convenient sites to encourage residents to use transit or carpool.	http://www.pwcgov.org//default.aspx?topic=010017001530000797
City	The length of College Park, MD	City of College Park, MD	Pedestrian, Bicycle and Multimodal Improvements	Demand	College Park Trolley Trail	Trail is to run the length of the City of College Park, in the old trolley right-of-way.	http://www.thewashcycle.com/college_park_trolley_trail/
City	Throughout Greenbelt	City of Greenbelt, MD	Public Transportation Improvements	Demand	Greenbelt Connection	A local bus in Greenbelt; runs upon request.	http://www.greenbeltmd.gov/public_works/connection.htm
City	Throughout City of Frederick	City of Frederick, MD	Pedestrian, Bicycle and Multimodal Improvements	Demand	Frederick Shared use paths	Promotes the use of, and creates new shared use paths.	http://www.cityoffrederick.com/cms/files/maps/shared-use-path.pdf
City	Throughout Falls Church and to the Metro stations	City of Falls Church, VA	Public Transportation Improvements	Demand	Falls Church GEORGE	Local bus system providing service to East and West Falls Church Metrorail stations and throughout the City of Falls Church.	http://www.fallschurchva.gov/Content/CultureRecreation/GEORGEmain.aspx

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
City	Throughout Alexandria	City of Alexandria, VA	Alternative Commute Programs	Demand	Local Motion	Promotes use of alternative modes.	www.Alexandriava.gov/LocalMotion
City	Throughout Alexandria	City of Alexandria, VA	Public Transportation Improvements	Demand	Alexandria DASH	Local bus system. Connects to Metrobus and Metrorail, VRE, and other local bus systems.	http://www.dashbus.com/
City	Throughout Alexandria	City of Alexandria, VA	Growth Management	Demand	Transportation Management Plans for Site Plan Developments	Coordinates site plan development (proposed land uses) with commuter and transit services.	www.Alexandriava.gov/6556
City	Throughout Alexandria	City of Alexandria, VA	Improving accessibility to multimodal options	Demand	Alexandria Transit Store	Provides resources and retail transactions for multimodal travel	www.Alexandriava.gov/11144
City	Throughout City of Fairfax	City of Fairfax, VA	Public Transportation Improvements	Demand	City of Fairfax's CUE	Public bus service within City of Fairfax. Also connects to Vienna Metrorail station.	http://www.fairfaxva.gov/CUEBus/CUEBus.asp
Local / Corridor-based	Along the corridor between Baltimore and DC	BWI Business Partnership	Alternative Commute Programs	Demand	BWI Business Partnership Commuter Resources	Provides information on commuter programs available to the BWI area.	http://www.bwipartner.org/index.php?option=com_content&task=view&id=21&Itemid=59
Local / Corridor-based	Downtown Bethesda Transportation Management District (TMD)	MCDOT/Commuter Services Section with contractor: Bethesda Transportation Solutions (BTS)	Alternative Commute Programs	Demand	Bethesda TMD	Provides information on alternative commute options: carpooling, biking, employer incentives	http://www.bethesdatransit.org/

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
Local / Corridor-based	Downtown Bethesda Transportation Management District (TMD)	MCDOT with contractor: Bethesda Urban Partnership (BUP)	Public Transportation Improvements	Demand	Bethesda Circulator	Downtown Bethesda Circulator Bus	http://www.bethesda.org/parking/circulatorinfo.htm
Local / Corridor-based	North BethesdaTransportation Management District (TMD)	MCDOT/Commuter Services Section with contractor: North Bethesda Transportation Center (NBTC)	Alternative Commute Programs	Demand	N. Bethesda TMD	Provides information on alternative commute options: carpooling, biking, employer incentives	http://www.nbtc.org
Local / Corridor-based	Friendship Heights Transportation Management District	MCDOT/Commuter Services Section (CSS)	Alternative Commute Programs	Demand	Friendship Heights TMD	Provides information on alternative commute options: carpooling, biking, employer incentives	http://www.montgomerycountymd.gov/commute
Local / Corridor-based	Silver Spring Transportation Management District (TMD)	MCDOT/Commuter Services Section (CSS)	Alternative Commute Programs	Demand	Silver Spring TMD	Provides information on alternative commute options: carpooling, biking, employer incentives	http://www.montgomerycountymd.gov/commute
Local / Corridor-based	Greater Shady Grove Transportation Management District (TMD)	MCDOT/Commuter Services Section (CSS)	Alternative Commute Programs	Demand	Greater Shady Grove TMD	Provides information on alternative commute options: carpooling, biking, employer incentives	http://www.montgomerycountymd.gov/commute

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
Local / Corridor-based	Loudoun, Fairfax, and Prince William Counties	Dulles Area Transportation Association (DATA)	Alternative Commute Programs	Demand	DATA Commuter Resources	Advocates for alternative commute programs, transit needs, and transit-oriented development.	http://www.datatrans.org/about.html
Local / Corridor-based	Reston	LINK	Alternative Commute Programs	Demand	Reston's LINK Commuter Resources	Provides information on carpooling, vanpooling, and regional bus schedules.	http://www.linkinfo.org/index.cfm
Local / Corridor-based	Tyson's Corner area	Tyson's Transportation Association (TYTRAN)	Alternative Commute Programs	Demand	TYTRAN's Commuter Resources	Provides information on carpooling, vanpooling, park-and-ride lots, and telework locations.	http://www.tytran.org/index.htm
Local / Corridor-based	Northern VA - Loudoun, Fairfax, Prince William	Northern Virginia Transportation Commission (NVTC)	Public Transportation Improvements	Demand	NVTC Research on public transit and HOV performance	NVTC compiles data on regional transit systems and HOV performance.	http://www.thinkoutsidethecar.org/transit.asp
Local / Corridor-based	Northern VA - Loudoun, Fairfax, Prince William	Northern Virginia Transportation Commission (NVTC)	Alternative Commute Programs	Demand	NVTC Commuter Info	Provides information on how to use the region's transit system, bicycle and pedestrian options, HOV schedules, and park-and-ride lots.	http://www.thinkoutsidethecar.org/info.asp
Local / Corridor-based	Eastern Arlington's Potomac Yard neighborhood	Full Access Solutions in Transportation (FAST) for Potomac Yard	Growth Management	Demand	Non-profit, developer-initiated FAST	Aims at reducing single-occupant trips to the growing Potomac Yard area. Promotes transit, biking, walking. Offers discounted Metrobus shuttle.	http://fastpotomacyard.com/index.html

3.2.3 Transit Systems

Transit systems can improve the operation of existing roadways and systems by carrying more passengers than a single-occupant vehicle. They can also be considered demand management strategies in that they can influence a person's traveling behavior and convince them to leave their car at home. Many of the transit systems in the region are operated by transit agencies or local government agencies, including:

- *Alexandria DASH*, a local bus service in Alexandria, Virginia
- *Arlington Transit (ART)*, a bus service in Arlington County, Virginia
- *Bethesda Circulator*, a downtown Bethesda bus service
- *Central Maryland Regional Transit*, a bus service for the City of Laurel and a portion of Prince George's County, with additional services in Anne Arundel and Howard Counties.
- *CUE in City of Fairfax*, a bus service in City of Fairfax, Virginia
- *DC Circulator* bus, serving downtown District of Columbia
- *Fairfax Connector*, a bus service in Fairfax County, Virginia
- *Frederick County TransIT*, a bus service in Frederick County, Maryland
- *GEORGE*, a bus serving Falls Church, Virginia
- *Greenbelt Connection*, bus serving Greenbelt upon request
- *Loudoun County Transit* operates commuter bus services from Loudoun to destinations that include West Falls Church Metro, Rosslyn, the Pentagon, and Washington, D.C., as well as providing services from West Falls Church Metro to and among employment sites in Loudoun County.
- *Maryland Transit Administration (MTA) MARC* train commuter rail, serving District of Columbia and Maryland
- *Montgomery County Ride On*, a local bus service in Montgomery County, Maryland
- *MTA Commuter Bus* provides 19 privately contracted Commuter Bus routes which provide 427 trips throughout Maryland's Washington D.C., suburbs including service from far reaching suburbs in Howard, Anne Arundel, Queen Anne's, and Charles Counties to Washington, D.C.
- *Potomac and Rappahannock Transportation Commission (PRTC)*, providing *OmniLink*, a local bus service in Eastern Prince William County and Manassas, and *OmniRide*, commuter bus services offering service from locations throughout Prince William County and the Manassas and Gainesville areas to destinations that include the Vienna, West Falls Church and Franconia/Springfield Metrorail Stations, the Pentagon, Crystal City, Rosslyn/Ballston, downtown Washington, D.C., Capitol Hill, and the Washington Navy Yard.
- *Prince George's County Call-A-Bus*, serving those in Prince George's County not served by existing bus or rail
- *Prince George's County TheBus*, serving Prince George's County
- *Virginia Railway Express (VRE)* commuter rail serving Virginia and District of Columbia
- *Virginia Regional Transit* (in cooperation with Loudoun County Transit), a bus service in Loudoun County, Virginia
- *Washington Metropolitan Area Transit Authority (WMATA) Metrobus*, serving the entire Washington metropolitan area

- *Washington Metropolitan Area Transit Authority (WMATA) Metrorail*, serving the entire Washington metropolitan area

While these transit systems are individually very important strategies, it is important to note that they work together to form an entire transit network important to our congestion management system. They work well with other strategies as well, such as VPLs and HOV lanes. In addition, with the help of Intelligent Transportation System (ITS) technologies, Advanced Traveler Information Systems and providing buses with bicycle racks, transit can be even more appealing to travelers.

The latest (2007/2008) regional household travel survey revealed that commuting transit modal share increased from 15.1% in 1994 to 17.7%, and daily transit modal share increased from 5.5% in 1994 to 6.1%[93]. These increases reflect the positive effect of the region's longstanding efforts to promote transit usage.

3.2.3.1 Significant Transit Construction and Capacity Increases

In December 2013, MTA began weekend service on MARC's Penn Line with nine three-car trains on Saturdays and six three-car trains on Sundays. The weekend ridership growth was steady during the first few months of service leading MTA to increase train capacities by one to two cars in March 2014.[94]

The Crystal City-Potomac Yard Transitway, the region's first bus rapid transit (BRT) lanes, are under construction and expected to open in 2014. The five-mile line is partially funded by an $8.5 million TIGER grant awarded to the TPB in 2010 for construction of the 0.8 mile segment between East Glebe Road and Potomac Avenue.[95] The BRT service will be run by WMATA and feature frequent service, off-board fare collection, and level boarding.[96]

As of the writing of this report, the first line in DDOT's streetcar system is expected to open in 2014. The 2.4 mile H/Benning Line will have eight stops on H St. NE and Benning Road between Union Station and Oklahoma Ave.[97] The line is the first segment in DDOT's 30-year, 37 mile streetcar vision. The streetcars will feature off-board fare collection and level boarding. As part of the streetcar project, new contraflow bike lanes were installed along G St and I St NE to provide an alternative for cyclists who travel on H St.

As of the writing of this report, the first phase of Metrorail's Silver Line is expected to open in Summer 2014. The 11.4-mile segment begins at the existing West Falls Church Station and

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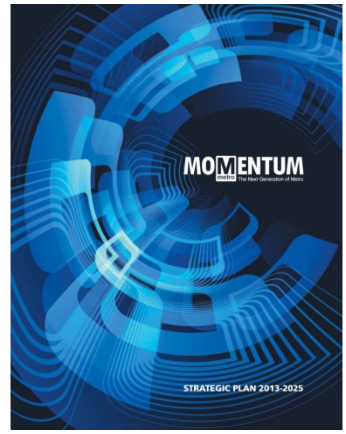
[93] A presentation of the 2007/2008 Household Travel Survey, May 19, 2009. http://www.mwcog.org/uploads/committee-documents/YV5cV1ZX20090520110217.pdf
[94] Rector, K. (2014, March 12). MARC to increase weekend capacity, citing rising Baltimore-Washington ridership. *The Baltimore Sun*. Retrieved http://articles.baltimoresun.com/2014-03-12/news/bs-md-marc-weekends-20140312_1_weekend-marc-service-penn-line-ridership
[95] https://www.mwcog.org/transportation/weeklyreport/2012/10-09.asp
[96] https://www.alexandriava.gov/tes/info/default.aspx?id=58644 (Accessed April 10, 2014)
[97] http://www.dcstreetcar.com/projects/hbenning/

includes five stations: McLean, Tysons Corner, Greensboro, Spring Hill and Wiehle-Reston East. Phase 2 with service to Dulles Airport is scheduled to begin in several years.[98]

Section 3.4.2 discusses technology-related transit projects such as bus priority systems.

3.2.3.2 Future Transit Planning



In 2013, WMATA released *Momentum,* its strategic plan for 2013-2025.[99] The plan is built around four major goals: (1) build and maintain a premier safety culture and system, (2) meet or exceed expectations by consistently delivering quality services, (3) improve regional mobility and connect communities, and (4) ensure financial stability and invest in [its] people and assets. The plan includes Metro 2025, a list of seven "pivotal investments" by 2025 to improve existing service and enhance travel in the region's core. These investments include 8-car trains on all lines during rush hour and new connections between busy stations. WMATA estimates that the increased capacity from Metro 2025 will remove 100,000 car trips from the region's road network daily while providing transit riders with an improved travel experience.[100]

In September 2013, the TPB released an Assessment of the Feasibility of Bus on Shoulders (BOS) at Select Locations in the National Capital Region.[101] This report presented the findings of the Bus on Shoulder Task Force was formed in in July 2012 to "identify promising locations in the region to operate buses on the shoulders of highways." Three corridors, MD 5/US 301, I-270, and I-66 inside the Beltway, were selected for detailed study which included existing bus service, traffic congestion, and shoulder conditions. VDOT plans to begin a one-year pilot BOS operation on I-66 in late 2014.[102]

3.2.3.3 University Transit Systems

Many area universities have their own transit systems for students, faculty, staff, and in some cases, visitors. These shuttle systems increase transit options for the university community and help reduce congestion on campus roads. Two examples of university transit systems are Shuttle-UM system at the University of Maryland, College Park and Masons Shuttles at George Mason University. The Shuttle-UM system is one of the nation's largest University transit services[103] with a fleet of 76 vehicles, including hybrid and clean diesel vehicles, and a ridership of 3,504,492 during FY 2013.[104] Mason Shuttles has routes that include Vienna Metro Station,

[98] http://silverlinemetro.com/sv-about/
[99] http://www.wmata.com/momentum/momentum-full.pdf
[100] http://www.mwcog.org/news/press/detail.asp?NEWS_ID=709
[101] https://www.mwcog.org/uploads/committee-documents/bV1aWlxd20130926085957.pdf
[102] *I-66 Inside the Beltway Bus on Shoulder Pilot Study Final Report*, September 2013
http://www.virginiadot.org/VDOT/Projects/Northern_Virginia/asset_upload_file945_71500.pdf
[103] http://www.transportation.umd.edu/shuttle.html (Accessed February 21, 2014)
[104] University of Maryland Department of Transportation Serviced 2013 Annual Report
http://www.transportation.umd.edu/images/about/pdfs/Annual%20Report%20FY%2713.pdf

Burke VRE Station, a shuttle between its Fairfax and Prince William campuses, and campus circulators which are operated under a contract with Reston Limousine. These routes supplement CUE and Fairfax Connector service. The George Mason shuttle system has an annual ridership of nearly 600,000 per year.[105] Both universities are providing riders with real-time bus arrival information.

3.2.4 Pedestrian and Bicycle Transportation

Walking and bicycling are garnering more attention as having positive environmental and health benefits. As a part of the region's transportation network, these activities impact congestion management as well. There are a number of things the Washington region is doing to enhance the area of bicycle and pedestrian transportation to encourage non-motorized transportation.

- Most of the area's local governments have adopted bicycle, pedestrian, trail plans, and/or policies. Bicycle or pedestrian coordinators and trail planners are now found at most levels of government.

- On May 16, 2012, the TPB approved the "Complete Streets Policy for the National Capital Region" which is a directive to all of the TPB member jurisdictions to ensure safe and adequate accommodation, in all phases of project planning, development, and operations, of all users of the transportation network in a manner appropriate to the function and context of the relevant facility.[106]

- Most of the region's transit agencies have bike racks on their buses. WMATA allows bikes on rail outside rush hour and on weekends.

- Secure, covered bicycle parking facilities including Bikestation Washington DC[107] adjacent to Union Station and WMATA's Bike and Ride facility at the College Park Metro Station[108] provide more convenience for multi-mode travelers.

- Local governments are starting to require bicycle parking, as well as provide free on-street racks. DC requires bike parking in all buildings that offer car parking.

- In accordance with federal guidance and new state policies, pedestrian and bicycle facilities are increasingly being provided as part of larger transportation projects. A number of local jurisdictions have implemented transit-oriented developments (TODs) and other walkable communities.

- VDOT has altered its secondary street acceptance requirements to mandate that streets built by private developers connect with adjacent streets and future developments in a manner that enhances pedestrian and bicycle access, and that adds to the capacity of the transportation system. Residential streets may be narrower and incorporate traffic calming features.

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[105] Josh Cantor, "Parking and Transportation Overview," August 2013 http://transportation.gmu.edu/pdfs/2013/overviewp-taugust2013.pdf
[106] http://www.mwcog.org/uploads/committee-documents/mV1dXl9e20120510092939.pdf
[107] http://home.bikestation.com/washingtondc
[108] http://www.wmata.com/about_metro/news/PressReleaseDetail.cfm?ReleaseID=5225

- Employers are investing in bike facilities at work sites, and developers are including paths in new construction.

- Specific bicycle/pedestrian campaigns are developing to encourage biking/walking, such as WALKArlington, Localmotion, and GoDCGo.[109]

- The Safe Routes to School program, which is administered through the States, provides funding for both hard and soft improvements and programs to encourage children to walk or bicycle to school, improve safety, and reduce congestion and air pollution near schools. Under the new federal transportation bill, MAP-21, the Safe Routes to School program was combined with two other former federal programs that fund non-motorized transportation, Transportation Enhancement (TE) and Recreational Trails, to form the Transportation Alternatives Program. This program, which is administered by the States and the National Capital Region Transportation Planning Board, provides funds for bicycle and pedestrian facilities, complete streets, safe routes to schools, and environmental mitigation.

- More and better on line bike and walk routing resources have become available from the private sector. Google Maps offers both walk and bike routing features. Another bike routing resource for the Washington region is RidetheCity.com/dc, which allows users to choose a preferred safety level.

Bicycle and pedestrian plans and projects are widespread throughout the Washington region. For example, in the District of Columbia, two cycle tracks, M Street, NW, and First Street, NE opened in 2014. Bicycling and walking have an even greater potential to grow as modes of transportation. Many trips taken by automobile could potentially be taken by bicycle. This is especially true in areas such as Activity Centers where a number of trips are more easily switched from motorized transportation to walking. Many people who live far from their jobs, but closer to transit or a carpool location could walk or bike to transit or the carpool instead of driving. When considering the following statistics, switching from a motor vehicle or bicycling or walking is feasible[110]:

- The median work trip length for all modes in the TPB Planning area is 9.3 miles.
- Twenty-five percent of commute trips are less than 4.3 miles, a distance most people can cover by bicycle.
- The median auto driver trip (for all purposes) is only 4 miles, and 25% of all auto driver trips are less than 1.5 miles.
- Auto passenger trips, often children being taken to school, are even shorter, with a median trip distance of 2.8 miles, and 25% of trips less than 1.2 miles.

In August of 2012, the Transportation Planning Board (TPB) received $200,000 through the Federal Highway Administration's Transportation, Community and System Preservation (TCSP) Grant Program to identify strategic recommendations for bicycle and pedestrian access

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[109] http://www.walkarlington.com/
[110] Griffiths, R. E. 2007/2008 Household Travel Survey: Presentation of Findings on Weekday Travel. Presentation to the Technical Committee of the National Capital Region Transportation Planning Board on May 1, 2009

improvements that complement employment and housing development close to rail stations with underutilized capacity. The project seeks to moderate demand on the transportation system by identifying improvements around stations that will encourage rail ridership in reverse-commute directions or by selling the same seat twice. The overall goal of this study is to identify projects that increase the ability of people to access jobs near stations that currently have available capacity to accommodate new riders. The final product of the project will identify a set of pedestrian and bicycle capital projects that could be quickly implemented in the vicinity of 25 rail stations with available ridership capacity that are anticipating employment growth in the near-term future and/or have significant transit-dependent populations living in close proximity. The TCSP project will refer to previous planning efforts, particularly the "Metrorail Bicycle and Pedestrian Access Improvements Study," which the Washington Metropolitan Area Transit Authority (WMATA) released in October 2010.[111] That study identified strategies to enhance pedestrian and bicycle access and connectivity in and around Metrorail stations, and provided recommendations for a range of physical infrastructure improvements and policies and programs to encourage multimodal trips.

The Transportation Alternatives Program is a federal program new under MAP-21 that provides funding to projects considered "alternatives" to traditional highway construction. The Transportation Alternatives Program combines three former federal programs: Transportation Enhancements (TE), Safe Routes to Schools (SRTS), and Recreational Trails (RTP). One of the key differences between the Transportation Alternatives Program and the previous programs is that large MPOs, including the Transportation Planning Board, will play a new role in project selection for a portion of program funds that will be sub-allocated to large metropolitan regions. For the National Capital Region, this new program offers an opportunity to fund regional priorities and complement regional planning activities. Projects approved for FY 2013 and FY 2014 include multi-use trail improvements between the 14th Street Bridge and East Basin Drive, Rosslyn-Ballston Corridor Accessibility Improvements, Reston Bike Share Infrastructure Support, and a Fairfax Mason to Metro Bicycle Route.[112]

Supporting bicycle and pedestrian planning is important to congestion management. Each additional person walking or biking for a trip is one less person on the road, thus easing congestion. Pedestrian and bicycle facility planning is something that will continue to be considered in the realm of congestion management, not only as a stand-alone area, but in conjunction with transit projects and land use planning.

Bikesharing

Capital Bikeshare, opened in September 2010 with 1100 bikes at 110 stations. The public-private partnership has since expanded to Arlington County, the City of Alexandria, and Montgomery County with over 2500 bicycles and over 300 stations.[113] The Spotcycle smartphone app allows users to see bicycle and dock availability.

[111] http://planitmetro.com/wp-content/uploads/2010/12/Metrorail-Bicycle-Pedestrian-Access-Improvements-Study-_Final.pdf
[112] www.mwcog.org/tap (Accessed April 10, 2014)
[113] http://capitalbikeshare.com/home (Accessed February 21, 2014)

The results of a survey[114] of Capital Bikeshare members conducted during November 2012 provided information on travel changes made in response to Capital Bikeshare availability. According to the survey report, bikeshare provides an additional transportation option to members to make trips that they may not have made in the past because it was too far to walk. More than half of Capital Bikeshare members do not have access to a car or personal vehicle. The survey found that bikeshare plays a role on multimodal transportation. When asked about their travel during the previous month, 54% of members used bikeshare to access a Metrorail station, 17% accessed a Metrorail station six or more times, and 23% used bikeshare to access a bus. The availability of bikeshare allows its members to switch trips to bike from other modes.

There are plans to expand Capital Bikeshare to College Park, MD and studies are underway to look at the feasibility of bikeshare in other locations in Prince George's County[115] as well as the City of Falls Church and Fairfax County.[116]

3.2.5 Car Sharing

Carsharing is a model of car rental where people rent cars for short periods of time, often by the hour. This supports residents, especially in densely populated urban environments, who make only occasional use of a vehicle, as well as others who would like occasional access to a vehicle of a different type than they use day-to-day. Urban car sharing is often promoted as an alternative to owning a car in dense, walkable, mixed-use development communities, where public transit, walking, and cycling can be used most of the time and a car is only necessary for out-of-town trips, moving large items, or special occasions. It can also be an alternative to owning multiple cars for households with more than one driver.[117]

Carshare companies follow one of two basic models. The first, used by companies such as Zipcar, and Enterprise, have designated parking spaces for each vehicle where the vehicle must be returned to at the end of the rental. The second, used by Car2Go, has a home area defined where users can park the vehicle in any legal public parking space at the end of the rental, allowing for one-way trips. Smartphone apps are available for all of the major carshare companies to locate and reserve cars. Zipcar remains the largest carshare company in the region with over 800 vehicles in the region. Car2Go has over 300 vehicles in the District of Columbia.

Jurisdictions work with the car share companies to arrange for parking permitting. For example, the District of Columbia provides on-street spaces, at a cost, for carshare vehicles, and encourages developers to provide off-street car share spaces in conjunction with new development. In November 2013, the DDOT began a program which allows carshare companies to purchase parking permits which allow their vehicles to be parked in Residential Parking

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[114] 2013 Capital Bikeshare Member Survey Report prepared by LDA Consulting, May 22, 2013 http://capitalbikeshare.com/assets/pdf/CABI-2013SurveyReport.pdf

[115] Lazo, L. (2013, October 12). Capital Bikeshare is coming to College Park. *The Washington Post*. Retrieved from http://www.washingtonpost.com

[116] Schumitz, K. (2014, January 30). Reston explores pilot bikeshare program. *The Fairfax Times*. Retrieved from http://www.fairfaxtimes.com/

[117] Adapted from Wikipedia, "Carsharing", http://en.wikipedia.org/wiki/Carsharing.

Permit zones.[118] Arlington County provides information on carsharing on its Commuter Page website.[119]

3.2.6 Land Use Strategies in the Washington Region

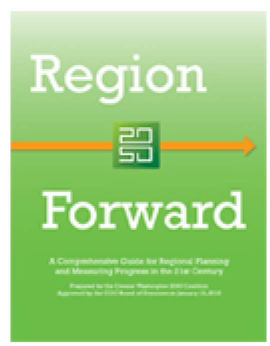
The relationship of land use and transportation often have an important influence on a person's willingness to commute by transit, ridesharing, bicycling, or walking; modes other than driving alone. The TPB is undertaking projects that consider the relationship of land use and transportation, all of which are important components of the CMP. Concentrating activities near transportation facilities helps reduce the number and length of vehicle trips necessary by residents and workers. More trips can be made by walking. Densities can be sufficient to make provision of transit services cost effective.

3.2.6.1 Cooperative Forecasting

TPB coordinates with the regional Cooperative Forecasting process at COG. Cooperative forecasting is a regional process that provides forecasts for demographic information that considers the potential impacts of future transportation facilities. The forecasts are based on national economic trends, local demographic factors, and are closely coordinated with regional travel forecasts.

Local jurisdictions develop independent projections of population, households, and employment based on pipeline development, market conditions, land use plans and zoning, and planned transportation improvements. These local forecasts are also compared and coordinated at the regional level to ensure compatibility. If there is a major change in planned transportation facilities (such as an addition or removal of a planned major facility) the cooperative forecasts are updated to reflect this change. Overall, Metropolitan Washington has strong, well-established processes to ensure transportation planning and land use planning are well-coordinated.

3.2.6.2 Region Forward and Regional Activity Centers



Region Forward is a vision for a more accessible, sustainable, prosperous, and livable National Capital Region. It was developed by the Greater Washington 2050 Coalition, a group of public, private, and civic leaders created by the Metropolitan Washington Council of Governments in 2008 to help the region meet future challenges like accommodating two million more people by 2050, maintaining aging infrastructure, growing more sustainably, and including all residents in future prosperity.

The Region Forward Compact seeks effective coordination of land use and transportation planning resulting in an integration of land use, transportation, environmental, and energy decisions. Specifically in the transportation sector, Region Forward:

[118] http://ddotdish.com/2013/11/25/parking-in-district-now-easier-for-carshare-users/
[119] http://www.commuterpage.com/pages/transportation-options/carsharing/ (Accessed May 6, 2014)

- Seeks a broad range of public and private transportation choices for our Region which maximizes accessibility and affordability to everyone and minimizes reliance upon single occupancy use of the automobile.
- Seeks a transportation system that maximizes community connectivity and walkability, and minimizes ecological harm to the Region and world beyond.[120]

Regional Activity Centers help coordinate transportation and land use planning in specific areas in the Washington region experiencing and anticipating growth. Focusing growth in Centers is important to congestion management, where transportation options for those who live and work there can be provided. The concentration of activities and location near transportation facilities help reduce vehicle trips, as more trips can be made by walking. Transit services also become more cost effective.

The first map of Regional Activity Centers was created in 1999, and since that time it has been updated several times, based upon current local comprehensive plans and zoning. The most recent map of Activity Centers was developed by the Region Forward Coalition with the COG Planning Directions Technical Advisory Committee, was adopted by the COG Board in January 2013.[121] The development of the 2013 map and used more targeted and specific criteria than in previous version (2007) to designate 141 Activity Centers (Figure 59). The criteria are primarily based on Region Forward.[122]

In January 2014, *Place + Opportunity: Strategies for Creating Great Communities and a Stronger Region* was approved by the COG Board. This document identifies "goals, strategies, and tools to assist local governments and other regional stakeholders in making investments in Activity Centers that enhance the quality of life and strengthen the local and regional economy."[123]

The latest round of Cooperative Forecasts, Round 8.3, indicates that between 2010 and 2040, 76.2% of employment growth, 55.1% of population growth, and 60.1% of household growth projected in the region will occur in Activity Centers.[124]

In-depth surveys of household travel behavior conducted by the Transportation Planning Board in strategically-chosen areas around the Washington region will help planners and local officials better understand travel patterns in Activity Centers and neighborhoods. More information on Household Travel Surveys can be found in Section 2.6.3.

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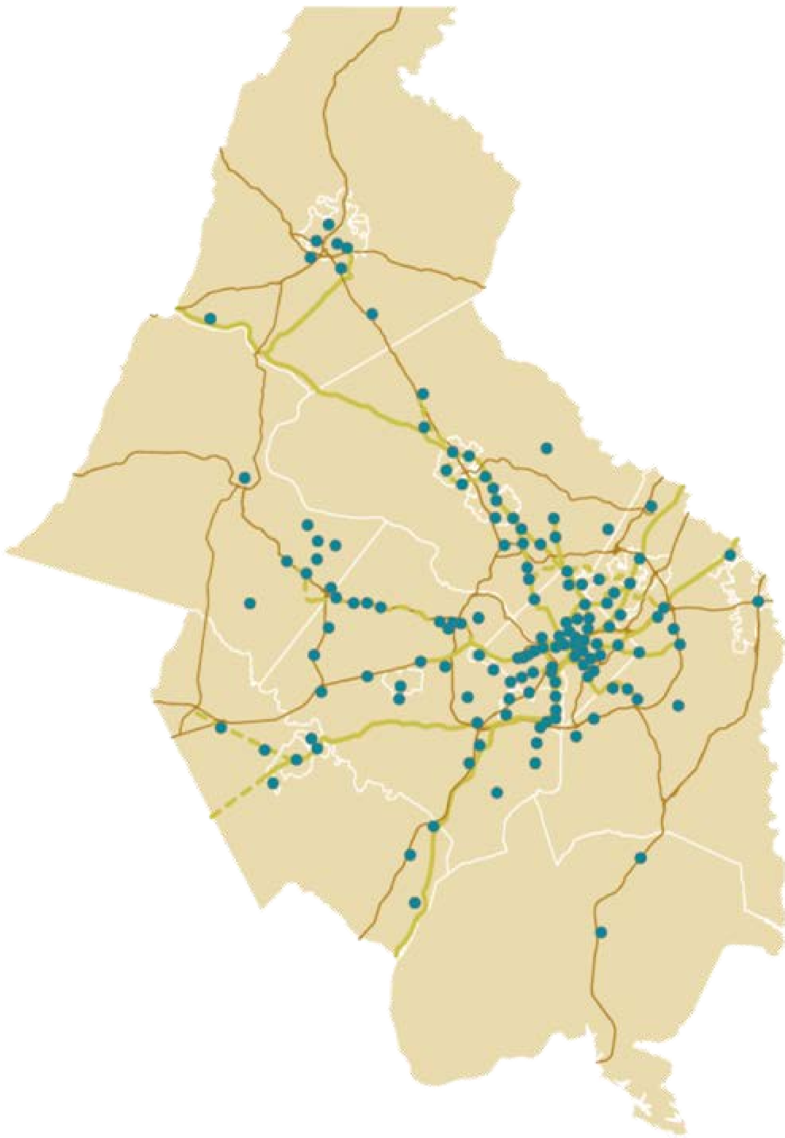
[120] http://www.regionforward.org/compact
[121] Regional Activity Centers Map, January 2013 http://www.mwcog.org/uploads/pub-documents/oV5cXVc20130813171550.pdf
[122] http://www.regionforward.org/activity-centers-where-metropolitan-washington-is-growing
[123] *Place + Opportunity: Strategies for Creating Great Communities and a Stronger Region* https://www.mwcog.org/uploads/pub-documents/vV5cWFg20140218094537.pdf
[124] DesJardin, P. and Griffiths, E. *Round 8.3 Cooperative Forecasts of Future Growth*. Presentation to the National Capital Region Transportation Planning Board, April 16, 2014. https://www.mwcog.org/uploads/committee-documents/ZV1ZV1lc20140410140523.pdf

Figure 59: 2013 Regional Activity Center Map



3.2.6.3 Transportation-Land Use Connection (TLC) Program

The Transportation-Land Use Connection (TLC) program provides support and assistance to local governments in the Washington region as they implement their own strategies to improve coordination between transportation and land use. The program does this in two ways. First, it provides information via the Regional TLC Clearinghouse, which is a web-based source of information and transportation/land use coordination, experiences with transit-oriented development, and key strategies. Secondly, the TLC Technical Assistance Program provides consultant services to local jurisdictions working on projects land use and transportation projects.

Nine projects were approved as part of the FY 2014 TLC program:

- District of Columbia: Parking Demand Research
- District of Columbia: Sustainable DC – Health by Design Standards for Affordable Housing
- City of Frederick: Golden Mile Multimodal Access Enhancement Plan
- City of Gaithersburg: The Gaithersburg Connector – A Circulator Bus Network
- Montgomery County: Guidance for Bikeway Classifications
- City of Bowie: Bowie Heritage Trail Pedestrian Underpass of MD 197
- Fairfax County: Bringing Capital Bikeshare to Reston, VA
- Loudoun County: Enhancing Bicycle/Pedestrian Connectivity around Future Metro Stations
- District of Columbia: Green Street – 19th Street Paving Removal Strategy

The TLC program allows for flexibility to study a wide variety of transportation – land use issues. Some projects are more demand management focused, focusing on pedestrian improvements, growth management, and transit-oriented development. Other projects address operational issues, including pedestrian safety improvements and roadway design. The goals among each may be different, but each project is applicable to congestion management.

3.2.6.4 Local Jurisdictional Land Use Planning Activities

Following are some of the major examples of activities going on at the local level that are important to congestion management. Activities range from having a strong comprehensive plan that guides local development, to the implementation of projects that include transportation options and pedestrian and bicycle facilities. Examples of local jurisdictional planning activities (please note: this is not a comprehensive list) include:

In the District of Columbia, key stakeholders including the District Government, Federal Government, and WMATA, are working together to maximize opportunities for transit-oriented development. Currently, three major federal campuses are in various stages of transformative redevelopment. St. Elizabeth's, in southeast Washington, will be redeveloped as a pedestrian oriented transit accessible technology and education hub that will leverage the campus' close proximity to the Capitol Heights and Anacostia Metro stations to sustainably strengthen the District's economy. [125] The former site of the Walter Reed Army Medical Center located in northwest Washington was closed as part of the Defense Base Closure and Realignment Commission (BRAC) process and is in the process of redevelopment into mixed use community. [126] This project enables efficient growth by taking advantage of high frequency bus service on both the east and west sides of the campus in addition to the Takoma Metro station and a planned streetcar line. Finally, the SW Eco District, which is comprised of federal buildings south of the National Mall near the L'Enfant Metro Station, is planned for an ambitious sustainable redevelopment. [127] Key features include reconnecting the areas grid of streets to facilitate more walking and biking and expansion of the commuter rail corridor that travels through the site to allow more commuters to arrive by train. These improvements will be built on top of one of the most accessible Metro stations in the system and connected to highly walkable surrounding areas. Lastly, the Washington Metropolitan Transit Authority is planning for mixed use development near three Metro stations in the District Brookland, Fort Totten, and Navy

[125] http://www.stelizabethseast.com/our-opportunity/master-plan/
[126] http://www.planning.org/tuesdaysatapa/2013/dc/pdf/jul.pdf
[127] http://www.ncpc.gov/plans/swecodistrict/summary.pdf

Yard.[128] Each of these developments will locate more homes and businesses near Metro stations promoting more transit trips and fewer automobile trips.

In Virginia, the Transforming Tysons plan will guide the area through a transformation from auto-oriented employment center to transit-oriented mixed use community. This plan enables the area to sustainably add 100,000 residents and 200,000 jobs to one of the nation's largest job centers.[129] This plan leverages the transformative effects of the new WMATA Silver Line which brings heavy rail service to the area for the first time. Based on the new Silver Line, Fairfax County has also approved a Comprehensive Plan Amendment for Reston which doubles the development potential of the Metro corridor. Together these plans play a key role in reducing congestion by focusing economic development near Metro stations and using transit-oriented development strategies. Additionally, Arlington County is planning major redevelopment of several mid-20th century office districts seeking to build on the County's celebrated pedestrian and bicycle infrastructure. Crystal City will be the most significant redevelopment; many of its buildings have been vacated through the last round of BRAC. Arlington seeks to redevelop Crystal City to be as pedestrian friendly and transit accessible as possible. The county is planning to add street grid connections while constructing new buildings that will be accompanied by high quality urban design. The area will be redeveloped with a greater mix of uses that will reduce the need for automotive trips by residents and workers alike. Additionally, the redevelopment will create a built environment that takes advantage of the Crystal City Metro station and the new Bus Rapid Transit Line to Potomac Yard.

In Maryland, Prince George's County recently adopted a new General Plan which calls for a county wide smart growth approach to development that targets future development to one of three Metro station areas (Prince George's Plaza, New Carrollton Metro, and Largo Town Center Metro). This approach will help the county and region take advantage of existing Metrorail system capacity to support economic development while reducing regional congestion by reducing east-west travel for employment. Montgomery County is using its sector planning program to re-envision Metro stations, including White Flint and Wheaton, which have the potential for more development. In both cases, the county has increased allowable densities while planning for enhanced pedestrian facilities that will better connect new development to existing Metro stations and their surrounding communities. Additionally, the county has planned and is developing the Great Seneca Science Corridor which is new life sciences-oriented, mixed-use development located along the future Corridor Cities Transit Way. This will be a very large development of up to 100 million square feet of office space, which is approximately the size of Tysons, Virginia today. New offices and labs will be coupled with adjacent mixed-use residential developments that will help employees in the corridor live near their work and travel via transit, walk, and bike.

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128 http://www.wmata.com/business/joint_development_opportunities/Joint%20Development%20Solicitation%202013.pdf

129 http://www.fairfaxcounty.gov/tysons/

3.3 Operational Management Strategies

3.3.1 HIGH-OCCUPANCY VEHICLE (HOV) FACILITIES

3.3.1.1 Overview

High Occupancy Vehicle (HOV) lanes are defined as roadways or roadway segments that are restricted to use by vehicles (cars, buses, vanpools) carrying the driver and one or more additional passengers.

HOV facilities offer several advantages over conventional lanes and roads. They increase the number of persons per motor vehicle using a highway over conventional (non-HOV) roadways, they preserve the person-moving capacity of a lane or roadway as demands for transportation capacity increase, and enhance bus transit operations. All of these advantages are important to effectively managing the operations of existing and new capacity on roadways.

However, HOV facilities can also be considered demand management strategies as well, providing predictable travel times even during peak periods of high demand for highway capacity. HOV lanes can help influence travelers' behavior and provide them with additional choices of how, or if, to travel a certain route.

Currently there are five HOV facilities in the Washington region on highways functionally classified as freeways:

- I-66 in the Northern Virginia counties of Prince William, Fairfax, and Arlington (this HOV system includes a section of the Dulles Connector in McLean, connecting to VA 267's HOV lanes – see below);
- Virginia Route 267 (Dulles Toll Road), where operation of concurrent-flow HOV lanes began in December 1998, connecting to I-66 via the Dulles Connector; and,
- I-95/I-395 (Shirley Highway) in the Northern Virginia counties of Prince William, Fairfax, and Arlington, and the City of Alexandria,
- I-270 and the I-270 spur in Montgomery County, Maryland;
- U.S. 50 (John Hanson Highway) in Prince George's County, Maryland.

COG/TPB staff typically studies the performance of HOV facilities every three or four years during the AM and PM peak periods. The most recent data collected and analyzed along these five HOV corridors was in Spring 2010 and the results can be found in the *2010 Performance of Regional High Occupancy Vehicle Facilities on Freeways in the Washington Region*[130]. Major findings from that report are discussed in Section 2.6.2. The next round of data collection and analysis is tentatively scheduled for 2014.

[130] *2010 Performance of Regional High Occupancy Vehicle Facilities on Freeways in the Washington Region*, September 7, 2011. http://www.mwcog.org/uploads/committee-documents/ll1fXl1b20110908082403.pdf

Following is a breakdown of each HOV facility in detail with statistics provided from the aforementioned HOV performance report.

3.3.1.2 I-66 (Custis Memorial Parkway)

Interstate-66 was opened to traffic between the Capital Beltway (I-495) and Rosslyn, in Arlington County, in 1982. Initially the facility was restricted to HOV-4 traffic, meaning four occupants per vehicle. This was lowered to HOV-3 in late 1983 and to HOV-2 in March 1995. During the 1990s, I-66 outside the Beltway was expanded to include a concurrent-flow HOV lane to Virginia Route 234 (Business) in Prince William County just north of Manassas.

The I-66 HOV corridor consists of two distinct sections. One section is between the Capitol Beltway (I-495) and Rosslyn. This segment of I-66 is restricted to HOV use only during the peak commute period of the peak direction, due to the large amount of traffic traveling inbound from Northern Virginia in the morning, and outbound from the District of Columbia in the evening. The other section, between Virginia Route 234 (Business) near Manassas and the Capitol Beltway, is a concurrent-flow lane HOV facility. The entire HOV corridor is about 27 miles in length, about 9 miles inside the Beltway and 18 miles outside the Beltway.

I-66 is a key commuting corridor, as it connects the District of Columbia with the suburbs of Virginia and beyond. Direct access to employment centers in Washington, D.C. is provided via the Theodore Roosevelt Bridge over the Potomac River. Along the I-66 corridor there are also several Metrorail stations that many commuters drive to everyday. Some of these stations contain Park-and-Ride facilities that allow commuters to drive and connect to other modes, such as rail or bus.

3.3.1.3 I-95/I-395 (Shirley Highway)

The Shirley Highway Corridor is one of the two corridors that provide direct access to the employment centers (the other is I-66). Therefore, understanding congestion on these corridors is crucial.

The HOV lanes in this corridor are entirely barrier-separated, and reversible, so they accommodate heavy AM peak period northbound traffic and operate southbound in the P.M. peak period. The HOV roadway is about 27 miles long, extending from Virginia Route 234 (Dumfries Road) near Dumfries, Prince William County to South Eads Street near the Pentagon in Arlington County. Several HOV-only ramps provide direct access to the HOV lanes from park-and-ride facilities in Prince William County.

The corridor is also served by the Virginia Railway Express (VRE) Fredericksburg Line. The Metrorail Blue Line terminates in the corridor at Franconia-Springfield. Numerous bus lines serve the corridor, including Metrobus, the City of Alexandria's DASH, Fairfax Connector, PRTC OmniRide and private motor coach companies serving communities in Stafford and Spotsylvania Counties and the City of Fredericksburg.

3.3.1.4 VA 267 (Dulles Toll Road)

Concurrent flow HOV lanes operate along this corridor from a point between Sully Road (VA 28) and Centreville Road (VA 657) to just west of Leesburg Pike (VA 7). There are no HOV lanes through the interchanges at VA 7, the main toll plaza, Spring Hill Road (VA684), I-495 and VA 123. HOV restrictions apply to all lanes of the Dulles Connector road from east of VA 123 to I-66. Fairfax Connector provides most transit bus service in the corridor, with the Loudoun County Commuter Express providing commuter bus service from Loudoun County to the Metro Core area (including stops in Rosslyn, Arlington County and downtown Washington, D.C.).WMATA operates the route 5A Metrobus service between Washington Dulles International Airport and the L'Enfant Plaza Metrorail station, with intermediate stops at the Herndon/Monroe Park and Ride, the Tysons-Westpark Transit Station, and the Rosslyn Metrorail station.

The HOV lanes require at least two persons per vehicle and the requirement is from 6:30A.M. to 9:00 A.M. and from 4:00 P.M. to 6:30 P. M.

3.3.1.5 I-270 HOV Facilities

In the southbound (A.M. peak) direction, the HOV concurrent-flow lane runs from I-370 near Gaithersburg south to the Rockville Pike/Capital Beltway interchange. There is also a concurrent flow HOV lane along the southbound lanes of the I-270 Spur. Together, the A.M. peak-flow direction lanes total about 11 miles in length. The Spur is just less than 2 miles long. In the northbound (P.M. peak) direction, concurrent-flow HOV lanes exist along the entire northbound I-270 Spur, and along I-270 from its southern terminus at I-495/Md. 355 to I-370 (the same sections of the corridor having HOV lanes southbound). Additionally, there are about 7.5 miles of HOV lane between I-370 and Maryland 121 near Clarksburg.

The Metro Red Line serves the I-270 corridor from Shady Grove (I-370), continues south to Bethesda, and on to the downtown area of the District of Columbia. The Mass Transit Administration's (MTA) MARC Brunswick Line also serves several stops in this corridor, and continues south to Silver Spring and on to Union Station in the District of Columbia. Montgomery County Ride On serves areas in the corridor north of I-370, and MTA coach service (between Hagerstown, Frederick and Shady Grove) use the HOV lanes. Express Metrobus service operates on the HOV lanes in the corridor between Bethesda and Gaithersburg.

3.3.1.6 US 50 HOV Facilities

Concurrent-flow HOV lanes operate in the U.S. 50 (John Hanson Highway) Corridor from just west of the Md. 704 Martin Luther King Highway interchange to east of the U.S. 301/Md. 3 interchange in Bowie. Unlike all other HOV lanes in the region, these lanes are HOV-2 restricted at all times (24 hours, 7 days) in both directions.

Buses operated the Washington Metropolitan Area Transit Authority (WMATA) and the Maryland Transit Administration (MTA) run on the U.S. 50 HOV lanes. To the east, the buses serve the City of Bowie in Prince George's County, and the Annapolis and Crofton areas of Anne Arundel County. All WMATA buses terminate at the New Carrollton rail station. Some MTA buses serve the downtown area of the District of Columbia, others terminate at New

Carrollton.

3.3.2 VARIABLY PRICED LANES/SYSTEMS

Variably Priced Lanes (VPLs), a demand management strategy, is one type of managed lanes where the pricing of roadways to helps reduce congestion and generates revenue for transportation projects. VPLs are an effective way to provide alternatives to travelers willing to pay for travel time reliability. There are several examples of managed lanes in the United States including SR-91 in Orange, California; I-95 in Miami, FL; and I-394 and I-35W in Minneapolis.

There are currently two VPL facilities in operation in the region and one under construction. All of these facilities are designed without toll booths. Drivers are required to have an E-ZPass transponder.

- *The Intercounty Connector (MD 200)* – a 6-lane, 18-mile east-west highway in Montgomery County and Prince George's County Maryland that will run between I-270/I-370 and I-95/US 1. The majority of the facility, from I-270/I-370 to I-95 opened in November 2011. Toll rates vary by time of day. The toll rate in the peak period averages $0.25 per mile, off-peak is $0.20 per mile, and overnight is $0.10 per mile.[131] MTA operates four bus routes on the ICC: Gaithersburg to BWI, Gaithersburg to Fort Meade, Columbia to Bethesda, and Frederick to College Park.[132] The final segment from I-95 to US 1 is tentatively scheduled to open in mid- to late-2014.

- *495 Express Lanes* – Fourteen miles of new high-occupancy toll (HOT) lanes (two in each direction) were constructed on I-495 between the Springfield Interchange and just north of the Dulles Toll Road. The lanes, operating under a public-private partnership between VDOT and Transurban (USA) Development, Inc., opened on November 17, 2012. The express lanes use dynamic pricing, updated approximately every 15 minutes, to ensure that travel remains free-flowing.[133] Vehicles carrying two or less people can travel in the lanes if they pay the toll. Buses, carpools and vanpools with three or more people, and motorcycles can ride in the lanes for free. The 495 Express Lanes offer HOV-3 connections with I-95/395, I-66 and the Dulles Toll Road for the first time.

  According to the 495 Express Lanes Usage Update for January 2014[134], during the fourth quarter of 2013, the express lanes reached one million unique customers. There were almost 38,000 average workday trips. The average dynamic toll charged during that quarter was $2.32. The maximum toll charged was $9.75, which was for travel on the entire length of the express lanes. HOV-3 trips and exempt vehicles make up approximately 9% of customers.

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[131] http://www.mdta.maryland.gov/ICC/Toll_Rates.html Accessed March 5, 2014
[132] http://www.mtaiccbus.com/ Accessed March 5, 2014
[133] /pricing Accessed March 5, 2014
[134] Transurban (USA) Operations, Inc. *495 Express Lanes Usage Update- January 2014.*
https://www.495expresslanes.com/uploads/1000/385-495_Express_Lanes_January_2014_FINALv2.pdf

The express lanes also provide benefits to bus riders. Omniride's Tysons Express from Woodbridge to Tysons Corner saves an average of 20 minutes by using the express lanes. Fairfax Connector began routes on the express lanes to Tysons Corner from Burke, Lorton, and Springfield.[135]

- *95 Express Lanes (Northern Virginia – under construction)* – This new project will create approximately 29 miles of Express Lanes on I-95. This project will add capacity to the existing HOV Lanes from the Prince William Parkway to the vicinity of Edsall Road; improve the existing two HOV lanes for six miles from Route 234 to the Prince William Parkway. An eight-mile reversible two-lane extension of the existing HOV lanes from Dumfries to Garrisonville Road in Stafford County will help to alleviate the worst traffic bottleneck in the region.[136]Vehicles carrying two people would have a choice to ride in the HOT lanes for a toll or travel in the regular lanes for free. Completion is expected in early 2015.

The TPB has had active interest in VPLs since June 2003 when the TPB, together with the Federal Highway Administration and the Maryland, Virginia, and District Department of Transportation, sponsored a successful one day conference on value pricing in the Washington region. After the conference, in Fall 2003, the TPB created a Task Force on Value Pricing to further examine and consider the subject. Under a grant from the Federal Highway Administration's Value Pricing Program, the TPB Value Pricing Task Force evaluated a regional network of variably priced lanes in the region producing a final report in February 2008.[137] The findings of the VPL study were used in the CLRP Aspirations Scenario Study and the newly adopted Regional Transportation Priorities Plan which are discussed in Chapter 5.

3.3.3 Traffic Management

The topic of Traffic Management, including Incident Management and Intelligent Transportation Systems (ITS) is considered under the Management, Operations, and Intelligent Transportation Systems (MOITS) Policy Task Force and MOITS Technical Subcommittee. MOITS advises the TPB on traffic management matters and provides a regional forum for coordination among TPB member agencies and other stakeholders on these topics.

Investments in operations-oriented strategies have time and again shown good benefit-cost ratios and best enable transportation agencies (for both highways and transit) to provide effective incident management and good customer service, through operations centers and staffs, motorist/safety service patrols, traffic signal optimization, and supporting technologies. Particularly, intersection improvements (signalization timing / geometrics) can provide cost efficient congestion reduction. Also, the Metropolitan Transportation Operations Coordination (MATOC) program, comprising DDOT, MDOT, VDOT, and WMATA, is a regional program to

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[135] Transurban (USA) Operations, Inc. 495 *Express Lanes: The First Year* https://www.495expresslanes.com/~express/uploads/495%20Express%20Lanes%20-%20The%20First%20Year.pdf

[136] http://www.vamegaprojects.com/about-megaprojects/i-95-hov-hot-lanes/ Accessed March 6, 2014

[137] *Evaluating a Network of Variably Priced Lanes for the Washington Metropolitan Region*, National Capital Region Transportation Planning Board, February 2008.

enhance the availability of real-time transportation information and strengthen coordination among transportation agencies.

3.3.3.1 Active Traffic Management (ATM)

As defined by FHWA, active traffic management is the "ability to dynamically manage recurrent and non-recurrent congestion based on prevailing and predicted traffic conditions." [138]

- VDOT's I-66 Active Traffic Management Project is under construction on a 34-mile section of highway extending from the District of Columbia to Haymarket in Prince William County. The 34 miles of roadway is divided into five segments, with different combinations of ATM treatments planned for each segment. ATM strategies in the corridor will include continuous CCTV camera coverage, dynamic message signs, vehicle detection, auxiliary lane control system, lane control system, back of queue warning system, dynamic merge system, adaptive dynamic ramp metering, and enhanced emergency pull-out.[139] Operation of the system will be managed by the VDOT Public Safety Transportation Operations Center (PSTOC). The project is expected to be completed by Summer 2014. [140]

- Montgomery County has an ATM system which includes strategies such a vehicle detection, video and aerial monitoring, and information outreach including broadcast media, internet (http://www6.montgomerycountymd.gov/content/dot/tmc/index.asp) variable message signs, and Travelers Advisory Radio System (TARS). Future strategies will include variable speed limit signs, monitoring parking and weather/pavement sensors, and in-vehicle paging services.[141]
- In July 2012, VDOT issued an RFP to "operate, integrate, and innovate the state's Transportation Operations Centers (TOCs)." [142] One of the proposed outcomes of the project is to develop, implement, and operate a new state-wide ATM system platform across the five TOCs. The contract was award to Serco, Inc. in May 2013.

3.3.3.2 Incident Management

According to the Federal Highway Administration, an estimated 50% of congestion is associated with incidents such as crashes, disabled vehicles, and traffic associated with special events. If an incident disrupts traffic, it is important for congestion that normal flow resumes quickly.

Many successful incident management activities are part of the robust activities undertaken by the Washington region's transportation agencies. The region's state DOTs all pursue strategies for managing their transportation systems, including operation of 24/7 traffic management centers, roadway monitoring, service patrols, and communications interconnections among personnel and systems. All three focus on getting timely word out to the media and public on

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[138] http://ops.fhwa.dot.gov/atdm/approaches/atm.htm (Accessed April 15, 2014)
[139] I-66 ATM Treatment Definitions http://www.virginiadot.org/projects/resources/NorthernVirginia/I-66_ATM_Treatment_Definitions.pdf
[140] VDOT I-66 ATM Fact Sheet (July 2011) http://www.virginiadot.org/projects/resources/NorthernVirginia/I-66_ATM_Fact_Sheet.pdf
[141] http://www.montgomerycountymd.gov/DOT-TMC/ATMS/gettmc.html (Accessed April 15, 2014)
[142] http://www.virginiadot.org/business/transportation_operations_centers.asp (Accessed April 15, 2014)

incidents. Local-level agencies also play an important role in transportation management, particular on local roads and traffic signal optimization.

Specific state-wide and regional incident management strategies include:

- ***Imaging / video for traffic monitoring and detection*** **–** help detect incidents and allow emergency vehicles to arrive quickly. Also helps travelers negotiate around incidents.
  - MDOT owns and maintains 275 controllable CCTV cameras statewide. In the Washington region, MDOT has access to video feeds from over 690 cameras.
  - Montgomery County operates an Advanced Transportation Management system (ATM), with 200 traffic monitoring cameras across the County;
  - Arlington County and City of Fairfax in Virginia also deployed many cameras.
  - The three state DOTs implement cameras for traffic monitoring and detection.

- ***Service patrols*** **–** These specially equipped motor vehicles and trained staff help in clearing incidents off a roadway and navigating traffic safely around an incident.
  - MDOT/CHART is now providing 24/7 safety patrols for the Washington region.
  - VDOT and DDOT also provide service patrols
  - Montgomery County became the region's first local jurisdiction to deploy patrols in 2006, concentrating on major arterials rather than freeways.

- ***Road Weather Management*** **–** Can take the forms of information dissemination, response and treatment, monitoring, prediction, and traffic control.
  - All three state DOTs implement road weather management systems that disseminate information, treat roadways, and monitor conditions, especially during winter snow and ice events.

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- ***Traffic Management Centers (TMCs)*** **–** These centers collect and analyze traffic data, then disseminate data to the public. Data collection includes CCTVs, cameras, and detectors.
  - All three state DOTs have TMCs:
    - *VDOT's McConnell Public Safety Transportation Operation Center (MPSTOC)* operates Northern Region Transportation Operations Center (TOC) and Signal System. The TOC monitors traffic and incidents by using cameras and other information-gathering mechanisms to better manage day-to-day traffic flow and large incidents.
    - *DDOT's Transportation Management Center* gathers and disseminates information to the public using a network of cameras and other devices.
    - *MDOT's Coordinated Highway Action Response Team (CHART)* collects traffic data, disseminates information to the public, and provides emergency motorist assistance.

- ***Curve Speed Warning Systems*** - use roadside detectors and electronic warning signs to warn drivers, typically those in commercial trucks and other heavy vehicles, of potentially dangerous speeds in approach to curves on highways, with the intention of preventing incidents.
  - Curve speed warning systems have been used on the Capital Beltway.

- ***Work zone management*** - uses traffic workers, signs, and temporary road blockers to direct and control traffic during construction activities.
    - All three state DOTs have work zone management programs to temporary implement traffic management and direct traffic. The goal is to reduce incidents by controlling the flow, speed, and direction of traffic.

- ***Automated truck rollover systems*** - detectors deployed on ramps to warn truck drivers if they are about to exceed their rollover threshold, thus helping to reduce incidents.
    - Automated truck rollover systems, similar to the curve speed warning systems, were implemented at the same locations on the Capital Beltway in Virginia and Maryland. This was in response to a high number of truck rollovers on the Beltway in the 1980's.

Studies have shown the impact incident management activities have on reducing congestion, in particular reducing duration of incidents and reducing chances for secondary incidents. An example of this type of study is the yearly analysis of impacts of the Coordinated Highway Action Response Team (CHART) on incident management in Maryland. The focus of the report is to gauge effectiveness of CHART's availability to detect and manage incidents on major freeways and highways.

The *Performance Evaluation and Benefit Analysis for CHART in Year 2012*[143] includes statistics and analysis such as:

- Distribution of incidents an disabled vehicles
    - By day and time
    - By road and location
    - By lane blockage type
    - By blockage duration
    - By nature of incident (accident, disabled vehicle, etc.)
- Comparison of current year's data with that of previous years
- Benefits from CHART's incident management
    - Assistance to drivers
    - Potential reduction in secondary incidents
    - Estimated benefits due to efficient removal of stationary vehicles
    - Direct benefits to highway users

Analysis and studies such as those conducted by CHART indicate that incident management activities do have a positive impact on congestion. Each minute of reduced duration of incidents, for example, reduces the chances of secondary incidents and has a concomitant reduction in the severity and duration of non-recurring congestion. It is estimated that 218 potential secondary

[143] Chang, G.L & M. Raqib. Performance Evaluation and Benefit Analysis for CHART in Year 2012 (Final Report). http://chartinput.umd.edu/reports/CHART_2012_final.pdf

incidents were avoided in 2012 due to shortened incident duration. The 2012 analysis of CHART shows the decrease in incident duration with SHA patrol:

- Duration averaged 22 minutes with SHA patrol, compared to 29 minutes without.
- For incidents blocking the shoulder only, duration averaged 18 minutes with SHA patrol, compared to 28 minutes without.
- For incidents blocking one lane, duration averaged 20 minutes with SHA patrol, compared to 26 minutes without.
- For incidents blocking two lanes, duration averaged 33 minutes with SHA patrol, compared to 40 minutes without.
- For incidents blocking three lanes, duration averaged 43 minutes with SHA patrol, compared to 46 minutes without.

It was estimated that in 2012, 429 potential lane-changing collisions were avoided due to the CHART program. Even a relatively simple activity such as a service patrol assisting a motorist with a flat tire, or one who is out of fuel, might prevent a congestion-inducing crash. Continuing enhancement and investment of incident management activities will support congestion management.

3.3.3.3 Traffic Signal Operations

Traffic Signal Optimization

Under the guidance of the TPB's Traffic Signals Subcommittee, TPB staff conducted a survey of signal timing throughout the region during April/May 2013. There are 21 different agencies that have ownership and/or maintenance responsibilities for the approximately 5,500 signals on public roads in the region. The survey found that an estimated 76% of the eligible traffic signals had been retimed within the past three years, which is a generally accepted guideline. The signals in the region use a variety of retiming methods including computer optimization, engineering judgment, and active management.[144]

DDOT has a comprehensive 5-year plan underway to improve the flow of traffic in the region, including signal timing, and impacts all 1600 traffic signals in the District of Columbia.[145] All the activities to improve signal timing and reduce delay for all modes have been completed east of the Anacostia River. Review of before and after travel time data indicate 5 to 10% improvement in travel time savings along the major corridors in the area east of the river with improved travel time reliability for all modes and studies by WMATA indicate on time arrival improvement of 8% for buses in the area.

Advanced Traffic Signal Systems

Advanced Traffic Signal Systems are used for coordination of traffic signal operations in a jurisdiction, or between jurisdictions using detectors to monitor real-time traffic conditions. This is important to congestion, as it reduces delay and improves travel time. It can include active

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[144] http://www.mwcog.org/uploads/committee-documents/al1ZXFpb20140212133426.pdf
[145] http://ddotdish.com/2013/10/08/signal-optimization-and-improving-traffic-flow-in-the-district/

traffic signal management – where traffic signals are managed through a control center, where technicians adjust the length of signal phases based on prevailing traffic conditions – or adaptive signal control – in which the controller automatically adjusts the timing of signals to accommodate changing traffic patterns.

- VDOT actively optimizes traffic signal timing plans and launched a signal/arterial traffic management control center located adjacent to the MPSTOC operating floor to proactively manage the arterial traffic.

- The City of Alexandria has implemented an adaptive traffic signal control system along Duke Street. The system can adapt to real-time traffic situations by changing cycle lengths as traffic flows change while keeping the corridor synchronized.

Traffic Signal Timing

Traffic signal timing plans adjust traffic signals during an incident, during inclement weather, or to improve transit performance. The overall objective is to reduce backups at traffic signals and to increase the level of service.

3.3.3.4 Regional Operations Coordination

Metropolitan Area Transportation Operations Coordination (MATOC)

The Metropolitan Area Transportation Operations Coordination (MATOC) Program is a coordinated partnership between transportation agencies in D.C., Maryland, and Virginia that aims to improve safety and mobility in the region through information sharing, planning, and coordination. Current agencies include the District of Columbia, Maryland, and Virginia Departments of Transportation along with County and City transportation departments and transit providers like WMATA and other local providers. For example, a recent review of the MATOC program showed that coordination between the MATOC family of agencies during a bus crash on I-66 resulted in a savings of over $382,000 for area commuters**.** This savings was a result of decreased emissions, fuel consumption and lost time. [146]

A benefit-cost study of the MATOC program was undertaken and the results were based on three incidents that were handled by MATOC. The benefit-cost study looked at travelers "modified trips" - trips made at a later time, on another route, by another mode, or not made due to regionally significant incidents. Benefits were estimated from reduced delay, fuel consumption, emissions (including greenhouse gases), and secondary incidents. Three case studies were conducted, two for freeway incidents and one for arterial incident. The study found an overall benefit/cost ratio conservatively estimated at 10 to 1. A summary report of this study called the MATOC Benefit Cost Analysis dated June 2010 is available. MATOC also maintains a public use website called Traffic View which can be accessed at www.trafficview.org which uses the RITIS traffic information to inform the public about regional incidents.

[146] www.matoc.org

MATOC has undertaken two new initiatives. The first, the MATOC Severe Weather Mobilization Coordination Effort, began during the winter of 2012-2013. This effort has led to "the development of consistent terminology to describe roadway and transit conditions throughout the region, protocols for sharing weather information from different agency-specific sources and detection systems, testing of coordinated messaging systems, and better ways to advise the overall regional winter storm decision-making process." [147] The second, the Regional Construction and Work Zone Coordination Study, was activated in 2014 to develop a framework for regional coordination around major construction projects as well as regional work zone-related lane closures.

3.3.3.5 Intelligent Transportation Systems (ITS)

ITS strategies can be defined as electronic technologies and communication devices aimed at monitoring traffic flow, detecting incidents, and providing information to the public and emergency systems on what is happening on our roadways and transit communities. Much of what is done with ITS helps in reducing non-recurring and incident-related congestion.

- ***Electronic Payment Systems*** **-** These systems can make transit use more convenient by allowing a user to pay for bus, rail, park-and-ride lots, and other transit services with one card. Convenience an appealing factor, and helps increase transit ridership and transfers among different transit modes.
    - SmarTrip cards are used for rail and bus fares (both WMATA and local buses) and for WMATA parking facilities.
    - The region's roadway toll agencies are part of the E-ZPass consortium electronic payment system. The ICC and the 495 Express Lanes are E-ZPass-only facilities (no toll booths).
    - TransIT (Frederick County) issued an RFP for a vendor to develop a phone app for payment of TransIT fares and to handle the backend payment processing with anticipation of having a system in place in 2014.

- ***Freeway Ramp Metering*** **-** Traffic signals on freeway ramps that alternate between red and green to control the flow of vehicles entering the freeway. This prevents incidents that may occur from vehicles entering the freeway too quickly, and also prevents a backup of traffic on the on-ramp.
    - Ramp meters are used inside the Capital Beltway (I-495) in Virginia on I-66 and I-395.

- ***Automated Enforcement (e.g. red light cameras)*** **-** Still or video cameras that monitor things such as speed, ramp metering, and the running of red lights, to name a few. They are important to preventing non-recurring and incident related congestion.
    - In the Washington region, the legal ability to deploy these systems is in place in the District of Columbia and Maryland, and pending in Virginia.

[147] http://www.regionforward.org/improving-metro-dcs-transportation-coordination-preparedness-after-snowstorm-produced-nightmare-commutes

- ***Reversible Lanes -*** Traffic sensors and lane control signs reverse the flow of traffic and allow travel in the peak direction during rush hours. This is important to alleviating congestion that may occur in one direction during a peak hour. Examples of reversible lanes include Rock Creek Parkway in the District and Colesville Rd./US29 in Maryland.

3.4 INTEGRATIVE/MULTI-MODAL STRATEGIES

3.4.1 Advanced Traveler Information Systems (ATIS)

ATIS are technology-based means of compiling and disseminating transportation systems information on a real-time or near-real-time basis prior to or during tripmaking. The prevalence of smartphones and other mobile internet-capable devices make real-time information more accessible to travelers.

- Virginia operates under a statewide 511 system via telephone, internet (http://www.511virginia.org/), and mobile app.
- The District of Columbia makes traffic information, including live traffic cameras, traffic alerts, and street closures, available on the DDOT website.
- Maryland provides live traffic information on traffic and incidents via the CHART website the MD 511 Interactive Voice Response (IVR) System and Website.
- Dynamic Message Signs (DMS) are used throughout the region including permanently installed signs on freeways and portable signs used on both freeways and arterials.
- WMATA provides real-time transit information (both bus and rail) on the web and on informational screens in the Metrorail stations.
- Real-time bus information is available for many of the region's bus systems (Montgomery, Arlington, and Prince George's Counties and the City of Fairfax). TransIT (Frederick County) has requested grant funds for AVL and a customer interface. The AVL data will also assist TransIT with developing future public transit schedules.
- TPB is overseeing a TIGER project for Real Time Passenger Information (RTPI). There are 225 proposed locations for electrified signs at bus shelters in nine corridors throughout the region. Completion of all corridors is expected in 2015.
- The MATOC website has links to all three state's traffic information. In addition, there is a link provided to the Traffic View website (www.trafficview.org) which aggregates traveler information including incidents, traffic camera feeds, construction activity and schedules, and variable message sign information for the region.
- Capital Region Updates (CapitalRegionUpdates.gov) was established to be a "one-stop-shop" where residents can get information during emergencies including real-time news and traffic and transit information.[148]

3.4.2 Bus Priority Systems

Bus priority systems are sensors used to detect approaching transit vehicles and alter signal timings to improve transit performance. For example, some systems extend the duration of green signals for public transportation vehicles when necessary. This is important because improved transit performance, including more reliable arrival times for buses, makes public transit a more appealing option for travelers.

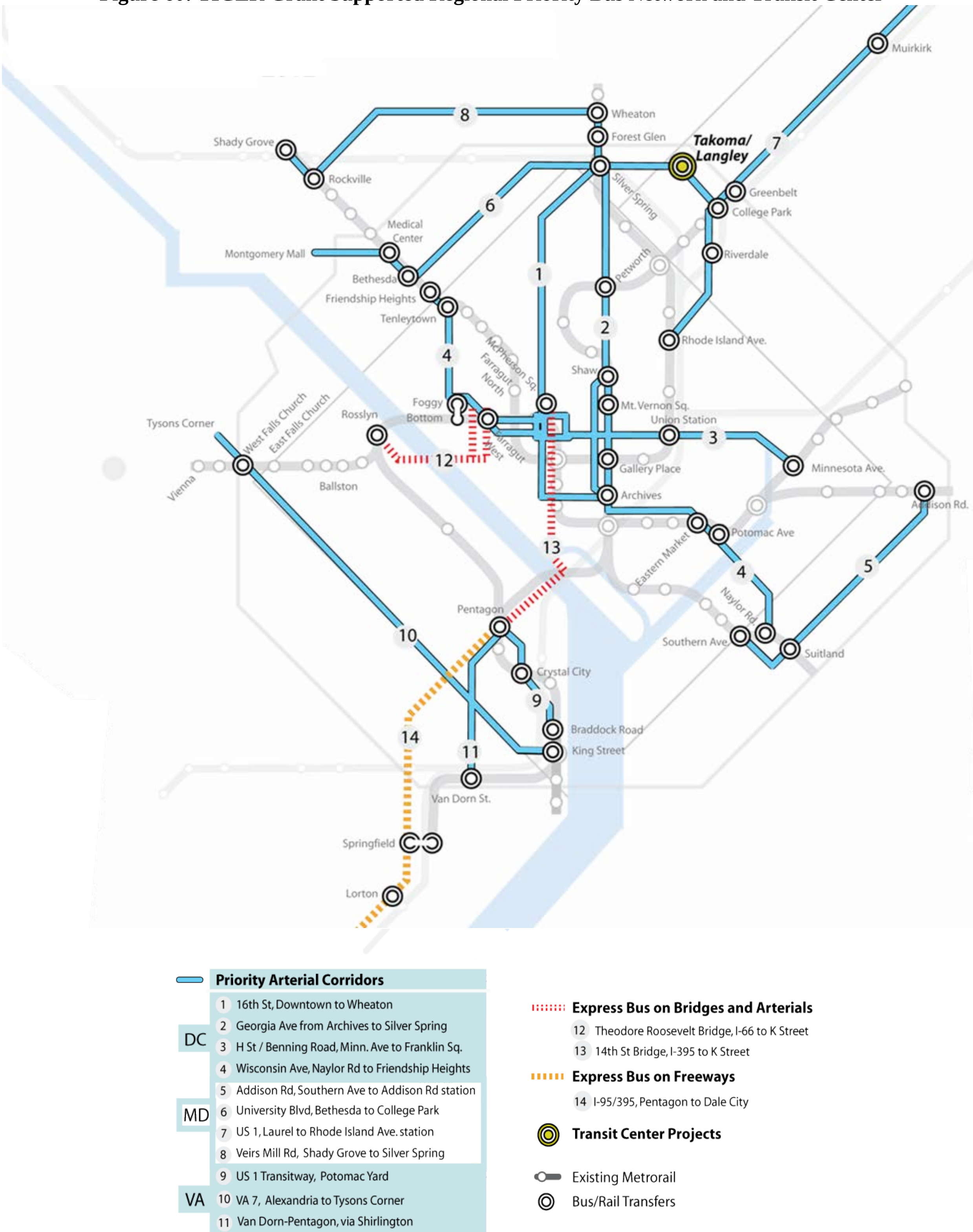
[148] http://www.mwcog.org/news/press/detail.asp?NEWS_ID=555

- There have been three pilot deployments in the region: U.S. 1 (Fairfax County), Columbia Pike (Arlington County), and Georgia Avenue (DC). These are pilot projects intended to provide lessons learned for wider deployments.

- Montgomery County has co-located traffic management and transit dispatch which enables adjustment of signals (by the centralized signal operations center) if deemed necessary for transit.

- The region, led by TPB, was awarded a $58 million federal Transportation Investment Generating Economic Recovery (TIGER) grant for developing a priority bus corridors network (Figure 60). A total of 14 priority bus corridors are funded in DC, Maryland and Virginia, and one transit center, Takoma/Langley Transit Center, is funded in Maryland. Bus priority improvements include running buses on dedicated lanes, adding queue jump lanes for buses, implementing transit signal priority, building super stops and improving bus stops. This regional priority bus network is anticipated to be complete by 2016.

Figure 60: TIGER Grant Supported Regional Priority Bus Network and Transit Center



3.4.3 Regional ITS Architecture

The TPB has developed a regional ITS architecture, the Metropolitan Washington Regional Intelligent Transportation Systems Architecture (MWRITSA)[149]. The Regional Architecture is intended to provide a regional ITS framework for the foreseeable future, to define and validate ITS operations of regional significance, and to address national and statewide conformity in accordance with federal law and guidance. The architecture aims to ensure knowledge of ITS operations across the region, encouraging appropriate systems integration and enhanced technical systems interoperability. In addition to describing the interrelationships among existing transportation technology systems, the MWRITSA can provide a starting point for identifying responsibility for ITS Projects and applicable standards. It can inform business cases for state and federal ITS investment in transportation improvement programs as well as other plans, programs, and projects. The three DOTs have worked collaboratively to bring consistency among their regional ITS architectures. The Regional Architecture is updated periodically to reflect changes in the region and is currently under revision.[150]

3.4.4 Integrated Corridor Management (ICM)

New technologies and concepts have been tested nationally or internationally to integrate operations to manage total corridor capacity including freeways, arterials, bus, rail, and parking systems. The purposes of the initiative include identifying innovative technologies to facilitate multi-modal local, regional, and national corridor travel, and identifying tools to provide information to travelers related to travel times and parking.

- VDOT's current ICM project development focuses on I-95 and US-1 corridor from the DC line to Fredericksburg. VDOT launched the first ICM initiative on the corridor in February 2014. The 511 website and mobile app now have a link for the I-95/395 corridor where users can see:
  - Current travel times in HOV Lanes versus general purpose lanes
  - Park-and-ride locations and number of spaces available
  - Real-time VRE travel information
  - PRTC bus schedules and stop locations
  - HOV lane open/closed status [151]

- VDOT released the I-66 Multi-modal Study Inside the Beltway in June 2012.[152]

3.4.5 Evaluating Significant Transportation Projects (Virginia)

In September 2013, VDOT and its partners initiated a study to evaluate and rate at least 25 significant transportation projects in Northern Virginia. This study, which was mandated by legislation passed by the Virginia General Assembly in 2012, requires the consideration of

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[149] The Metropolitan Washington Regional Intelligent Transportation Systems Architecture. http://www.mwcog.org/itsarch/Home.htm

[150] http://www.mwcog.org/itsarch/

[151] http://www.95expresslanes.com/uploads/1000/433-VDOT_LAUNCHES_NEW_NORTHERN_VIRGINIA_COMMUTER_TOOLS_ON_511.pdf

[152] http://virginiadot.org/projects/resources/NorthernVirginia/I-66_Multimodal_-_Final_Report.pdf

operations in capital program. More specifically, the projects will be evaluated based on the expected ability to reduce congestion and in prove regional mobility. [153]

3.4.6 Mobile Devices and Social Media

3.4.6.1 Mobile Devices

The increasing number of people with mobile internet-capable devices, such as smartphones and tablets, combined with the availability of real-time travel data, is changing the way travelers receive information and make decisions on their choice of mode, route, and/or departure time. Most travelers now carry a mobile device with maps and GPS allowing for information to be tailored to their location. DOTs, transit agencies, private transportation providers, and other third parties have developed mobile versions of websites and mobile applications (apps) to make it easier for travelers to receive information on their devices.

- Both Maryland 511 and Virginia 511 provide a mobile version of their website. Commuters can sign up to get email and text alerts about travel time and incident information on preferred routes.
- WMATA provides real-time rail arrivals on the mobile version of its website.
- Many bus operators make real-time arrival information and/or static schedules available on their mobile websites and/or make data available to third party websites and applications. NextBus is one of the most popular bus information apps.
- MARC provides real time incident and delay alerts through text, and email to commuters. The MARCTracker website provides live GPS train locations.
- Capital Bikeshare and the carshare companies in the region (ZipCar, Car2Go, and Enterprise) have mobile apps which allow users to make travel decision on the spot.
- Traffic information, based on data sources such as INRIX, is available through a number of apps (INRIX, Google Maps, and WAZE being among some of the most popular. See Section 3.4.6.2 for more information about WAZE.)
- Wireless Emergency Alerts (WEA) are sent by authorized government alerting authorities. These alerts can contain information that is valuable to the traveling public such as extreme weather warnings and local emergencies requiring evacuation or other immediate action.[154]

Safety while using the devices while traveling remains a concern; all three states have laws against distracted driving and texting while driving.

3.4.6.2 Social Media

The traveling public is now oriented toward the use of social media for many aspects of their lives. The social media landscape is constantly evolving and it is causing the transportation sector to rethink its model for providing information. Transportation agencies in the region have

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[153] *Evaluation of Significant Transportation Projects in Northern Virginia Transportation District Fact Sheet* Fall 2013 http://www.virginiadot.org/projects/resources/NorthernVirginia/Significant_Projects_-_Fact_Sheet.pdf
[154] http://www.nws.noaa.gov/com/weatherreadynation/wea.html#.U20oqFdRFLk Accessed May 9, 2014.

adopted social media as a means of sharing information with a large segment of the public. Instead of providing information only on a central website that the user has to visit, social media provides a way to deliver that information to users through a forum to which they already subscribe, such as Twitter which is one of the most popular social media sites for the transportation sector. In addition, social media can provide a means for agencies to receive information from users in order to better manage the system.

- MDOT, VDOT, and DDOT all use Twitter to share information.
- Local police departments user Twitter to provide preliminary information and updates on active incidents.
- WMATA uses four different Twitter accounts to share general information, Metrorail information, Metrobus information, and crime prevention tips. Supplemental two-way customer support is provided on the Metrorail and Metrobus feeds from 7 a.m. to 6 p.m.[155]
- WAZE[156] is a community-based traffic and navigation app. WAZE goes beyond other apps that provide traffic data by providing a crowdsourcing component. Users can passively contribute to providing traffic information by having the mobile app open while driving. They can also contribute by sharing information about incidents and other travel conditions.
- MATOC users its own Twitter account to provide updates on incidents. It follows other twitter feeds (including police departments, local jurisdictions, transit agencies, news organizations, etc.) and crowdsourcing websites like WAZE to obtain more timely and accurate information about incidents.

3.4.7 Traffic Management Activities Associated with Defense Base Closure and Realignment Commission (BRAC) Actions

3.4.7.1 Walter Reed

The Walter Reed National Military Medical Center (WRNMMC) is located at 8901 Rockville Pike in Bethesda, Montgomery County. The facility occupies most of the east side of Rockville Pike (MD 355) between Jones Bridge Road and Cedar Lane. Under the BRAC action, this facility represents the absorption of the former Walter Reed Army Medical Center, an Army facility located at 6900 Georgia Avenue, NW in the District of Columbia (now closed), into the Bethesda site previously called the National Naval Medical Center. The Uniformed Services University of Health Sciences (USUHS) is located on the WRNMMC site.

Employment at the site has increased from about 8,000 in 2008 to about 10,200 in 2012. According to the Walter Reed Web site, about 23% of employees "utilize environmentally-friendly transportation modes to come to work each day." A new pedestrian tunnel under Rockville Pike linking the site to the Medical Center stop on the Metrorail Red Line and new elevators from near the hospital entrance to the Metro platform are scheduled for completion by 2017.[157] Additionally, the Maryland State Highway Administration and Montgomery County

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[155] http://www.wmata.com/rider_tools/metro_service_status/connect_with_twitter.cfm (Accessed May 8, 2014).
[156] https://www.waze.com/about (Accessed May 9, 2014.)
[157] http://www.montgomerycountymd.gov/dot-dte/projects/355Underpass/index.html (Accessed April 23, 2014)

Department of Transportation are undertaking major intersection improvements at the intersections of Rockville Pike and Cedar Lane / West Cedar Lane (construction underway), Old Georgetown Road and West Cedar Lane (construction expected to begin Summer 2014), and Connecticut Avenue (MD 185) at Jones Bridge Road (construction almost complete on the first phase; new construction expected to begin Summer 2015).[158] For years, these three intersections have consistently been among the most congested in the County. Smaller scale improvements are also being / have been implemented at other intersections along the roads adjacent to the site.

3.4.7.2 Mark Center

The Mark Center (also known as BRAC-133) is located at the southwest quadrant of the interchange of I-395 and Seminary Road in the City of Alexandria. Access to the site is via Mark Center Avenue, which intersects Seminary Road, and Mark Center Drive, which intersects North Beauregard Street. Approximately 6,400 jobs were moved to Mark Center. Adjacent is the Institute for Defense Analysis, which houses about 600 employees. A report with monthly traffic monitoring conducted between August 2011 and November 2013 was released in March 2014.[159]

A new transit bus station with five bus bays, which accommodates service from WMATA Metrobus, Alexandria DASH and private providers was built a short walk from the Mark Center. The Beauregard corridor was one of three corridors studies by the City for high-capacity transit service.[160] The Virginia Department of Transportation (VDOT) is building a new reversible ramp from the I-395 High Occupancy Vehicle (HOV) lanes to enable direct access from those lanes to Seminary Road during the morning peak commute period, and from Seminary Road to the HOV lanes in the afternoon commute period. These lanes are limited to HOV-3 (three-person car-pools, van-pools, buses and motorcycles) while in northbound operation from 6:00 AM to 9:00 AM and southbound from 3:30 PM to 6:00 PM. This project is expected to be completed in late 2015.[161]

3.4.7.3 Fort Belvoir

Fort Belvoir is located along Richmond Highway (US 1) and I-95 in Fairfax County. It consists of two separate sites, the larger main post (located on the east and west sides of U.S. 1 south of Mount Vernon Highway (VA 235) and the smaller Fort Belvoir North area (the former Engineer Proving Ground), generally bounded by I-95, the Fairfax County Parkway (VA 7100) and the neighborhoods just south of the Franconia-Springfield Parkway (VA 7900).[162] The National

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[158] http://apps.roads.maryland.gov/WebProjectLifeCycle/ProjectSchedule.aspx?projectno=MO5932125 (2/11/1014 Status Update, Accessed April 23, 2014)

[159] http://www.vamegaprojects.com/tasks/sites/default/assets/File/pdf/BRAC/MarkCenter/Mark_Center_Traffic_Monitoring_Revised_Final_Report_032014.pdf

[160] Transitway Corridor Feasibility Study Corridor C (Van Dorn / Beauregard) Recommendation by High Capacity Transit Corridor Work Group https://www.alexandriava.gov/uploadedFiles/tes/info/2011-05-19_CWG%20Motion%20on%20Corridor%20C%284%29.pdf

[161] http://www.vamegaprojects.com/about-megaprojects/mark-center-taskforce/ (Accessed April 23, 2014)

[162] Both of these facilities will soon be renumbered as part of their placement onto the VDOT primary road network as a result of Commonwealth Transportation Board (CTB) action earlier this year.

Geospatial Agency (NGA) is the primary tenant at Fort Belvoir North, while the main post hosts a number of Army functions.

In 2006, there were about 23,300 jobs at Fort Belvoir and Fort Belvoir North. As of 2011, there were about 36,400 jobs on the two sites (there will be additional off-base jobs which are not included in this total).

Transportation improvements in the area include:

- Completion of the final section of VA 286 between Newington and VA 289, including a new interchange on the west side of Fort Belvoir North at Barta Road
- A new ramp from the I-95 Express Lanes (HOV-3 restricted during peak commute times) to Heller Road on Fort Belvoir North to open in 2014
- Widening US 1 from four to six lanes from VA 611 to VA 235. The projects will also include the addition of left and right turn lanes at intersections and connecting roadways, and provision of a multi-use trail, pedestrian sidewalk, and on-road bicycle accommodations. Construction is scheduled to begin Spring 2014.[163]

3.5 Additional System Capacity

3.5.1 Documentation of Congestion Management for Additional System Capacity

Federal regulations state that any project proposing an increase in Single-Occupant Vehicle Capacity should show that congestion management strategies have been considered. The specific language from the Federal Rule states that Transportation Management Areas (TMAs) shall provide for:

> "*an appropriate analysis of reasonable (including multimodal) travel demand reduction and operational management strategies for the corridor in which a project that will result in a significant increase in SOVs is proposed to be advanced with Federal Funds. If the analysis demonstrates that travel demand reduction and operational management strategies cannot fully satisfy the need for additional capacity in the corridor, and additional SOV capacity is warranted, then the congestion management process shall identify all reasonable strategies to managed the SOV facility safely and effectively.*"

In the Washington region, the TPB is ensuring that all proposed SOV capacity increasing projects (except those which are exempt) show that congestion management strategies have been considered to effectively manage the additional capacity. This is being done with agencies completing a "CMP Documentation Form" when submitting a proposal for projects in the long-range plan and Transportation Improvement Program (TIP).

[163] http://rte1ftbelvoir.com/ (Accessed April 23, 2014)

A sample CMP documentation form was developed to provide guidance to agencies completing these forms[164] (Appendix F). Agencies completing these forms are able to cite various ongoing strategies in the region, local jurisdiction, and corridor in the vicinity of their project.

3.5.2 Where Additional System Capacity Is Needed and How the Additional System Capacity Will be Managed Efficiently

The CLRP, updated regularly, identifies where major roadway capacity expansions are planned. The TPB, through the CLRP, asks that congestion management strategies be considered for these capacity increases. In the Washington region, all proposed SOV capacity increasing projects (except those which are exempt), show that congestion management strategies have been considered to effectively manage the additional capacity. These types of strategies could be of demand or operational management, or both, as outlined in this report. Many of these strategies are considered before any capacity-increasing project is adopted.

The CLRP, through the CMP, strongly encourages consideration and implementation of strategies such as the following to manage both existing and future additional roadway capacity:

- Transportation Demand Management (TDM) strategies, such as Commuter Connections programs.
- Traffic Operational Improvements
- Public Transportation Improvements
- Intelligent Transportation Systems technologies
- Combinations of the above strategies.

Roadway capacity increases may be needed in specific locations for a number of reasons including bottleneck removal, safety improvements, economic development, and other reasons. Managing this capacity through the CMP is key.

3.6 Project-Related Congestion Management

In recent years, the Washington region has successfully implemented project-related congestion management for major construction projects. Strategies include providing incentives for commuters to give up driving alone and try transit, carpooling, vanpooling, and other alternatives, disseminating more information about construction projects and congestion, improving alternative routes, providing fire and rescue equipment and staff for emergency services along with additional police services, adding additional spaces to park-and-ride lots, providing additional shuttle bus services, etc.

Some successful examples of implementing project-related congestion management during construction include the Woodrow Wilson Bridge project, the I-95/I-495 Springfield Interchange project and the South Capitol Street project.

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[164] TPB, *Call for Projects for the 2013 CLRP and FY 2013-2018*, Approved on October 17, 2012. http://www.mwcog.org/clrp/resources/2013/Call_for_Projects.pdf

Ongoing major construction projects continue the practice of implementing project-related congestion management. Examples are DDOT 11th Street Bridges project and Northern Virginia Megaprojects.

11th Street Bridges Project

During the construction phases of the DDOT 11th Street Bridges project, several congestion management approaches were considered and the following was implemented to mitigate congestion and keep traffic moving:

- Maintain three lanes of traffic in each direction across the river;
- Provide additional transit enhancements during peak traffic periods;
- Provide traveler information systems, including low power highway advisory radio, and Intelligent Transportation Systems, including real-time message signs with alternate route suggestions;
- Provide updated freeway guide signing within the immediate project area that reflects temporary access routes during the various phases of construction. Also provide way-finding signage for freeway access points on local roads in the project study area; and event management systems, such as roving tow services.

Northern Virginia Megaprojects

Northern Virginia Megaprojects[165] are a series of large-scale and simu ltaneous transportation improvements aimed to ease congestion and provide alternatives to travelers. The projects currently underway include 95 Express Lanes, I-95 Auxiliary and Shoulder Improvements, Dulles Metrorail and BRAC Projects.

In 2007, the Virginia Department of Transportation (VDOT) began a new program of congestion management during the construction of megaprojects. The megaproject-related congestion management provides both “Commuter Solutions” and “Employer Solutions”.

“Commuter Solutions” include:

- Free Saturday bus service between the Potomac Mills Mall and the Franconia-Springfield Metrorail station to help alleviate congestion during the weekend when the HOV lanes are closed for construction. A three-month pilot program began in September 2013 and was extended into May 2014
- Tysons Express bus routes – Service from Woodbridge to Tysons is funded by Virginia Mega Projects. Service from Loudoun County to Tysons is funded by the Metropolitan Washington Airports Authority’s Dulles Metrorail Project

[165] http://www.vamegaprojects.com/ Accessed March 6, 2014

- Amtrak Step-up Ticket – Passengers with a VRE ticket can use Amtrak trains with a Step-up ticket for $3 to provide additional options for getting around during the 95 Express Lanes construction
- NuRide offers reward points for registered members who record trips taken with modes other than SOV

"Employer Solutions" will provide assistance to employers to help them create new approaches or enhance existing services to keep their employees moving during construction.

4. STUDIES OF CONGESTION MANAGEMENT STRATEGIES

Defining, analyzing and assessing congestion management strategies are important components of the CMP. This chapter reviews performance measures adopted by the TPB and its subcommittees and the effectiveness of demand and operational management strategies. Several important studies of strategies are also documented in this chapter as examples.

4.1 Review of Performance Measures

4.1.1 Introduction to Performance Measures

A performance measure, or indicator, is a means to gauge and understand the usage of a transportation facility, or the characteristics of particular travelers and their trips. The performance measure/indicator may refer to a particular location or "link" of the transportation system.

Performance measures can be either quantitative or qualitative. It may refer to the experience of a traveler on a trip between a particular origin and a particular destination. It may summarize all trips or trip makers between a particular origin and destination pair. Or, it may describe the operation of one mode of transportation versus another.

Federal regulations state that the CMP should include:

"Definition of congestion management objectives and performance measures to assess the extent of congestion and support the evaluation of the effectiveness of congestion reduction and mobility enhancement strategies for the movement of people and goods."

The fields of transportation planning have typically used mode-specific performance measures/indicators to gauge conditions on the system. These include motor-vehicle specific performance measures such as traffic volumes, capacities, and level-of-service.

The TPB adopted a set of performance measures in the 1994 Congestion Management System (CMS) Work Plan. Since then, there has been an evolution towards more traveler-oriented metrics in conveying congestion and related information to the general public. Some of the measures are leveraged by emerging highway performance monitoring activities such as the I-95 Corridor Coalition Vehicle Probe Project that provides probe-based continuous monitoring. The federal MAP-21 legislation will further evolve the TPB's reporting of congestion-related indicators when national performance measures are released in the second half of 2014.

4.1.2 MAP-21 Performance Measures

The Moving Ahead for Progress in the 21st Century Act (MAP-21) established new requirements for Metropolitan Planning Organizations (MPOs) towards performance-based planning and programming. The U.S. Department of Transportation is in the process of establishing transportation performance management measures through a rulemaking process as of the writing of this report. According to the Federal Highway Administration (FHWA) Notice of Proposed Rulemaking (NPRM) regarding the National Performance Management Measures and the Highway Safety Improvement Program[166], the FHWA will assess performance in 12 areas, four of which are relevant to the CMP, including:

1) Traffic congestion,
2) Performance of the Interstate system,
3) Performance of the non-Interstate National Highway System (NHS), and
4) Freight movement on the Interstate system.

The NPRM regarding the above four areas is expected in August 2014. The CMP will adopt the anticipated NPRM performance measures and final measures in the future.

4.1.3 Traveler-oriented CMP Performance Measures

Since the TPB development of the CMP performance measures in 1994 (see Section 4.1.4), there has been an evolution towards more traveler-oriented metrics in conveying congestion and related information to the general public. Some of the measures are leveraged by emerging highway performance monitoring activities such as the I-95 Corridor Coalition's Vehicle Probe Project that provides probe-based continuous monitoring. Earlier in this report, the following four measures were used, with the first two quantifying congestion and the latter two travel time reliability. The 2010 Strategic Plan for the Management, Operations and Intelligent Transportation Systems (MOITS) Program[167] adopted Travel Time Index, Buffer Time Index and Planning Time Index as three regional indices of travel conditions and traveler's experience.

4.1.3.1 Travel Time Index (TTI)

TTI is defined as the ratio of actual travel time to free-flow travel time, measures the intensity of congestion. The higher the index, the more congested traffic conditions it represents, e.g., TTI = 1.00 means free flow conditions, while TTI = 1.30 indicates the actual travel time is 30% longer than the free-flow travel time. For more information, please refer to Travel Time Reliability: Making It There On Time, All The Time, a report published by the Federal Highway Administration and produced by the Texas Transportation Institute with Cambridge Systematics, Inc. This report uses the following method to calculate TTI:

1) Download INRIX 5-minute raw data from the I-95 Traffic Monitoring website (http://i95.inrix.com) or the VPP Suite website (https://vpp.ritis.org).

2) Aggregate the raw data to monthly average data by day of the week and hour of the day. Harmonic Mean was used to average the speeds and reference speeds (Harmonic Mean is only used here; other averages used are all Arithmetic Mean). For each segment (TMC), the monthly data have 168 observations (7 days in a week * 24 hours a day) in a month.

3) Calculate TTI = reference speed / speed in the monthly data. If TTI < 1 then make TTI = 1. If constraint TTI >= 1 was not imposed, some congestion could be cancelled by conditions with TTI < 1.

[166] Federal Register, Vol. 79, No.47, March 11, 2014.
[167] COG/TPB, http://www.mwcog.org/transportation/activities/operations/plan/MOITS-Strategic-Plan-Final-2010-06-16.pdf

4) Calculate regional average TTI for the Interstate system, non-Interstate NHS, non-NHS, and all roads for AM peak (6:00-10:00 am) and PM Peak (3:00-7:00 pm) respectively, using segment length as the weight.

5) Calculate the average TTI of the AM Peak and PM Peak to obtain an overall congestion indicator.

4.1.3.2 Planning Time Index (PTI)

PTI is defined as the ratio of 95th percentile travel time to free flow travel time, measures travel time reliability. The higher the index, the less reliable traffic conditions it represents, e.g., PTI = 1.30 means a traveler has to budget 30% longer than the uncongested travel time to arrive on time 95% of the times (i.e., 19 out of 20 trips), while TTI = 1.60 indicates that one has to budget 60% longer than the uncongested travel time to arrive on time most of the times. For more information, please refer to Travel Time Reliability: Making It There On Time, All The Time, a report published by the Federal Highway Administration and produced by the Texas Transportation Institute with Cambridge Systematics, Inc. This report uses the following method to calculate PTI:

1) Calculate TTI = reference speed / speed in the monthly data obtained in step 2 of the above TTI methodology. Do not impose constraint TTI >= 1, since the purpose of this calculation is to rank the TTIs to find the 95th percentile, not to average the TTIs.

2) Calculate monthly average PTI: including sorting the data obtained in step 1 by segment, peak period, and month, finding the 95th percentile TTI and this TTI is PTI by definition, and averaging the PTIs using segment length as the weight to get regional summaries (for the Interstate system, non-Interstate NHS, non-NHS, and all roads for AM peak (6:00-10:00 am) and PM Peak (3:00-7:00 pm) respectively).

3) Calculate yearly average PTI: including sorting the data obtained in step 1 by segment and peak period, finding the 95th percentile TTI and this TTI is PTI by definition, and averaging the PTIs using segment length as the weight to get regional summaries.

4) Calculate the average PTI of the AM Peak and PM Peak to obtain an overall travel time reliability indicator.

4.1.4 How Performance Measures/Indicators Were Selected For The 1994 CMS Work Plan

Level of Service has generally been the most widely used performance measure in the Washington region, as can be seen in the Freeway Monitoring Program and Arterial Monitoring Program. However, there are other performance measures that are used, such as Volume/Capacity (V/C) ratio.

In 1993, the CMS Task Force undertook discussion of performance measures/indicators because of the emphasis in federal CMS guidance on this issue, culminating in the publication of performance measures in the 1994 CMS Work Plan[168]. The efforts at the beginning of the process involved a literature search and brainstorming process. An array of possible performance measures were developed based on materials from an FHWA instructional course on CMP. The CMP Task Force worked with these draft lists, adding, deleting, and changing the performance measures to suit the needs of the Washington region. The result was a stratified list of CMP performance measures.

Early in the process, the CMS Task Force was already aware of the gap between the intermodal, locally focused performance measures/indicators available and the multi-modal, wide-area scope desired for congestion management. Other issues were raised, as well, which set the tone of the discussion. The following were taken into consideration:

- Can the particular performance measure/indicator (or the data needed to feed it) be forecast by known tools and capabilities?

- Traditional congestion indicators tended to be precise in scale, addressing a particular link or intersection on the transportation system, yet modeling or forecasting capabilities tended to be rough in scale, forecasting at best, a regional or sub-regional scale. Post processing forecast data would improve the precision at a corridor level. The choice of performance measures may lead or bias the investigator toward only certain kinds of solutions, and eliminate others that may actually be worthy. This was a particular concern expressed by elected officials on the TPB.

- The CMP tries to have a layman's term, "congestion" apply to a technical process. Congestion could be characterized by crowdedness, by delay, or by decreases in traffic speeds. Conversely, crowdedness, delay, and slowing are not all the same phenomenon not always experienced, and not always tantamount to congestion.

- Level of Service appeared to be the most promising alternative to using delay. It has been used frequently in the past, and there is a level of understanding and buy-in from regional decision makers and the public. Level-of service does have some drawbacks, including not being multi-modal. Even though LOS E and F are considered as congested, in urban areas some levels of congestion is considered acceptable. In addition, it is difficult to distinguish from the varying severities of Level of Service "F."

The solution proposed and adopted instead was to choose a whole list of indicators, and apply them where and when relevant. The CMS Task Force reviewed over 100 different performance measures in use or suggested for use by States and localities around the country. This list was then narrowed to a manageable few. Some of the major criteria used to rate the utility of prospective performance measures were the following:

- Had to be clear and understandable.
- Had to be sensitive to modes.
- Had to be sensitive to time.

[168] *CMS Work Plan for the Washington Region*, approved by the TPB on September 21, 1994.

- Based on readily available data.
- Can be forecast.
- Able to gauge the impact of one or more congestion management strategies.

4.1.5 Selected CMP Performance Measures from the 1994 CMS Work Plan

4.1.5.1 Summary List

Following is a list of performance measures selected:[169]

- *Data for Direct Assessment of Current (or future background) Conditions:*
  - Traffic volumes
  - Facility capacity
  - Speed
  - Vehicle density
  - Vehicle classification
  - Vehicle occupancy
  - Transit ridership
  - Accident/Incident data

- *Calculated performance measures/indicators for congestion assessment:*
  - Volume-to-capacity (V/C) ratio
  - Level of Service
  - Person miles of travel/vehicle miles of travel
  - Truck hours of travel
  - Person hours of delay/vehicle hours of delay
  - Modal shares
  - Safety considerations
  - Vehicle trips
  - Emissions reduction benefits

4.1.5.2 Descriptions of the Performance Measures

Direct Assessment

- *Traffic volumes* – number of vehicles crossing a certain point, usually expressed for an average weekday. This indicator would be applicable in corridors or spot locations, and of interest in the assessment of most CMP strategies.
- *Facility capacity* – Typically for highways, and expressed in terms of the number of passenger car equivalents that can pass over a certain point in an hour, given the geometric characteristics and environment of the highway.
- *Speed* – Defined as the average running speed of motor vehicles traversing a section of roadway. Speed as an indicator is applicable in corridors or spot locations, and is of interest in the assessment of most CMP strategies.

[169] As originally identified in the 1994 *CMS Work Plan for the Washington Region*.

- *Vehicle density* – Described as passenger-car-equivalents per lane per mile. It is of interest for highway-oriented CMP strategies such as traffic operations and HOV facilities.
- *Vehicle classification* – Entails determining the proportion of vehicle traffic type passing a given point. Can be passenger cars, trucks, buses, or other vehicle types. It is applicable to spot locations, and is of interest in the assessment of most CMP strategies.
- *Vehicle occupancy* – average number of persons per motor vehicle for a given location. It is applicable region-wide, or on a corridor or spot basis. Can be used in the comparison of corridors.
- *Transit ridership* – average daily volume of passengers on given transit lines or facilities. It is of interest in the assessment of the following CMP strategies: Transportation Demand Management (TDM), transit, congestion pricing, and growth management.
- *Accident/Incident data* – average number of accidents per million vehicle miles of travel by different facility types. Higher accident rates is an indirect indication of congestion.

Calculated

- *Volume-to-Capacity (V/C) Ratio* – ratio of demand flow rate at a given level of vehicle capacity for a roadway. Calculated from available highway data according to national standards in the Highway Capacity Manual. V/C Ratio was analyzed in the 2008-2030 Plan Performance evaluation.
- *Level of Service* – rating of the quality of service provided by a roadway under a given set of operating conditions. A roadway is classified with a letter “A” through “F” with “A” being the least congestion and “F” being the most congested. For LOS F conditions density/speed is used as an indication of the severity of the F. This performance measure is currently used in the Freeway Monitoring Program.
- *Person Miles of Travel/Vehicle Miles of Travel* – sum of all miles of travel by all vehicles for a given area or facility for a given period of time, factored by the vehicle occupancy to gauge person movement.
- *Modal Shares* – indicate the apportioning of person trips among possible transportation modes: single-occupant vehicle (SOV), high-occupancy vehicle (HOV), transit, non-motorized, or other modes of transportation.
- *Safety Considerations* – include empirical or sketch planning evaluation of safety or hazard issues in a given congestion situation or in consideration of potential congestion management strategies.
- *Vehicle Trips* – number of motor vehicle trips from a given origin to a given destination, which may be stratified by mode purpose, time period, vehicle type, or other classifications.
- *Emissions Reductions Benefits* – reductions in criteria pollutant emissions based on reductions in vehicle miles of travel or vehicle trips. Currently, this performance measure is used when analyzing the TERMs for the region.

Other Performance Measures for Consideration

There are a number of performance measures that would be beneficial to congestion management, but the data availability is too limited for use in the CMP. Some of these include:

- *Bicycle usage and pedestrian counts*
  - Very little data on these have been collected in the region, but would be beneficial in areas such as bicycle and pedestrian planning and growth management.
- *Number of congested intersections*
  - Will give an indication of the extent and severity of congestion. Possible sources include traffic volumes, Data Clearinghouse information, and traffic operations models.
- *Hours per day of congestion*
  - Will directly address the need to gauge the extent of congestion on the transportation system. This indicator is dependent upon having travel volumes by time of day.
- *Percent person miles of travel by congestion level*
  - Will allow comparison of the extent of congestion among CMP locations.
- *Percent delay*
  - The total delay (in minutes) divided by the designated threshold (meaning expected, ideal, or free-flow) travel time. For example, a percent delay of 25% would mean that travel time on a certain segment of the transportation system is taking 25% longer than it would be expected to under non-congested conditions.
- *Average duration of incidents*
  - Could be incidents, special events, infrastructure or equipment failures, or other unusual circumstances that lead to a one-time-only or occasional increase in traveler delay.
- *Truck and freight movement involvement with congestion*
  - Impact of truck and freight movement on congestion. Currently the region does not have much data on hand in this area.
- *Percent of person miles of travel by transit load factor*
  - This is the transit analog of highway congestion as described by Level of Service. Load factor indicates the crowdedness of the transit vehicles, thus providing an overall indication of crowdedness on the portion of the transportation system.
- *Person volume-to-person capacity ratio*
  - Used to develop a Level of Service for transportation corridors by taking the sum of automobile and transit capacities. Levels of service are then determined with reference to volume-to-capacity standards.

4.2 Review of Congestion Management Strategies

4.2.1 Introduction

Federal regulations state that the CMP should include:

> *"Identification and evaluation of the anticipated performance and expected benefits of appropriate congestion management strategies that will contribute to the more effective use and improved safety of existing and future transportation systems based on the established performance measures. The following categories of strategies, or combinations of strategies, are some examples of what should be appropriately considered for each area:*

(i) Demand Management measures, including growth management and congestion pricing;
(ii) Traffic operational improvements;
(iii) Public transportation improvements;
(iv) ITS technologies as related to the regional ITS architecture; and
(v) Where, necessary, additional system capacity."[170]

To address this point, strategy lists have been developed as a way of categorizing congestion management strategies and characterizing the current impact, or potential impact, these strategies have throughout our region.

These lists are modeled after the longstanding Transportation Emission Reduction Measure (TERM) process for air quality in the region. The TERM list was formed as a way of developing additional plan and program elements which could be utilized to mitigate emission increases.

Similarly, lists have been developed for strategies under consideration for Congestion Management. At this time the effort is proposed to be qualitative, as the congestion information is not tied to one specific location. In addition, some strategies are regional while others are local , and a qualitative effort better characterizes the impact they have on the region as a whole.

The following section contains background and summary information of how the Strategy Lists were developed.

4.2.2 Descriptions of Strategies

The general characteristics of strategies are provided in Table 14 and Table 15; one for operational management strategies (those strategies contributing to a more effective use of existing systems) and one for demand management strategies (those that influence travel behavior). The qualitative criteria across the top of the lists, and the methodology used to categorize each strategy as "some impact (x)", "significant impact (xx)", and "high impact (xxx)" are the same for both tables. The separate tables are simply for the purpose of distinguishing the two types of strategies. A more detailed review of the strategies is provided in Appendix G.

[170] §450.320(c), Metropolitan Transportation Planning, Final Rule, Federal Register, February 14, 2007 – emphasis added.

Table 14: Congestion Management Process (CMP) Demand Management Strategies Criteria

1. Some Impact (x)
2. Significant Impact (xx)
3. High Impact (xxx)

		QUALITATIVE CRITERIA									
		Impacts on Congestion									
STRATEGY		Reduces Overall Congestion	Reduces Incident-related Congestion	Supports/Promotes Multi-modal Transportation	Regional Applicability	Local Applicability	Existing Level of Deployment	Ease of Implementation	Cost	Cost Effectiveness	Enhance Existing Programs
C.5.0	***Alternative Commute Programs***										
C.5.1	Carpooling	xxx	x	x	xxx	xxx	xxx	xx	x	xxx	xxx
C.5.2	Ridematching Services	xxx	x	x	xxx	xxx	xxx	xx	x	xxx	xxx
C.5.3	Vanpooling	xxx	x	x	xxx	xx	xx	xx	x	xxx	xxx
C.5.4	Telecommuting	xx	x	x	xxx	xx	xx	xxx	x	xx	xxx
C.5.5	Promote Alternate Modes	xx	x	xxx	xxx	xxx	xxx	xxx	x	xx	xxx
C.5.6	Compressed/flexible w orkw eeks	xx	x	x	xxx	xxx	xxx	xxx	x	x	xx
C.5.7	Employer outreach/mass marketing	xx	x	xxx	xxx	xxx	xx	xx	xx	xx	xxx
C.5.8	Parking cash-out	xx	x	xxx	x	xxx	x	x	xx	xx	x
C.5.9	Alternative Commute Subsidy Program	xx	x	xxx	xxx	xx	xx	x	x	xxx	xxx
C.6.0	***Managed Facilities***										
C.6.1	HOV	xx	x	xxx	xxx	xx	xx	xx	xxx	xxx	xxx
C.6.2	Variably Priced Lanes (VPL)	xxx	x	xx	xxx	xx	x	x	xxx	xxx	xx
C.6.3	Cordon Pricing	xxx	x	xxx	xxx	x	x	x	xx	xxx	xx
C.6.4	Bridge Tolling	xxx	x	x	xx	xx	x	x	xxx	xx	x
C.7.0	***Public Transportation Improvements***										
C.7.1	Electronic Payment Systems	xx	x	xxx	xx	xx	xxx	xx	xx	xxx	xx
C.7.2	Improvements/added capacity to regional rail and bus transit	xx	xx	xxx	xx	xxx	xx	x	xxx	xxx	xx
C.7.3	Improving accessibility to multi-modal options	xx	x	xxx	xx	xxx	xx	xx	xx	xx	xxx
C.7.4	Park-and-ride lot improvements	xx	x	xx	xx	xx	xx	xx	xx	xx	xx
C.7.5	Carsharing Programs	xx	x	xxx	xxx	xxx	xx	xxx	xx	xx	xxx
C.8.0	***Pedestrian, bicycle, and multi-modal improvements***										
C.8.1	Improve pedestrian facilities	xx	x	xxx	xx	xxx	xx	xx	xx	xx	xxx
C.8.2	Creation of new bicycle and pedestrian lanes and facilities	xx	x	xxx	xxx	xxx	xx	xx	xx	xx	xxx
C.8.3	Addition of bicycle racks at public transit stations/stops	x	x	xx	xxx	xxx	xx	xxx	x	x	xxx
C.8.4	Bike sharing programs	xx	x	xxx	xxx	xxx	xx	xxx	xx	xx	xxx
C.9.0	***Growth Management***										
C.9.1	Coordination of Regional Activity Centers	xx	x	xxx	xxx	xxx	xx	x	xxx	xxx	xx
C.9.2	Implementation of TLC program (i.e. coordination of transportation and land use w ith local gov'ts)	xx	x	xxx	xxx	xxx	xx	xxx	x	xxx	xxx
C.9.3	"Live Near Your Work" program	xx	x	xx	xxx	xx	x	xx	x	x	xx

Table 15: Congestion Management Process (CMP) Operational Management Strategies Criteria

1. Some Impact (x)
2. Significant Impact (xx)
3. High Impact (xxx)

STRATEGY		QUALITATIVE CRITERIA: Impacts on Congestion: Reduces Overall Congestion	Impacts on Congestion: Reduces Incident-related Congestion	Impacts on Congestion: Supports/Promotes Multi-modal Transportation	Regional Applicability	Local Applicability	Existing Level of Deployment	Ease of Implementation	Cost	Cost Effectiveness	Enhance Existing Programs
C.1.0	***Incident Mngt./Non-recurring***										
C.1.1	Imaging/Video for surveillance and Detection	xx	xxx	xx	xxx	xxx	xx	xx	xx	xxx	xxx
C.1.2	Service patrols	xx	xxx	x	xxx	xxx	xx	xxx	xx	xxx	xxx
C.1.3	Emergency Mngt. Systems (EMS)	x	xx	x	xx	xxx	xxx	xx	xxx	xxx	xxx
C.1.4	Emergency Vehicle Preemption	x	xx	x	x	xxx	xx	xx	xx	x	xx
C.1.5	Road Weather Management	x	xxx	x	xxx	xxx	xx	xx	xx	xx	xx
C.1.6	Traffic Mngt. Centers (TMCs)	xx	xxx	xx	xxx	xx	xx	xx	xx	xxx	xxx
C.1.7	Curve Speed Warning System	xx	xx	x	x	xx	x	xx	xx	xx	x
C.1.8	Work Zone Management	xx	xxx	x	xx	xxx	xx	xx	xx	xx	xx
C.1.9	Automated truck rollover systems	x	xx	x	x	xx	xx	xx	xx	xx	xx
C.2.0	***ITS Technologies***										
C.2.1	Advanced Traffic Signal Systems	xxx	xx	xx	xxx	xxx	xx	xx	xxx	xxx	xxx
C.2.2	Electronic Payment Systems	xxx	x	xx	xxx	xx	xx	xx	xx	xxx	xx
C.2.3	Freeway Ramp Metering	xx	x	x	xx	xx	x	xx	xx	xx	xx
C.2.4	Bus Priority Systems	x	x	xxx	xxx	xxx	x	xx	xxx	xx	xx
C.2.5	Lane Management (e.g. Variable Speed Limits)	xx	xx	x	xx	xxx	x	xx	xx	xx	xx
C.2.6	Automated Enforcement (e.g. red light cameras)	x	x	x	x	xxx	xx	xx	xx	xx	xx
C.2.7	Traffic signal timing	xxx	x	xx	xxx	xxx	xx	xxx	x	xxx	xxx
C.2.8	Reversible Lanes	xx	x	x	xx	xxx	x	x	xx	xx	xx
C.2.9	Parking Management Systems	xx	x	xx	xx	xxx	x	x	xxx	xx	xx
C.2.10	Dynamic Routing/Scheduling	xx	x	xx	xxx	xxx	x	x	xxx	xx	xx
C.2.11	Service Coordination and Fleet Mngt. (e.g. buses and trains sharing real-time information)	xx	x	xxx	xxx	xxx	x	x	xx	xx	xx
C.2.12	Probe Traffic Monitoring	xx	xxx	x	xx	xx	x	xx	xx	xxx	xx
C.3.0	***Advanced Traveler Information Systems***										
C.3.1	511	xx	xxx	xx	xxx	x	xx	xx	xxx	xx	xxx
C.3.2	Variable Message Signs (VMS)	xx	xxx	xx	xx	xxx	xx	xx	xx	xxx	xxx
C.3.3	Highway Advisory Radio (HAR)	x	xx	x	xx	xxx	xx	xxx	xx	x	xx
C.3.4	Transit Information Systems	xx	xx	xxx	xx	xxx	xx	x	xx	xx	xxx
C.4.0	***Traffic Engineering Improvements***										
C.4.1	Safety Improvements	x	xxx	x	x	xxx	xx	xxx	x	xxx	xxx
C.4.2	Turn Lanes	xx	x	x	x	xxx	xx	xx	xx	xx	x
C.4.3	Roundabouts	x	xx	x	x	xxx	x	x	x	xx	xx

4.3 Examples of Strategies Studies

4.3.1 Analysis of Transportation Emissions Reduction Measures (TERMs)

4.3.1.1 Overview

Transportation Emission Reduction Measures (TERMs) are strategies or actions employed to offset increases in nitrogen oxide (NOx) and volatile organic compound (VOC) emissions from mobile sources. The TPB has been adopting TERMs since FY 1995.

The Clean Air Act Amendments of 1990 (CAAA) and SAFETEA-LU requires metropolitan planning organizations and DOTs to perform air quality analyses, to ensure that the transportation plan and program conform to mobile emission budget established in the State Implementation Plans (SIP). Consequently MPOs and DOTs are required to identify TERMs that would provide emission-reduction benefits and other measures intended to modify motor vehicle use.

Selection of the TERMs requires quantitative as well as qualitative assessment. The quantitative assessment includes specific information on the benefits, costs, and expected air-quality benefits. Qualitative criteria includes ranking based on the subjective criteria's such as ease of implementation, how to implement, and synergy with other measures.

As greenhouse gas (GHG) emission becomes a global climate issue, the effects of TERMs on GHG reduction in the Washington region are analyzed in the "What Would It Take" Scenario Study (see Section 4.3.3).

4.3.1.2 Findings and Applications to Congestion Management

Most TERMs are intended to reduce either the number of vehicle trips (VT), vehicle miles traveled (VMT), or both. These strategies may include ridesharing and telecommuting programs, improved transit and bicycling facilities, clean fuel vehicle programs or other possible actions. These TERMs are not only important to offsetting increases in NOx and VOC, but many are important in congestion management by reducing trips and miles of travel.

The Washington region has adopted and implemented several TERMs with the sole aim of reducing emissions, such as the addition of clean diesel bus service, taxicabs with Compressed Natural Gas (CNG) cabs, and CNG buses. However, many TERMs also have an impact on congestion management. Examples of some of these congestion-mitigating TERMs that have been implemented include:

- *Upgraded Signal Systems in Maryland*
    - MD 85 Executive Way to MD 355
    - MD 355, I-70 ramps to Grove Road
    - MD 410, 62nd Avenue to Riverdale Rd
- *Traffic Signal Optimization*
- *Alexandria Telecommuting Program*

- *Cherry Hill VRE access*
- *Bicycle facilities*
- *Additional park-and-ride lots*
    - Shady Grove West park-and-ride
    - White Oak park-and-ride
    - Tacketts Mill park-and-ride
    - Town of Leesburg park-and-ride
- *Pedestrian facilities to Metrorail*
- *Employer outreach/Guaranteed Ride Home*
- *District of Columbia Incident Response and Traffic Management System*
- *Carsharing program*

4.3.2 Scenario Planning

4.3.2.1 "CLRP Aspirations" Scenario

"CLRP Aspirations" scenario is an integrated future land use and transportation scenario for building on the key results of previous TPB scenario studies. It includes concentrated land use growth in Regional Activity Centers, a regional network of variably priced lanes, and a high quality bus rapid transit network operating on the VPL network for the current planning horizon year 2040. The most recent version of the CLRP Aspirations Scenario was presented to the TPB in October 2013. Relative to the 2012 CLRP baseline for 2040, the full CLRP Aspirations Scenario showed increases in trips of all modes (auto person trips, transit trips, and non-motorized trips) due to the increase in population, both auto and transit capacity, and shifts in land use that enable more non-motorized trips. The Scenario showed a slight decrease in VMT, a decrease in VMT per capita, and a significant decrease in regional vehicle-hours of delay. [171]

4.3.2.2 "What Would It Take?" Scenario

"What Would It Take?" scenario starts with the adopted COG non-sector specific goals for reducing mobile source greenhouse gas emissions for 2030 and beyond. It assesses how such goals might be achieved in the transportation sector through different combinations of interventions that include increasing fuel efficiency, reducing the carbon-intensity of fuel, and improving travel efficiency. The study was completed in May 2010. The study found that:

- Strategies analyzed to date do not achieve regional goals of reducing greenhouse gas emissions, and additional strategies can and should be analyzed.
- Goals are difficult to meet and will require emission reductions in all three categories: Vehicle efficiency (CAFE improvement), alternative fuel (cellulosic ethanol), and travel efficiency (strategies aimed at reducing VMT, congestion, and delays).
- While major reductions can come from federal energy policies, local governments can make significant reductions quickly.

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[171] Kirby, R. *Briefing on Update to the CLRP Aspirations Scenario*. Presentation to the National Capital Region Transportation Planning Board, April 17, 2013. http://www.mwcog.org/uploads/committee-documents/kV1bW1xe20130411142653.pdf

- Some strategies may not have major greenhouse gas (GHG) reduction potential, but have multiple benefits worth exploring through benefit-cost analysis (e.g. the MATOC program).

The study also recommended nine potential local actions that can be implemented quickly to reduce GHG. The study has not been updated since 2010. EPA has released a new emissions model (MOVES) and the current version does not reflect the most current fuel efficiency standards. The next update of the model, expected in 2014, will have those standards included.

4.3.3 MATOC Benefit-Cost Analysis

The Metropolitan Area Transportation Operations Coordination (MATOC) Program is a joint program of VDOT, MDOT, DDOT, WMATA and TPB. It aims to provide real-time situational awareness of transportation operations in the National Capital Region (NCR), especially during emergencies and other incidents with significant impacts on travelers and on the transportation systems of the region.

A benefit-cost study has been carried out to quantify the effectiveness of this program as well as to better advise stakeholders in funding identification.

The benefit-cost study looked at traveler's "modified trips" - trips made at a later time, on another route, by another mode, or not made due to regionally significant incidents. Benefits were estimated from reduced delay, lower fuel consumption, lower emissions (including greenhouse gases), and avoidance of secondary incidents. Three case studies made up of two freeway incidents and one arterial incident was conducted. The study found an overall benefit/cost ratio conservatively estimated at 10 to 1. The study was released in June 2010. MATOC uses the method from that study to report monthly estimated benefits from the program.

4.3.4 MOITS Strategic Plan

The Management, Operations, and Intelligent Transportation Systems (MOITS) program of the TPB developed a strategic plan for the program dated June 16, 2010 and the plan is available on MWCOG website.[172] The Strategic Plan defines and promotes potential regional projects or activities for the management, operations, and application of advanced technology for the region's transportation systems, as well as to advise member agencies on management, operations, and transportation technology deployments for meeting common regional goals and objectives.

The MOITS Strategic Plan builds upon the TPB Vision by identifying four key tactical actions toward achieving and building upon the goals, objectives, and strategies of the Vision. It identifies nine emphasis areas derived from the National ITS Architecture, seven proposed projects out of which three have been implemented, and two are in the planning stage three strategic efforts out of which two are being considered for implementation, and a number of "best practices" for consideration by the member agencies and jurisdictions. The Plan also recommends use of a few key performance measures, including travel time index, buffer time index and planning time index, which are already used in this CMP Technical Report. The

[172] http://www.mwcog.org/transportation/activities/operations/plan/MOITS-Strategic-Plan-Final-2010-06-16.pdf

Strategic Plan concludes with seven key recommendations for the MOITS Technical Subcommittee and Program.

5. HOW RESULTS OF THE CMP ARE INTEGRATED INTO THE CLRP

According to federal regulations, the CMP should be an integrated process in the CLRP rather than a standalone product of the regional transportation planning process. This chapter clarifies this integration.

5.1 Components of the CMP Are Integrated in the CLRP

There are four major components of the CMP as described in the CLRP:

- Monitor and evaluate transportation system performance
- Define and analyze strategies
- Implement strategies and assess
- Compile project-specific congestion management information

In monitoring and evaluating transportation system performance, the TPB uses probe vehicle data (INRIX), aerial photography freeway monitoring (Skycomp), and a number of other travel monitoring activities to support both the CMP and travel demand forecast model calibration, complementing operating agencies' own information, and illustrating locations of existing congestion. CLRP travel demand modeling forecasts, in turn, provide information on future congestion locations. This provides an overall picture of current and future congestion in the region, and helps set the stage for agencies to consider and implement CMP strategies, including those integrated into capacity-increasing roadway projects.

The CMP component of the CLRP defines and analyzes a wide range of potential demand management and operations management strategies for consideration. TPB, through its Technical Committee, Travel Management Subcommittee, Travel Forecasting Subcommittee, and other committees, reviews and considers both the locations of congestion and the potential strategies when developing the CLRP.

For planned (CLRP) or programmed (TIP) projects, cross-referencing the locations of planned or programmed improvements with the locations of congestion helps guide decision makers to prioritize areas for current and future projects and associated CMP strategies. Maps in the 2009 CLRP showed a high correlation between the locations of planned or programmed projects and locations where congestion is being experienced or is expected to occur.

Thus CLRP and TIP project selection is informed by the CMP, and implementation of CMP strategies is encouraged. The region relies particularly on non-capital congestion strategies in the Commuter Connections program of demand management activities, and the Management, Operations, and Intelligent Transportation Systems (MOITS) program of operations management strategies. Assessments of these programs are analyzed, along with regular updates of travel monitoring to look at trends and impacts, to feed back to future CLRP cycles.

The TPB also compiles information pertinent to specific projects in its CMP documentation process (form) within the annual CLRP Call for Projects. This further assures and documents that the planning of federally-funded SOV projects has included considerations of CMP strategy alternatives and integrated components.

5.2 Demand Management in the CLRP

Demand Management aims at influencing travelers' behavior for the purpose of redistributing or reducing travel demand. Existing demand management strategies contribute to a more effective use and improved safety of existing and future transportation systems. The long-range plan takes a number of demand management strategies into consideration when planning for the region's transportation infrastructure. Such strategies include alternative commute programs, managed facilities (such as HOV facilities and variably priced lanes), public transportation improvements, pedestrian and bicycle facility improvements, and growth management (implementing transportation and land use activities). These strategies are outlined in detail in Section 3.2

In "Call for Projects" for the CLRP and TIP, for any project providing a significant increase to SOV capacity, it must be documented that the implementing agency considered all appropriate systems and demand management alternatives to the SOV capacity. A Congestion Management Documentation Form is distributed along with the Call for Projects and a special set of SOV congestion management documentation questions must be answered for any project to be included in the Plan or TIP that significantly increases the single occupant vehicle carrying capacity of a highway.

A set of projects included in the CLRP and TIP are exclusively dedicated to (and titled as) transportation demand management (TDM), such as TDM for employer outreach, TDM media program, and implement a TDM program.

Some projects included in the CLRP and TIP are revised as needed to reflect pertinent TDM study results, e.g., the I-95/395 HOV-HOT-Bus Lanes project was revised to reflect the results of the Transit/Transportation Demand Management Study conducted by the Virginia Department of Rail and Public transportation (DRPT) and the Technical Advisory Committee in the 2008 CLRP.

Finally, the TPB certifies demand management of the CMP in the overall certification of the transportation planning process in the National Capital Region. The Board finds the transportation planning process is addressing the major issues in the region and is being conducted in accordance with all applicable requirements.

5.3 Operational Management in the CLRP

Part of the CMP effort focuses on defining the existing operational management strategies that contribute to the more effective use and improved safety of existing and future transportation systems. Such strategies include incident management programs, ITS Technologies, Advanced Traveler Information Systems, and traffic engineering improvements. These strategies are outlined in detail in Section 3.3.

Along with demand management strategies, operational management alternatives must also be considered when SOV capacity expanding projects are submitted to the Call for Projects of the

CLRP and TIP. The considerations are documented in the Congestion Management Documentation Form.

The TPB also certifies operational management of the CMP in the overall certification of the transportation planning process in the National Capital Region.

5.4 Capacity Increases in the CLRP and Their CMP Components

Federal law and regulations list capacity increases as another possible component of operational management strategies, for consideration in cases of:

- *Elimination of bottlenecks*, where a modest increase of capacity at a critical chokepoint can relieve congestion affecting a facility or facilities well beyond the chokepoint location. Widening the ramp from I-495 Capital Beltway Outer Loop to westbound VA 267 (Dulles Toll Road) relieved miles of regularly occurring backups on the Beltway and across the American Legion Bridge.

- *Safety improvements*, where safety issues may be worsening congestion, such as at high-crash locations, mitigating the safety issues may help alleviate congestion associated with those locations.

- *Traffic operational improvements*, including adding or lengthening left turn, right turn, or merge lanes or reconfiguring the engineering design of intersections to aid traffic flow while maintaining safety.

These considerations should be included in the Congestion Management Documentation Form in the CLRP and TIP project submissions.

5.5 Regional Transportation Priorities Plan Facilitates CMP-CLRP Integration

The Regional Transportation Priorities Plan (RTPP)[173], which is a milestone of TPB's Performance-Based Planning approach, facilitates the integration of the CMP and the CLRP. The RTPP was approved by the TPB in January 2014.

Building on the *TPB Vision* and previous regional transportation planning activities, the RTPP identifies those transportation strategies that offer the greatest potential contributions to addressing continuing regional challenges, and to provide support for efforts to incorporate those strategies into future updates of the CLRP in the form of specific programs and projects. The plan articulates regional priorities for enhancing the performance of the CLRP by advancing six regional goals:

1) Provide a Comprehensive Range of Transportation Options
2) Promote a Strong Regional Economy, Including a Healthy Regional Core and Dynamic Activity Centers

[173] Regional Transportation Priorities Plan, http://www.mwcog.org/uploads/pub-documents/vF5cWFc20140219085242.pdf

3) Ensure Adequate System Maintenance, Preservation, and Safety
4) Maximize Operational Effectiveness and Safety of the Transportation System
5) Enhance Environmental Quality, and Protect Natural and Cultural Resources
6) Support Inter-Regional and International Travel and Commerce

After public review of the challenges the region faces, three regional priorities were defined:

1) Meet Our Existing Obligations: Maintain the Transportation System We Already Have
2) Strengthen Public Confidence and Ensure Fairness: Pursue Greater Accountability, Efficiency, and Accessibility
3) Move More People and More Goods More Efficiency: Alleviate Congestion and Crowding and Accommodate Future Growth

The strategies identified in the RTPP for the third priority focus on congestion management, and includes strategies that are have already been introduced in this region and are described in Chapter 3.

- Alleviate roadway bottlenecks
- Increase roadway efficiency
- Promote commute alternatives
- Increase bicycle and pedestrian infrastructure
- Apply priority bus treatments
- More capacity on the existing transit system
- Bus rapid transit (BRT) and other cost-effective transit alternatives
- Express toll lanes

Many of the strategies and priorities laid out in the Priorities Plan are loosely connected to COG’s Place + Opportunity Report, which was approved by the COG Board in December 2013 and focuses on strengthening and enhancing the region’s 141 Activity Centers. In FY 2015, COG/TPB staff will identify ways to further promote those linkages through analysis and outreach.

The RTPP is a policy document to help guide implementing agencies (local, state and regional) in the project development process to consider regional needs when identifying transportation improvements for inclusion in the CLRP. The CMP can help inform that process.

6. CONCLUSIONS

The 2014 CMP Technical Report hereby concludes with a summary of key findings and important recommendations from throughout the report to improve the Congestion Management Process in the Washington region.

6.1 Key Findings of the 2014 CMP Technical Report

1. The Washington region experienced decreasing congestion during peak periods from 2010-2013, but the pace of decrease had slowed down significantly in 2013. The decrease in Travel Time Index from previous year was 4.3%, 2.6% and 0.8% in 2011, 2012 and 2013, respectively; the annual average decrease was 2.6%. With regard to the Percent of Congested Miles, the decrease was even more dramatic. The decrease from previous year was 37%, 22% and 3% in 2011, 2012 and 2013, respectively (Section 2.1.1.1).

2. The Washington region experienced steady improvement in travel time reliability during peak periods from 2010-2013. The improvement in travel time reliability, measured by Planning Time Index, from previous year was 6%, 5% and 7% in 2011, 2012 and 2013, respectively; the annual average improvement was 6% (Section 2.1.1.2).

3. Long queues along southbound I-95 in Virginia, northbound I-95 in Maryland and northbound MD-295 were partially due to bottlenecks outside of the TPB Planning Area. In particular, bottlenecks in Fredericksburg and Stafford County, Virginia generated queues as long as 30 miles, with tremendous impact on the southbound travel along I-95 in the region. Addressing these bottlenecks involves coordination with jurisdictions outside the TPB Planning Area (Section 2.1.1.5).

4. The Commuter Connections program remains the centerpiece to assist and encourage people in the Washington region to use alternatives to the single-occupant automobile. The transit system in the Washington region serves as a major alternative to driving alone – transit mode share is among the highest several metropolitan areas in the country (Section 3.2.1).

5. This region has enhanced efforts in regional transportation operations coordination. The Metropolitan Area Transportation Operations Coordination (MATOC) program was recently enhanced with more staff covering longer time period, and a dedicated MATOC public website (www.matoc.org) providing real-time traffic and incidents information (Section 3.3.3.4).

6. Congestion management strategies of Management, Operations, and Intelligent Transportation Systems (MOITS) provide essential ways to make most of the existing transportation facilities (Section 3.3.3).

7. Variably Priced Lanes (VPLs) provide options to travelers. Maryland Route 200 (Intercounty Connector (ICC)) was fully opened in November 2011 for the section between I-270 and I-95; a Before-and-After study identified the ICC improved its

adjacent area's traffic by 3-4%. The 495 Express Lanes opened on the Virginia side of the Capital Beltway in November 2012 and in the fourth quarter of 2013, there were almost 38,000 average weekday trips and the lines reached a milestone of over one million unique customers. The 95 Express Lanes in Northern Virginia are expected to open in 2015 (Section 3.3.2).

8. Bikesharing and carsharing programs continue to grow providing transportation options to urban residents to wish to remain car-free or car-lite (Sections 3.2.4 and 3.2.5).

9. Mobile devices and social media are changing the way travelers make decisions. Real-time traffic and transit information are available from a number of sources though mobile applications and mobile versions of websites. Social media provides a mutually beneficial direct connection between transportation providers and users. Mobile applications related to non-auto modes, such as bikesharing and carsharing, allow travelers to be flexible with their mode choices (Section 3.4.6).

10. The TPB's Regional Transportation Priorities Plan (RTPP) takes a performance-based transportation planning approach to identify those transportation strategies that offer the greatest potential contributions to addressing continuing regional challenges, and to provide support for efforts to incorporate those strategies into future updates of the CLRP in the form of specific programs and projects. The MAP-21 legislation strengthens the performance-based approach to planning. The CMP supports the RTPP by monitoring congestion and providing strategies that could improve the mobility of the transportation systems (Section 5.5).

6.2 Recommendations for the Congestion Management Process

The 2014 CMP Technical Report documents the updates of the Congestion Management Process in the Washington region from mid-2012 to mid-2014. Looking forward, the report leads to several important recommendations for future improvements.

1. **Refine the Congestion Management Process to help meet the requirements stipulated by MAP-21 and its subsequent federal regulations.** It is anticipated that traffic congestion, system performance of the Interstate System and non-Interstate NHS, and freight movement on the Interstate System will be analyzed and reported by FHWA standards specified in forthcoming rulemakings. The CMP will also improve to help support performance-based planning and programming processes as mandated by the MAP-21.

2. **Continue the Commuter Connections program.** The Commuter Connections program is a primary key strategy for demand management in the National Capital Region and it is beneficial to have a regional approach. Meanwhile, this program reduces transportation emissions and improves air quality, as identified by the TERMs evaluations.

3. **Continue and enhance the MATOC program and support agency/jurisdictional transportation management activities.** The MATOC program/activities are key strategies of operational management in the National Capital Region. Recent

enhancements have including efforts on severe weather mobilization and the construction and coordination. Future enhancements of the MATOC program should be considered when appropriate to expand the function and participation of the program.

4. **Pursue sufficient investment in the existing transportation system, which is important for addressing congestion.** Prioritizing maintenance for the existing transportation system as called for in TPB's Regional Transportation Priorities Plan is critical to congestion management.

5. **Encourage implementation of congestion management for major construction projects.** The construction project-related congestion management has been very successful in the past such as for the 11th Street Bridge and Northern Virginia Megaprojects.

6. **Consider variable pricing and other management strategies in conjunction with capacity increasing projects.** Variably priced lanes (VPLs) provide a new option to avoid congestion for travelers and an effective way to manage congestion for agencies.

7. **Continue to encourage transit in the Washington region and explore transit priority strategies.** The transit system in the Washington region serves as a major alternative to driving alone, and it is an important means of getting more out of existing infrastructure. Local jurisdictions are encouraged to work closely with transit agencies to explore appropriate transit priority strategies that could have positive impacts on travelers by all modes.

8. **Continue to encourage access to non-auto travel modes**. The success of the Capital Bikeshare program and the decrease in automobile registrations in the District of Columbia indicate that there is a shift, at least in the urban areas, to non-automobile transportation.

9. **Pursue increased integration of operations management and travel demand management components of congestion management for more efficient use of the existing transportation network.** State DOTs are encouraged to continue to explore ATM strategies along congested freeways and actively manage arterials along freeways. Transportation agencies (including transit agencies) and stakeholders are encouraged to work collaboratively along a congested corridor to explore the feasibility of an ICM system. Ongoing projects on I-95/I-395 and I-66 support these concepts.

10. **Continue and enhance providing real-time, historical, and multimodal traveler information.** Providing travelers with information before and during their trips can help them to make decisions to avoid congestion and delays and better utilize the existing road and transit infrastructure. Websites such as MATOC's www.trafficview.org, www.CapitalRegionUpdates.gov, state DOTs' 511 systems, and real-time transit information allow travelers to make more informed decisions for their trips. The value of real-time traveler information can be largely enriched by integrating historical travel information which can provide valuable travel time reliability measures.

11. **Continue to look for ways to safely interface with the public through new technology such as mobile devices and social media.** The increased prevalence of mobile internet-capable devices and social media present a rapidly evolving platform for both disseminating and gathering information.

12. **Encourage connectivity within and between Regional Activity Centers.** The recent refinement of the Regional Activity Centers map, adopted in 2013, helps coordinate transportation and land use planning for future growth. Geographically-focused Household Travel Surveys can collect data which allows planners to see local level travel patterns and behaviors impacting mode shifts.

13. **Continue and enhance the regional congestion monitoring program with multiple data sources.** There are a wealth of sources, both public and private sector, for data related to congestion which have their individual strengths and shortcomings. Private sector probe-based monitoring provides unprecedented spatial and temporal coverage on roadways, but still needs to be supplemented with data from other sources including data on traffic volumes and traffic engineering considerations. There should be continual review of the quality and availability of data provided by different sources and the structuring of a monitoring program in way that is adaptable for potential future changes in data reporting and/or data sources.

14. **Continue to monitor recent trends in congestion**. Recent data show flat or decreasing congestion, in contrast to many years historically of increasing congestion. This trend should be closely monitored to determine whether this is a short-term trend or a long-term change in travel behavior and how this should affect long-range planning.

15. **Monitor trends in freight, specifically truck travel, as the opening of the Panama Canal expansion nears.** This expansion will allow much larger ships from Asia to serve East Coast ports, including the nearby ones in Baltimore and the Hampton Roads area in Virginia. Much of the new cargo arriving at these ports will pass through the Washington region by truck or rail on its way to inland destinations.

APPENDICES

APPENDIX A – 2013 PEAK HOUR TRAVEL TIME INDEX ON NATIONAL HIGHWAY SYSTEM

Note:

1. Calculation and visualization were provided by the “Trend Map” tool of the Vehicle Probe Project Suite developed by the CATT Lab of the University of Maryland, https://vpp.ritis.org/.

2. Peak Hour: 8:00-9:00 am is the regional morning peak hour, and 5:00-6:00 pm is the regional afternoon peak hour, Monday through Friday.

3. Congestion levels are categorized by the value of Travel Time Index:
   TTI = 1.0: Free flow
   1.0<TTI<=1.3: Minimal
   1.3<TTI<=1.5: Minor
   1.5<TTI<=2.0: Moderate
   2.0<TTI<=2.5: Heavy
   2.5<TTI: Severe

Figure A1: Travel Time Index on the Interstate System during Weekday 8:00-9:00 am, 2013

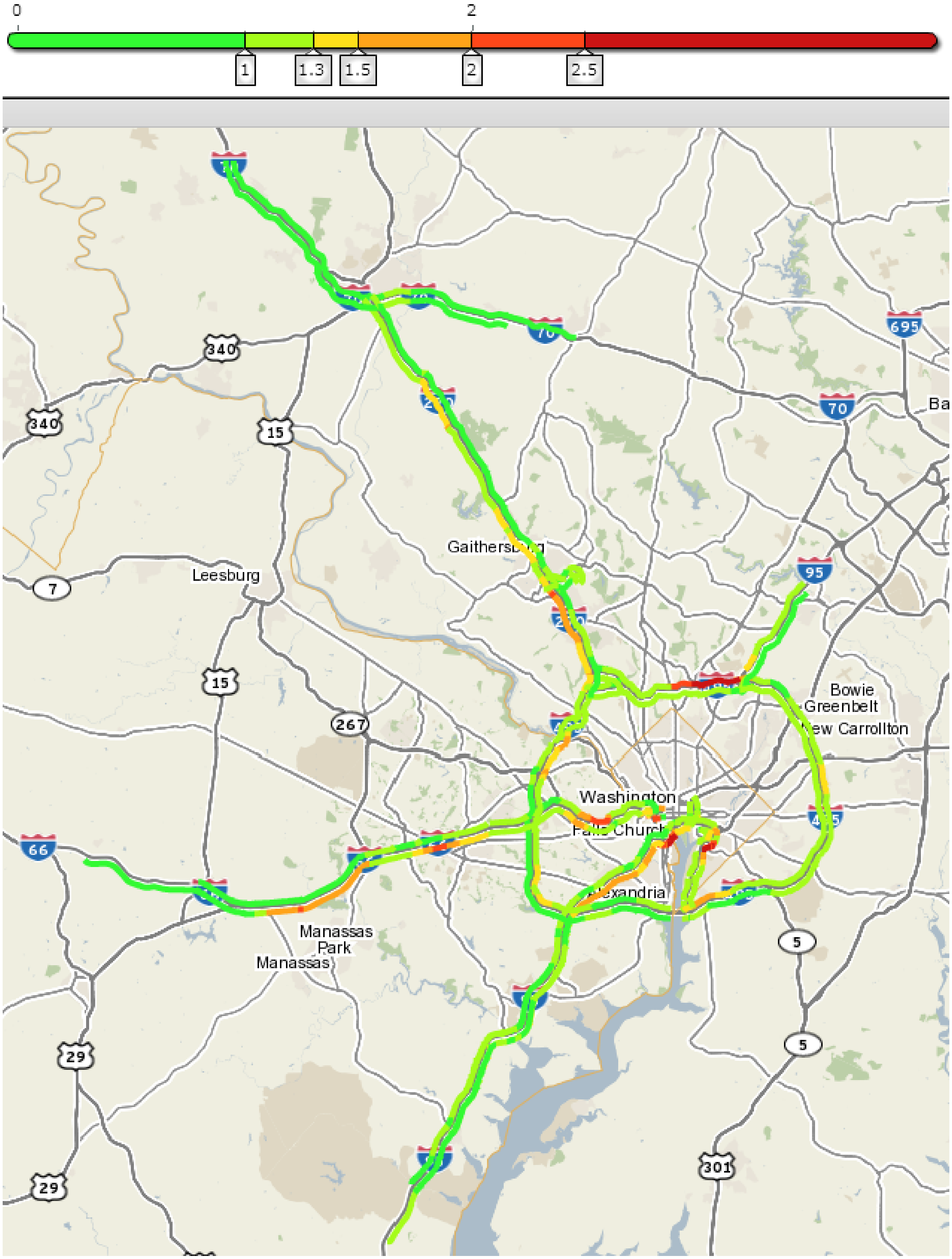


Figure A2: Travel Time Index on the Interstate System during Weekday 5:00-6:00 pm, 2013

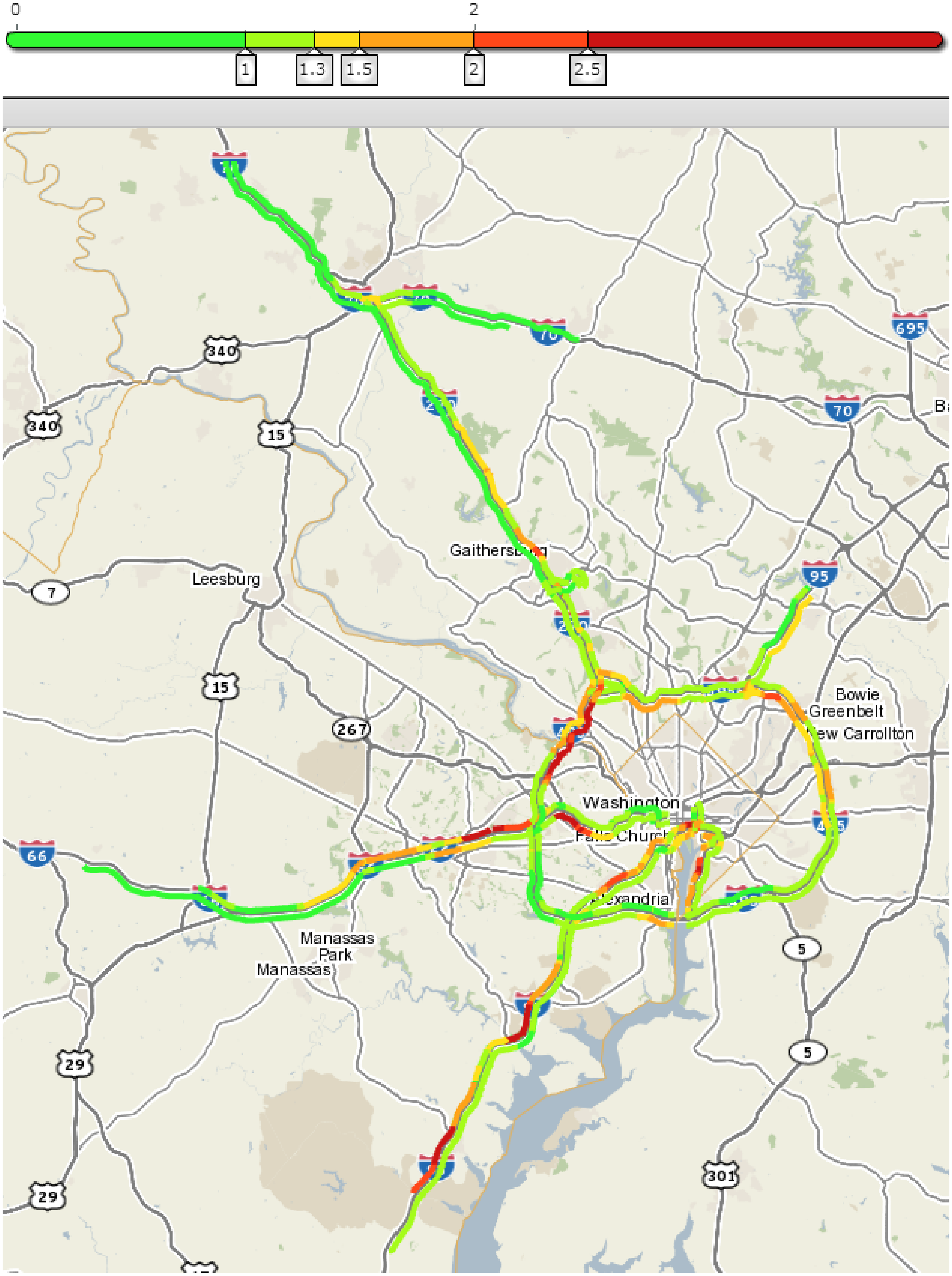


Figure A3: Travel Time Index on the Non-Interstate NHS in DC during Weekday 8:00-9:00 am, 2013

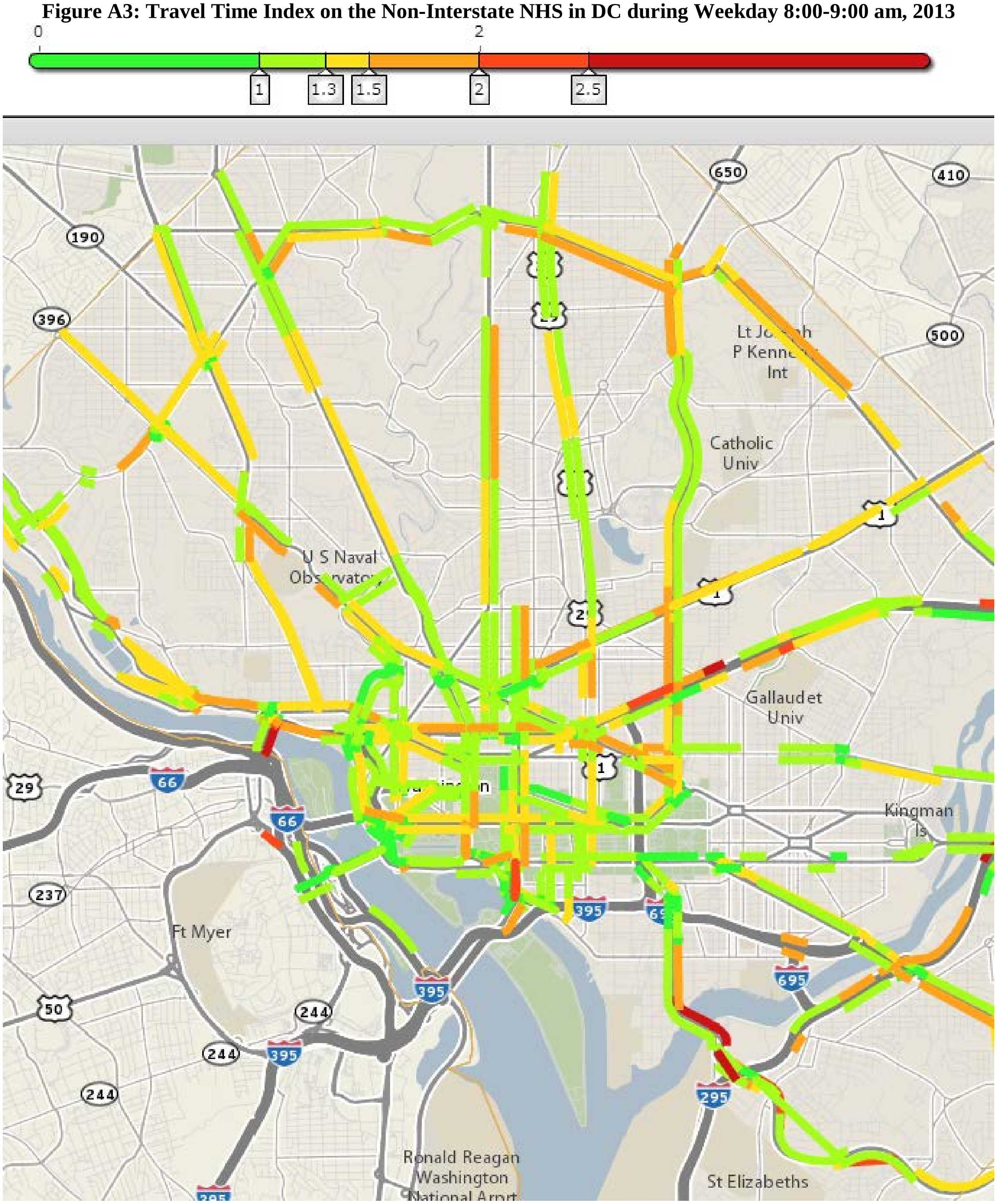


Figure A4: Travel Time Index on the Non-Interstate NHS in DC during Weekday 5:00-6:00 pm, 2013

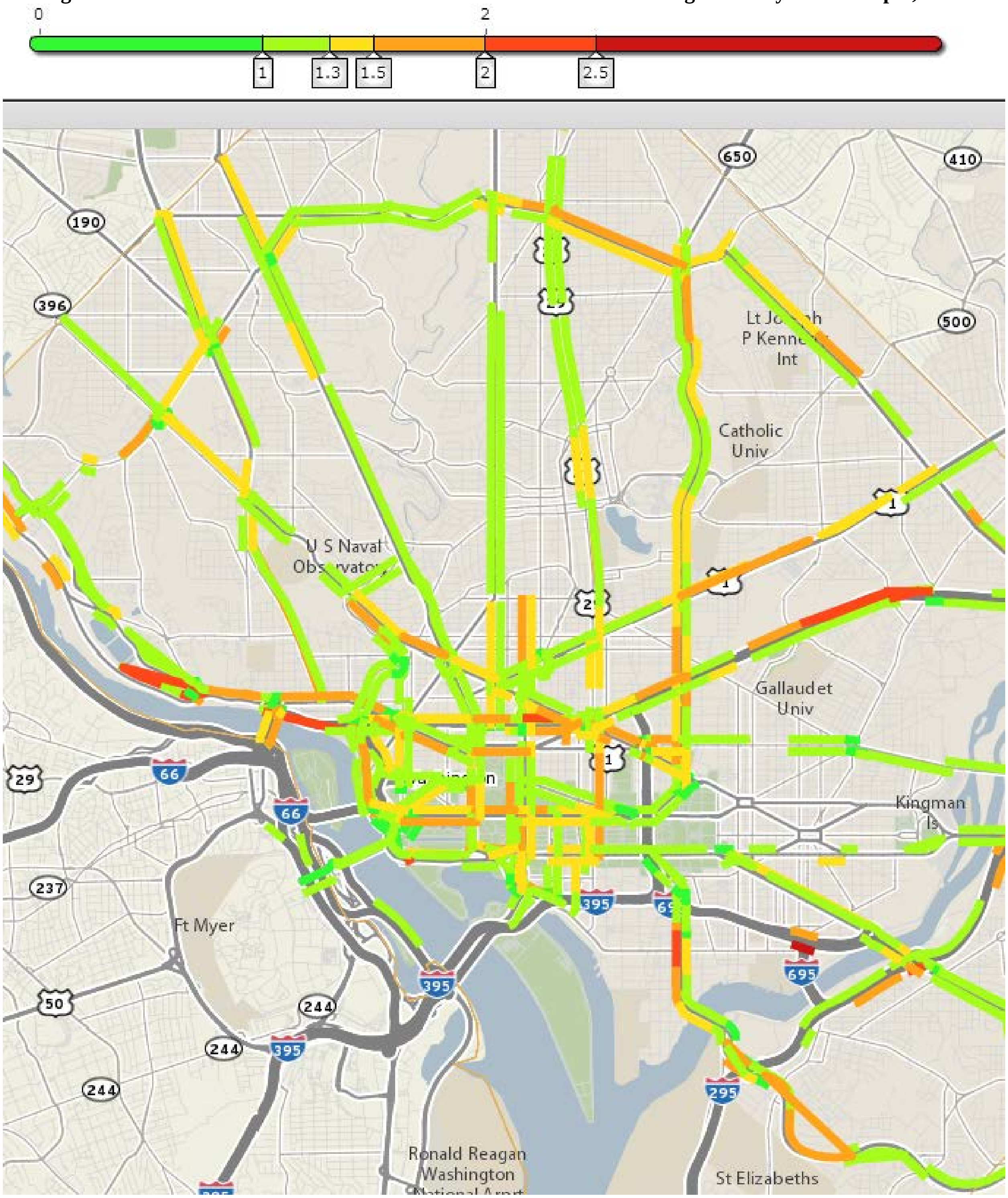


Figure A5: Travel Time Index on the Non-Interstate NHS in Frederick County, MD during Weekday 8:00-9:00 am, 2013

Figure A6: Travel Time Index on the Non-Interstate NHS in Frederick County, MD during Weekday 5:00-6:00 pm, 2013

Figure A7: Travel Time Index on the Non-Interstate NHS in Montgomery County, MD during Weekday 8:00-9:00 am, 2013

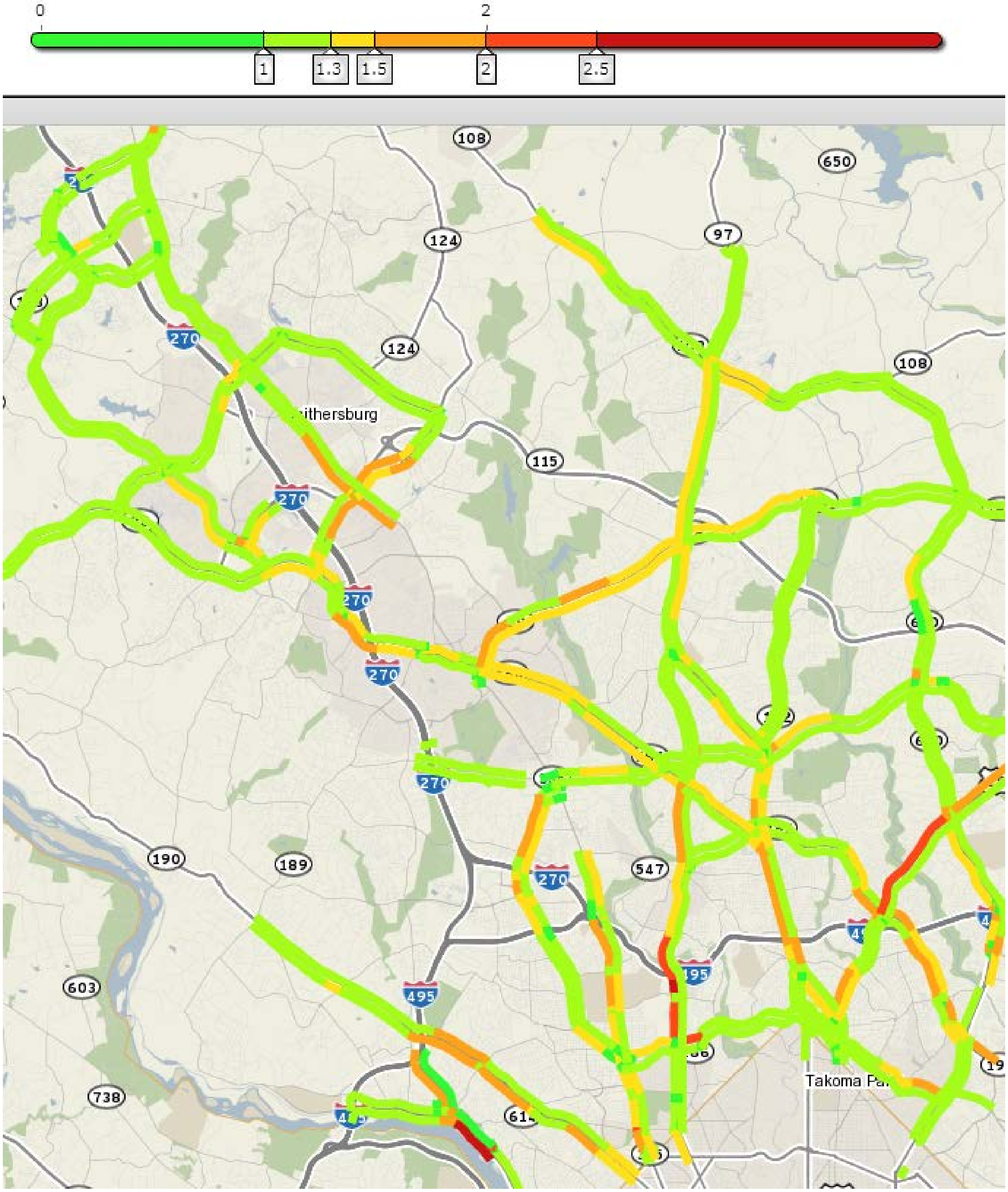


Figure A8: Travel Time Index on the Non-Interstate NHS in Montgomery County, MD during Weekday 5:00-6:00 pm, 2013

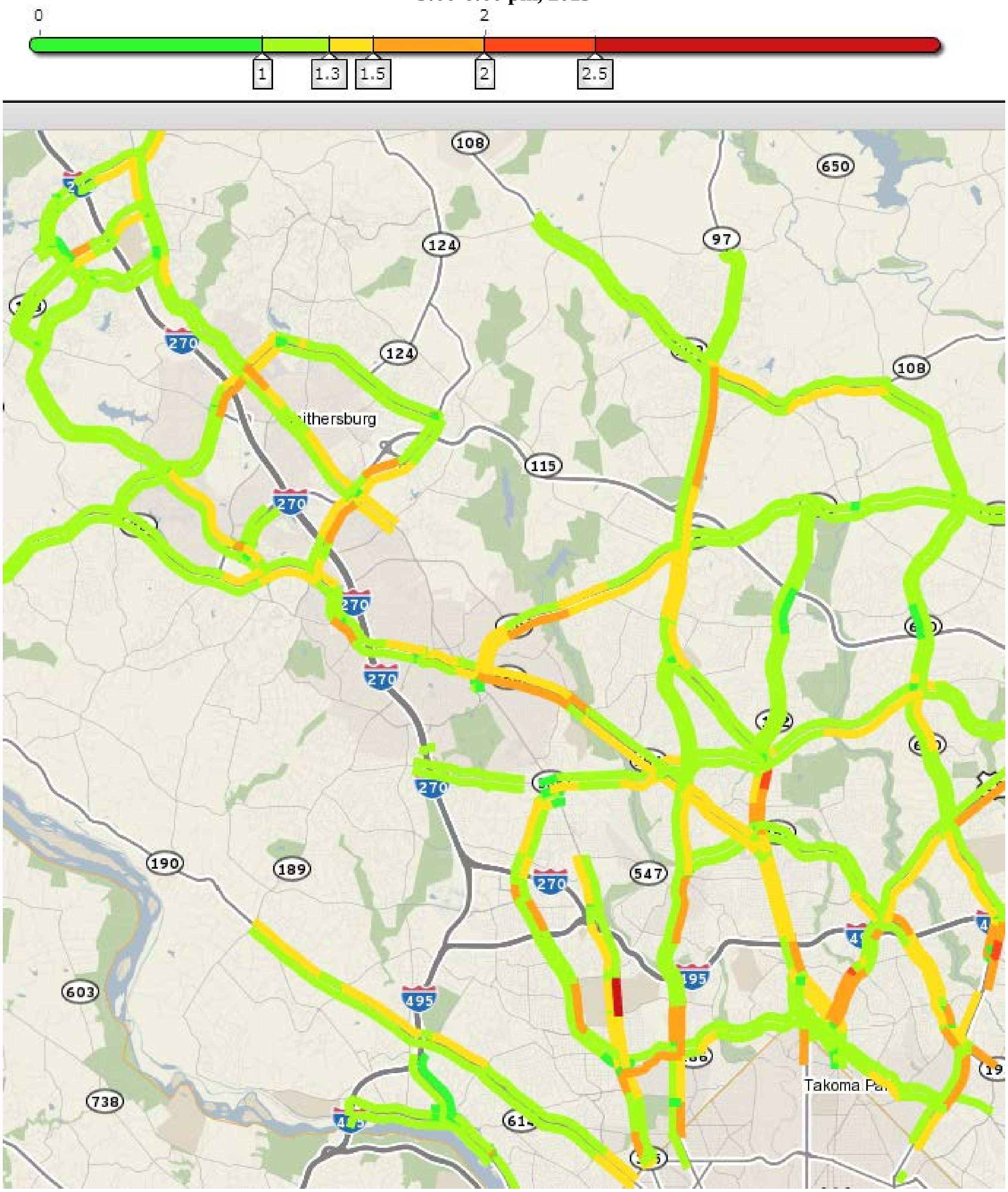


Figure A9: Travel Time Index on the Non-Interstate NHS in Prince George's County and Charles County, MD during Weekday 8:00-9:00 am, 2013

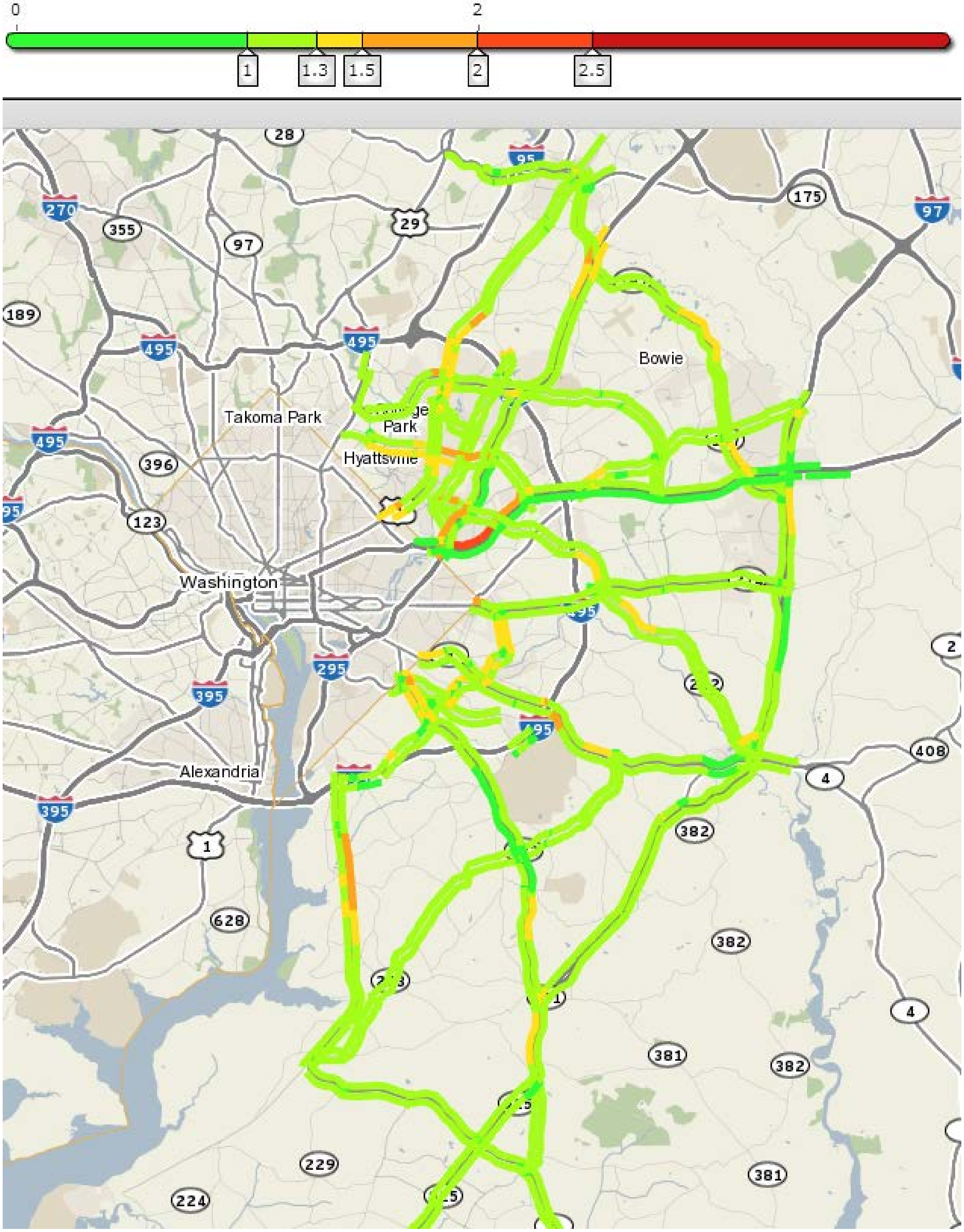


Figure A10: Travel Time Index on the Non-Interstate NHS in Prince George's County and Charles County, MD during Weekday 5:00-6:00 pm, 2013

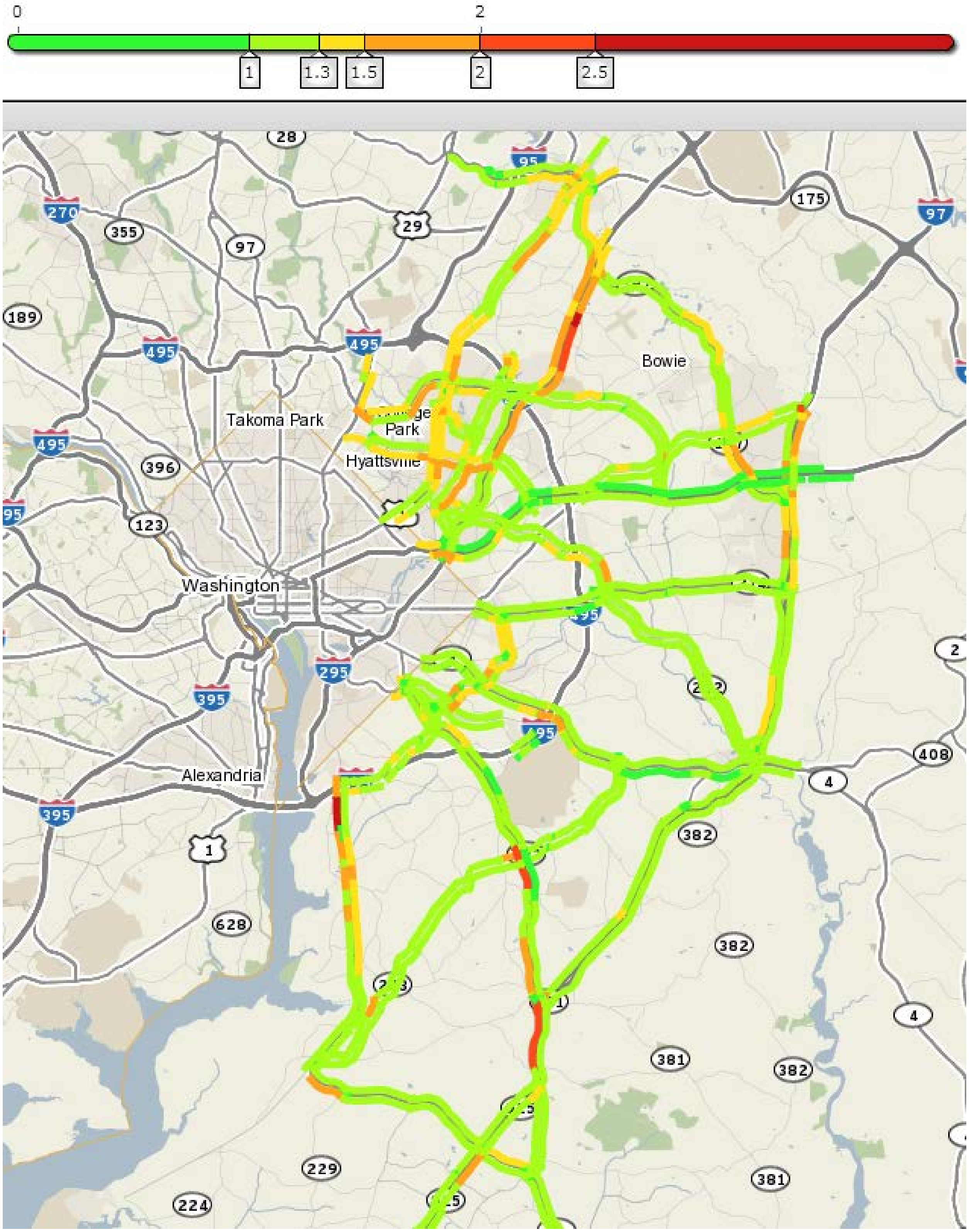


Figure A11: Travel Time Index on the Non-Interstate NHS in Loudoun County, VA during Weekday 8:00-9:00 am, 2013

Figure A12: Travel Time Index on the Non-Interstate NHS in Loudoun County, VA during Weekday 5:00-6:00 pm, 2013

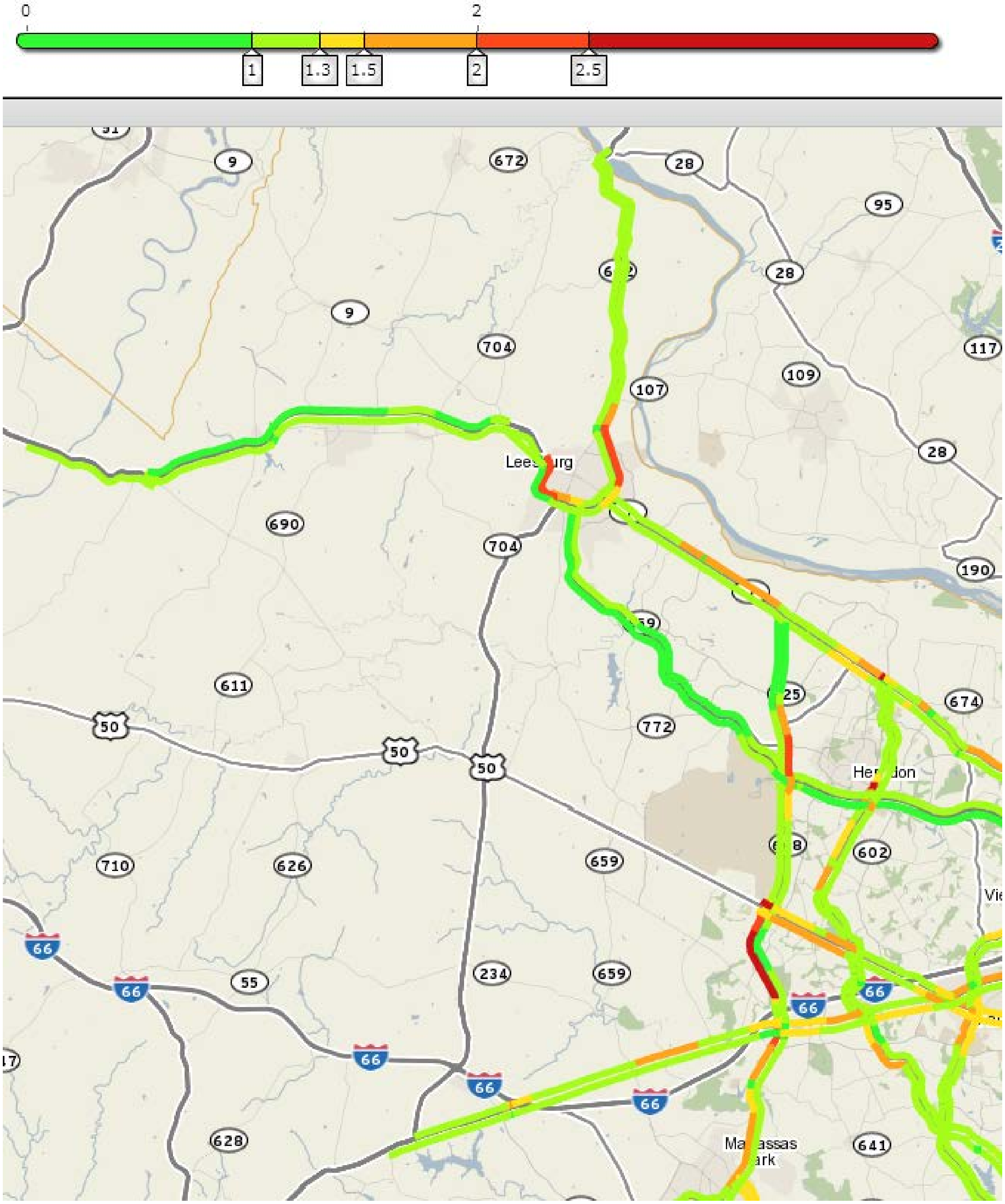


Figure A13: Travel Time Index on the Non-Interstate NHS in Virginia during Weekday 8:00-9:00 am, 2013

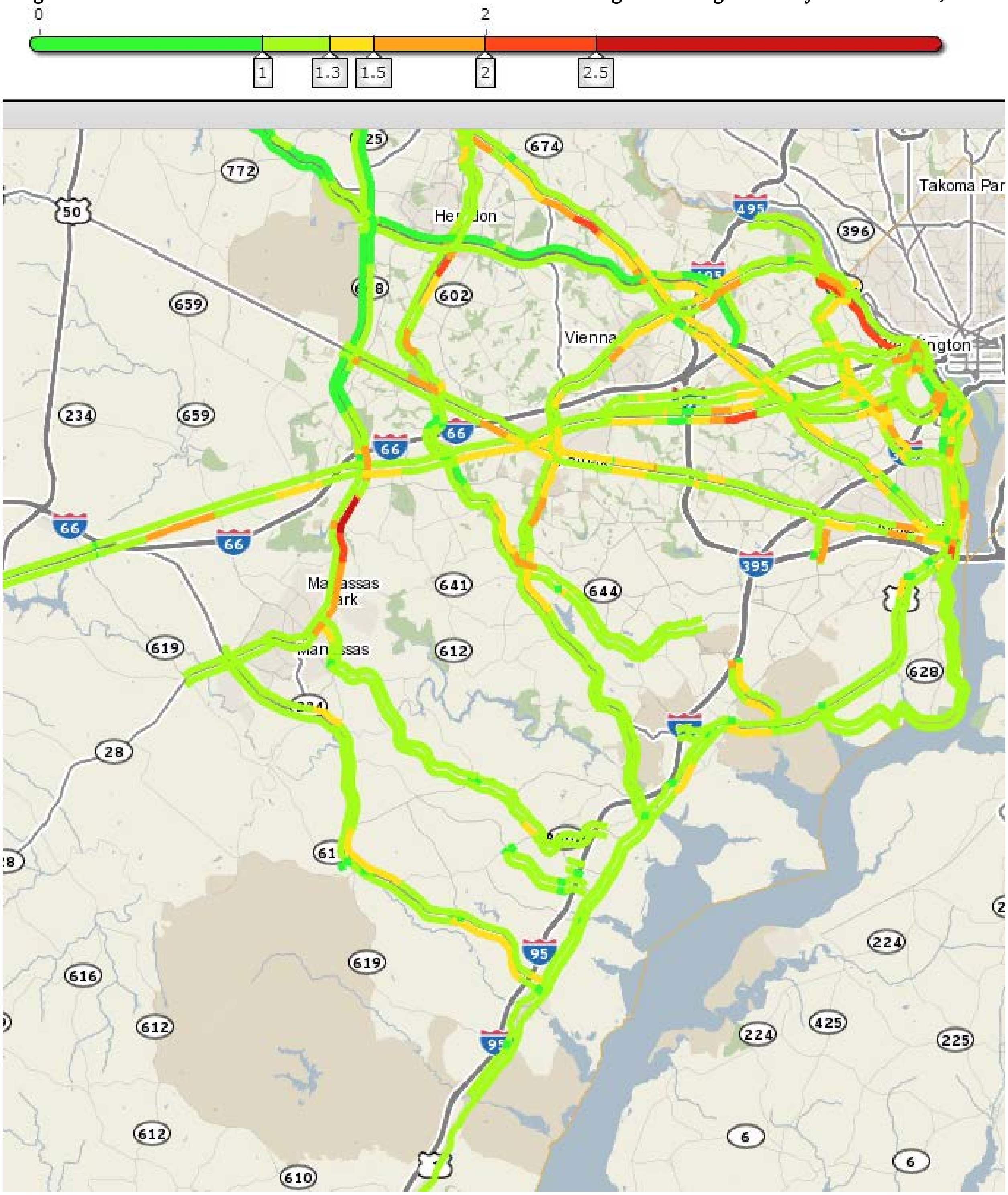
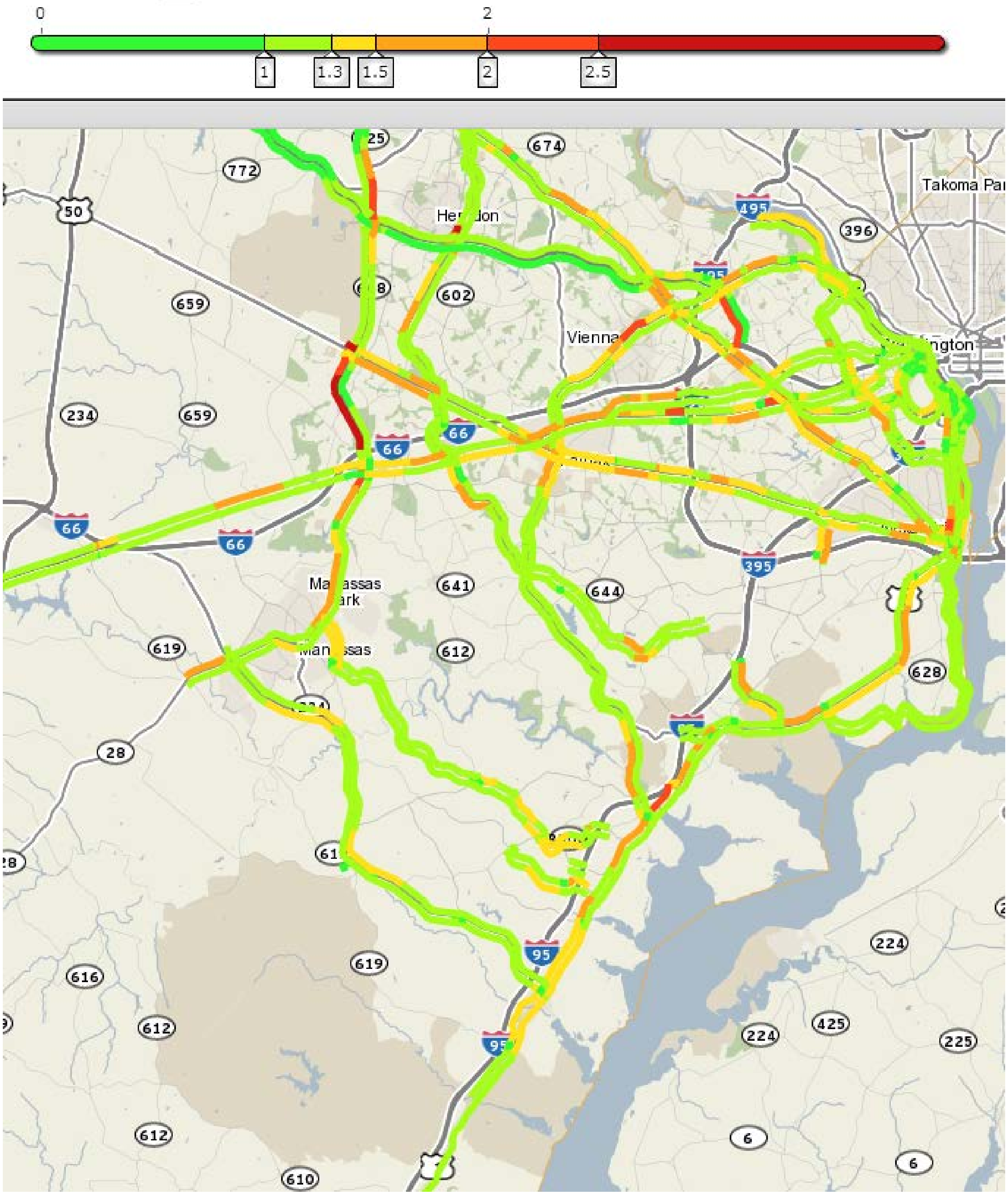


Figure A14: Travel Time Index on the Non-Interstate NHS in Virginia during Weekday 5:00-6:00 pm, 2013



APPENDIX B – 2013 PEAK HOUR PLANNING TIME INDEX ON NATIONAL HIGHWAY SYSTEM

Note:

1. Calculation and visualization were provided by the "Trend Map" tool of the Vehicle Probe Project Suite developed by the CATT Lab of the University of Maryland, https://vpp.ritis.org/.

2. Peak Hour: 8:00-9:00 am is the regional morning peak hour, and 5:00-6:00 pm is the regional afternoon peak hour, Monday through Friday.

Figure B1: Planning Time Index on the Interstate System during Weekday 8:00-9:00 am, 2013

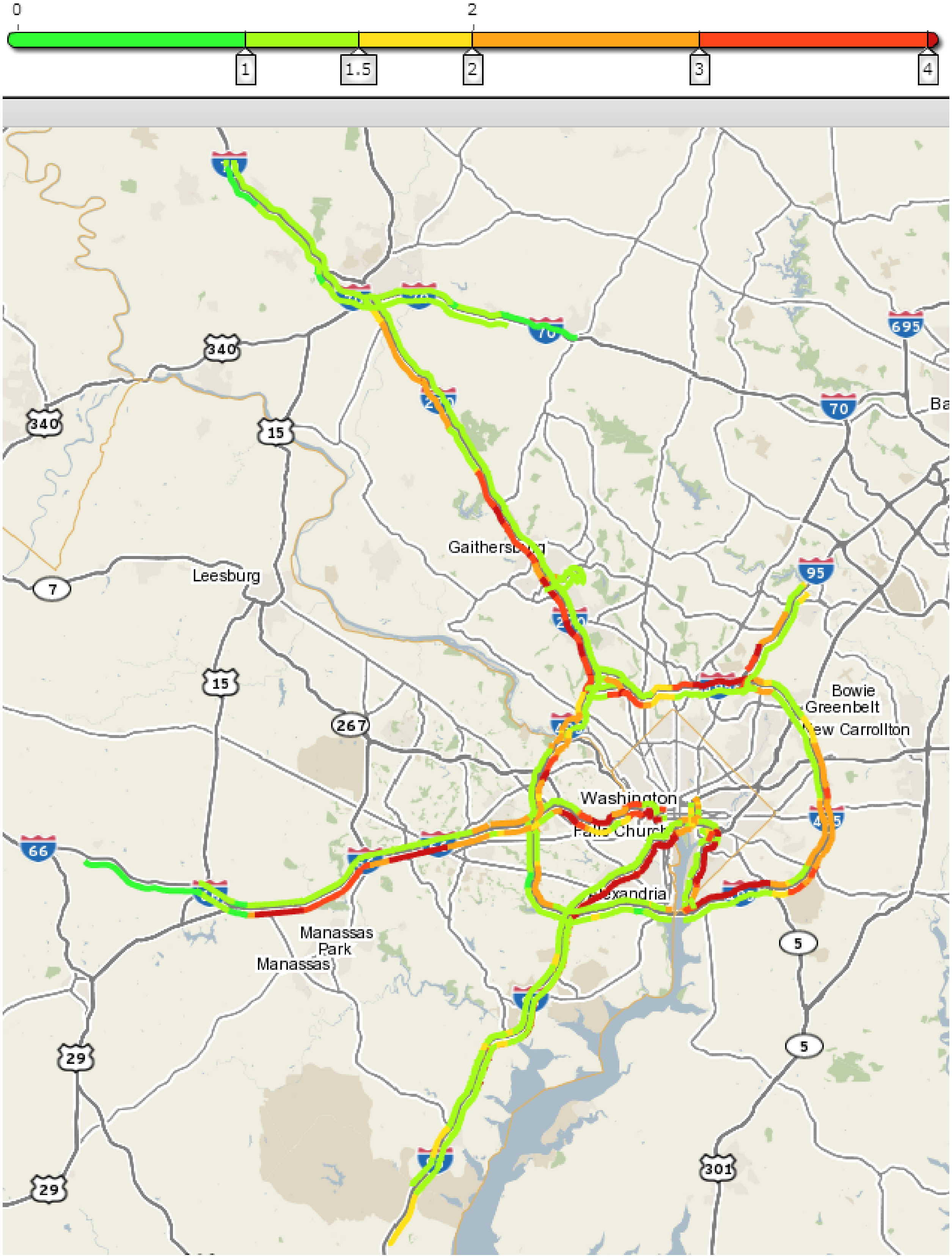


Figure B2: Planning Time Index on the Interstate System during Weekday 5:00-6:00 pm, 2013

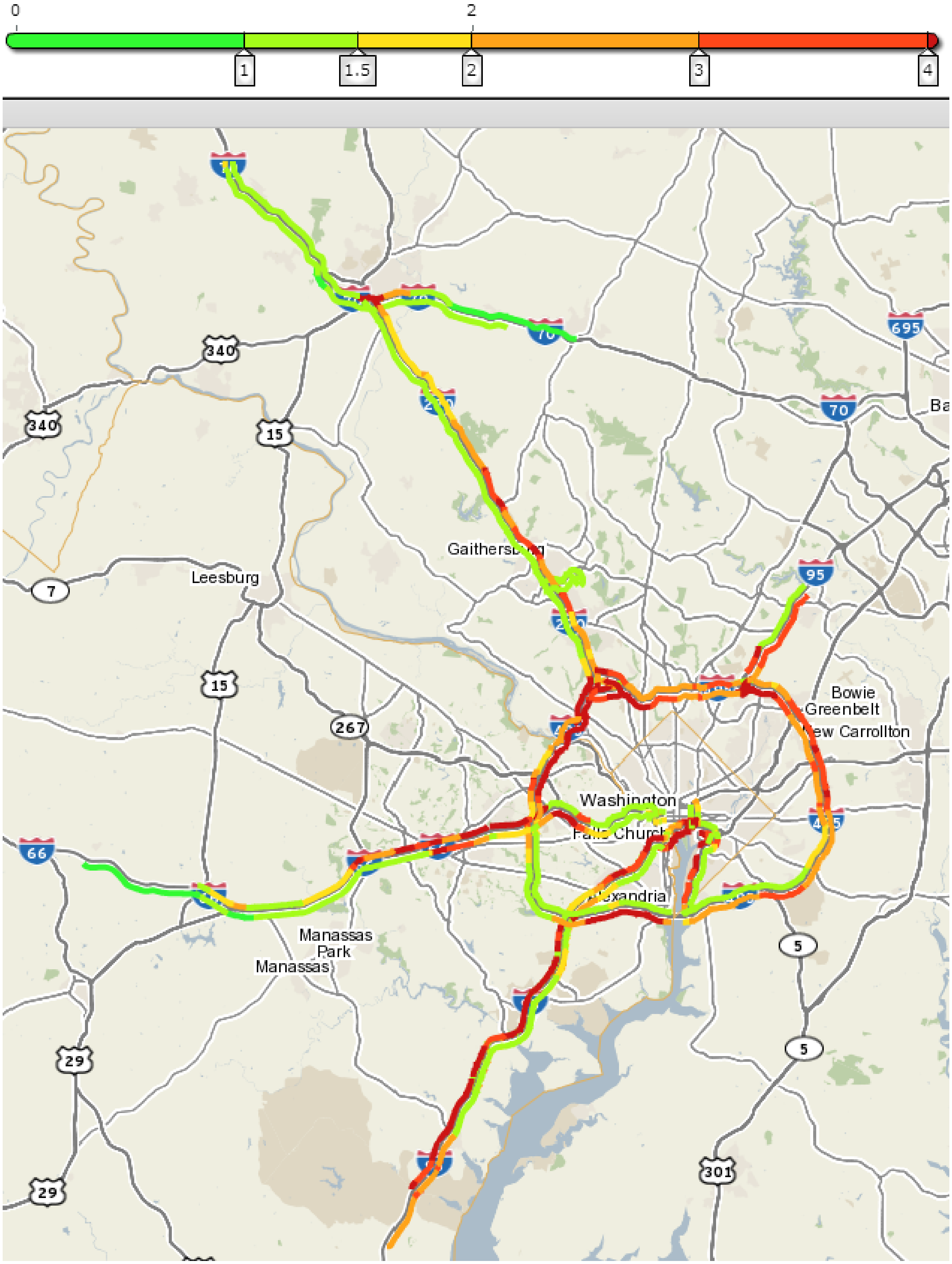


Figure B3: Planning Time Index on the non-Interstate NHS in DC during Weekday 8:00-9:00 am, 2013

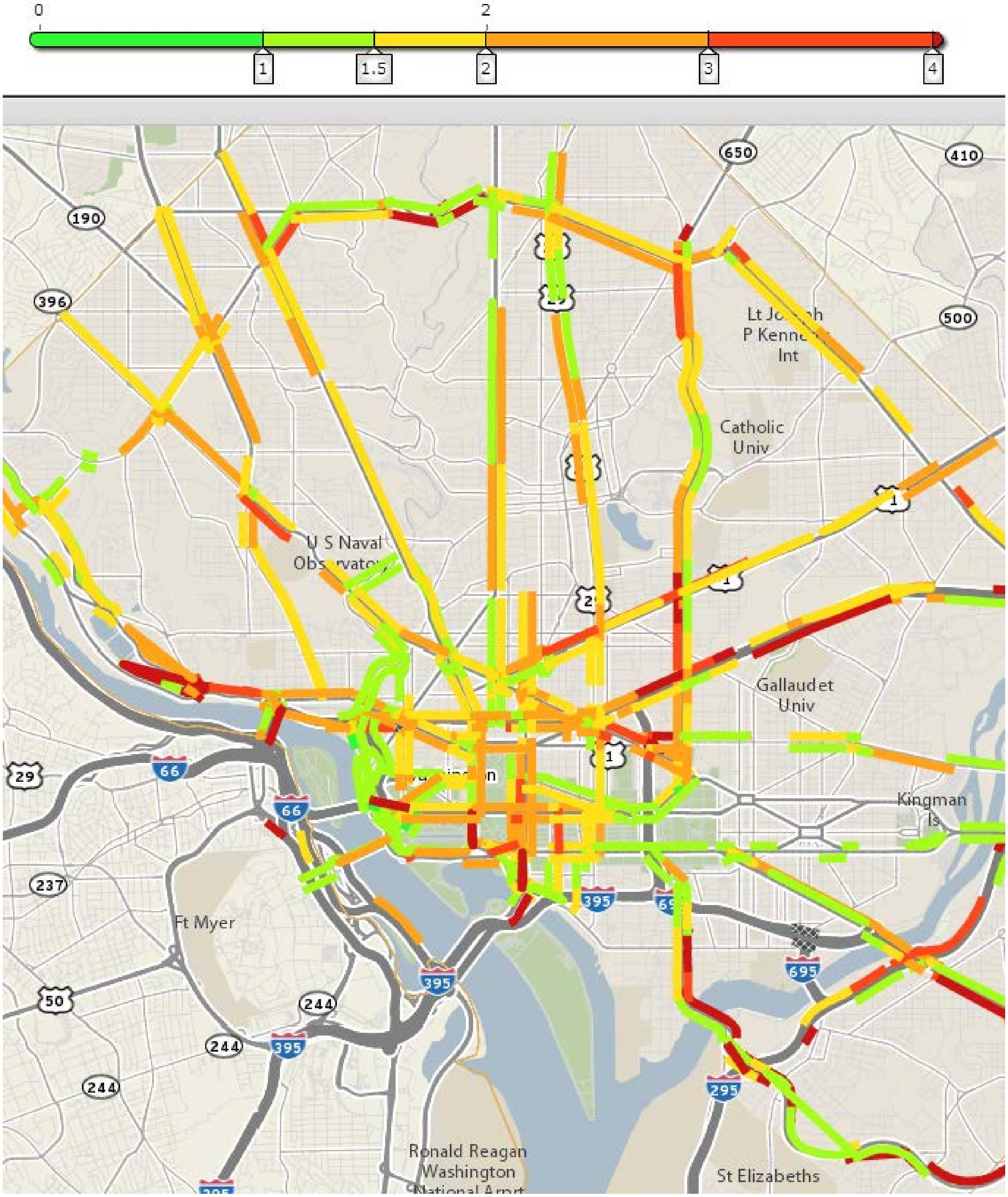


Figure B4: Planning Time Index on the non-Interstate NHS in DC during Weekday 5:00-6:00 pm, 2013

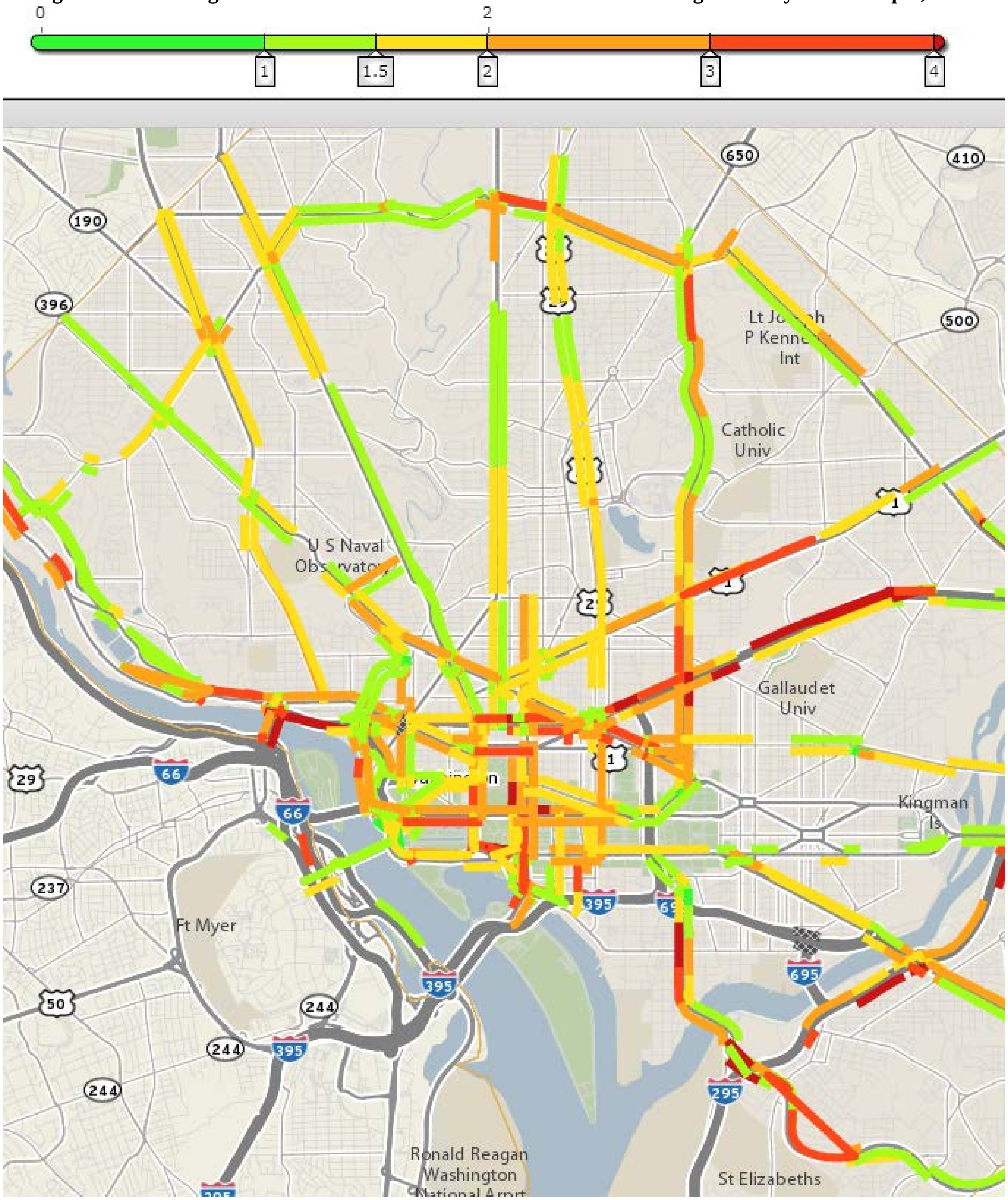


Figure B5: Planning Time Index on the non-Interstate NHS in Frederick County, MD during Weekday 8:00-9:00 am, 2013

Figure B6: Planning Time Index on the non-Interstate NHS in Frederick County, MD during Weekday 5:00-6:00 pm, 2013

Figure B7: Planning Time Index on the non-Interstate NHS in Montgomery County, MD during Weekday 8:00-9:00 am, 2013

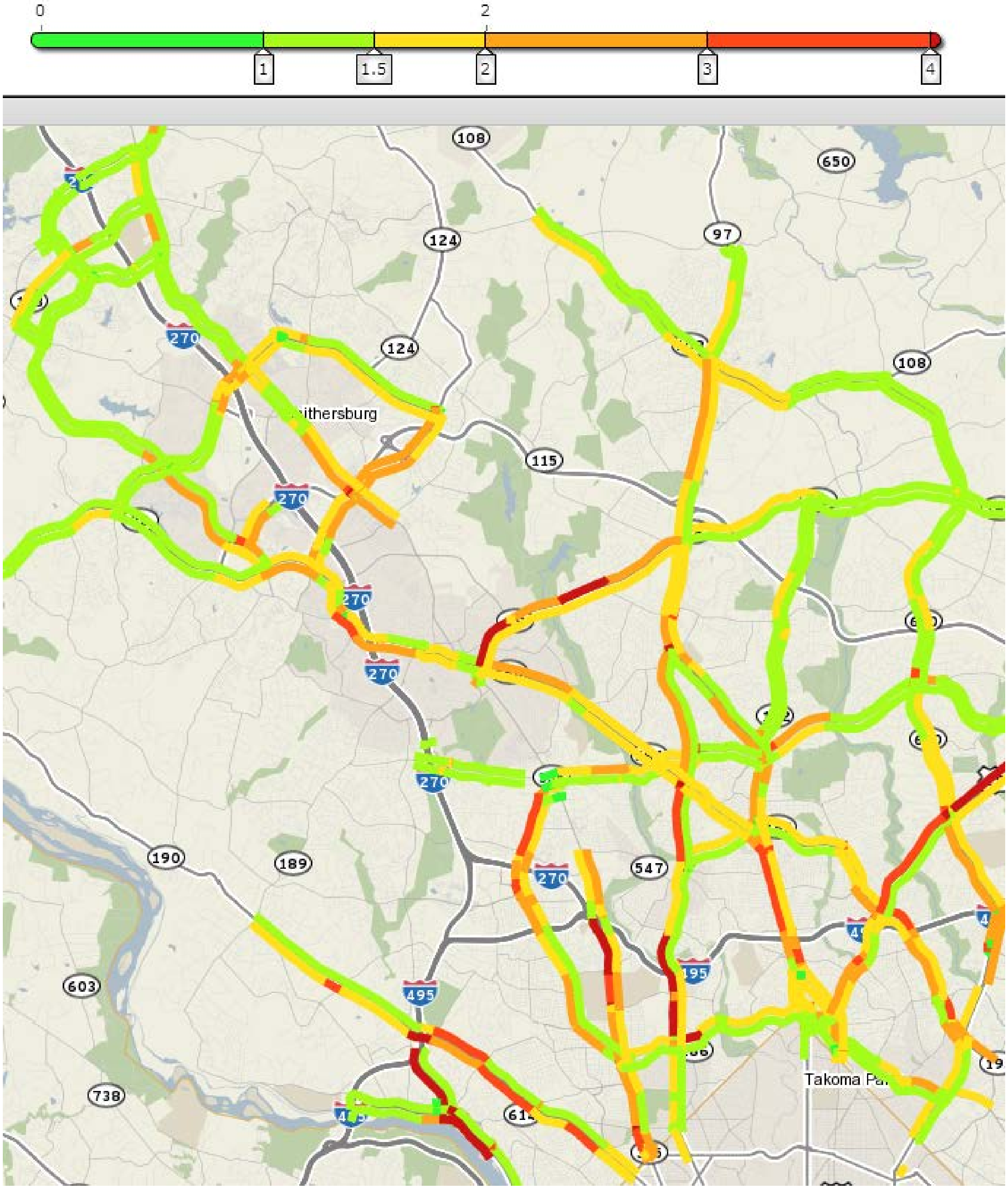


Figure B8: Planning Time Index on the non-Interstate NHS in Montgomery County, MD during Weekday 5:00-6:00 pm, 2013

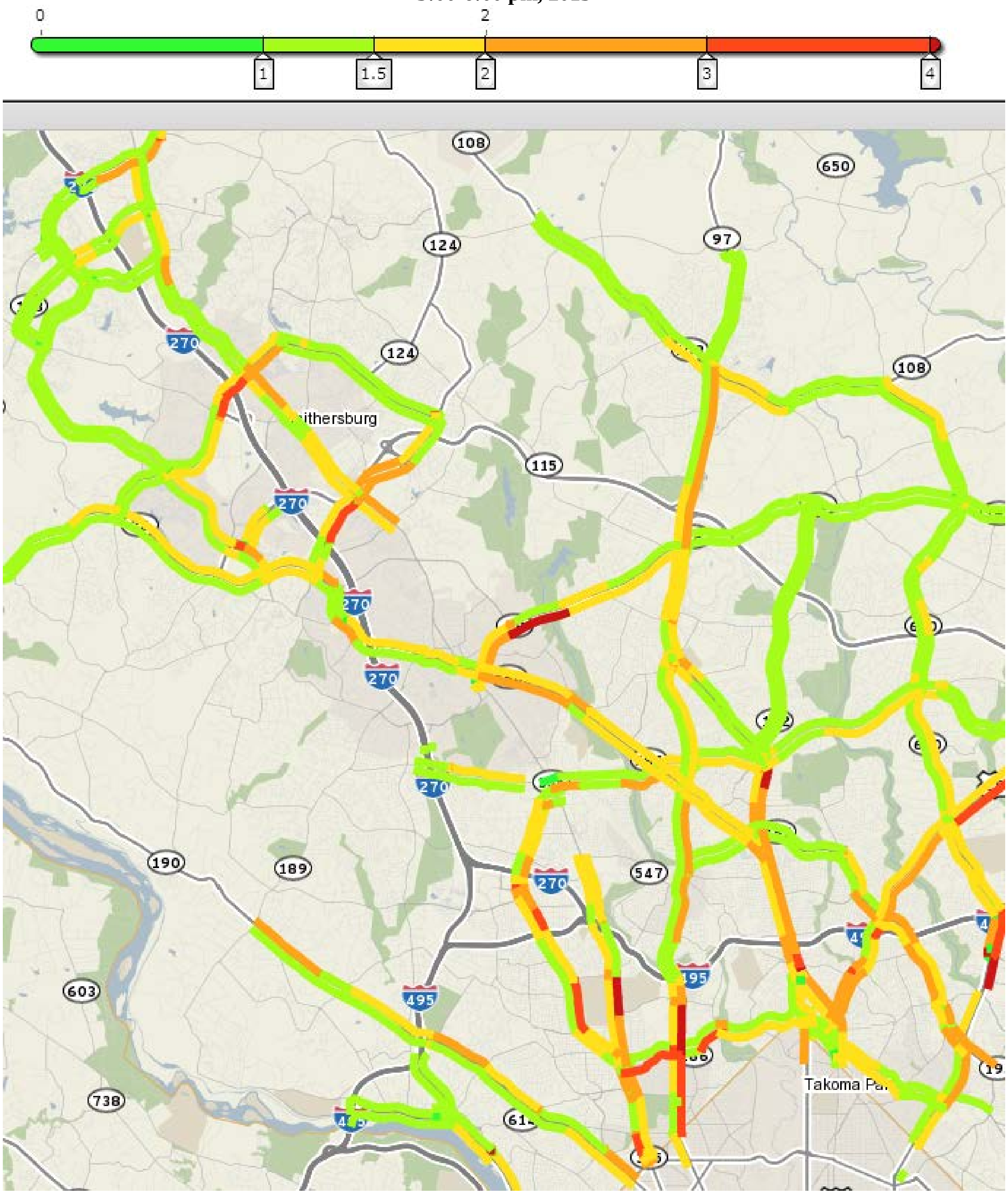


Figure B9: Planning Time Index on the non-Interstate NHS in Prince George's County and Charles County, MD during Weekday 8:00-9:00 am, 2013

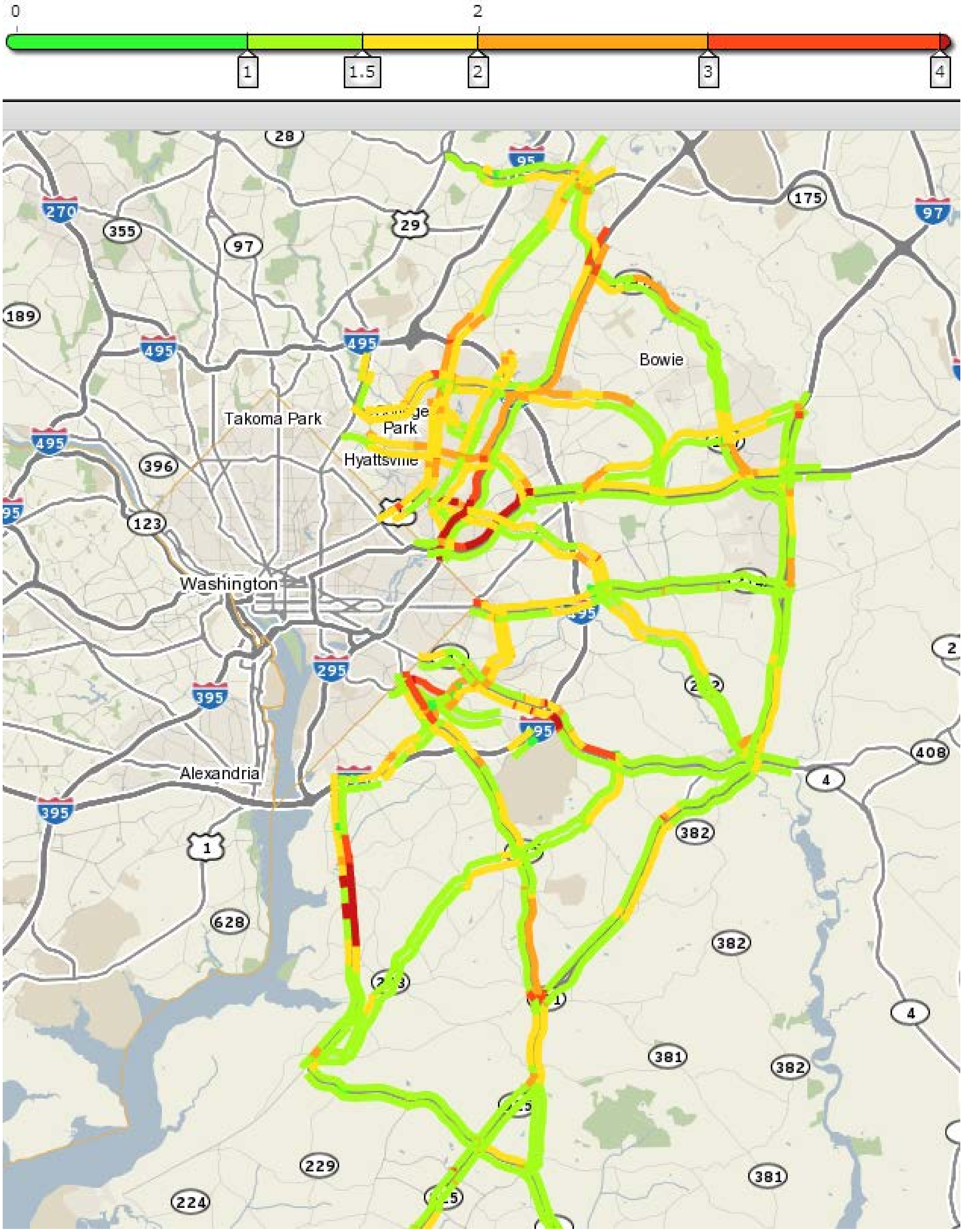


Figure B10: Planning Time Index on the non-Interstate NHS in Prince George's County and Charles County, MD during Weekday 5:00-6:00 pm, 2013

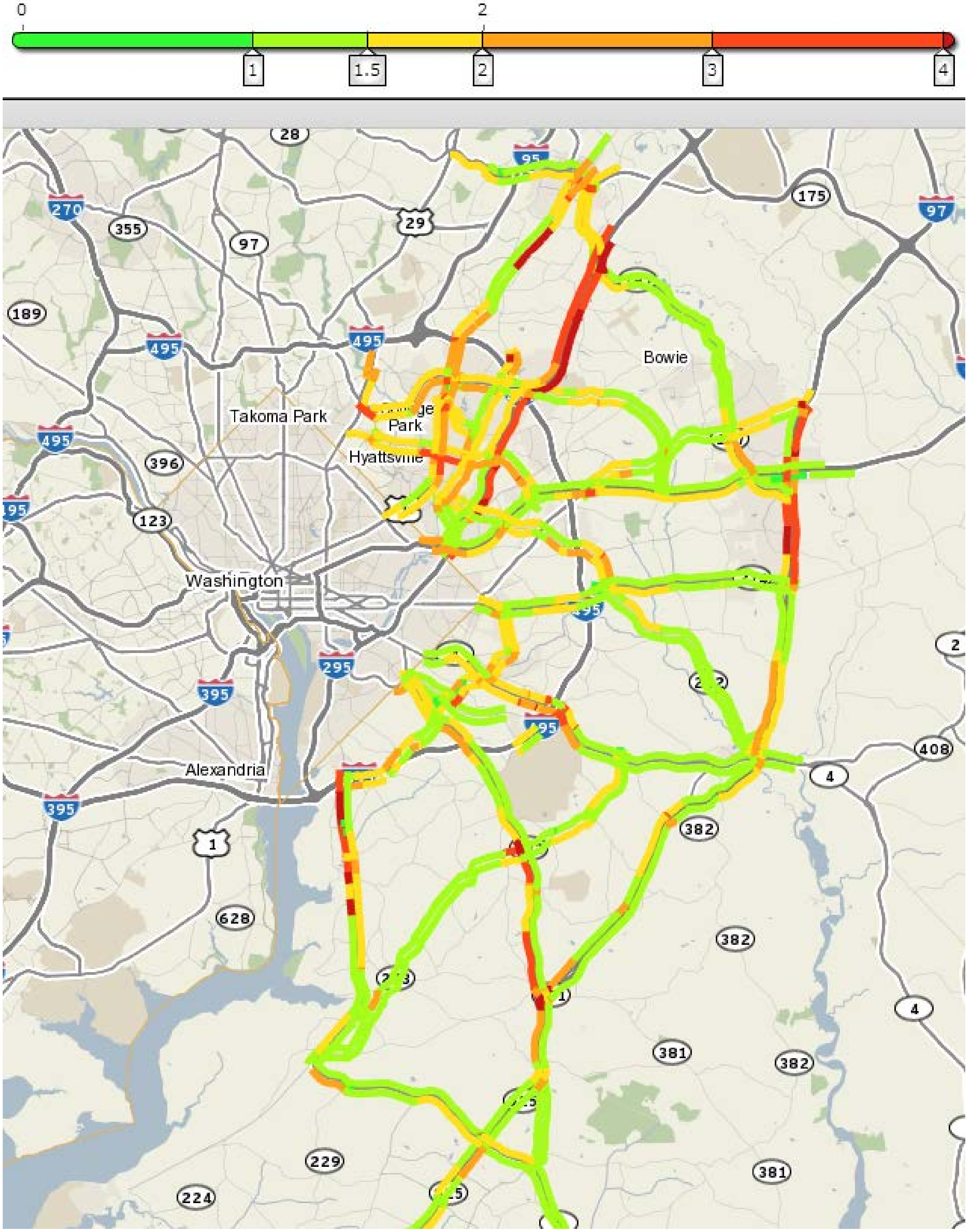


Figure B11: Planning Time Index on the non-Interstate NHS in Loudoun County, VA during Weekday 8:00-9:00 am, 2013

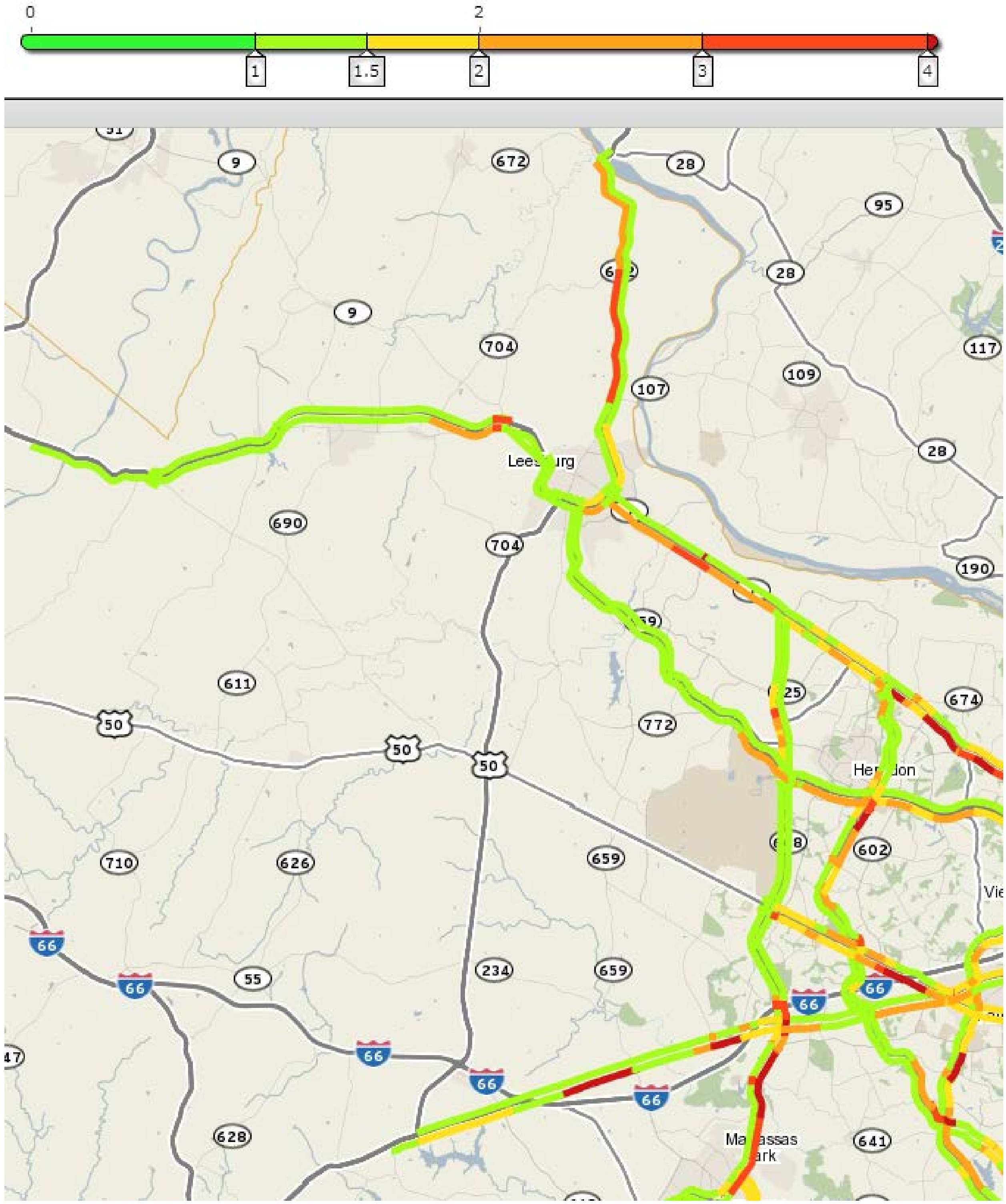


Figure B12: Planning Time Index on the non-Interstate NHS in Loudoun County, VA during Weekday 5:00-6:00 pm, 2013

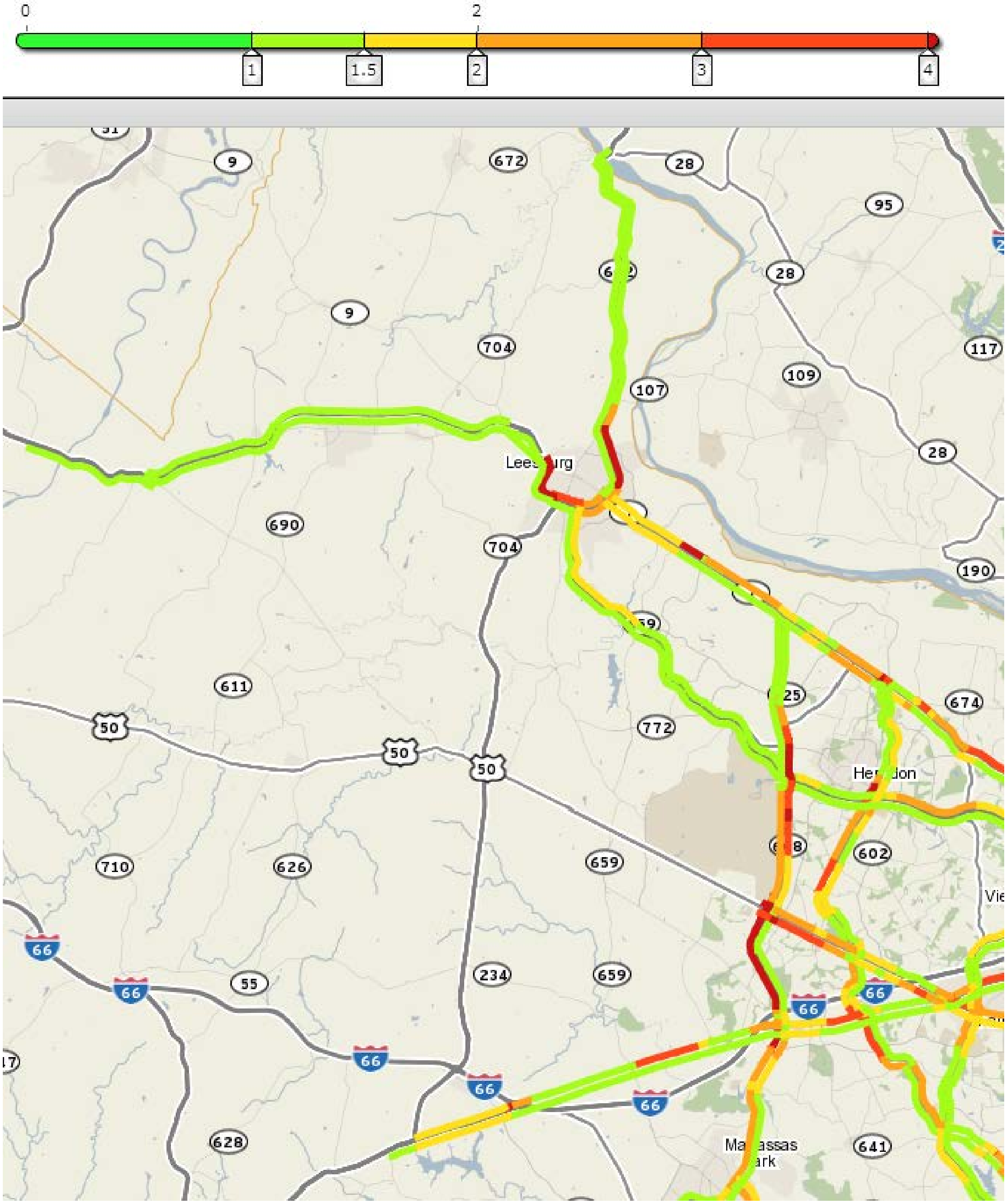


Figure B13: Planning Time Index on the non-Interstate NHS in Virginia during Weekday 8:00-9:00 am, 2013

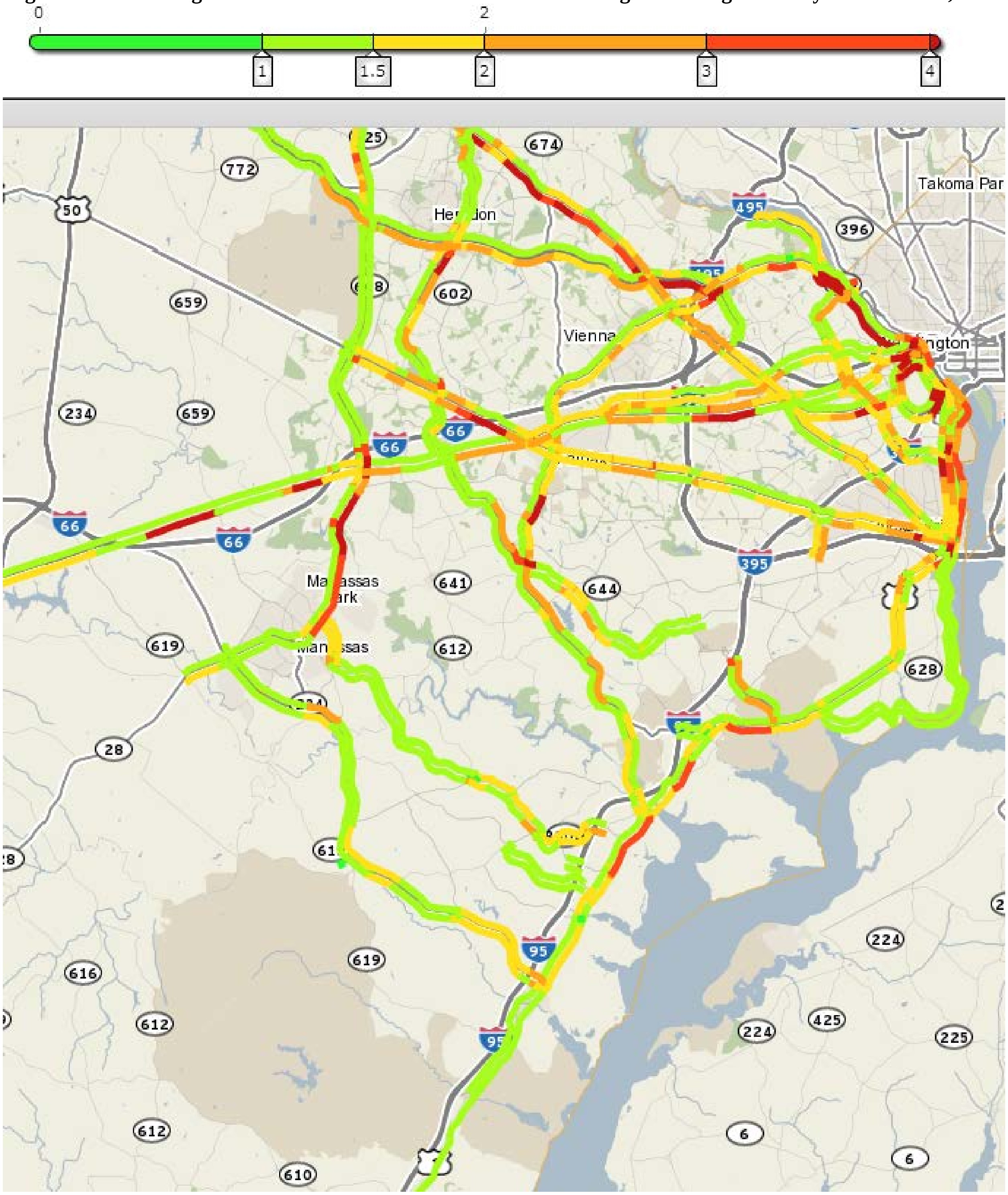
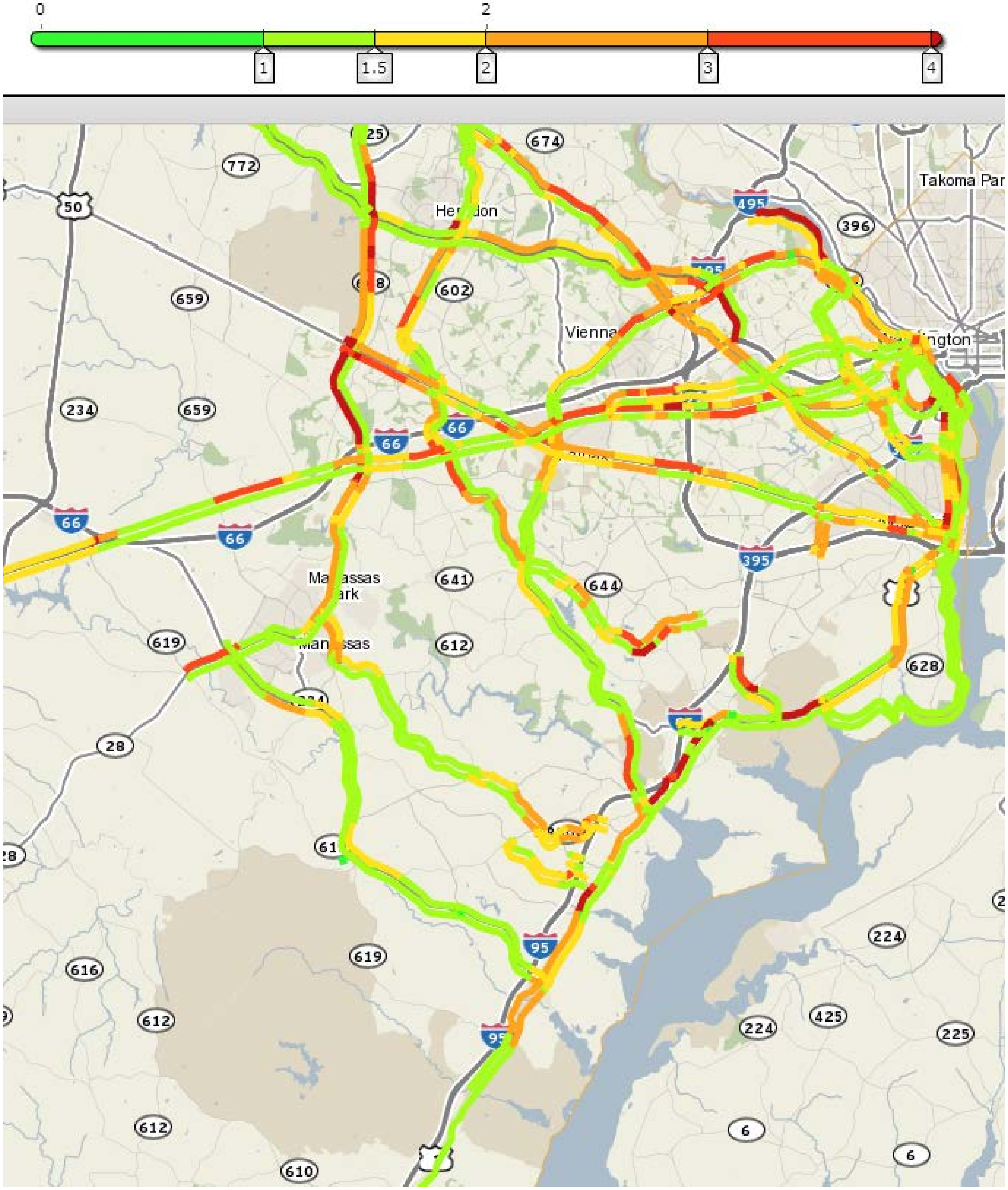


Figure B14: Planning Time Index on the non-Interstate NHS in Virginia during Weekday 5:00-6:00 pm, 2013



APPENDIX C – 2010-2013 TRAVEL TIMES ALONG MAJOR FREEWAY COMMUTE CORRIDORS

Note:

1. Calculation and visualization were provided by the “Performance Charts” tool of the Vehicle Probe Project Suite developed by the CATT Lab of the University of Maryland, https://vpp.ritis.org/.

2. There are 18 major commuter corridors defined in this report:

   C1 I-270 between I-370/Sam Eig Hwy/Exit 9 and I-70/US-40
   C2 I-270 between I-370/Sam Eig Hwy/Exit 9 and I-495/MD-355
   C3 VA-267 between VA-28/Exit 9a and VA-123/Exit 19
   C4 I-66 between VA-28/Exit 53 and I-495/Exit 64
   C5 I-66 between I-495/Exit 64 and Theodore Roosevelt Memorial Bridge
   C6 I-95 between VA-234/Exit 152 and Franconia Rd/Exit 169
   C7 I-95 HOV between VA-234/Exit 152 and Franconia Rd/Exit 169
   C8 I-395 between I-95 and H St
   C9 I-395 HOV between I-95 and US-1
   C10 US-50 between MD-295/Kenilworth Ave and US-301/Exit 13
   C11 MD-295 between US-50/MD-201/Kenilworth Ave and MD-198
   C12 I-95 between I-495/Exit 27-25 and MD-198/Exit 33
   C13 I-495 between I-270/Exit 35 and I-95/Exit 27
   C14 I-495 between I-95/Exit 27 and US-50/Exit 19
   C15 I-495 between US-50/Exit 19 and I-95/I-395/Exit 57
   C16 I-495 between I-95/I-395/Exit 57 and I-66/Exit 9
   C17 I-495 between I-66/Exit 9 and I-270/Exit 35
   C18 I-295 between I-495 and 11th St. Bridge

3. Travel times were drawn for only normal weekdays – Tuesdays, Wednesdays and Thursdays.

Figure C1

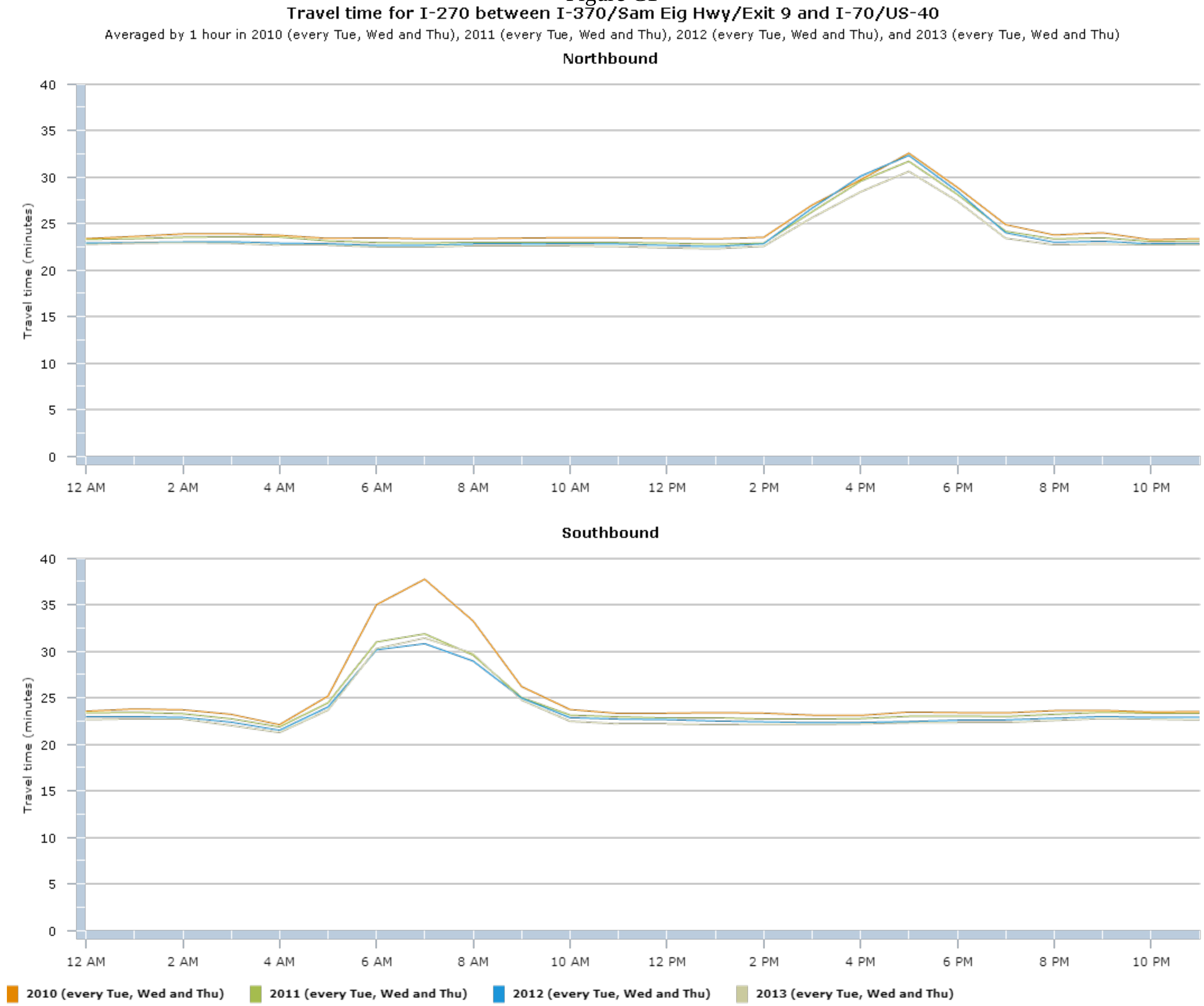

Travel time for I-270 between I-370/Sam Eig Hwy/Exit 9 and I-70/US-40
Averaged by 1 hour in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Northbound
Travel time (minutes)
0
5
10
15
20
25
30
35
40
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
Southbound
Travel time (minutes)
0
5
10
15
20
25
30
35
40
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C2

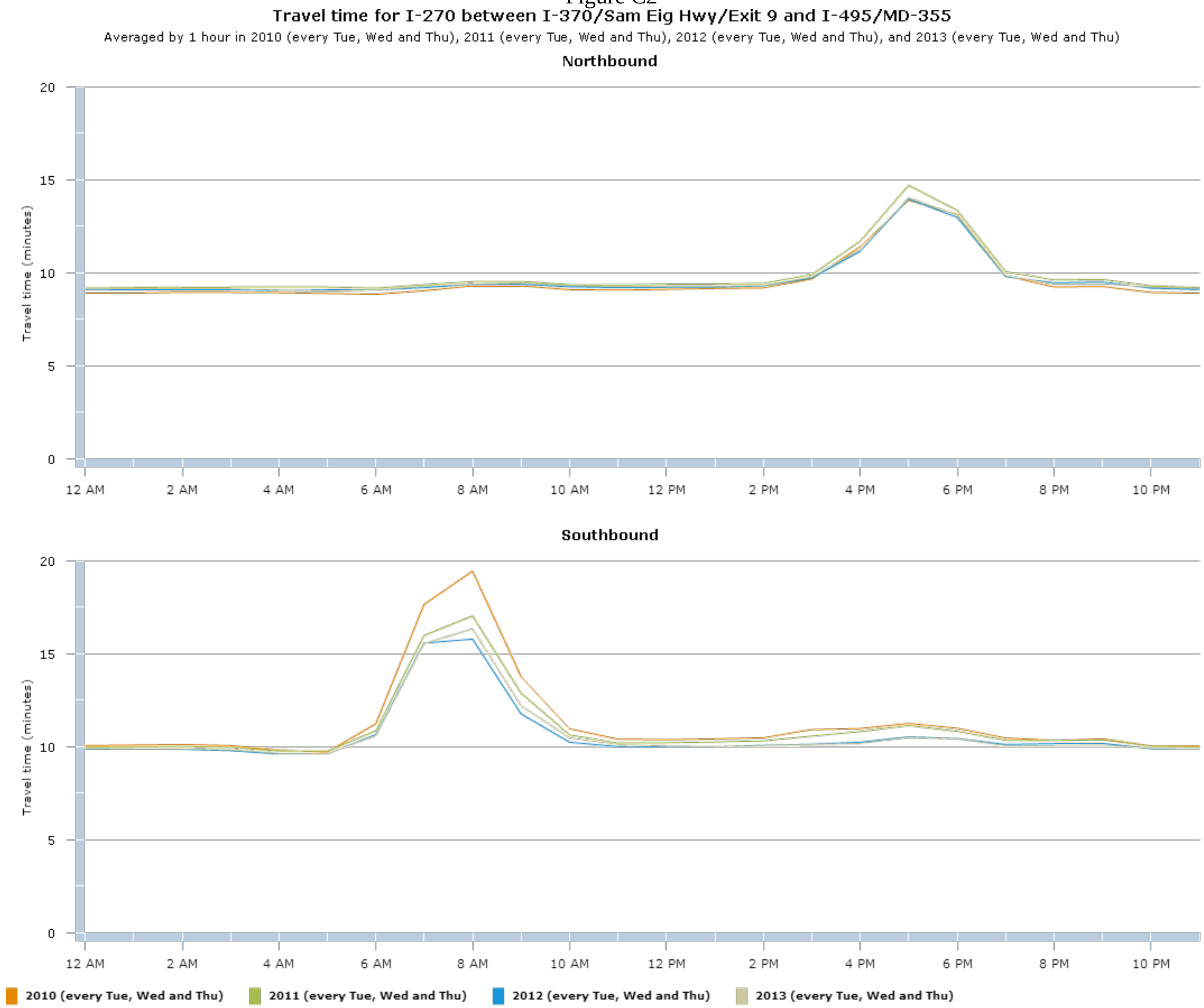

Travel time for I-270 between I-370/Sam Eig Hwy/Exit 9 and I-495/MD-355
Averaged by 1 hour in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Northbound
Southbound
Travel time (minutes)
0
5
10
15
20
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C3

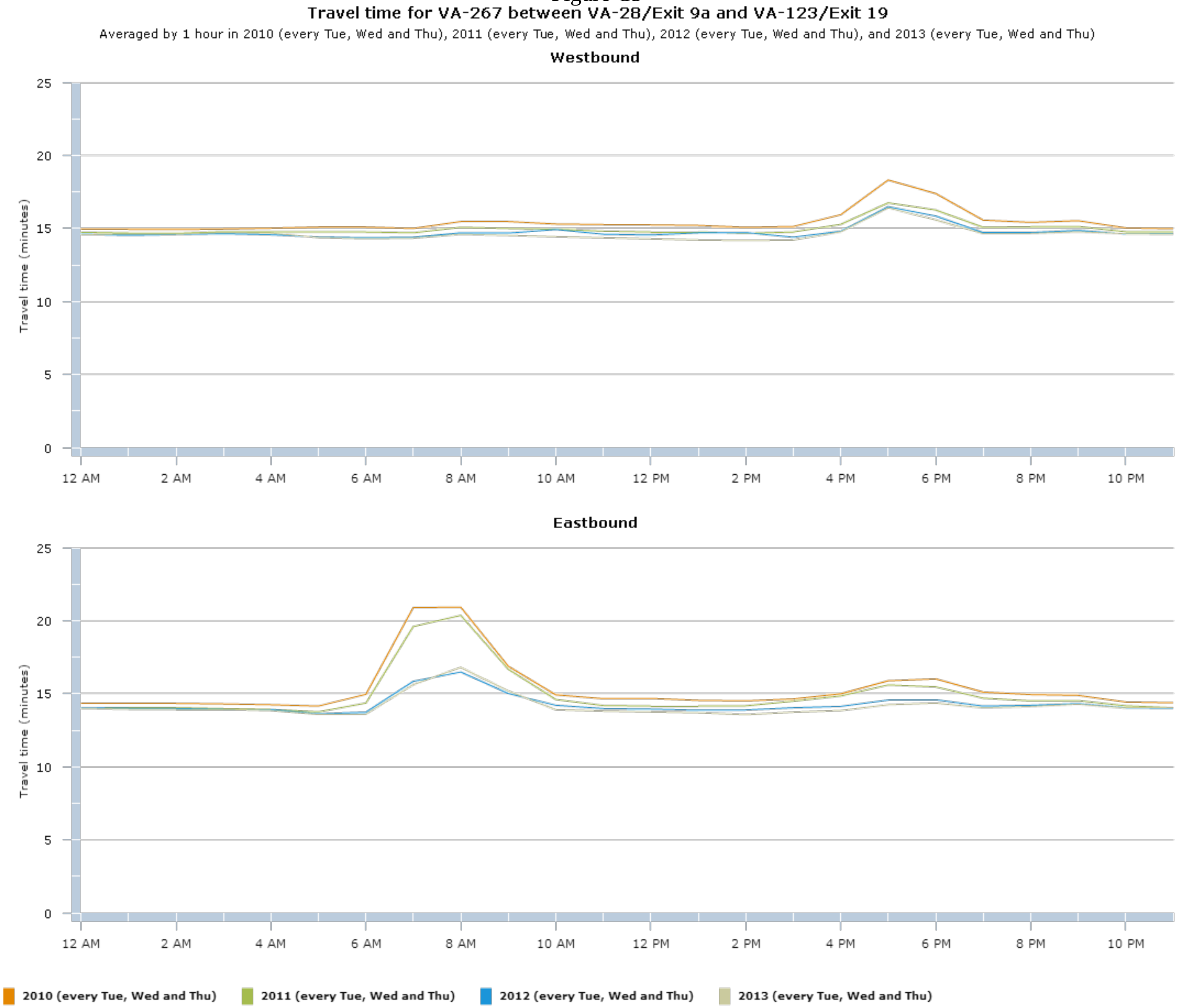

Travel time for VA-267 between VA-28/Exit 9a and VA-123/Exit 19
Averaged by 1 hour in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Westbound
Travel time (minutes)
0
5
10
15
20
25
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
Eastbound
Travel time (minutes)
0
5
10
15
20
25
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C4

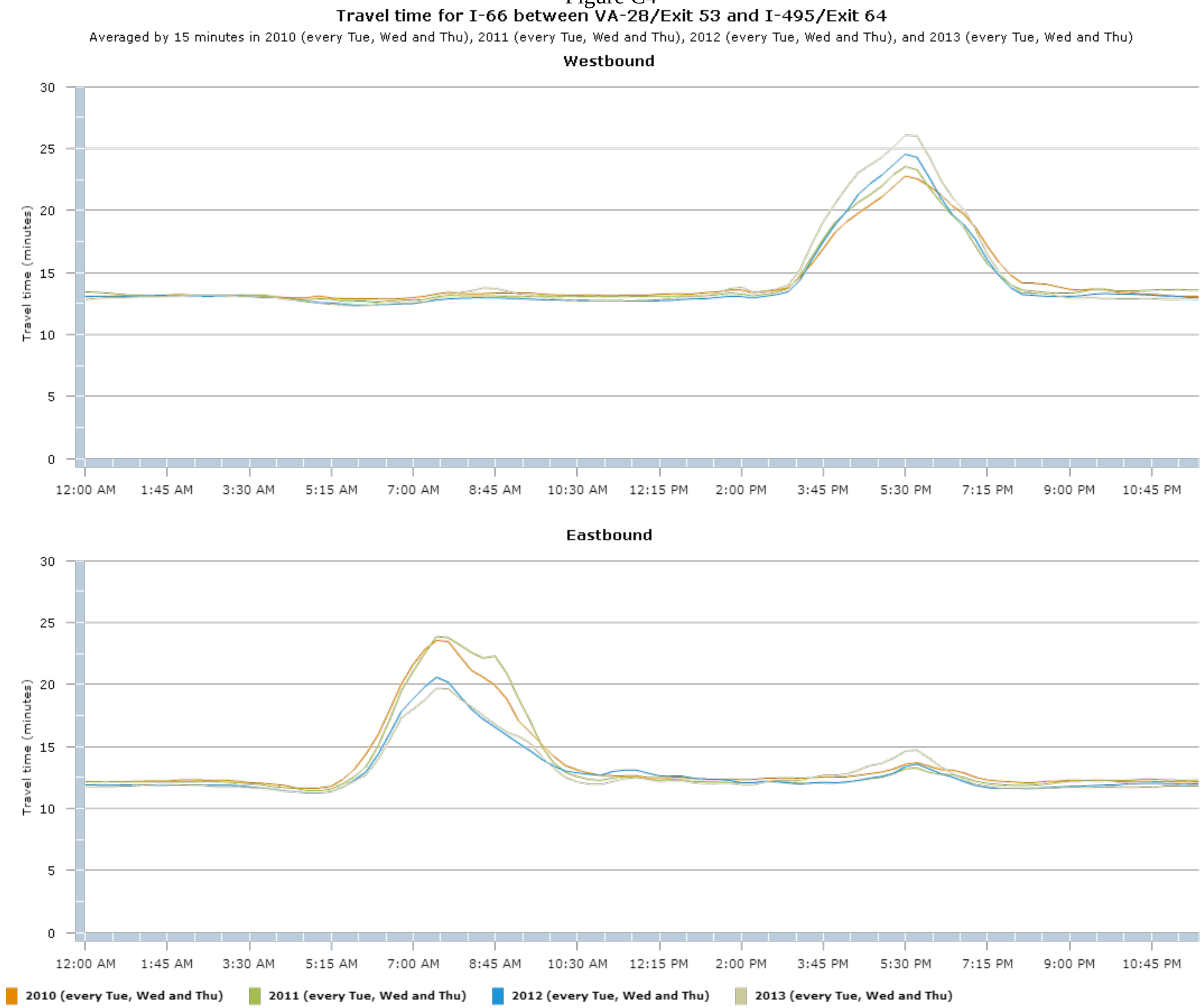

Travel time for I-66 between VA-28/Exit 53 and I-495/Exit 64
Averaged by 15 minutes in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Westbound
Travel time (minutes)
0
5
10
15
20
25
30
12:00 AM
1:45 AM
3:30 AM
5:15 AM
7:00 AM
8:45 AM
10:30 AM
12:15 PM
2:00 PM
3:45 PM
5:30 PM
7:15 PM
9:00 PM
10:45 PM
Eastbound
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C5

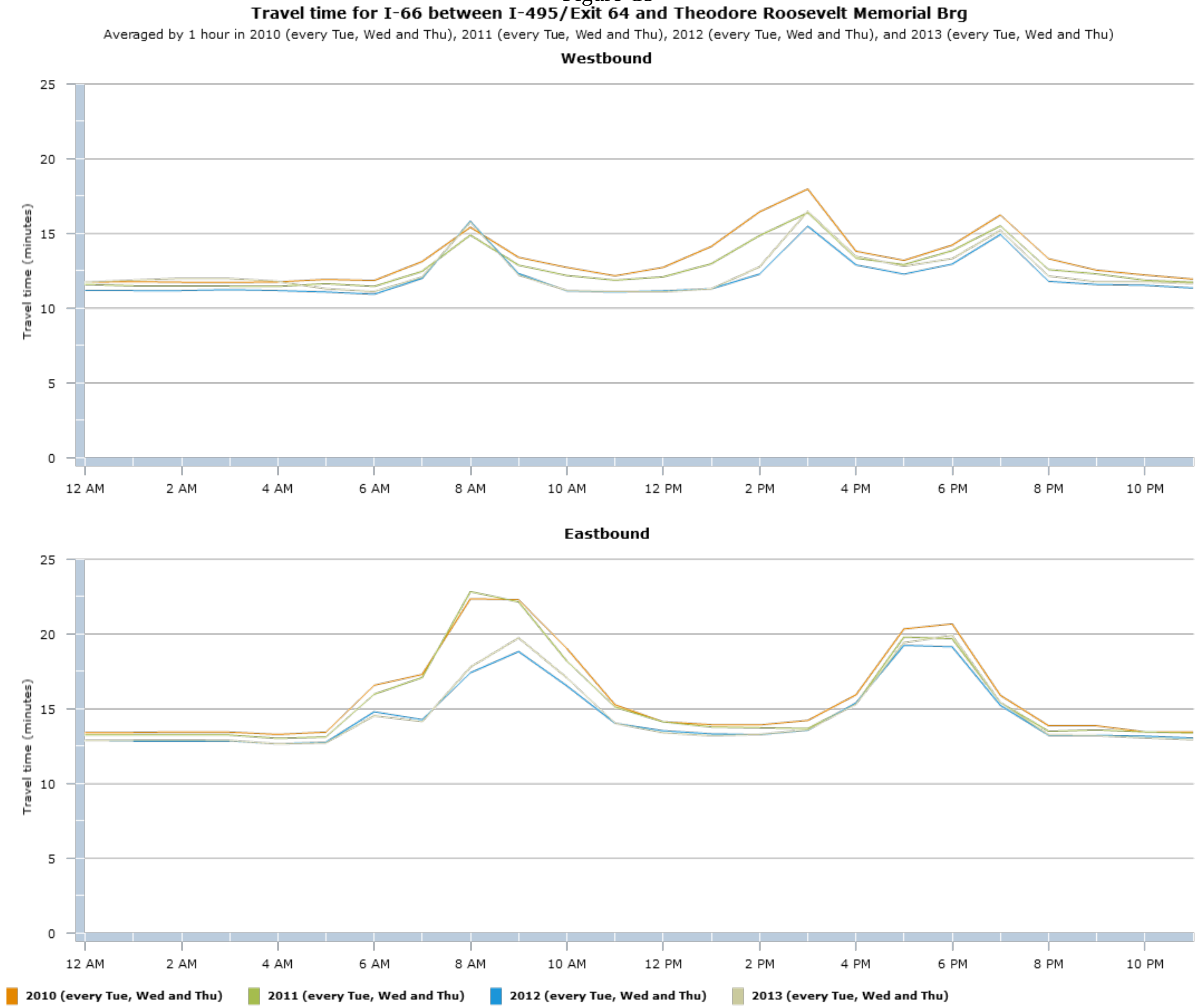

Travel time for I-66 between I-495/Exit 64 and Theodore Roosevelt Memorial Brg
Averaged by 1 hour in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Westbound
Travel time (minutes)
25
20
15
10
5
0
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
Eastbound
Travel time (minutes)
25
20
15
10
5
0
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C6

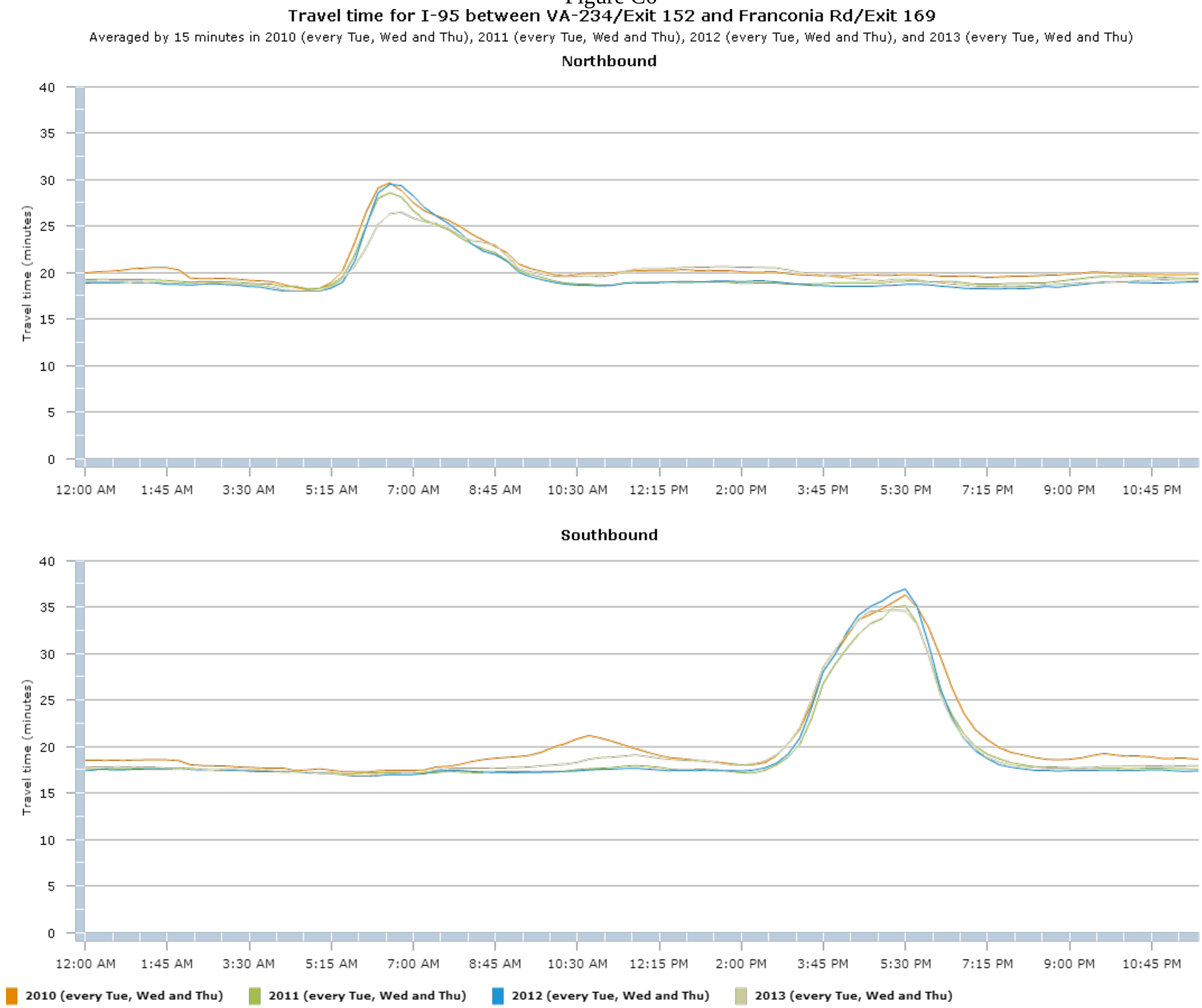

Travel time for I-95 between VA-234/Exit 152 and Franconia Rd/Exit 169
Averaged by 15 minutes in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Northbound
Southbound
Travel time (minutes)
0
5
10
15
20
25
30
35
40
12:00 AM
1:45 AM
3:30 AM
5:15 AM
7:00 AM
8:45 AM
10:30 AM
12:15 PM
2:00 PM
3:45 PM
5:30 PM
7:15 PM
9:00 PM
10:45 PM
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C7

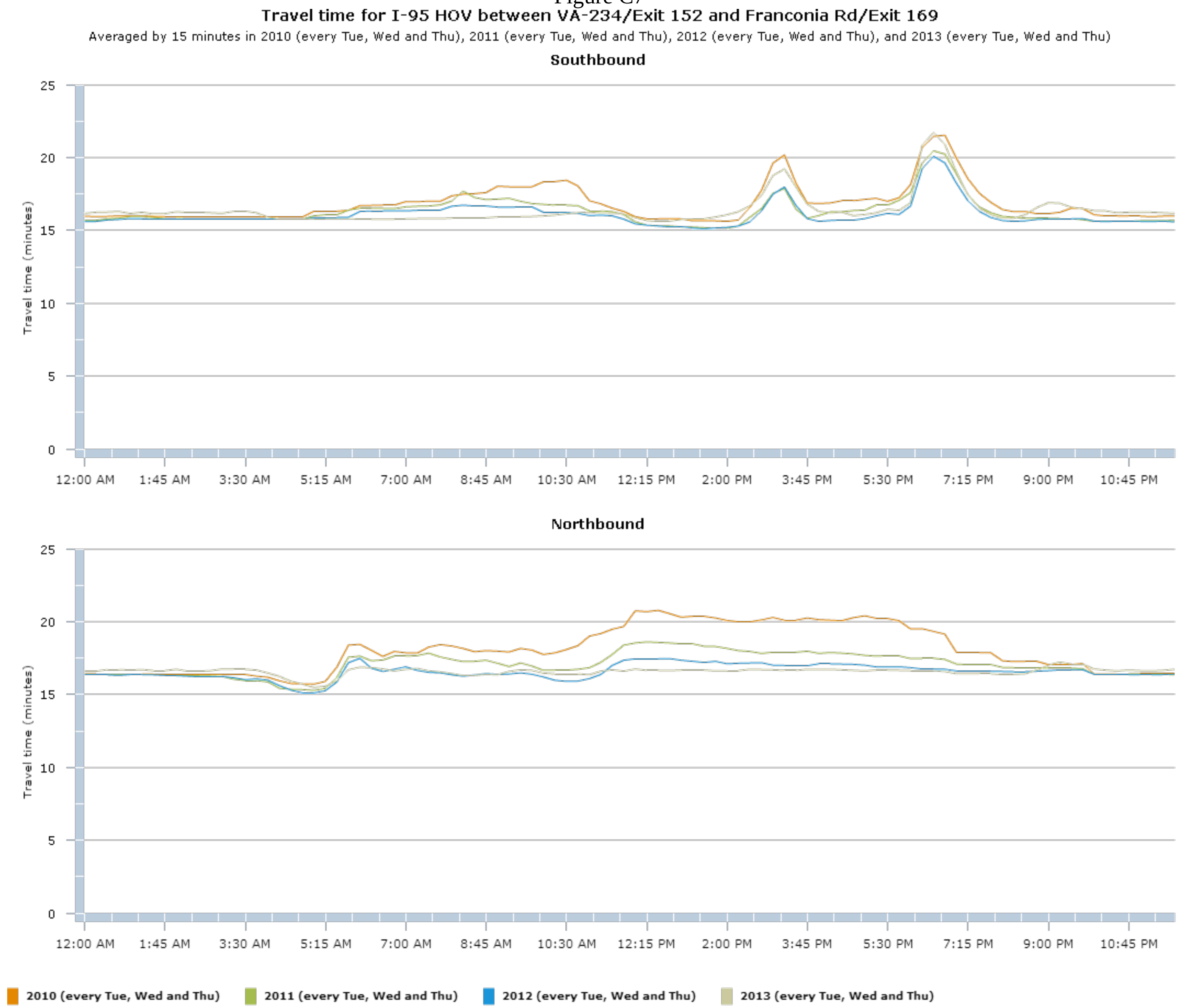

Travel time for I-95 HOV between VA-234/Exit 152 and Franconia Rd/Exit 169
Averaged by 15 minutes in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Southbound
Northbound
Travel time (minutes)
0
5
10
15
20
25
12:00 AM
1:45 AM
3:30 AM
5:15 AM
7:00 AM
8:45 AM
10:30 AM
12:15 PM
2:00 PM
3:45 PM
5:30 PM
7:15 PM
9:00 PM
10:45 PM
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C8

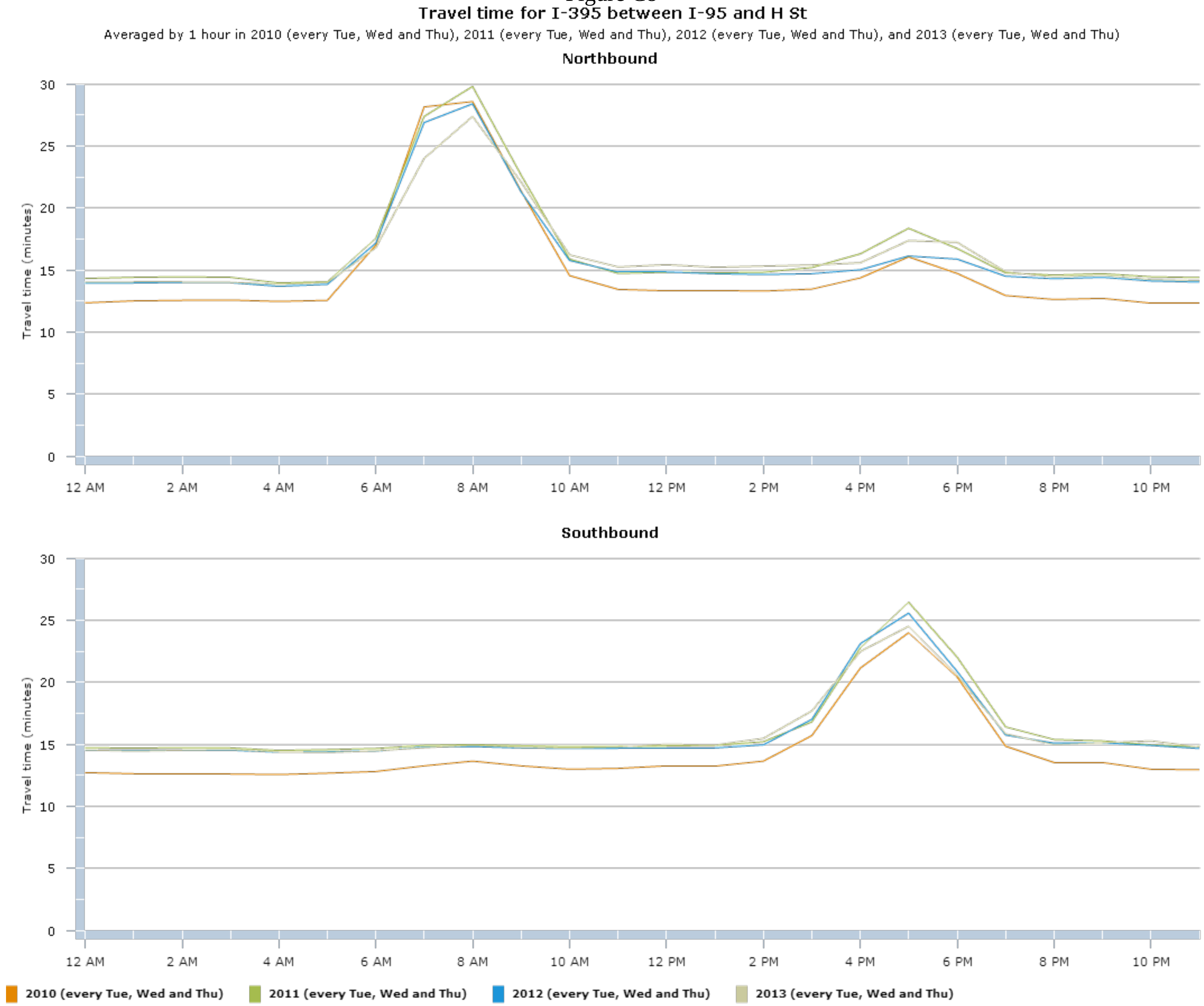

Travel time for I-395 between I-95 and H St
Averaged by 1 hour in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Northbound
Travel time (minutes)
0
5
10
15
20
25
30
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
Southbound
Travel time (minutes)
0
5
10
15
20
25
30
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C9

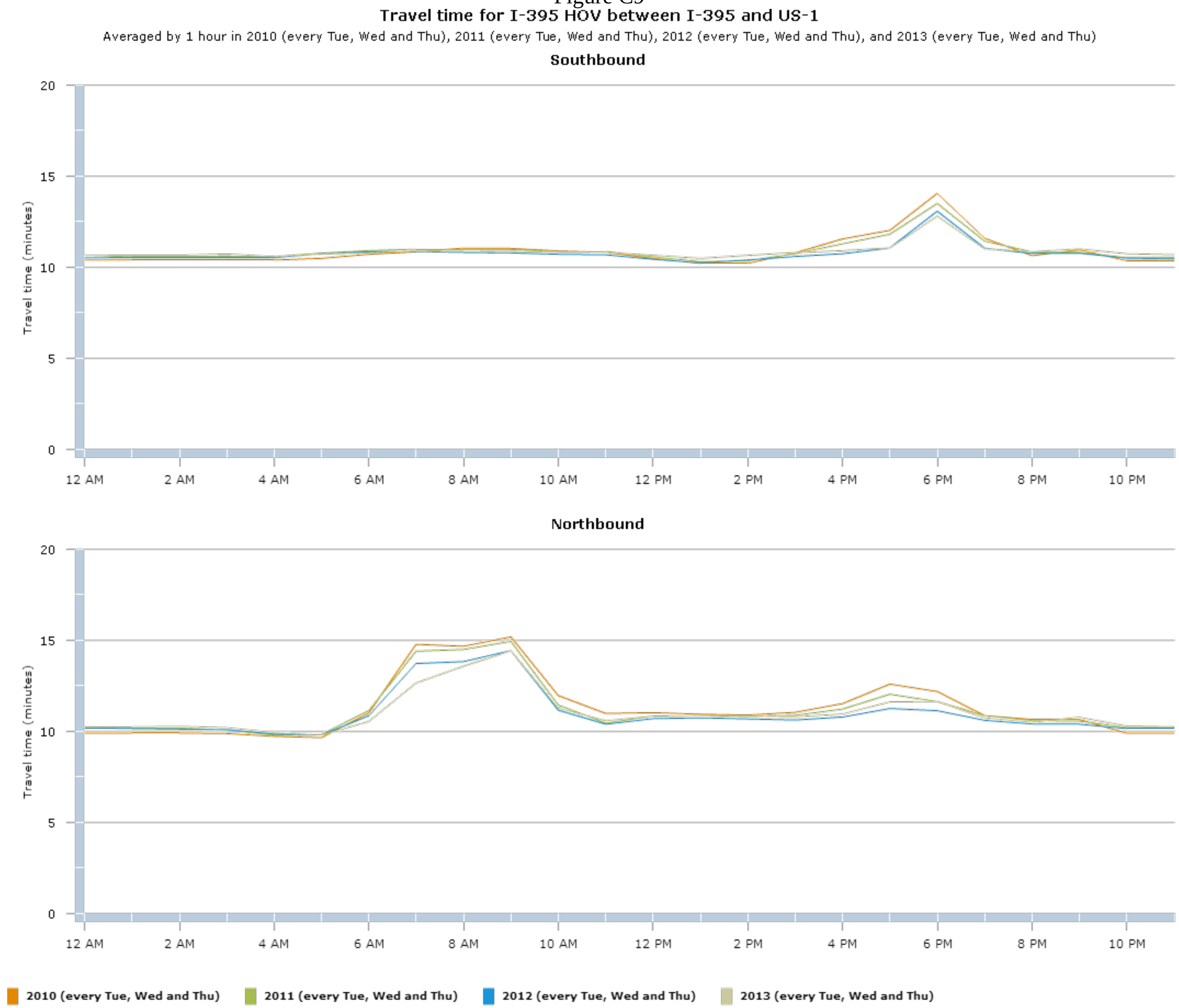

Travel time for I-395 HOV between I-395 and US-1
Averaged by 1 hour in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Southbound
Northbound
Travel time (minutes)
0
5
10
15
20
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C10

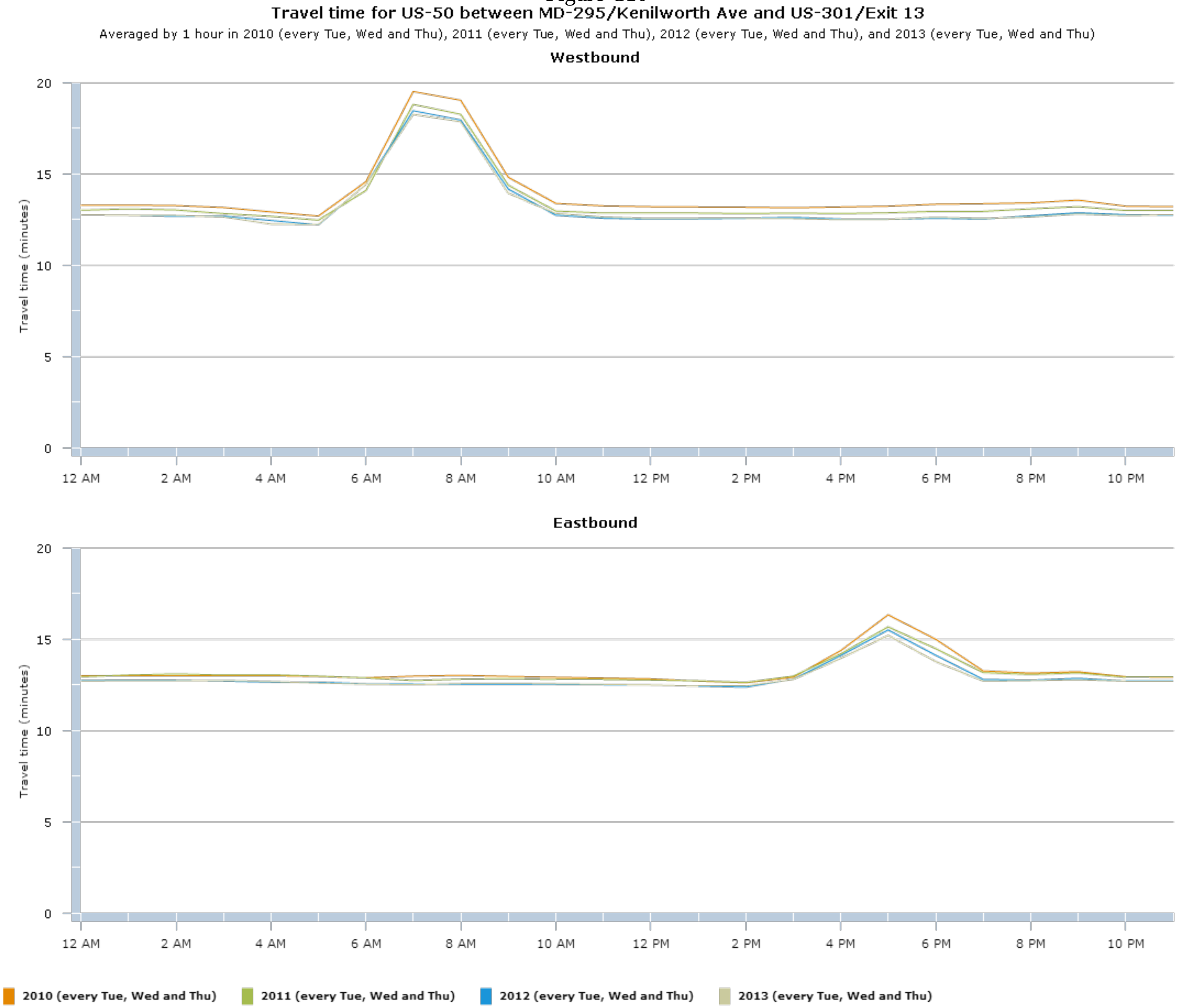

Travel time for US-50 between MD-295/Kenilworth Ave and US-301/Exit 13
Averaged by 1 hour in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Westbound
Travel time (minutes)
20
15
10
5
0
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
Eastbound
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C11

Travel time for MD-295 between US-50/MD-201/Kenilworth Ave and MD-198

Averaged by 1 hour in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)

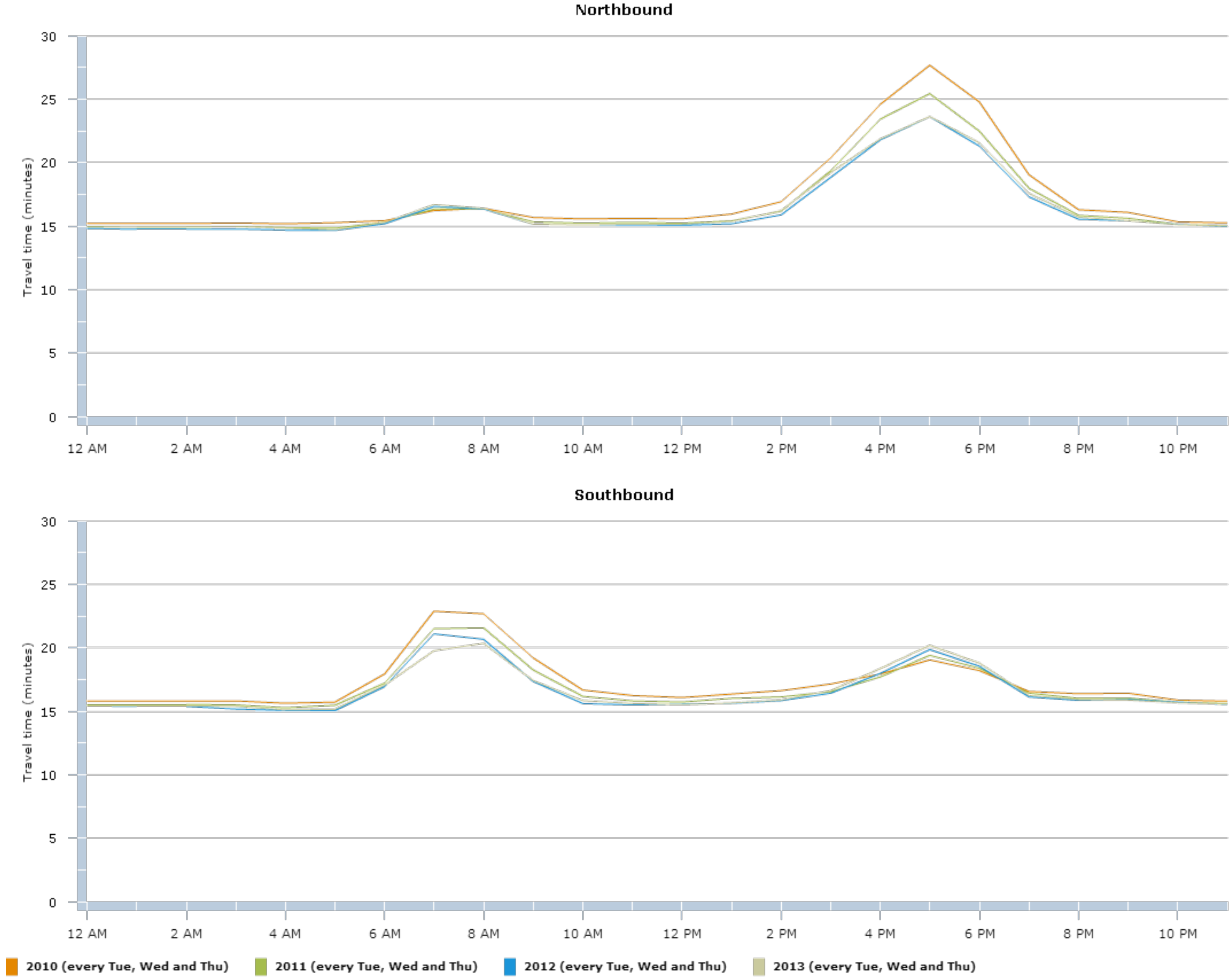


Figure C12

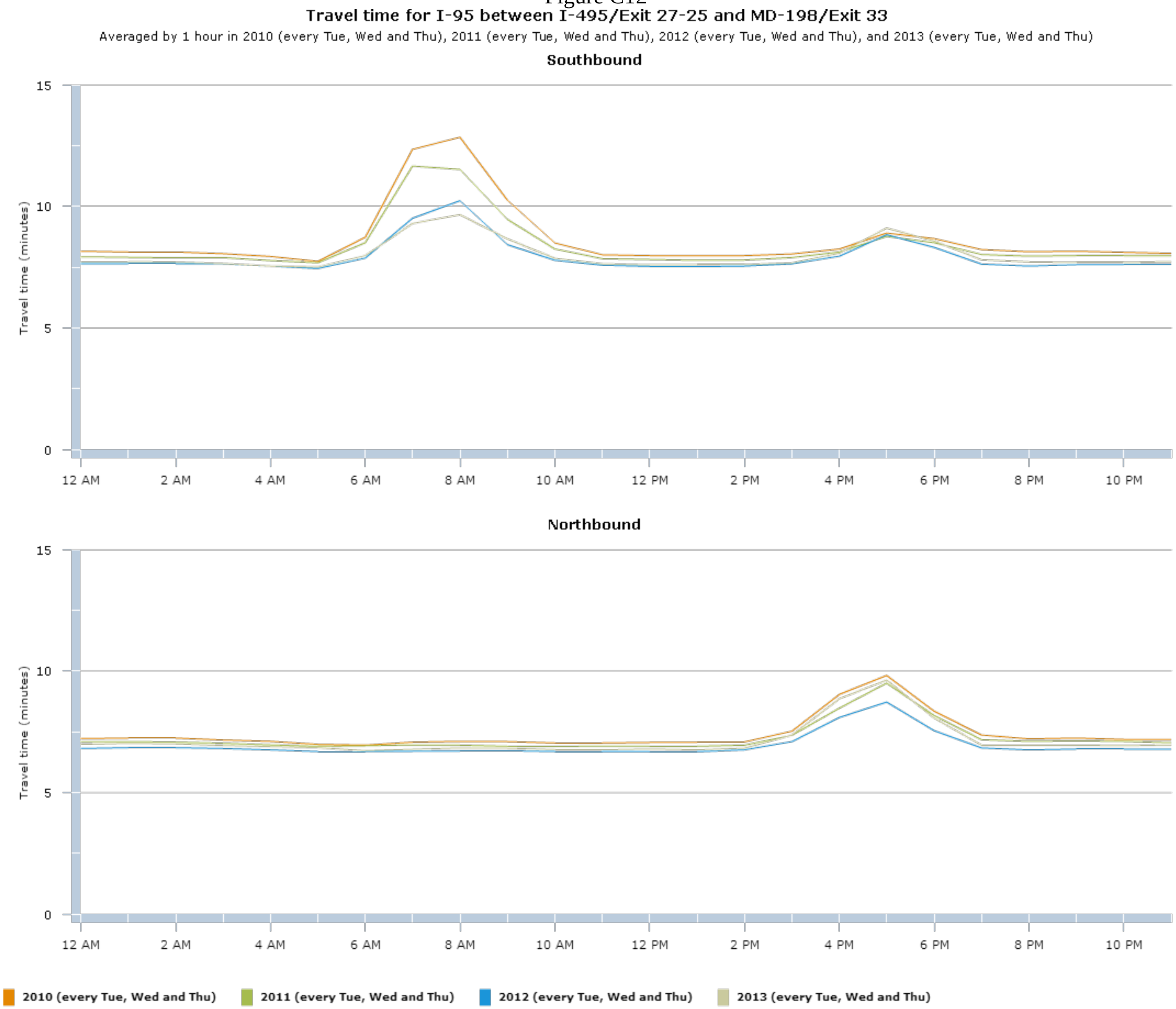

Travel time for I-95 between I-495/Exit 27-25 and MD-198/Exit 33
Averaged by 1 hour in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Southbound
Northbound
Travel time (minutes)
0
5
10
15
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C13

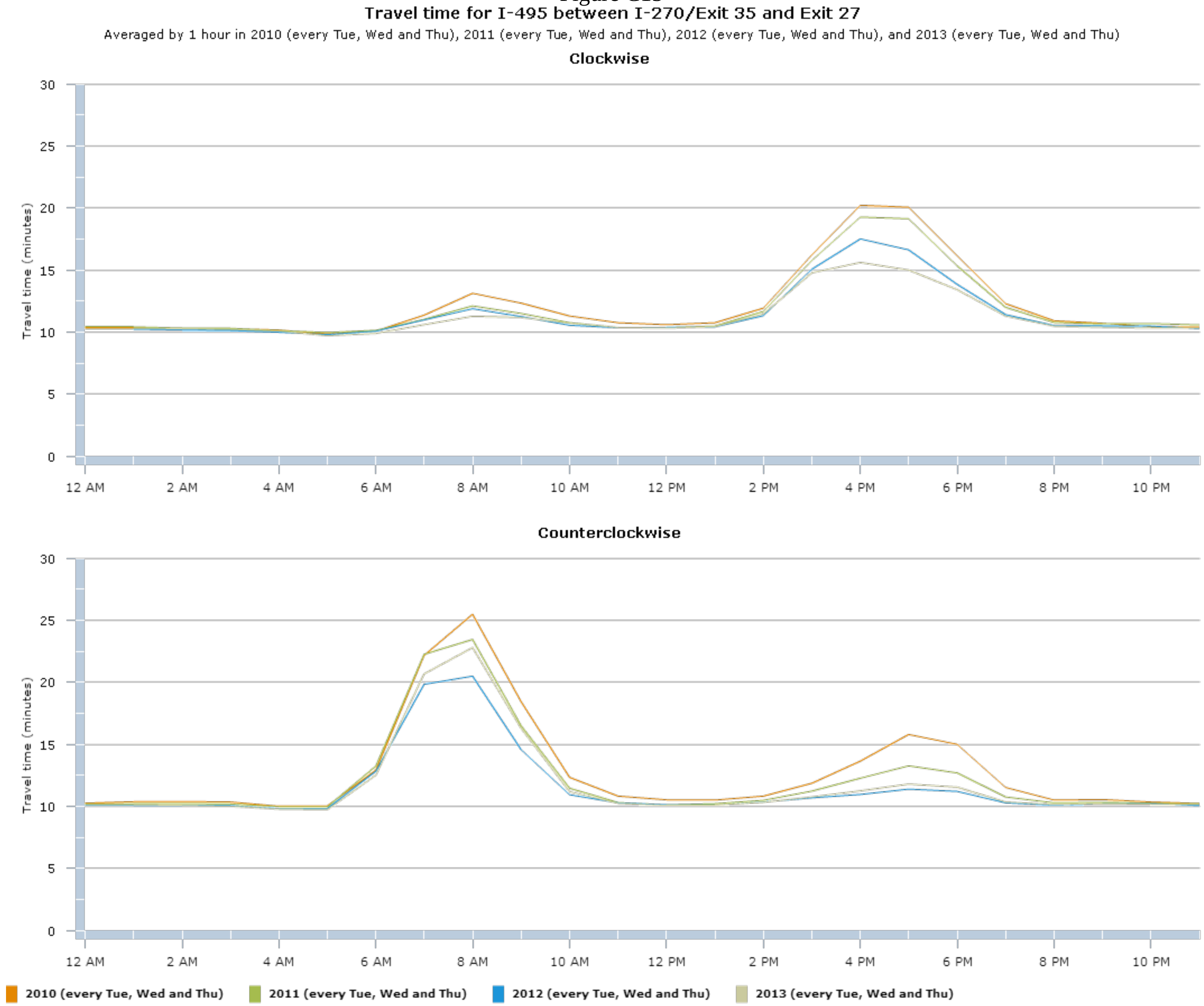

Travel time for I-495 between I-270/Exit 35 and Exit 27
Averaged by 1 hour in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Clockwise
Counterclockwise
Travel time (minutes)
30
25
20
15
10
5
0
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C14

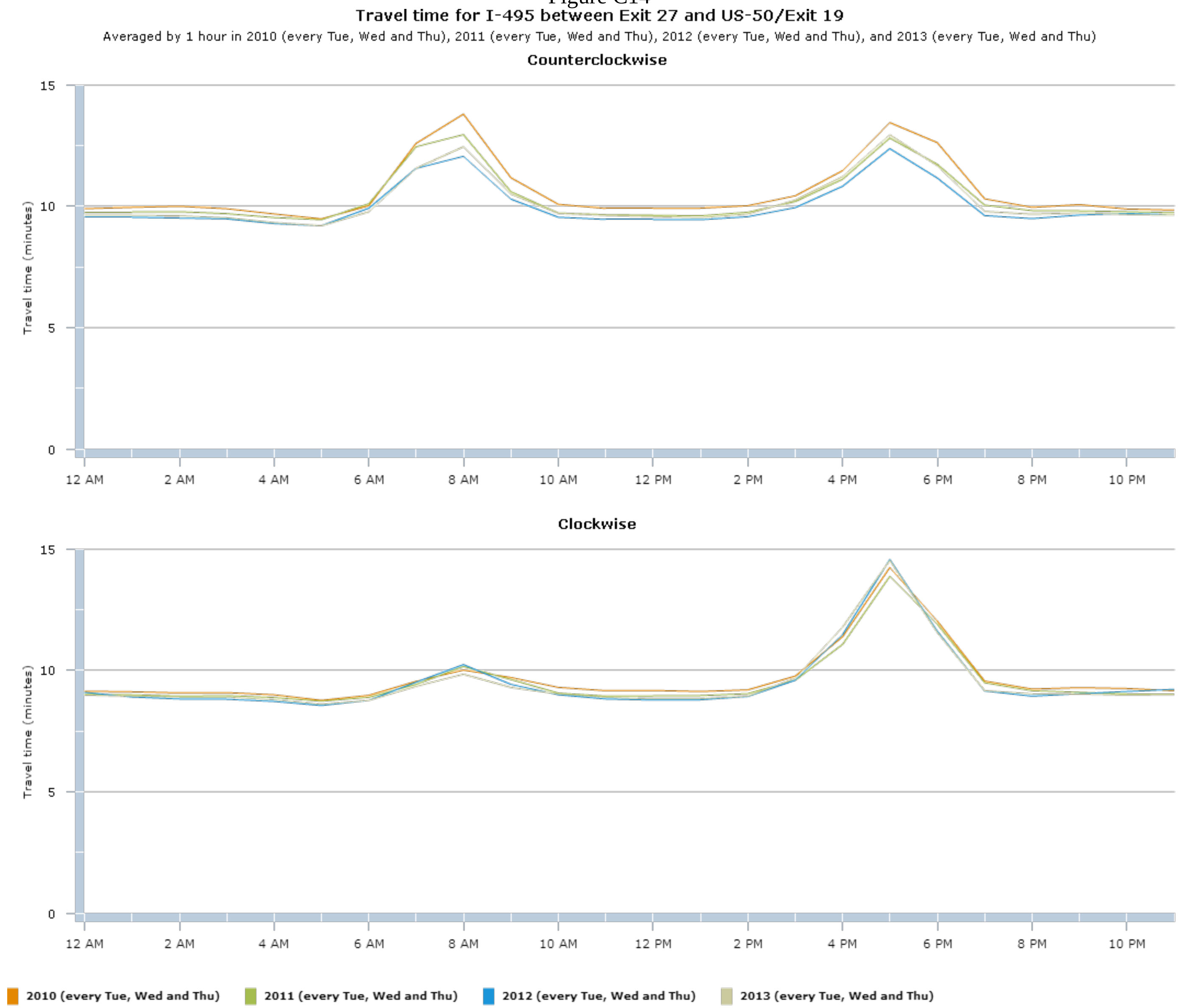

Travel time for I-495 between Exit 27 and US-50/Exit 19
Averaged by 1 hour in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Counterclockwise
Travel time (minutes)
15
10
5
0
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
Clockwise
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C15

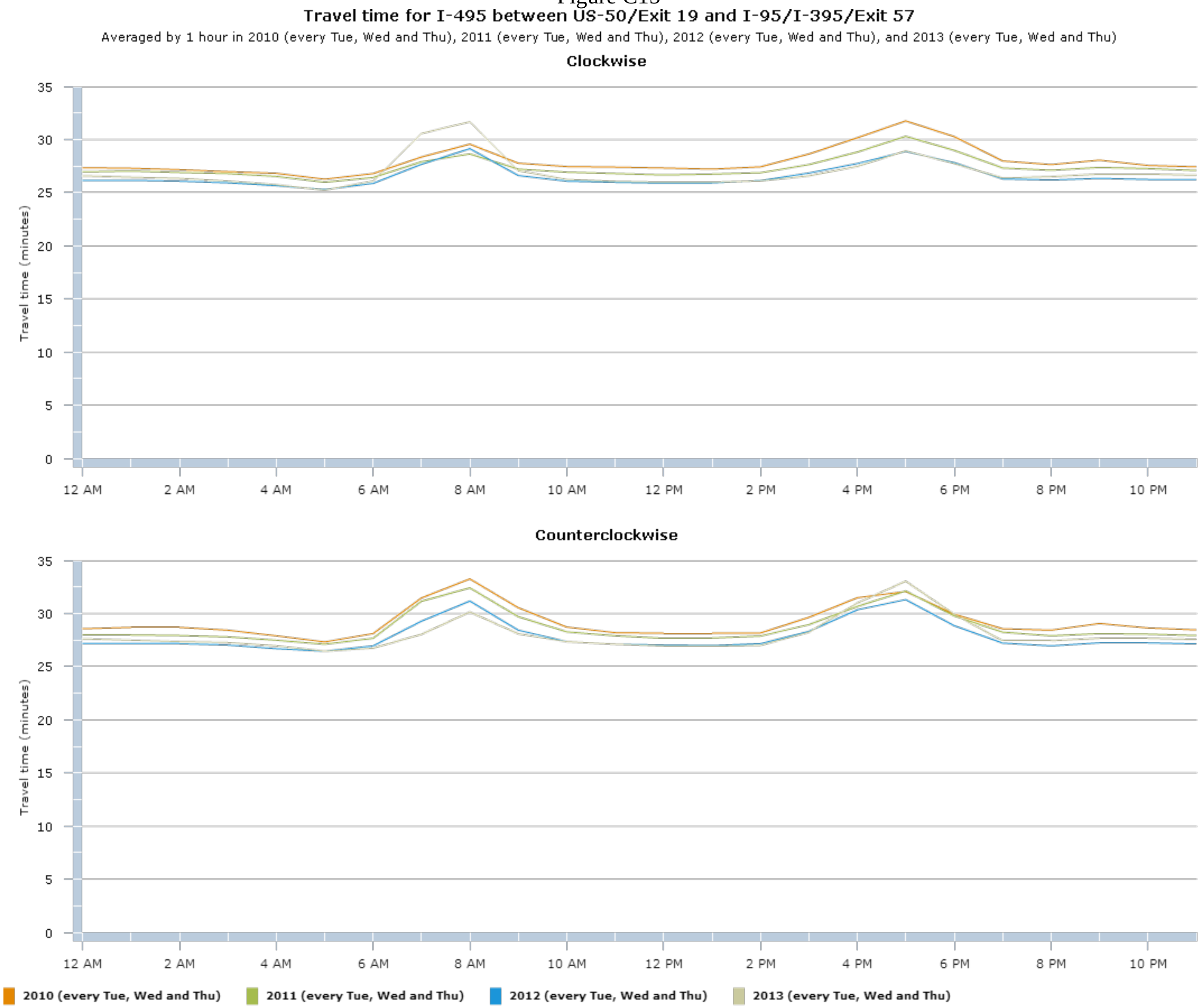

Travel time for I-495 between US-50/Exit 19 and I-95/I-395/Exit 57
Averaged by 1 hour in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Clockwise
Counterclockwise
Travel time (minutes)
0
5
10
15
20
25
30
35
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C16

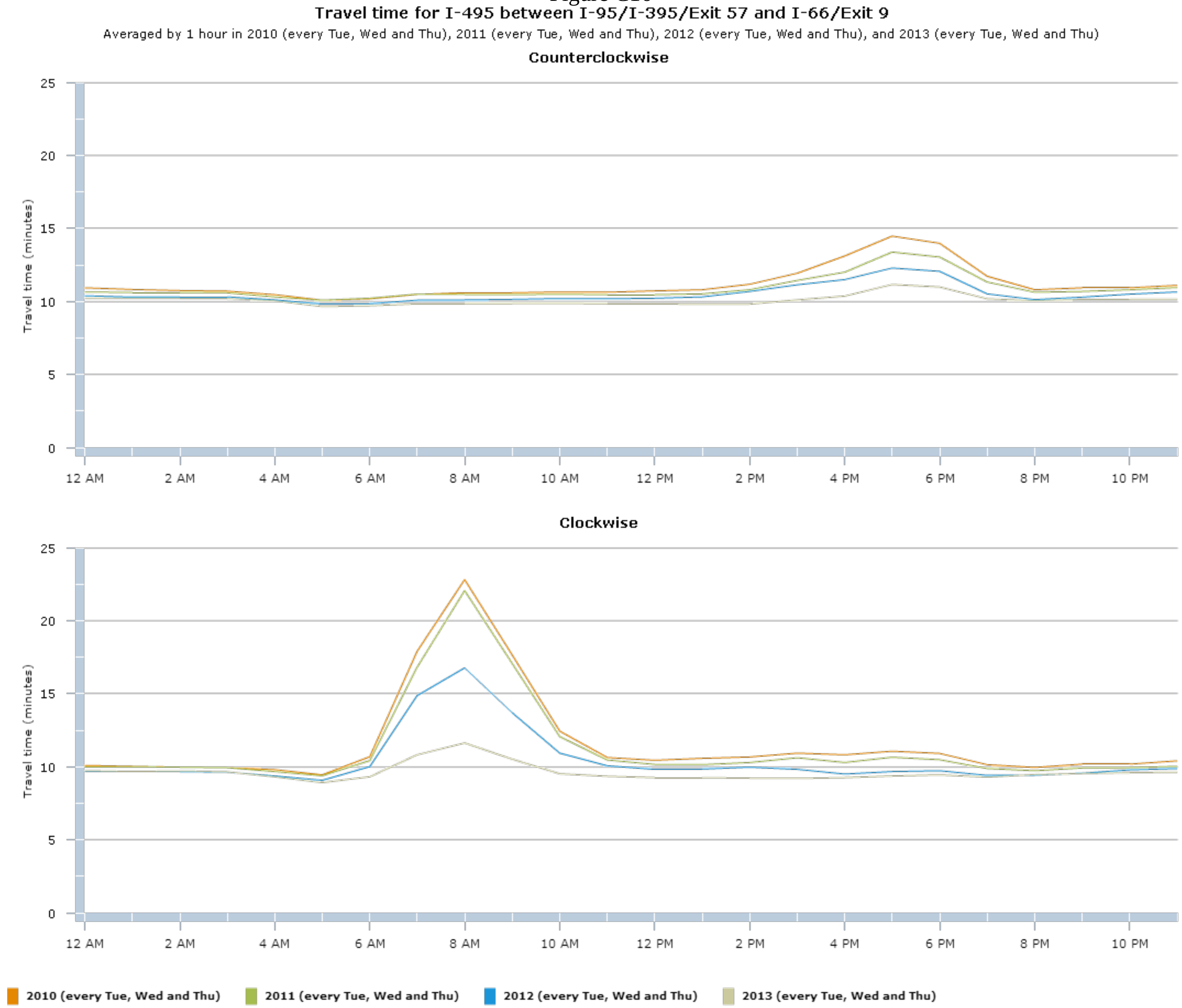

Travel time for I-495 between I-95/I-395/Exit 57 and I-66/Exit 9
Averaged by 1 hour in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Counterclockwise
Clockwise
Travel time (minutes)
0
5
10
15
20
25
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C17

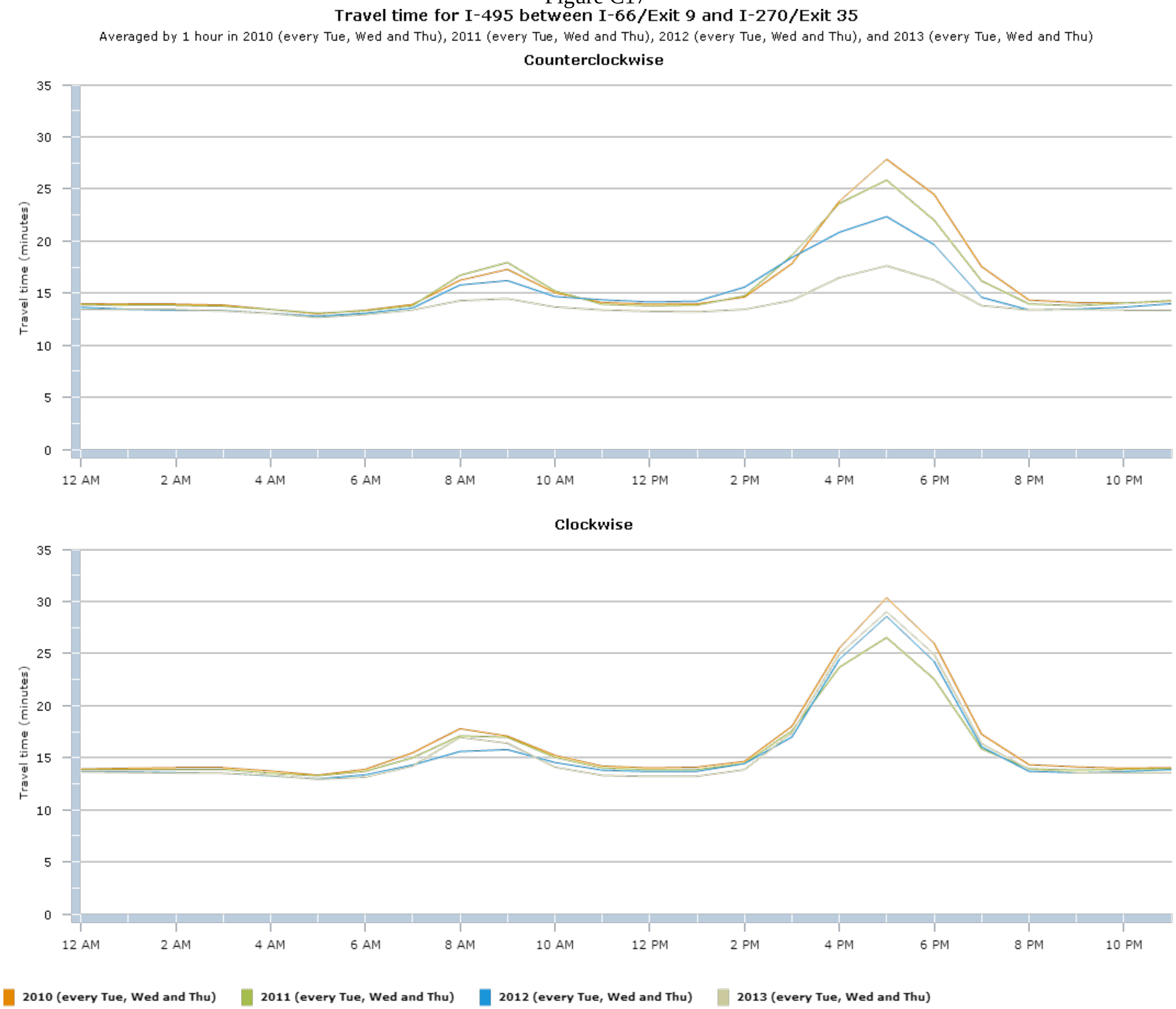
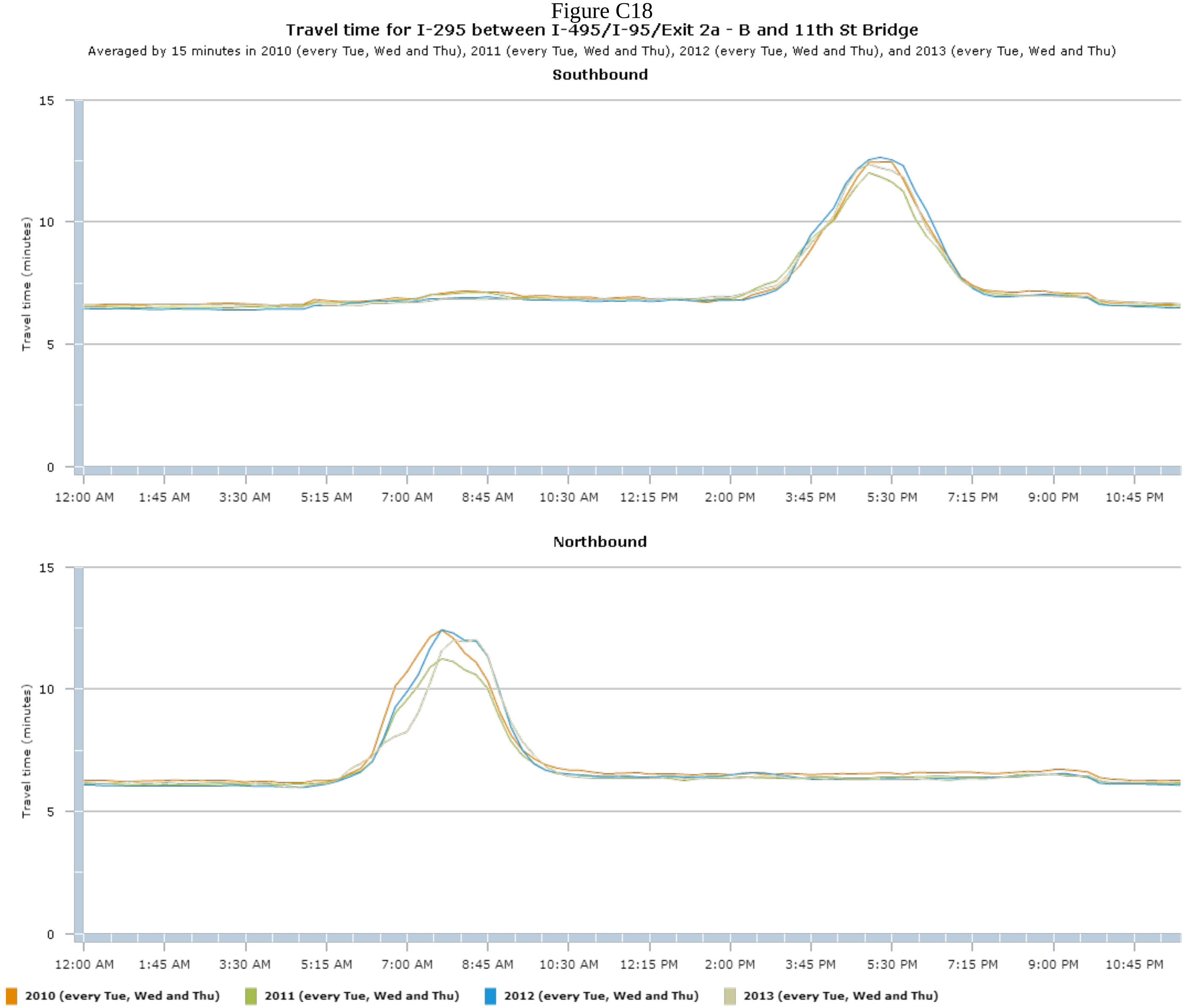

Travel time for I-495 between I-66/Exit 9 and I-270/Exit 35
Averaged by 1 hour in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Counterclockwise
Travel time (minutes)
0
5
10
15
20
25
30
35
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
Clockwise
Travel time (minutes)
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

Figure C18


Travel time for I-295 between I-495/I-95/Exit 2a - B and 11th St Bridge
Averaged by 15 minutes in 2010 (every Tue, Wed and Thu), 2011 (every Tue, Wed and Thu), 2012 (every Tue, Wed and Thu), and 2013 (every Tue, Wed and Thu)
Southbound
Northbound
Travel time (minutes)
15
10
5
0
12:00 AM
1:45 AM
3:30 AM
5:15 AM
7:00 AM
8:45 AM
10:30 AM
12:15 PM
2:00 PM
3:45 PM
5:30 PM
7:15 PM
9:00 PM
10:45 PM
2010 (every Tue, Wed and Thu)
2011 (every Tue, Wed and Thu)
2012 (every Tue, Wed and Thu)
2013 (every Tue, Wed and Thu)

APPENDIX D – 2010 PERFORMANCE OF HIGH-OCCUPANCY VEHICLE FACILITIES ON FREEWAYS IN THE WASHINGTON REGION

Figure D1: HOV Facilities in the Washington Region

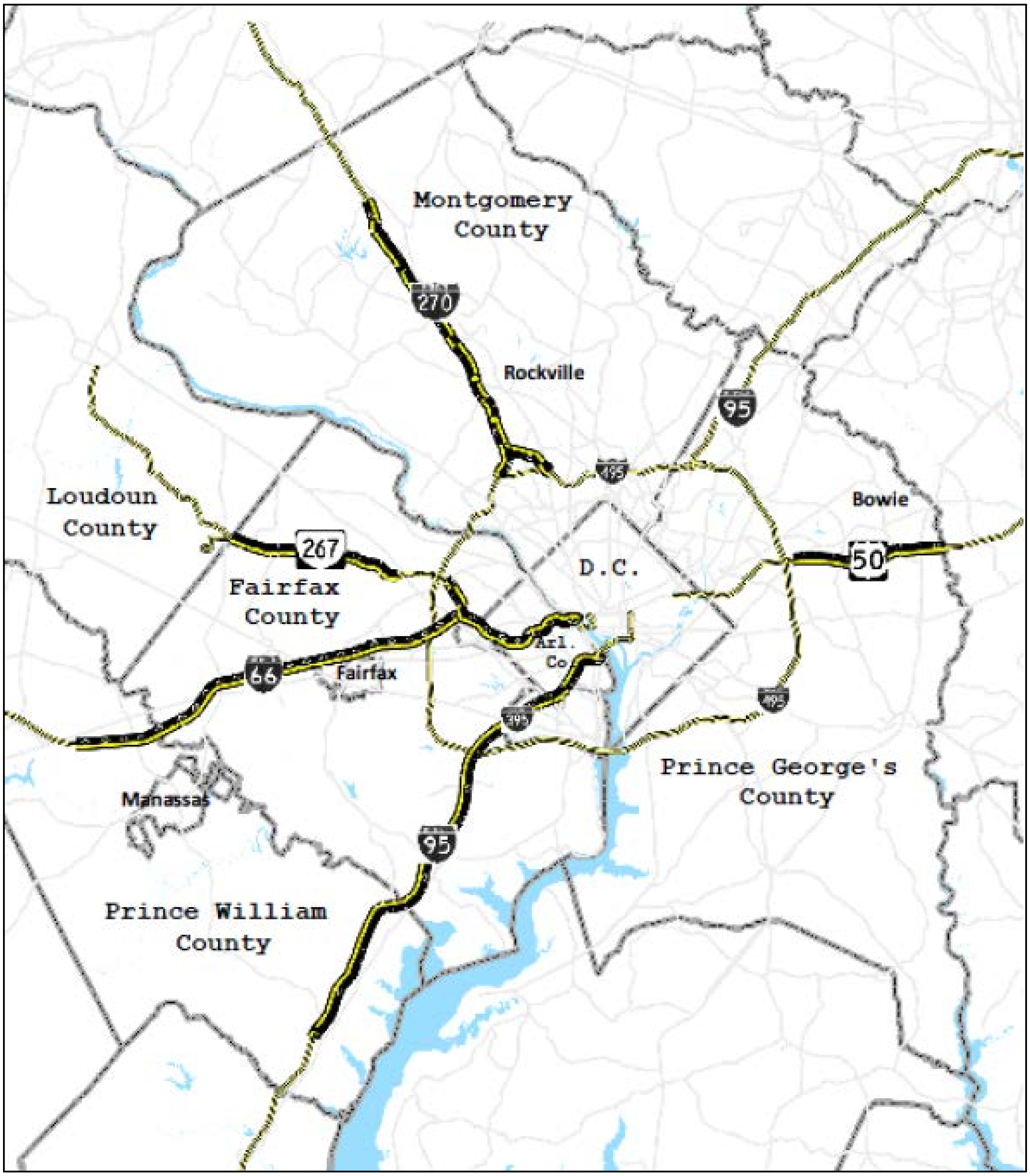


Table D1: Observed Average Auto Occupancies in the AM Peak Direction during HOV-Restricted Periods (Spring 2010)

Observed average auto occupancies in the A.M. peak direction during HOV-restricted periods (Spring, 2010)				
Facility	HOV lane average auto occupancies	Number of autos needed to move 1000 persons	Non-HOV lane average auto occupancies	Number of autos needed to move 1000 persons
I-395 Shirley Highway between Va. 120 (S. Glebe Road) and Arlington Ridge Road	2.8	360	1.1	910
I-95 Shirley Highway between Va. 7100 (Fairfax County Parkway) and Va. 7900 (Franconia Springfield Parkway)	2.5	400	1.1	910
I-66 between Sycamore Street and Fairfax Drive	1.5	670	N/A	N/A
I-66 between Va. 243 (Nutley Street) and I-495	1.8	560	1.1	910
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike)	1.7	590	1.1	910
I-270 between Montrose Road and the "split" (Max Load Point)	1.9	530	1.0	1000
I-270 between the "split" and Rockledge Drive	2.0	500	1.0	1000
I-270Y (I-270 Spur) between the "split" and Democracy Boulevard	1.9	530	1.0	1000
U.S 50 between Md. 197 (Collington Road) and Md. 704 (MLK, Jr. Hwy)	1.8	560	1.0	1000

Table D2: Observed Average Auto Occupancies in the PM Peak Direction during HOV-Restricted Periods (Spring 2010)

Observed average auto occupancies in the P.M. peak direction during HOV-restricted periods (Spring, 2010)				
Facility	HOV lane average auto occupancies	Number of autos needed to move 1000 persons	Non-HOV lane average auto occupancies	Number of autos needed to move 1000 persons
I-395 Shirley Highway between Arlington Ridge Road and Va. 120 (S. Glebe Road)	2.8	360	1.1	910
I-95 Shirley Highway between Va. 7900 (Franconia Springfield Parkway) and Va. 7100 (Fairfax County Parkway)	2.9	340	1.1	910
I-66 between Fairfax Drive and Sycamore Street	1.4	710	N/A	N/A
I-66 between I-495 and Va. 243 (Nutley Street)	1.9	530	1.1	910
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike)	1.5	670	1.1	910
I-270 between Rockledge Drive and the "split"	1.9	530	1.1	910
I-270Y (I-270 Spur) between Democracy Boulevard and the "split"	2.0	500	1.1	910
I-270 between the "split" and Montrose Road (Max Load Point)	2.0	500	1.1	910
U.S 50 between Md. 704 (MLK, Jr. Hwy) and Md. 197 (Collington Road)	1.7	590	1.0	1000

Table D3: Observed Average HOV Auto Occupancies in the AM Peak Direction Over Time

2010 Observed average HOV auto occupancies in the A.M. Peak Direction Over Time						
Facility	Year					
	1997	1998	1999	2004	2007	2010
I-395 Shirley Highway between Va. 120 (S. Glebe Road) and Arlington Ridge Road	2.7	2.6	2.9	2.5	2.5	2.8
I-95 Shirley Highway between Va. 7100 (Fairfax County Parkway) and Va. 7900 (Franconia Springfield Parkway)	2.6	2.8	2.8	2.6	2.6	2.5
I-66 between Sycamore Street and Fairfax Drive	1.8	1.8	1.8	1.7	1.8	1.5
I-66 between Va. 243 (Nutley Street) and I-495	2.0	1.7	1.9	2.0	1.9	1.8
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike)	N/A	N/A	1.8	1.8	1.8	1.7
I-270 between Montrose Road and the "split" (Max Load Point)	N/A	N/A	N/A	1.7	1.6	1.9
I-270 between the "split" and Rockledge Drive	1.9	1.7	1.7	1.9	1.5	2.0
I-270Y (I-270 Spur) between the "split" and Democracy Boulevard	1.9	1.8	1.8	1.5	1.8	1.9
U.S 50 between Md. 197 (Collington Road) and Md. 704 (MLK, Jr. Hwy)	N/A	N/A	N/A	1.6	1.9	1.8

Notes: Data in table are rounded.

Table D4: Observed Average HOV Auto Occupancies in the PM Peak Direction Over Time

2010 Observed average HOV auto occupancies in the P.M. Peak Direction Over Time						
Facility	Year					
	1997	1998	1999	2004	2007	2010
I-395 Shirley Highway between Arlington Ridge Road and Va. 120 (S. Glebe Road)	3.1	3.1	3.2	2.8	2.9	2.8
I-95 Shirley Highway between Va. 7900 (Franconia Springfield Parkway) and Va. 7100 (Fairfax County Parkway)	2.9	2.7	3.0	2.7	2.8	2.9
I-66 between Fairfax Drive and Sycamore Street	1.8	1.8	1.9	1.7	1.8	1.4
I-66 between I-495 and Va. 243 (Nutley Street)	2.0	2.0	1.9	2.0	2.0	1.9
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike)	N/A	N/A	1.8	1.8	1.6	1.5
I-270 between Rockledge Drive and the "split"	2.1	1.8	1.6	2.1	1.9	1.9
I-270Y (I-270 Spur) between Democracy Boulevard and the "split"	2.1	1.8	2.1	1.5	2.1	2.0
I-270 between the "split" and Montrose Road (Max Load Point)	N/A	N/A	N/A	1.8	2.0	2.0
U.S 50 between Md. 704 (MLK, Jr. Hwy) and Md. 197 (Collington Road)	N/A	N/A	N/A	2.1	1.8	1.7

Notes: Data in table are rounded.

Table D5: Observed Person Movements in the AM Peak Direction during HOV-Restricted Periods (Spring 2010)

Observed person movements in the A.M. peak direction during HOV-restricted periods (Spring, 2010)						
Facility And Hours of HOV-restricted operation	Number of HOV lanes	HOV lane person movements during HOV-restricted period	HOV lane persons per lane per hour	Number of non-HOV lanes	Non-HOV lane person movements during HOV-restricted period	Non-HOV lane persons per lane per hour
I-395 between Va. 120 and Arlington Ridge Rd 6:00 A.M. to 9:00 A.M.	2	30,800	5,100	4	24,200	2,000
I-95 between Va. 7100and Va. 7900 6:00 A.M. to 9:00 A.M.	2 *Includes Newington Flyover Ramp*	24,200	4,000	4	17,000	1,400
I-66 between Sycamore St and Fairfax Dr 6:30 A.M. to 9:00 A.M.	2	15,800	3,200	0 *No non-HOV lanes*	N/A	N/A
I-66 between Va. 243 & I-495 5:30 A.M. to 9:30 A.M.	1	10,400	2,600	3	20,100	1,700
Va. 267 west of Va. 7 6:30 A.M. to 9:00 A.M.	1	10,200	4,100	3	12,800	1,700
I-270 between Montrose Road and the "split" 6:00 A.M. to 9:00 A.M.	1	8,900	3,000	5	27,800	1,900
I-270 between the "split" and Rockledge Drive 6:00 A.M. to 9:00 A.M.	1	5,500	1,800	3	15,000	1,700
I-270 Spur between the "split" and Democracy Blvd 6:00 A.M. to 9:00 A.M.	1 *Includes Westlake Drive Ramp*	3,400	1,100	2	12,800	2,100
U.S 50 between Md. 197 & Md. 704 24 Hours, 7 Days/Week (5:00 A.M. to 10:00 A.M. assumed in calculations)	1	4,600	900	3	21,800	1,500

Note: All person movements rounded to nearest 100

Table D6: Observed Person Movements in the PM Peak Direction during HOV-Restricted Periods (Spring 2010)

Observed person movements in the P.M. peak direction during HOV-restricted periods (Spring, 2010)

Facility And Hours of HOV operation	Number of HOV lanes	HOV lane person movements during HOV-restricted period	HOV lane persons per lane per hour	Number of non-HOV lanes	Non-HOV lane person movements during HOV-restricted period	Non-HOV lane persons per lane per hour
I-395 between Arlington Ridge Rd. and Va. 120 3:30 P.M. to 6:00 P.M.	2	25,600	5,100	4	22,200	2,200
I-95 between Va. 7900 and Va. 7100 3:30 P.M. to 6:00 P.M.	2	24,000	4,800	4	9,300	900
I-66 between Fairfax Dr and Sycamore St 4:00 P.M. to 6:30 P.M.	2	14,000	2,800	0 *No non-HOV lanes*	N/A	N/A
I-66 between I-495 and Va. 243 3:00 P.M. to 7:00 P.M.	1	9,200	2,300	3	17,500	1,500
Va. 267 west of Va. 7 4:00 P.M. to 6:30 P.M.	1	11,100	4,400	3	15,300	2,000
I-270 between Rockledge Drive and the "split" 3:30 P.M. to 6:30 P.M.	1	5,700	1,900	2	12,400	2,100
I-270Y Spur between Democracy Blvd & the "split" 3:30 P.M. to 6:30 P.M.	1 *Includes Westlake Drive Ramp*	6,700	2,200	2	13,300	2,200
I-270 between the "split" and Montrose Road 3:30 P.M. to 6:30 P.M.	1	12,400	4,100	5	25,700	1,700
U.S 50 between Md. 704 and Md. 197 24 Hours, 7 Days/Week (3:00 P.M. to 8:00 P.M. assumed in calculations)	1	8,100	1,600	3	22,200	1,500

Note: All person movements rounded to nearest 100

Table D7: AM Peak Hour Person Movements during HOV-Restricted Periods (Spring 2010)

A.M. peak hour person movements during HOV-restricted periods (Spring 2010)						
Facility And peak hour within HOV-restricted period	Number of HOV lanes	HOV lane person movements during peak hour in HOV-restricted period	HOV lane persons per lane per hour	Number of non-HOV lanes	Non-HOV lane person movements during HOV-restricted period	Non-HOV lane persons per lane per hour
I-395 between Va. 120 and Arlington Ridge Rd. 7:30 A.M. to 8:30 A.M.	2	11,000	5,500	4	9,300	2,300
I-95 between Va. 7100 and Va. 7900 5:30 A.M. to 6:30 A.M.	2 *Includes Newington Flyover Ramp*	8,400	4,200	4	6,200	1,600
I-66 between Sycamore St and Fairfax Dr 5:30 A.M. to 6:30 A.M.	2	4,900	2,500	0 *No non-HOV lanes*	N/A	N/A
I-66 between Va. 243 & I-495 5:45 A.M. to 6:45 A.M.	1	3,000	3,000	3	5,100	1,700
Va. 267 west of Va. 7 6:45 A.M. to 7:45 A.M.	1	4,400	4,400	3	5,900	2,000
I-270 between the "split" and Rockledge Dr 7:00 A.M. to 8:00 A.M.	1	2,200	2,200	3	6,100	2,000
I-270 Spur between the "split" & Democracy Blvd 7:00 A.M. to 8:00 A.M.	1 *Includes Westlake Drive Ramp*	1,400	1,400	2	4,400	2,200
I-270 between Montrose Road and the "split" 6:45 A.M. to 7:45 A.M.	1	3,700	3,700	5	10,500	2,100
U.S 50 between Md. 197 and Md. 704 7:30 A.M. to 8:30 A.M.	1	700	700	3	6,400	2,100

Note: All person movements rounded to nearest 100

Table D8: PM Peak Hour Person Movements during HOV-Restricted Periods (Spring 2010)

P.M. peak hour person movements during HOV-restricted periods (Spring 2010)						
Facility And peak hour within HOV-restricted period	Number of HOV lanes	HOV lane person movements during peak hour in HOV-restricted period	HOV lane persons per lane per hour	Number of non-HOV lanes	Non-HOV lane person movements during HOV-restricted period	Non-HOV lane persons per lane per hour
I-395 between Arlington Ridge Rd. and Va. 120 4:30 P.M. to 5:30 P.M.	2	12,800	6,400	4	9,600	2,400
I-95 between Va. 7100 and Va. 7900 6:00 P.M. to 7:00 P.M.	2	6,000	3,000	4	4,200	1,100
I-66 between Fairfax Dr and Sycamore St 6:45 P.M. to 7:45 P.M.	2	4,900	2,500	0 *No non-HOV lanes*	N/A	N/A
I-66 between I-495 & Va. 243 6:15 P.M. to 7:15 P.M.	1	2,400	2,400	3	5,500	1,800
Va. 267 west of Va. 7 5:15 P.M. to 6:15 P.M.	1	4,900	4,900	3	6,500	2,200
I-270 between Rockledge Drive and the "split" 3:45 P.M. to 4:45 P.M.	1	2,000	2,000	2	3,900	2,000
I-270 Spur between Democracy Blvd & the "split" 3:30 P.M. to 4:30 P.M.	1 *Includes Westlake Drive Ramp*	2,600	2,600	2	4,900	2,500
I-270 between the "split" and Montrose Road 3:45 P.M. to 4:45 P.M.	1	4,300	4,300	5	8,500	1,700
U.S 50 between Md. 704 and Md. 197 5:30 P.M. to 6:30 P.M.	1	2,300	2,300	3	5,500	1,800

Note: All person movements rounded to nearest 100

Table D9: Mean AM Peak Period / Peak Direction Travel Times Over Time by Facility

Facility	HOV route travel time (minutes)					Non-HOV route travel time (minutes)					Time Savings (HOV Time - Non-HOV Time)				
	1997	1999	2004	2007	2010	1997	1999	2004	2007	2010	1997	1999	2004	2007	2010
I-95/I-395 (northbound) From Va.234 (Dumfries) to Va. end of 14th St. Bridge HOV route is 28.1 miles	26 (+/- 1)	27 (+/- 1)	29 (+/- 4)	31 (+/- 6)	35 (+/- 8)	65 (+/- 6)	58 (+/- 3)	66 (+/- 15)	82 (+/- 22)	76 (+/- 26)	39	31	37 *	51 *	41 *
I-66 (eastbound) From Va.234 Business (Manassas) to Va. end of T. Roosevelt Bridge HOV route is 27.8 miles	43 (+/- 3)	41 (+/- 8)	53 (+/- 8)	48 (+/- 9)	66 (+/- 17)	71 (+/- 11)	69 (+/- 5)	70 (+/- 14)	76 (+/- 13)	102 (+/- 29)	28	28	17 *	28 *	36 *
Va.267/I-66 (eastbound) From Va.28 to Va. end of T. Roosevelt Bridge HOV route is 23.4 miles HOV route is 23.4 miles	N/ A	31 (+/- 1)	28 (+/- 1)	26 (+/- 2)	47 (+/- 9)	N/ A	51 (+/- 5)	48 (+/- 2)	33 (+/- 5)	77 (+/- 17)	N/ A	20	20 *	7	30
I-270 & East Spur (southbound) From I-370 to Old G'town Road HOV route is 8.8 miles	11 (+/- 1)	18 (+/- 1)	13 (+/- 2)	12 (+/- 4)	12 (+/- 3)	16 (+/- 3)	22 (+/- 4)	19 (+/- 3)	20 (+/- 8)	18 (+/- 3)	5	4	6	8	6
I-270 and West Spur (southbound) From I-370 to S end of I-270 Spur HOV route is 8.6 miles	11 (+/- 2)	16 (+/- 3)	14 (+/- 7)	13 (+/- 3)	12 (+/- 3)	17 (+/- 4)	23 (+/- 3)	22 (+/- 3)	18 (+/- 5)	16 (+/- 5)	6	7	8	5	4
U.S.50 (westbound) From U.S.301/Md.3 to I-95/I-495 HOV route is 9.0 miles	N/ A	N/ A	9 (+/- 0)	7 (+/- 1)	7 (+/- 1)	N/ A	13 (+/- 2)	12 (+/- 2)	8 (+/- 2)	8 (+/- 1)	N/ A	N/ A	3	1	1

Notes:
- Data in table are rounded to whole minutes.
- I-66 (eastbound) non-HOV route uses I-66 to I-495 (southbound) to U.S.50 (eastbound) to I-66 on T. Roosevelt Bridge
- Va.267 (eastbound) HOV route uses Va. 267 to Dulles Connector Road to I-66 (eastbound)
- Va.267 (eastbound) non-HOV route uses Va.267 to I-495 (northbound) to G.Washington Mem. Parkway (southbound) to I-66 on T. Roosevelt Bridge
- All travel time runs on Va.267 (HOV and non-HOV) performed with an EZ-Pass transponder.
- Travel time savings shown with an asterisk (*) are statistically significant at the 95% confidence level using a Tukey Test for 2004-2010. Time savings without an asterisk are not statistically significant.
- Margins of Error computed at 95% confidence level using two-tailed test.

Table D10: Mean PM Peak Period / Peak Direction Travel Times Over Time by Facility

Facility	HOV route travel time (minutes)					Non-HOV route travel time (minutes)					Time Savings (Non-HOV Time - HOV Time)				
	1997	1999	2004	2007	2010	1997	1999	2004	2007	2010	1997	1999	2004	2007	2010
I-95/I-395 (southbound) From Va. end of 14th St. Bridge to south of Va. 234 HOV route is 27.9 miles	26 (+/- 2)	28 (+/- 1)	25 (+/- 0)	33 (+/- 11)	30 (+/- 6)	60 (+/- 6)	64 (+/- 12)	53 (+/- 10)	61 (+/- 23)	73 (+/- 19)	39	31	37 *	28 *	43 *
I-66 (westbound) From Va. end of T. Roosevelt Bridge to Va.234 Business (Manassas) HOV route is 30.7 miles	27 (+/- 1)	32 (+/- 2)	34 (+/- 3)	37 (+/- 8)	44 (+/- 7)	44 (+/- 7)	55 (+/- 11)	56 (+/- 6)	55 (+/- 11)	68 (+/- 12)	28	28	17 *	18 *	24 *
Va.267/I-66 (westbound) From Va. end of T. Roosevelt Bridge to Va.28 HOV route is 24.2 miles	N/ A	31 (+/- 1)	28 (+/- 1)	24 (+/- 1)	27 (+/- 3)	N/ A	51 (+/- 5)	48 (+/- 2)	32 (+/- 3)	42 (+/- 7)	N/ A	20	20	8	15
I-270 & E.Spur (northbound) just north of I-495 to Md. 121 (Clarksburg) HOV route is 18.4 miles	11 (+/- 1)	18 (+/- 1)	13 (+/- 2)	22 (+/- 7)	21 (+/- 3)	16 (+/- 3)	22 (+/- 4)	19 (+/- 3)	29 (+/- 1)	31 (+/- 5)	5	4	6 *	7	10
I-270Y (I-270 Spur) and I-270 (northbound) From I-495 to Md. 121 (Clarksburg) HOV route is 18.5 miles	11 (+/- 2)	16 (+/- 3)	14 (+/- 7)	20 (+/- 2)	19 (+/- 2)	17 (+/- 4)	23 (+/- 3)	22 (+/- 3)	29 (+/- 5)	28 (+/- 4)	6	7	8 *	9	9
U.S.50 (eastbound) From I-95/I-495 to U.S.301/Md.3 HOV route is 8.4 miles	N/ A	N/ A	9 (+/- 0)	7 (+/- 0)	8 (+/- 2)	N/ A	13 (+/- 2)	12 (+/- 2)	8 (+/- 2)	10 (+/- 4)	N/ A	N/ A	3	1	2

Notes:
- Data in table are rounded to whole minutes.
- I-66 (westbound) non-HOV route uses T. Roosevelt Bridge to U.S. 50 (westbound) to I-495 (northbound) to I-66 (westbound)
- Va.267 (westbound) HOV route uses I-66 (westbound) to Dulles Connector Road to Va. 267 (westbound)
- Va.267 (westbound) non-HOV route uses T.Roosevelt Bridge to G.Washington Mem.Parkway (northbound) to I-495 (southbound) to Va.267 (wes
- All travel time runs on Va.267 (HOV and non-HOV) performed with an EZ-Pass transponder.
- Travel time savings shown with an asterisk (*) are statistically significant at the 95% confidence level using a Tukey Test for 2004-2010. Time savings without an asterisk are not statistically significant.
- Margins of Error computed at 95% confidence level using two-tailed test.

Table D11: AM Peak Direction Travel Time Summary for HOV and non-HOV Lanes (Spring 2010)

Facility	Facility Section	Length (miles)	HOV Time (mins.)	Non-HOV Time (mins.)	Time Savings In Minutes	Time Savings in Min./Mi.	Average Speed HOV (MPH)	Average Speed Non-HOV (MPH)
I-95/I-395	From Va. 234 to the Pentagon	27.6	35	76	41	1.5	50	24
	Outside Beltway	*18.0*	*18*	*31*	*13*	*0.7*	*64*	*37*
	Inside Beltway	*9.6*	*17*	*45*	*28*	*2.9*	*36*	*16*
I-66	From Va. 234 (Business) to the T. Roosevelt Bridge	28.8	66	102	36	1.3	31	20
	Outside Beltway	*17.8*	*45*	*57*	*12*	*0.7*	*30*	*24*
	Inside Beltway	*10.5*	*20*	*45*	*25*	*2.4*	*35*	*18*
Va. 267	From Va.28 to to the T. Roosevelt Bridge	23.4	47	77	30	1.3	29	20
	Va. 267 only	*14.9*	*25*	*32*	*7*	0.5	*29*	*25*
I-270	From I-370 to I-495 (passing Md. 187)	8.8	12	18	6	0.7	44	30
	I-270Y (I-270 Spur) From I-370 to I-495 (passing Democracy Blvd.)	8.6	12	16	4	0.5	46	34
U.S. 50	From U.S. 301/Md. 3 to Capital Beltway	9.0	7	8	1	0.1	67	60

Notes:
- Facility Length rounded to nearest 1/10 of a mile
- HOV Times, Non-HOV Times and Time Savings in Minutes rounded to nearest whole minute
- Time Savings rounded to nearest 1/10 of a minute

Table D12: PM Peak Direction Travel Time Summary for HOV and non-HOV Lanes (Spring 2010)

					Time Savings		Average Speed	
Facility	Facility Section	Length (miles)	HOV Time (mins.)	Non-HOV Time (mins.)	In Minutes	in Min./Mi.	HOV (MPH)	Non-HOV (MPH)
I-95/I-395	From The Pentagon to Va. 234	27. 9	30	73	43	1. 5	58	24
	Outside Beltway	*17. 7*	*21*	*55*	*34*	*1. 9*	*56*	*22*
	Inside Beltway	*10. 2*	*9*	*18*	*9*	*0. 9*	*64*	*33*
I-66	From T. Roosevelt Bridge to Va. 234 (Business)	30. 7	44	68	24	0. 8	43	29
	Outside Beltway	*20. 3*	*31*	*39*	*8*	*0. 4*	*42*	*35*
	Inside Beltway	*10. 4*	*13*	*29*	*16*	*1. 5*	*51*	*23*
Va. 267	From the T. Roosevelt Bridge to Va. 28	24. 2	27	42	15	0. 6	47	33
	Va. 267 only	*15. 5*	*17*	*30*	*13*	0. 8	*35*	*32*
I-270	From I-495 (passing Md. 187) to Md. 121 (Clarksburg)	18. 4	21	31	10	0. 5	53	36
	I-270Y (I-270 Spur) From I-495 (passing Democracy Blvd.) to Md. 121 (Clarksburg)	18. 5	19	28	9	0. 5	59	41
U.S. 50	From the Capital Beltway to U.S. 301/Md. 3	8. 4	8	10	2	0. 2	65	58

Notes:
- Facility Length rounded to nearest 1/10 of a mile
- HOV Times, Non-HOV Times and Time Savings in Minutes rounded to nearest whole minute
- Time Savings rounded to nearest 1/10 of a minute

APPENDIX E – SUMMARY OF TRANSPORTATION EMISSION REDUCTION MEASURE (TERM) ANALYSIS FY2009-FY2011

Background

The Transportation Emission Reduction Measures (TERM) Analysis FY 2009-2011 Report[174] presents the results of an evaluation of four TERMs, voluntary Transportation Demand Management (TDM) measures implemented by the National Capital Region Transportation Planning Board's (TPB) Commuter Connections program at the Metropolitan Washington Council of Governments (COG) to support the Washington, DC metropolitan region's air quality conformity determination and congestion management process. This evaluation documents transportation and air quality impacts for the three-year evaluation period between July 1, 2008 and June 30, 2011, for the following TERMs:

- Maryland and Virginia Telework – Provides information and assistance to commuters and employers to further in-home and telecenter-based telework programs.
- Guaranteed Ride Home – Eliminates a barrier to use of alternative modes by providing free rides home in the event of an unexpected personal emergency or unscheduled overtime to commuters who use alternative modes.
- Employer Outreach – Provides regional outreach services to encourage large, private-sector and non-profit employers voluntarily to implement commuter assistance strategies that will contribute to reducing vehicle trips to worksites, including the efforts of jurisdiction sales representatives to foster new and expanded trip reduction programs.
- Mass Marketing – Involves a large-scale, comprehensive media campaign to inform the region's commuters of services available from Commuter Connections as one way to address commuters' frustration about the commute.

COG's National Capital Transportation Planning Board (TPB), the designated Metropolitan Planning Organization (MPO) for the Washington, DC metropolitan region, adopted and continues to support these TERMs, among others, as part of the regional Transportation Improvement Program (TIP) to help the region reach emission reduction targets that would maintain a positive air quality conformity determination for the region and to meet federal requirements for the congestion management process. It is also important to note that the regional travel demand model was calibrated and validated against the year 2000 traffic counts and regional emission credits are only taken for TERM benefits that occurred after the year 2000 in the regional TERM tracking sheet and might not be consistent with results in this report.

COG/TPB's Commuter Connections program, which also operates an ongoing regional rideshare program, is the central administrator of the TERMs noted above. Commuter Connections elected

[174] http://www.mwcog.org/store/item.asp?PUBLICATION_ID=425

to include a vigorous evaluation element in the implementation plan for each of the adopted TERMs to develop information to be used to guide sound decision-making about the TERMs. This report summarizes the results of the TERM evaluation activities and presents the transportation and air quality impacts of the TERMs and the Commuter Operations Center (COC).

This evaluation represents a quite comprehensive evaluation for these programs. It should be noted that the evaluation still remains conservative in the sense that it includes credit only for impacts that can be reasonably documented with accepted measurement methods and tools. However, we also note that many of the calculations used survey data from surveys that are subject to statistical error rates.

A primary purpose of this evaluation was to develop useful and meaningful information for regional transportation and air quality decision-makers, COG/TPB staff, COG/TPB program funding agencies, and state and local commute assistance program managers to guide sound decision-making about the TERMs. The results of this evaluation will provide valuable information for regional air quality conformity and the region's congestion management process, improve the structure and implementation procedures of the TERMs themselves, and to refine future data collection methodologies and tools.

Summary of Results

The objective of the evaluation is to estimate reductions in vehicle trips (VT), vehicle miles traveled (VMT), and tons of vehicle pollutants (Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC), Particulate Matter (PM2.5), Particulate Matter NOx precursors (PM_NOx), and Carbon Dioxide (CO2)) resulting from implementation of each TERM and compare the impacts against the goals established for the TERMs. The impact results for these measures are shown in Table E1 for each TERM individually. Results for all TERMs collectively and for the Commuter Operations Center (COC) are presented in Table E2.

As shown in Table E1, the TERMs combined exceeded the collective goals for both vehicle trips reduced and VMT reduced by about 21%. The TERMs did not reach the emission goals; the impact for NOx was about 15% under the goal and VOC impact was 12% under the goal, but this was due entirely to a change in the emission factors. The goals were set in 2006, using 2006 emission factors, but the 2011 factors used in the 2011 evaluation were considerably lower.

When the COC results are added to the TERM impacts, as presented in Table E2, the combined impacts again met both the vehicle trip and VMT reduction goals, in this case by 15% and 12% respectively. The combined TERM – COC programs fell about 21% short of the NOx goal and 18% under the VOC goal. Again, the change in the emission factors affected the emission results.

Two TERMs, Telework and Employer Outreach, met their individual participation and travel impact goals. Telework exceeded its vehicle trip reduction goal by about five percent and just met the VMT goal. Employer Outreach, both the overall program and the New/Expanded component, exceeded its vehicle trip and VMT goals by a margin substantial enough to overcome the difference between the 2006 and 2011 emission rates; Employer Outreach met all the emission goals as well as the travel goals. Employer Outreach for Bicycling also met its goals.

The Mass Marketing (MM) TERM came within 10% of its vehicle trip reduction goals, but was substantially under the goal for VMT reduction, primarily because 2011 Mass Marketing program participants traveled much shorter distances to work (9.6 miles one-way) than did 2008 MM participants (31 miles). In 2011, MM influenced a greater share of commuters to shift to bicycle and transit, both of which have short-distance travel profiles. Thus, even with robust participation and vehicle trip reduction, the TERM missed the VMT goal.

Finally, impacts for Guaranteed Ride Home were well below the goals for this program. The Commuter Operations Center and the Software Upgrades TERM also missed their goals. The reasons for the shortfalls from the goals vary by TERM and are discussed in individual report sections on each TERM.

Table E1: Summary of Daily Impact Results for Individual TERMs (7/08– 06/11) and Comparison to Goals

TERM	Participation [1)]	Daily Vehicle Trips Reduced	Daily VMT Reduced	Daily Tons NOx Reduced	Daily Tons VOC Reduced
Maryland and Virginia Telework [2)]					
2011 Goal	31,854	11,830	241,208	0.122	0.072
Impacts (7/08 – 6/11)	35,237	12,499	241,834	0.099	0.062
Net Credit or (Deficit)	**3,383**	**669**	**626**	**(0.023)**	**(0.011)**
Guaranteed Ride Home					
2011 Goal	36,992	12,593	355,136	0.177	0.097
Impacts (7/08 – 6/11)	22,984	7,983	208,346	0.076	0.042
Net Credit or (Deficit)	**(14,008)**	**(4,610)**	**(146,790)**	**(0.101)**	**(0.055)**
Employer Outreach – all employers participating [3)]					
2011 Goal	581	64,644	1,065,851	0.549	0.343
Impacts (7/08 – 6/11)	1,119	90,350	1,657,809	0.578	0.367
Net Credit or (Deficit)	538	**25,706**	**591,958**	**0.029**	**0.024**
Employer Outreach – new / expanded employer services since July 2008 [3)]					
2011 Goal	96	8,618	140,622	0.072	0.046
Impacts (7/08 – 6/11)	551	28,098	461,250	0.177	0.108
Net Credit or (Deficit)	**455**	**19,480**	**320,628**	**0.105**	**0.062**
Employer Outreach for Bicycling [3)]					
2011 Goal	61	130	567	0.001	0.001
Impacts (7/08 – 6/11)	274	180	1,083	0.001	0.001
Net Credit or (Deficit)	**213**	**50**	**516**	**0.000**	**0.000**
Mass Marketing					
2011 Goal	11,023	7,758	141,231	0.072	0.044
Impacts (7/08 – 6/11)	10,438	6,922	78,297	0.031	0.021
Net Credit or (Deficit)	**(585)**	**(836)**	**(62,934)**	**(0.041)**	**(0.023)**
TERMS (all TERMs collectively)					
2011 Goal		96,825	1,803,426	0.920	0.556
Impacts (7/08 – 6/11)		117,754	2,186,286	0.784	0.492
Net Credit or (Deficit)		**20,929**	**382,860**	**(0.136)**	**(0.064)**

1) Participation refers to number of commuters participating, except for the Employer Outreach TERM. For this TERM, participation equals the number of employers participating.

2) Impact represents portion of regional telework attributable to TERM-related activities. Total telework credited for conformity is higher than reported for the TERM.

3) Impacts for Employer Outreach - all employers participating includes impacts for Employer Outreach – new / expanded employer services since July 2008 and for Employer Outreach for Bicycling.

Table E2: Summary of TERM and COC Results (7/08 – 6/11) and Comparison to Goals

TERM	Participation [1)]	Daily Vehicle Trips Reduced	Daily VMT Reduced	Daily Tons NOx Reduced	Daily Tons VOC Reduced
TERMS (all TERMs collectively)					
2011 Goal		96,825	1,803,426	0.920	0.556
Impacts (7/08 – 6/11)		117,754	2,186,286	0.784	0.492
Net Credit or (Deficit)		**20,929**	**382,860**	**(0.136)**	**(0.064)**
Commuter Operations Center – Basic Services [2)]					
2011 Goal	152,356	10,399	296,635	0.147	0.081
Impacts (7/08 – 6/11)	81,675	6,190	180,409	0.066	0.036
Net Credit or (Deficit)	(70,681)	**(4,209)**	**(116,226)**	**(0.081)**	**(0.045)**
Commuter Operations Center – Software Upgrades [2)]					
2011 Goal		2,370	62,339	0.031	0.017
Impacts (7/08 – 6/11)	3,373	1,717	51,569	0.020	0.010
Net Credit or (Deficit)		**(653)**	**(10,770)**	**(0.012)**	**(0.007)**

All TERMS plus COC					
2011 Goal		109,594	2,162,400	1.098	0.654
Impacts (7/08 – 6/11)		125,661	2,418,264	0.870	0.538
Net Credit or (Deficit)		**16,067**	**255,864**	**(0.228)**	**(0.116)**

1) Participation refers to number of commuters participating, except for the Employer Outreach TERM. For this TERM, participation equals the number of employers participating.

2) Impacts for Commuter Operations Center – software Upgrades are in addition to the impacts for the Commuter Operations Center – Basic Services. This project was part of the Integrated Rideshare TERM.

Table E3, on the following page, presents annual emission reduction results for PM 2.5, PM 2.5 pre-cursor NOx, and CO2 emissions (Greenhouse Gas Emissions - GHG) for each TERM and for the COC. COG/TPB did not establish specific targets for these impacts for the Commuter Connections TERMs. But COG has begun to measure these impacts for other TERMs, thus these results are provided.

As shown, the TERMs collectively reduce 6.43 annual tons of PM 2.5, 223.1 annual tons of PM 2.5 precursor NOx, and 254,277 annual tons of CO2 (greenhouse gas emissions). When the Commuter Operations Center is included, these emissions impacts rise to 7.1 annual tons of PM 2.5, 246.4 annual tons of PM 2.5 pre-cursor NOx, and 282,001 annual tons of CO2 (greenhouse gas emissions).

Table E3: Summary of Annual PM 2.5 and CO2 (Greenhouse Gas) Emission Results for Individual TERMs

TERM	Annual Tons PM 2.5 Reduced	Annual Tons PM 2.5 Precursor NOx Reduced	Annual Tons CO2 Reduced
Maryland and Virginia Telework [1)]	0.8	27.0	30,770
Guaranteed Ride Home	0.7	22.2	26,272
Employer Outreach – all employers [2)]	4.7	165.5	189,976
Employer Outreach – new / expanded Employers [2)]	1.4	48.5	55,584
Employer Outreach for Bicycling	0.0	0.1	138
Mass Marketing	0.2	8.4	9,259
TERMS (all TERMs collectively)	6.4	223.1	254,277
Commuter Operations Center – basic services (not including Software Upgrades)	0.5	18.0	21,393
Commuter Operations Ctr – Software Upgrades	0.2	5.3	6,331
All TERMs plus Commuter Operations Center	7.1	246.4	282,001

1) Impact represents portion of regional telecommuting attributable to TERM-related activities. Total telecommuting credited for conformity is higher than reported for the TERM.

2) Impacts for new / expanded employer programs and Employer Outreach for Bicycling are included in the Employer Outreach – all employers.

Finally, Table E4 shows comparisons of daily reductions in vehicle trips, VMT, NOx, and VOC from the 2008 TERM analysis to results of the 2011 results. Note that, as described in the footnotes to the table, the emission factors declined between 2008 and 2011, resulting in decreased emission reductions, even though the TERMs achieved greater vehicle trip and VMT reductions in 2011.

Table E4: Summary of Results for Individual TERMs 7/08– 6/11 Compared to 7/05 – 6/08

TERM	Daily Vehicle Trips Reduced	Daily VMT Reduced	Daily Tons NOx Reduced	Daily Tons VOC Reduced
Maryland and Virginia Telework				
July 2008 – June 2011	12,499	241,834	0.099	0.062
July 2005 – June 2008	21,866	413,703	0.211	0.126
Change [1]	(9,367)	(171,869)	(0.112)	(0.064)
Guaranteed Ride Home				
July 2008 – June 2011	7,983	208,346	0.076	0.042
July 2005 – June 2008	8,680	227,428	0.106	0.056
Change [1]	(697)	(19,082)	(0.030)	(0.014)
Employer Outreach – All services except Employer Outreach for Bicycling				
July 2008 – June 2011	90,170	1,656,727	0.577	0.366
July 2005 – June 2008	59,163	969,174	0.443	0.266
Change [1]	31,007	687,553	0.134	0.100
Employer Outreach for Bicycling				
July 2008 – June 2011	180	1.083	0.001	0.001
July 2005 – June 2008	188	1,127	0.001	0.001
Change [1]	(8)	(44)	0.000	0.000
Mass Marketing				
July 2008 – June 2011	6,922	78,297	0.031	0.021
July 2005 – June 2008	2,577	69,274	0.032	0.017
Change [1]	4,345	9,023	(0.001)	0.004
InfoExpress Kiosks [2]				
July 2008 – June 2011	Deleted	Deleted	Deleted	Deleted
July 2005 – June 2008	2,840	52,638	0.027	0.016
Change [1]	N/A	N/A	N/A	N/A
All TERMs				
July 2008 – June 2011	117,754	2,186,287	0.784	0.492
July 2005 – June 2008	95,314	1,733,344	0.820	0.482
Change [1]	22,440	452,943	(0.036)	0.010
Commuter Operations Center (Basic Services + Software Upgrades)				
July 2008 – June 2011	7,907	231,978	0.086	0.046
July 2005 – June 2008	22,473	721,678	0.320	0.158
Change [1]	(14,566)	(489,700)	(0.234)	(0.112)

1) Change in emissions is due in part to reduction in emission factors from 2008 to 2011.
2) InfoExpress Kiosks TERM eliminated prior to July 2008 – no longer in TERM calculation.

APPENDIX F – SAMPLE CMP DOCUMENTATION FORM

Congestion Management Documentation Form for Projects in the 2040 CLRP

BASIC PROJECT INFORMATION

1. Agency: Secondary Agency:

2. Project Title:

	Prefix	Route	Name	Modifier
4. Facility:				
5. From (_ at):				
6. To:				

7. Jurisdiction(s):

8. Indicate whether the proposed project's location is subject to or benefits significantly from any of the following in-place congestion management strategies:

_ Metropolitan Washington Commuter Connections program (ridesharing, telecommuting, guaranteed ride home, employer programs)

_ A Transportation Management Association is in the vicinity

_ Channelized or grade-separated intersection(s) or roundabouts

_ Reversible, turning, acceleration/deceleration, or bypass lanes

_ High occupancy vehicle facilities or systems

_ Transit stop (rail or bus) within a 1/2 mile radius of the project location

_ Park-and-ride lot within a one-mile radius of the project location

_ Real-time surveillance/traffic device controlled by a traffic operations center

_ Motorist assistance/hazard clearance patrols

_ Interconnected/coordinated traffic signal system

_ Other in-place congestion management strategy or strategies (briefly describe below:)

9. List and briefly describe how the following categories of (additional) strategies were considered as full or partial alternatives to single-occupant vehicle capacity expansion in the study or proposal for the project.

a. Transportation demand management measures, including growth management and congestion pricing

b. Traffic operational improvements

c. Public transportation improvements

d. Intelligent Transportation Systems technologies

e. Other congestion management strategies

f. Combinations of the above strategies

10. Could congestion management alternatives fully eliminate or partially offset the need for the proposed increase in single-occupant vehicle capacity? Explain why or why not.

11. Describe all congestion management strategies that are going to be incorporated into the proposed highway project.

12. Describe the proposed funding and implementation schedule for the congestion management strategies to be incorporated into the proposed highway project. Also describe how the effectiveness of strategies implemented will be monitored and assessed after implementation.

APPENDIX G – REVIEW OF CONGESTION MANAGEMENT STRATEGIES

This appendix references the Table 14 and Table 15 on pages 188 and 189, which are repeated on the next two pages for convenience.

GENERAL CHARACTERISTICS

Strategy Name and Number:

The strategies down the left-hand side of the lists were developed based on the types of strategies being pursued in the region and elsewhere, and could be considered for implementation in our region. Inclusion of any given strategy on the list does not imply endorsement, but rather is included on the list only for consideration and comparison purposes.

Each strategy has a number associated with it (C.1.0, C.1.1, etc.) to make it easier to find and discuss the strategies. The number is not in any way a ranking.

Those listed in bold italics are the strategy categories and underneath them are the specific strategies in that category.

Table G1: Congestion Management Process (CMP) Demand Management Strategies Criteria

1. Some Impact (x)
2. Significant Impact (xx)
3. High Impact (xxx)

		QUALITATIVE CRITERIA									
		Impacts on Congestion									
STRATEGY		Reduces Overall Congestion	Reduces Incident-related Congestion	Supports/Promotes Multi-modal Transportation	Regional Applicability	Local Applicability	Existing Level of Deployment	Ease of Implementation	Cost	Cost Effectiveness	Enhance Existing Programs
C.5.0	***Alternative Commute Programs***										
C.5.1	Carpooling	xxx	x	x	xxx	xxx	xxx	xx	x	xxx	xxx
C.5.2	Ridematching Services	xxx	x	x	xxx	xxx	xxx	xx	x	xxx	xxx
C.5.3	Vanpooling	xxx	x	x	xxx	xx	xx	xx	x	xxx	xxx
C.5.4	Telecommuting	xx	x	x	xxx	xx	xx	xxx	x	xx	xxx
C.5.5	Promote Alternate Modes	xx	x	xxx	xxx	xxx	xxx	xxx	x	xx	xxx
C.5.6	Compressed/flexible w orkw eeks	xx	x	x	xxx	xxx	xxx	xxx	x	x	xx
C.5.7	Employer outreach/mass marketing	xx	x	xxx	xxx	xxx	xx	xx	xx	xx	xxx
C.5.8	Parking cash-out	xx	x	xxx	x	xxx	x	x	xx	xx	x
C.5.9	Alternative Commute Subsidy Program	xx	x	xxx	xxx	xx	xx	x	x	xxx	xxx
C.6.0	***Managed Facilities***										
C.6.1	HOV	xx	x	xxx	xxx	xx	xx	xx	xxx	xxx	xxx
C.6.2	Variably Priced Lanes (VPL)	xxx	x	xx	xxx	xx	x	x	xxx	xxx	xx
C.6.3	Cordon Pricing	xxx	x	xxx	xxx	x	x	x	xx	xxx	xx
C.6.4	Bridge Tolling	xxx	x	x	xx	xx	x	x	xxx	xx	x
C.7.0	***Public Transportation Improvements***										
C.7.1	Electronic Payment Systems	xx	x	xxx	xx	xx	xxx	xx	xx	xxx	xx
C.7.2	Improvements/added capacity to regional rail and bus transit	xx	xx	xxx	xx	xxx	xx	x	xxx	xxx	xx
C.7.3	Improving accessibility to multi-modal options	xx	x	xxx	xx	xxx	xx	xx	xx	xx	xxx
C.7.4	Park-and-ride lot improvements	xx	x	xx	xx	xx	xx	xx	xx	xx	xx
C.7.5	Carsharing Programs	xx	x	xxx	xxx	xxx	xx	xxx	xx	xx	xxx
C.8.0	***Pedestrian, bicycle, and multi-modal improvements***										
C.8.1	Improve pedestrian facilities	xx	x	xxx	xx	xxx	xx	xx	xx	xx	xxx
C.8.2	Creation of new bicycle and pedestrian lanes and facilities	xx	x	xxx	xxx	xxx	xx	xx	xx	xx	xxx
C.8.3	Addition of bicycle racks at public transit stations/stops	x	x	xx	xxx	xxx	xx	xxx	x	x	xxx
C.8.4	Bike sharing programs	xx	x	xxx	xxx	xxx	xx	xxx	xx	xx	xxx
C.9.0	***Growth Management***										
C.9.1	Coordination of Regional Activity Centers	xx	x	xxx	xxx	xxx	xx	x	xxx	xxx	xx
C.9.2	Implementation of TLC program (i.e. coordination of transportation and land use w ith local gov'ts)	xx	x	xxx	xxx	xxx	xx	xxx	x	xxx	xxx
C.9.3	"Live Near Your Work" program	xx	x	xx	xxx	xx	x	xx	x	x	xx

Table G2: Congestion Management Process (CMP) Operational Management Strategies Criteria

1. Some Impact (x)
2. Significant Impact (xx)
3. High Impact (xxx)

		QUALITATIVE CRITERIA									
		Impacts on Congestion									
STRATEGY		Reduces Overall Congestion	Reduces Incident-related Congestion	Supports/Promotes Multi-modal Transportation	Regional Applicability	Local Applicability	Existing Level of Deployment	Ease of Implementation	Cost	Cost Effectiveness	Enhance Existing Programs
C.1.0	***Incident Mngt./Non-recurring***										
C.1.1	Imaging/Video for surveillance and Detection	xx	xxx	xx	xxx	xxx	xx	xx	xx	xxx	xxx
C.1.2	Service patrols	xx	xxx	x	xxx	xxx	xx	xxx	xx	xxx	xxx
C.1.3	Emergency Mngt. Systems (EMS)	x	xx	x	xx	xxx	xxx	xx	xxx	xxx	xxx
C.1.4	Emergency Vehicle Preemption	x	xx	x	x	xxx	xx	xx	xx	x	xx
C.1.5	Road Weather Management	x	xxx	x	xxx	xxx	xx	xx	xx	xx	xx
C.1.6	Traffic Mngt. Centers (TMCs)	xx	xxx	xx	xxx	xx	xx	xx	xx	xxx	xxx
C.1.7	Curve Speed Warning System	xx	xx	x	x	xx	x	xx	xx	xx	x
C.1.8	Work Zone Management	xx	xxx	x	xx	xxx	xx	xx	xx	xx	xx
C.1.9	Automated truck rollover systems	x	xx	x	x	xx	xx	xx	xx	xx	xx
C.2.0	***ITS Technologies***										
C.2.1	Advanced Traffic Signal Systems	xxx	xx	xx	xxx	xxx	xx	xx	xxx	xxx	xxx
C.2.2	Electronic Payment Systems	xxx	x	xx	xxx	xx	xx	xx	xx	xxx	xx
C.2.3	Freew ay Ramp Metering	xx	x	x	xx	xx	x	xx	xx	xx	xx
C.2.4	Bus Priority Systems	x	x	xxx	xxx	xxx	x	xx	xxx	xx	xx
C.2.5	Lane Management (e.g. Variable Speed Limits)	xx	xx	x	xx	xxx	x	xx	xx	xx	xx
C.2.6	Automated Enforcement (e.g. red light cameras)	x	x	x	x	xxx	xx	xx	xx	xx	xx
C.2.7	Traffic signal timing	xxx	x	xx	xxx	xxx	xx	xxx	x	xxx	xxx
C.2.8	Reversible Lanes	xx	x	x	xx	xxx	x	x	xx	xx	xx
C.2.9	Parking Management Systems	xx	x	xx	xx	xxx	x	x	xxx	xx	xx
C.2.10	Dynamic Routing/Scheduling	xx	x	xx	xxx	xxx	x	x	xxx	xx	xx
C.2.11	Service Coordination and Fleet Mngt. (e.g. buses and trains sharing real-time information)	xx	x	xxx	xxx	xxx	x	x	xx	xx	xx
C.2.12	Probe Traffic Monitoring	xx	xxx	x	xx	xx	x	xx	xx	xxx	xx
C.3.0	***Advanced Traveler Information Systems***										
C.3.1	511	xx	xxx	xx	xxx	x	xx	xx	xxx	xx	xxx
C.3.2	Variable Message Signs (VMS)	xx	xxx	xx	xx	xxx	xx	xx	xx	xxx	xxx
C.3.3	Highw ay Advisory Radio (HAR)	x	xx	x	xx	xxx	xx	xxx	xx	x	xx
C.3.4	Transit Information Systems	xx	xx	xxx	xx	xxx	xx	x	xx	xx	xxx
C.4.0	***Traffic Engineering Improvements***										
C.4.1	Safety Improvements	x	xxx	x	x	xxx	xx	xxx	x	xxx	xxx
C.4.2	Turn Lanes	xx	x	x	x	xxx	xx	xx	xx	xx	x
C.4.3	Roundabouts	x	xx	x	x	xxx	x	x	x	xx	xx

Qualitative Criteria:

The qualitative criteria listed across the top of the lists are used to show what kind of impact strategies have on various areas. The first three criteria listed are all impacts on congestion. However, there are several other criteria that could be looked at to determine if a strategy should be considered. The following is a definition of each criterion, and the questions we may want to ask when giving each strategy a "high," "medium," or "low" indicator:

- ***Reduces Overall Congestion***
  - How much of an impact does a strategy have in reducing overall traffic congestion?
- ***Reduces Incident-related Congestion***
  - How much of an impact does a strategy have in reducing incidents and incident-related congestion?
- ***Support/Promotes Multi-modal Transportation***
  - Does this strategy play a particular role in supporting multi-modal transportation, such as the use of bus, rail, bicycling, or pedestrian facilities?
- ***Regional Applicability***
  - Is this the type of strategy that would be easier to implement at the regional level (e.g. alternative commute programs across the region)?
- ***Local Applicability***
  - Is this the type of strategy that would be easier to implement at the local level (e.g. Automated Enforcement, which depends greatly on the local laws and law enforcement)?
- ***Existing Level of Deployment***
  - Is this strategy implemented anywhere in the region now, and if so, to what extent?
- ***Ease of Implementation***
  - How easy is the strategy to implement? Not only in terms of complexity, but in also in terms of funding, and a local jurisdiction's unique programs and laws. Some strategies are more common and more promising, while others may be more difficult to implement.
- ***Cost***
  - How much does a strategy cost to implement?
- ***Cost Effectiveness***
  - How much does the value outweigh the cost (i.e. how high are the benefits)? This is different than the previous "cost" category. For example, carpooling may be indicated as low in terms of cost, because the cost is generally low to implement. However, carpooling may be indicated as high in terms of cost effectiveness, because the benefits and value gained in the region far outweigh the cost.
- ***Enhance Existing Programs***
  - How well does this strategy fit in with existing strategies in the region? Is it new and something that existing strategies would benefit from? This category, previously broken down into "DC," "MD," and "VA," was collapsed into one category. It was found that when trying to determine if a strategy enhanced existing programs, there was not much variation among the jurisdictions.

Some, Significant, and High Indicators:

Each strategy was given an indicator of “some impact (x),” “significant impact (xx),” or “high impact (xxx),” which was based on a similar nomenclature used in the TERM process. Each indicator was developed from the knowledge and research of what sorts of activities are going on in our region. By nature of various strategies, some will be evaluated with greater or lesser impacts (e.g. a strategy may be listed as “low” for regional applicability but “high” for local applicability”). That being said, some strategies that are “low” in some categories may be of interest for other reasons.

To further explain and clarify the reason for these indicators, let’s walk through the indicators of one strategy, *C.8.1 – Improve Pedestrian Facilities*:

- Improving pedestrian facilities was thought to have a medium impact on reducing overall congestion in the region. Improving pedestrian facilities provides an alternative mode of transportation and takes some cars off the road.
- Its contribution to reducing incident-related congestion is limited; therefore it is indicated low in that category.
- Improving pedestrian facilities greatly support and promote multi-modal transportation, therefore indicated high.
- It is something that can be implemented region-wide, but is more likely to be applied more on a local level, given the unique programs and laws of jurisdictions (thus a medium indicator for regional applicability and a high indicator for local applicability).
- It has a fairly good existing level of deployment across the region (although given the high demand for pedestrian facilities in this region, some areas are lacking facilities).
- Ease of implementation for improving pedestrian facilities could be less expensive than building new roadways, and it could be easier to implement than ITS technologies. However, challenges such as local approval, and demand for these facilities, still remain. Indicator: medium.
- Cost is neither extremely low nor especially high, and it really depends on what type of pedestrian facility is being implemented. Cost effectiveness was indicated medium, as pedestrian facilities provide a good benefit for what it costs to implement them.
- Improvement of pedestrian facilities enhance existing programs. Pedestrian facilities support local growth management plans and provide access to transit options. Indicator: high.

Tying It All Together:

The strategy long lists are important to the regional CMP for several reasons:

- The lists outline various existing and potential strategies that could be considered for our region. As congestion is becoming and epidemic here and elsewhere, these strategies will serve as a point of reference to indicate what is being done in this region to address this.
- The “high,” “medium,” and “low” indicators characterize the impact strategies have. They provide a starting point for discussion show that there are various reasons why one

may want to implement a strategy. While something may have a high cost, it may also have a high impact on reducing congestion and a high cost effectiveness.

- The lists address federal requirements, which state that the region should identify and evaluate anticipated performance and expected benefits of existing strategies.

As the region continues to grow these are just some of the strategies that could be considered for our region. Many strategies on these lists are ongoing and will continue to be implemented on a greater scale. For other strategies these lists may act as a starting point for future consideration. Regardless, congestion management strategies will be at the forefront of discussion as the Washington region continues to be a dynamic living and working environment.

DETAILED DESCRIPTIONS OF STRATEGIES

Following is a list of congestion management strategies listed in the Strategy Long Lists. The numbers correspond with the numbered strategies in the list.

Operational Management Strategies:

C.1.0 - Incident Management./Non-recurring - This category of strategies are aimed at reducing non-recurring congestion; congestion caused primarily by incidents and events. Many of these incident management systems are aimed at clearing an incident so that traffic can resume its normal flow.

- *C.1.1 – Imaging/Video for Surveillance and Detection*
    - Cameras throughout our transportation system, on roadways, at intersections, and at transit stations. Help detect incidents quickly, help emergency response units arrive quickly and help travelers safely negotiate around incidents.
- *C.1.2 – Service Patrols*
    - Specially equipped motor vehicles and trained staff that help in clearing incidents off a roadway and navigating traffic safely around an incident.
- *C.1.3 – Emergency Management Systems (EMS)*
    - EMS notify, dispatch, and guide emergency responders to an incident. Aid in detecting, tracking, and clearing incidents.
- *C. 1.4 – Emergency Vehicle Preemption*
    - Signal preemption for emergency vehicles use sensors to detect and emergency vehicle and provide a green signal to the vehicle. This is important to incident management in that it allows for emergency vehicles to get to the scene of and incident and clear it so that traffic can resume its normal flow.
- *C.1.5 – Road Weather Management*
    - Can take the forms of information dissemination, response and treatment, surveillance monitoring, and prediction, and traffic control. Helps prevent incidents due to inclement weather (snow, ice).
- *C.1.6 – Traffic Management Centers (TMCs)*
    - Centers that collect and analyze traffic data and then disseminate data to the public. Data collection elements might include CCTVs, cameras, and loop detectors. Might relay information to the public through radio, TV, or the Internet. This is important to the public, as it allows them to get information about existing traffic conditions and plan their route and timing accordingly.

- *C.1.7 – Curve Speed Warning System*
    - GPS and digital devices on a highway that assess and detect the threat of vehicles moving toward a curve too quickly. This is important in preventing incidents and thus preventing non-recurring congestion.
- *C.1.8 – Work Zone Management*
    - Can take the form of traffic workers, signs, and temporary road blockers used to direct traffic during an incident or construction. The temporary implementation of traffic management or incident management capabilities can help direct the flow of traffic, keep traffic moving, and prevent additional incidents.
- *C.1.9 – Automated truck rollover systems*
    - Detectors deployed on ramps to warn trucks if they are about to exceed their rollover threshold. If the data concludes a truck's maximum safe speed is to be exceeded around a turn, then a message sign would flash, "TRUCKS REDUCE SPEED." This is important in preventing incidents caused by large trucks, and thus preventing non-recurring congestion.

C.2.0 – ITS Technologies – This category of strategies can be defined as electronic technologies and communication devices aimed at monitoring traffic flow, detecting incidents, and providing information to the public and emergency systems on what is happening on our roadways and transit communities. Much of what is done with ITS helps in reducing non-recurring and incident-related congestion, and works hand-in-hand with those strategies listed in the above category (C.1.0).

C.2.1 – Advanced Traffic Signal Systems
    - The coordination of traffic signal operation in a jurisdiction, or between jurisdictions. This is important to congestion, as it reduces delay and improves travel times.
- *C.2.2 – Electronic Payment Systems*
    - These systems can make transit use more convenient by allowing a user to pay for bus, rail, park-and-ride lots, and other transit services with one card. Convenience an appealing factor, and helps increase transit ridership and transfers among different transit modes.
- *C.2.3 – Freeway Ramp Metering*
    - Traffic signals on freeway ramps that alternate between red and green to control the flow of vehicles entering the freeway. This prevents incidents that may occur from vehicles entering the freeway too quickly, and also prevents a backup of traffic on the on-ramp.
- *C.2.4 – Bus Priority Systems*
    - Bus priority systems are sensors used to detect approaching transit vehicles an alter signal timings to improve transit performance. For example, some systems extend the duration of green signals for public transportation vehicles when necessary. This is important because improved transit performance, including a more precisely predicted time for bus arrivals, makes public transit a more appealing option for travelers.
- *C.2.5 – Lane Management (e.g. Variable Speed Limits)*

  - Variable Speed Limits are sensors used to monitor prevailing weather or traffic conditions, and message signs posting enforceable speed limits. These systems can promote the most effective use of available capacity during emergency evacuations, incidents, construction, and a variety of other traffic and/or weather conditions.
- *C.2.6 – Automated Enforcement (e.g. red light cameras)*
  - Still or video cameras that monitor things such as speed, ramp metering, and the running of red lights, to name a few. They are important to preventing non-recurring and incident related congestion.
- *C.2.7 – Traffic Signal Timing*
  - Traffic signal timing plans adjust traffic signals during an incident, during inclement weather, or to improve transit performance. The overall objective is to reduce backups at traffic signals and to increase the level of service.
- *C.2.8 – Reversible Lanes*
  - Traffic sensors and lane control signs reverse the flow of traffic and allow travel in the peak direction during rush hours. This is important to alleviating congestion that may occur in one direction during a peak hour.
- *C.2.9 – Dynamic Routing/Scheduling*
  - Public transportation routing and scheduling can automatically detect a vehicle's location, and dispatching and reservation technologies can facilitate the flexibility of routing/scheduling. This is can help increase the timeliness of public transportation, keep transit on schedule, which in turn increases ridership.
- *C.2.11 – Service Coordination and Fleet Management (e.g. buses and trains sharing real-time information*
  - Monitoring and communication technologies in a vehicle that facilitate the coordination of passenger transfers between vehicles or transit systems. This is important and appealing to passengers that use more than one type of transit.
- *C.2.12 – Probe Traffic Monitoring*
  - Using individual vehicles in the traffic stream to measure the time it takes them to travel between two points and also to report abnormal traffic flow caused by incidents. Tracking could be done with the use of cellular phones, and in the future with the installation of a system in the vehicle which would send information to transportation operators. This is important to monitoring recurring and non-recurring congested locations, and travel time.

C.3.0 – Advanced Traveler Information Systems **–** Provide information to travelers which allow them to adjust the timing of their travels or the route that they take to avoid any incidents, construction, or weather problems.

- *C.3.1 – 511*
  - A variety of applications for travelers to use either before their trip or en-route, such as 511 telephone systems, internet websites, pagers, cell phones, and radio, to obtain up-to-date traveler information. This helps travelers plan their timing and routes accordingly.
- *C.3.2 – Variable Message Signs (VMS)*
  - One way ITS operators can share traffic information with travelers is through a Variable Message Sign (VMS) along the roadway. Such signs could provide

information on road closures, emergency messages, weather message, and construction. This helps travelers plan their timing and routes accordingly. These signs can also prevent incidents from occurring as they provide warnings about speed, weather, construction, etc.

- *C.3.3 – Highway Advisory Radio (HAR)*
  - Another way ITS operators can share traffic information with travelers is through Highway Advisory Radio (HAR). The radio can provide information on road closures, emergency messages, weather, and construction (such as the Woodrow Wilson Bridge Project). Travelers can plan their timing and route accordingly.
- *C.3.4 – Transit Information Systems*
  - Can provide up-to-date transit information, such as arrival times for bus and rail. The WMATA Metrorail display signs depicting arrival times for trains are examples of this. Having this type of information available can increase transit ridership, and can also allow riders to make decisions on what type of transit to use based on up-to-date information.

C.4.0 – Traffic Engineering Improvements **–** Improvements implemented on roadways where congestion problems have occurred in the past or are anticipated to occur in the future. Some of these engineering improvements can be aimed at reducing incidents on a particularly dangerous section of roadway, while others may be attempting to relieve a choke-point or bottleneck.

- *C.4.1 – Safety Improvements*
  - Improvements done to increase safety and reduce incident-related congestion. Examples of some improvements include traffic calming devices, speed bumps, widening or narrowing a roadway, and textured pavement. These safety improvements can prevent incidents and non-recurring congestion resulting from incidents.
- *C.4.2 – Turn lanes*
  - Might be implemented to reduce the queuing of cars waiting to make a right or left turn at an intersection, thus reducing congestion.
- *C.4.3 – Roundabouts*
  - Barriers placed in the middle of an intersection, creating a circle, and thus directing vehicles in the same direction. This can help reduce congestion by slowing the speed of cars on a street and/or preventing thru traffic on a neighborhood street.

Demand Management Strategies:

C.5.0 – Alternative Commute Programs **–** Provides travelers with options other than the single-occupant vehicle. These programs are aimed in reducing the amount of single-occupant vehicles are on our roadways.

- *C.5.1 – Carpooling*
  - Two or more people traveling together in one vehicle. This reduces the amount of vehicles on the road.
- *C.5.2 – Ridematching Services*
  - Enables commuters to find other individuals that share the same commute route and can carpool/vanpool together. This provides carpooling options for people

who may not know of someone to carpool with, thus broadening the carpooling option.

- *C.5.3 – Vanpooling*
    - When a group of individuals (usually long-distance commuters) travel together by van, which is sometimes provided by employers. This reduces the amount of vehicles on the road, which is especially important for long-distance transportation modes.
- *C.5.4 – Telecommuting*
    - Workers either work from home or from a regional telecommute center for one or more days of the week. This reduces the amount of vehicles on the road, especially during rush hour when many commuters are going to work at once.
- *C.5.5 – Promote Alternate Modes*
    - Programs, such as Commuter Connections, or regional Transportation Management Areas (TMAs) provide information to the public on alternative commute programs. This gets the word out about commute options in the region, many who may not have considered alternative commute programs as an option before.
- *C.5.6 – Compressed/flexible workweeks*
    - Employees compressing their work week into a shorter number of days, which allows them to avoid commuting one or more days a week. This reduces the amount of vehicles on the road.
- *C.5.7 – Employer outreach/mass marketing*
    - Organizations, such as Commuter Connections, providing information to employers on the benefits of alternative commute programs for their employees. This allows employers to see the benefits that alternative commute programs can have in their organization.
- *C.5.8 – Parking cash-out*
    - Employees essentially pay their employees not to park at work. The employees receive compensation for the parking space they would have otherwise used if they did not walk, bike, take transit, etc. This encourages more people to leave their car at home in favor of another mode of transportation.
- *C.5.9 – Alternative Commute Subsidy Program*
    - Employees provide a transit subsidy to their employees, which encourages them to use public transit instead of driving to work. This reduces the amount of vehicles on the road.

C.6.0 – Managed Facilities – These facilities have restrictions for use of the roadways. In some cases, only those other than single-occupant vehicles can use the lane or roadway. In other cases, a fee is implemented for single-occupant vehicles. Still, in other case, a fee might be implemented for every car on the roadway entering a city. They all have a common goal of reducing the amount of single-occupant vehicles on the roadways and promoting other forms of transportation.

- *C.6.1 - HOV*

  - High Occupancy Vehicle (HOV) are lanes reserved for vehicles with a driver and one or more passengers. This promotes the use of carpools, which can use a less-congested lane on the highway.
- *C.6.2- Variably Priced Lanes (VPL)*
  - Lanes which are typically used by carpoolers for free, while solo drivers pay tolls that change according to varying congestion levels. This encourages the use of carpooling, but also raises revenue for additional transportation projects that would reduce congestion.
- *C.6.3 – Cordon Pricing*
  - Cordon area congestion pricing is a fee paid by users to enter a restricted area in the city center. This is a way of promoting other alternative modes of transportation, while raising revenue for other transportation projects that would reduce congestion.
- *C.6.4 – Bridge Tolling*
  - Tolling over a bridge, in either one or both directions. This may decrease congestion on a bridge, as people may find an alternative route in lieu of paying the fee. Also, it raises revenue for transportation projects that would help in reducing congestion.

C.7.0 – Public Transportation Improvements – These improvements are done to the region's public transportation to ensure that it remains a safe and viable mode for travelers. Improvements can maintain the amount of users and attract new ones who never considered public transit as an option before.

- *C.7.1 – Electronic Payment Systems*
  - These systems can make transit use more convenient by allowing a user to pay for bus, rail, park-and-ride lots, and other transit services with one card. Convenience an appealing factor, and helps increase transit ridership and ridership between different transit modes.
- *C.7.2 – Improvements/added capacity to regional rail and bus transit*
  - Added capacity and improvements to rail and bus to help keep up with increasing demand on public transportation. This is important in keeping with the growing demand on public transportation as an alternative mode.
- *C.7.3 – Improving accessibility to multi-modal options*
  - Ensuring that connections are provided to multi-modal options, such as bus, rail, and pedestrian and bicycle facilities. More connections makes it easier for people to access multi-modal options, thus increasing use.
- *C.7.4 – Park-and-Ride Lot Improvements*
  - Improvements to park-and-ride lots to keep up with increasing demand and growth in the region. Park-and-Ride lots allow people to access public transportation, who may not be able to access it from their home. Improvements to these lots can ensure that this growing need is met and that people can continue to have transit access.
- *C.7.5 – Carsharing Programs*
  - A convenient and cost-effective mobility option for those that typically do not have a need to own a car. This reduces the amount of cars on the road because

generally the car is only used when needed, and public transportation or other modes are used most of the time.

C.8.0 – Pedestrian, Bicycle, and Multi-modal Improvements – Maintaining and creating new pedestrian, bicycle, and multi-modal facilities is improvement in that it improves accessibility. If something is accessible by a walk or bike path, people are more likely to leave their car at home.

- *C.8.1- Improve Pedestrian Facilities*
    - Improvement and addition of new pedestrian and bicycle facilities to keep up with a growing demand and ensure safety for users. This ensures that those using these facilities will continue to do so, and that potential users will find pedestrian facilities more appealing and accessible.
- *C.8.2 – Creation of new bicycle and pedestrian lanes and facilities*
    - Addition of new lanes to keep up with a growing demand and created new connections throughout the region. This will extend the option of bicycle and pedestrian lanes to those that may not already have access to it, as well as provide increased access to employment, recreation, retail, and housing in the region.
- *C.8.3 – Addition of bicycle racks at public transit stations/stops*
    - Allows people who bike to connect to other forms of transportation. This gives people another option for traveling other than a single-occupant vehicle.
- *C.8.4 – Bike sharing Programs*
    - A convenient and cost-effective mobility option for those that typically do not have a need to own a bicycle. This allows people to shift easily from other forms of transport to bicycle and back again.

C.9.0 – Growth Management – Growth Management is the term used in the Federal Rule, but really this term pertains to ensuring the coordination of transportation and land use. In terms of Growth Management we are talking about making sure that everyone has the option to public transportation and alternative modes no matter where they live or work in the region.

- *C.9.1 – Coordination of Regional Activity Centers*
    - Help coordinate transportation and land use planning in specific areas in the Washington region experiencing and anticipating growth. Focusing growth in Regional Activity Centers is important to congestion management, where transportation options for those who live and work there can be provided.
- *C.9.2 – Implementation of TLC program (i.e. coordination of transportation and land use with local governments).*
    - Provides support and assistance to local governments in the Washington region as they implement their own strategies to improve coordination between transportation and land use. The idea is to provide public transit options to everyone in the region.
- *C.9.3 – "Live Near Your Work" program*
    - Supporting the idea that locating jobs and housing closer together can provide alternative commuting options that may not have been options otherwise.