Council to inform their commentary on this year's State Consolidated Transportation Program (CTP) project priorities. The last version of this report was completed in May of 2008.

Historically, this report has focused on vehicular mobility. In order to describe a more holistic analysis of transportation in the report, pedestrian count, bus movement and other transit data have been identified. These new data sources will become integrated into this mobility report, as the constraints and validity of the data are vetted by Department staff. Broader mobility measurements will therefore be incorporated in the Highway Mobility Report on an ongoing basis.

Changes from 2008 HMR Report

Several changes to the 2008 report format were made in 2009. Beyond vehicular mobility covered in previous HMR reports, this document contains analysis of transit data including Montgomery County Ride On bus and Metrorail information as well as pedestrian crossing counts. A discussion of national, state and local trends in vehicle miles traveled has also been added. Other enhancements to the 2009 HMR include more extensive travel time analysis with greater number of samples along on priority corridors, improving the quality of the data and ensuring that peak travel time is captured, and new traffic counts at roughly 130 key intersections (as identified by MNCPPC staff) which were conducted in support of this report in the late winter and early spring of 2009.

II. CURRENT CONGESTION

Measures of Congestion

The status of congestion on the County's major highway and arterials is a primary indicator of vehicle mobility. For this reason, two key performance measurements were used to report on current congestion; Critical Lane Volumes (CLVs), and GPS-based Arterial Travel Times and Speeds.

Observed Critical Lane Volumes (CLVs): The Department's Intersection Traffic Count Database contains the essential data needed to calculate and identify levels of congestion at signalized intersections throughout the County. The CLV is calculated mathematically using the following variables for a particular intersection: (a) throughput and conflicting movement traffic volume data, (b) geometric configuration information, and (c) traffic signal phasing specifications. This calculation uses the lane configuration and lane use factors for each of the intersection's approach legs to determine the north/south and east/west peak direction flow of traffic, which are also referred to as the "critical movements". The intersection's signal phasing then specifies whether or not the approach traffic on a specific leg of the intersection moves independently from the traffic approaching from the opposite direction. This information is used to determine whether or not a potential turning movement (i.e. left turn) conflict exists. These conflicting movements are taken into consideration for the purpose of calculating the intersection's CLV.

Observed Travel Times and Speeds: During February and March of 2009, roughly 85% of the County's major State highways (excluding roads located in the rural policy areas) were surveyed via GPS-equipped probe vehicles in order to obtain PM peak-period travel time and speed samples. This type of data has been collected for the Department since 2004 for congestion monitoring purposes in various sample sizes. This data continues to be a useful resource in terms of measuring levels of congestion along some of the County's most heavily traveled routes and corridors, and is used to represent the degree of mobility observed along various roadway sections, also referred to as "arterial mobility". Arterial Mobility is determined by comparing the congested travel time along a particular roadway to the uncongested travel time, hence the need to also observe non-peak period travel times and speeds. In

order to economize on the sampling, travel time data was only collected during the PM peak period. As with the 2008 version of the HMR report, calculated travel times, associated with the posted speed limits along a roadway, were used as a proxy to represent the values of uncongested travel time.

Critical Lane Volumes (CLVs at Signalized Intersections)

Description of data parameters

The Intersection Traffic Count database maintained by the MNCPPC Transportation Division contains recent counts for 592 of the 772 (existing and planned) signalized intersections in Montgomery County. Many more counts are archived in the database for historical record. Counts are entered into the system as a mandatory part of the development review process, from counts maintained by the State Highway Administration and via consultant data coordinated with requests made by MNCPPC for special studies including the Highway Mobility Report. Excluding counts that are archived, the oldest count in the database is from March 1, 2001. For the purposes of this report, and in keeping with precedent set in previous HMR reports, intersection counts for the past three years are included in the 2009 HMR. Due to the early date of analysis in 2009 (late winter/early spring) counts were included if they fall between the beginning of fiscal year 2007 (July 1, 2006) and May 2009. The total number of intersection counts analyzed for the 2009 HMR is therefore 360 including the roughly 130 special counts made in support of the HMR during February, March, April and May 2009.

Comparison of CLV data with LATR standards

Intersection CLV to LATR ratios have changed somewhat when compared with 2008 analysis. Data for 2009 indicates a two percent increase in intersections with a ratio above 1.00 (from 14 percent to 16 percent) while intersections with a ratio of 0 – 0.60 exhibited a decline of five percent. The breakdown of intersection CLV to LATR ratios in 2008 was nearly the same as 2006, so the new ratios depicted in Figure 2.2 indicate a change in ratio trends rather than a confirmation of previously observed data. At first glance, the 2009 data seems to be out of synch with known reduction or leveling off of vehicle miles traveled in the County (discussed later in this document) over the past year. A chief contributor to this shift in ratio results is the infusion of 2009 data collected specifically for this report. Following the recommendation of the 2008 HMR, new 2009 counts were taken at 130 intersections, yielding an influx of new data targeted to some of the busiest intersections in the County. Of these 130 intersections, approximately 70 percent have CLV/LATR ratios greater than 0.8, compared with 48 percent in the entire 2006 to 2009 sample.

Figure 2.1 illustrates the location of intersections in the County where the PM peak hour C LV/LATR ratios are above 0.80. Red dots indicate locations where the intersection exceeds the LATR standard, and orange dots indicate locations where the CLV/LATR standard is between 0.80 and 1.00. The size of the dot indicates volume of vehicles passing through the intersection. Intersections that exceed their standard are primarily located along the major arterial corridors (e.g. US 29, Colesville Road/Columbia Pike and MD 355, Wisconsin Ave/Rockville Pike/Hungerford Road/Frederick Road).

Figure 2.1: PM Peak Hour CLV/LATR Ratios by Total Volume

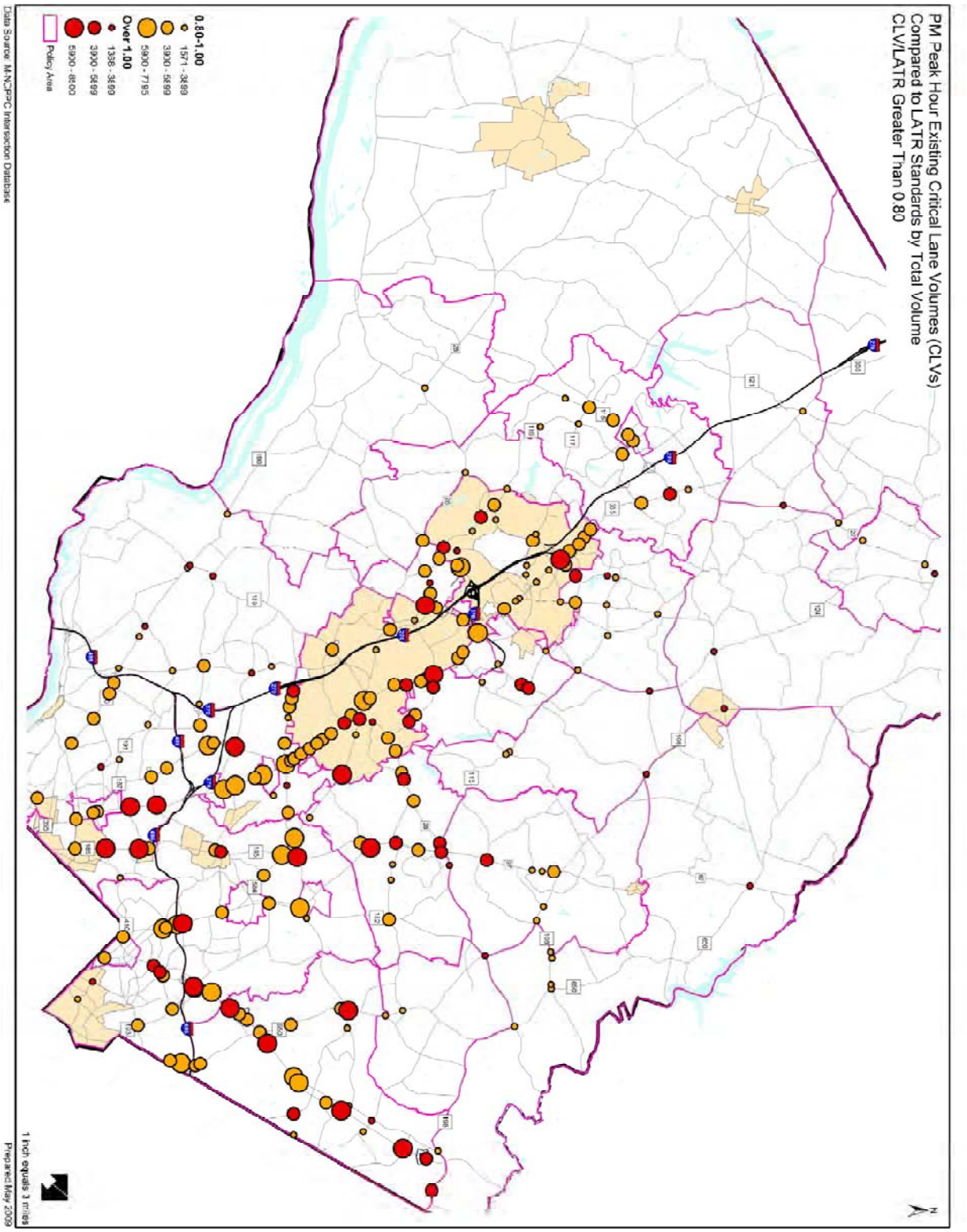


Figure 2.2: CLV/LATR Ratio Categorization (N=360)

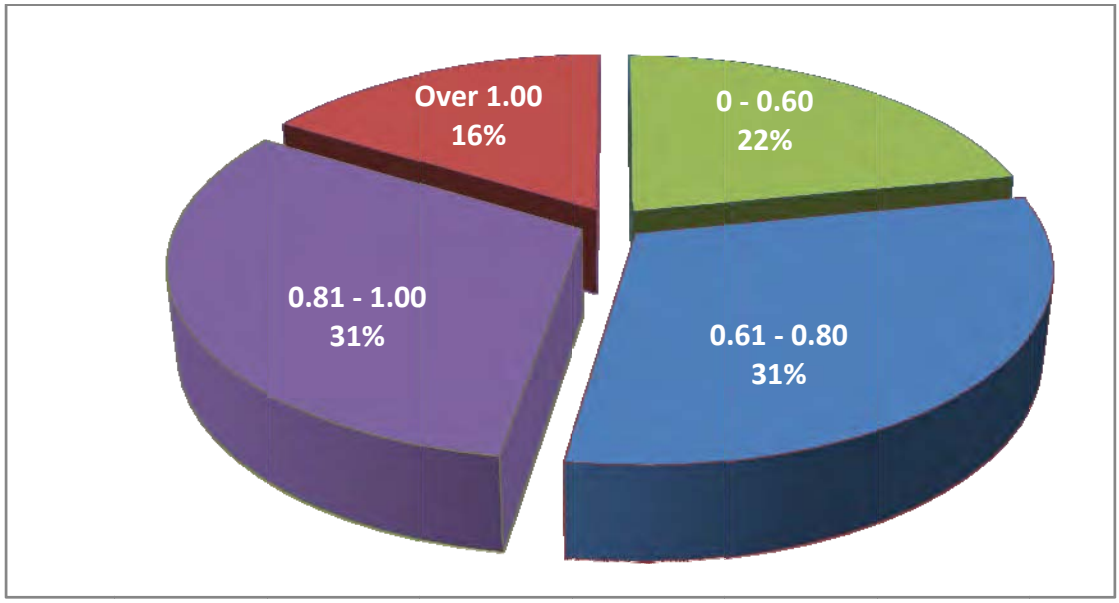
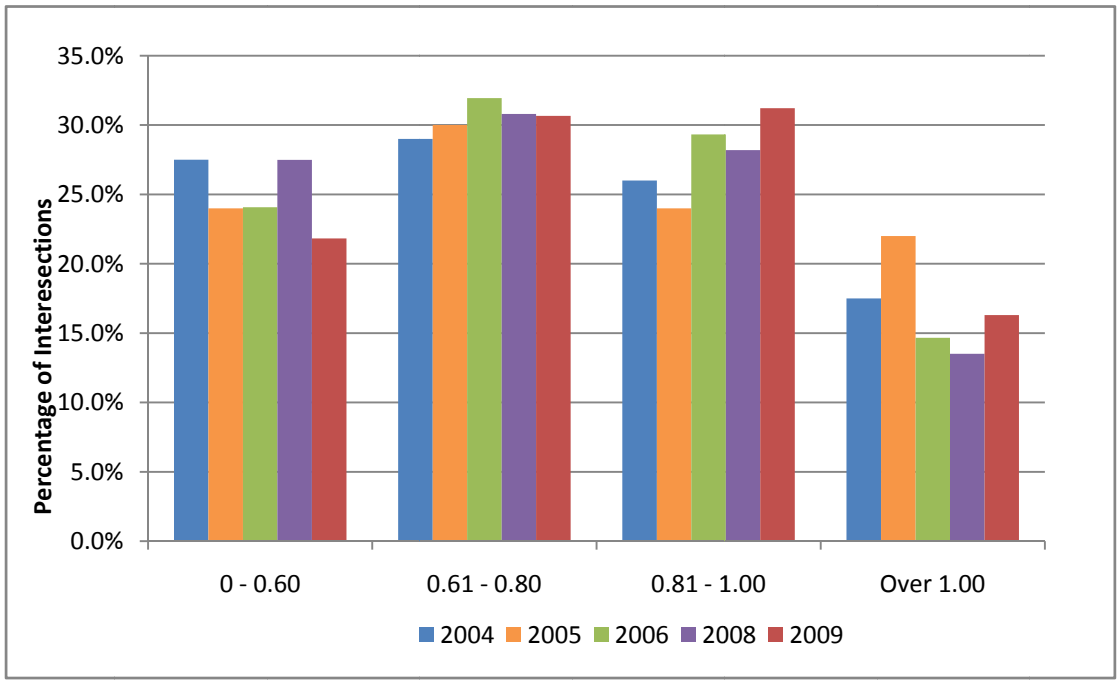


Figure 2.3 illustrates the current allocation of intersections by CLV/LATR ratio class in comparison with data from previous HMR sample sets. It is worth noting, as evidenced in Figure 2.3, that although more intersections exceed the LATR standard in the 2009 sample than the 2008 data set, analysis in 2005 yielded ratios similar to those in the current 2009 data sample.

Figure 2.3: Year to Year Comparison of CLV/LATR Ratios



Review of LATR Standards

Current LATR standards for CLV counts are listed in table 2.1. These standards reflect the approved figures in the 2007-2009 Growth Policy as adopted by the County Council on November 13, 2007. Rankings of CLV in the standard reflect the County's policy of concentrating growth in areas with existing transit and infrastructure such as the Central Business Districts of Silver Spring and Bethesda and limiting growth outside of urban areas.

Table: 2.1: LATR Congestion Standards

Congestion (CLV) Standard	Policy Area
1350	Rural Areas* (Poolesville, Goshen, Patuxent, Darnestown / Travilah)
1400	Damascus*
1425	Clarksburg*, Germantown East*, Germantown West*, Montgomery Village/Airpark*
1450	Cloverly*, Gaithersburg City, North Potomac*, Olney*, Potomac*, R&D Village*
1475	Aspen Hill*, Derwood, Fairland/White Oak*
1500	Rockville City
1550	North Bethesda
1600	Bethesda / Chevy Chase, Kensington / Wheaton, Silver Spring / Takoma Park, Germantown Town Center
1800	Bethesda CBD, Friendship Heights CBD, Glenmont, Grosvenor, Shady Grove, Silver Spring CBD, Twinbrook, Wheaton CBD, White Flint

* LATR standard tightened with the approval of the FY07-09 Growth Policy

10 Most Congested Intersections

Table 2.2 lists the 10 most congested intersections in the County in 2009. As with previous HMR reports, there has been shuffling in the ranking of intersections within the highest CLV counts in the County. Four intersections from the 2008 top ten list appear in this year's most congested ranking, two were in the top 20 in 2008 and the remaining four intersections in this year's list were ranked higher than 60 in both the 2008 and 2006 report. The intersections in the 2009 listing are also more concentrated along established congested corridors (discussed later in this document) than in previous years. The locations of these intersections can be seen in Figure 2.4 .

Table 2.2: Most Congested Intersections for 2009

Ranking			INTERSECTION NAME	COUNT DATE	CLV	LATR STD.	Policy Area
2009	2008	2006					
1	6	*	Shady Grove Rd at Midcounty Hwy	3/5/2008	1894	1475	Derwood
2	*5*	*2*	*Rockville Pike at W Cedar Ln*	*1/7/2008*	*1883*	*1600*	*Bethesda/Chevy Chase*
3	10	*	Randolph Rd at New Hampshire Ave	3/26/2009	1834	1500	Fairland/White Oak
4	*	*	Connecticut Ave at Plyers Mill Rd	4/28/2009	1825	1600	Kensington/Wheaton
5	*18*	*12*	*Georgia Ave at Norbeck Rd*	*1/22/2009*	*1816*	*1500*	*Aspen Hill*
6	*	*	MD 355 at Edmonston Dr	3/12/2008	1810	1500	Rockville City
7	*	*	Connecticut Ave at Randolph Rd	1/8/2008	1804	1600	Kensington/Wheaton
8	*11*	*22*	*Veirs Mill Rd at Twinbrook Pkwy*	*2/3/2009*	*1771*	*1550*	*North Bethesda*
9	*4*	*7*	*Connecticut Ave at Jones Bridge Rd*	*3/19/2009*	*1769*	*1600*	*Bethesda/Chevy Chase*
10	*	*	Rockville Pike at East-West/Old G'town	2/6/2007	1745	1800	Bethesda CBD

* Unranked either because data was unavailable or CLV did not exceed standard

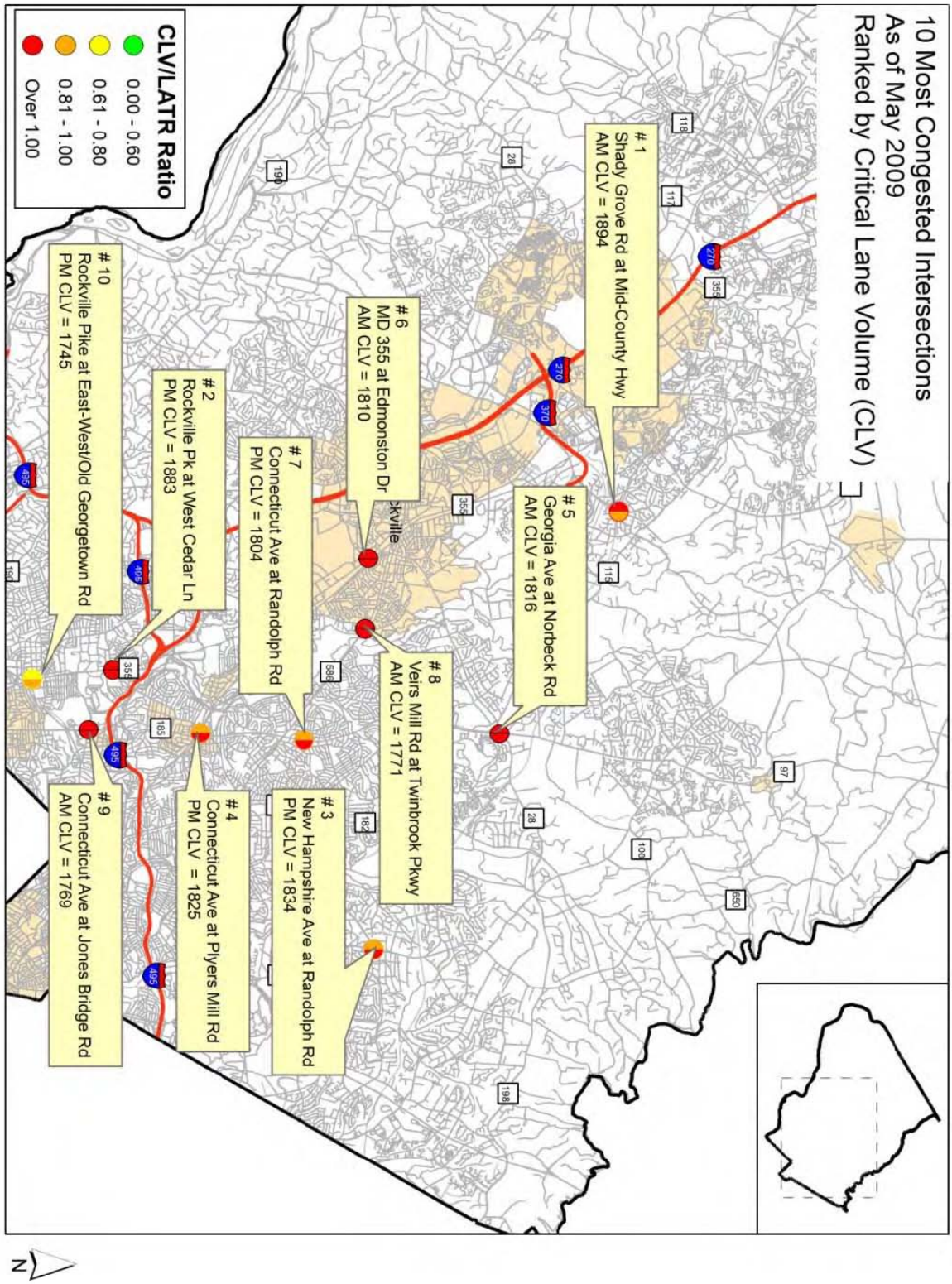
Comments (by rank) for Table 2.2 entries in italic font are listed below:

- Intersection #2: Grade separated interchange is recommended in the master plan; intersection is one of several to be improved as part of the BRAC process – construction is scheduled to begin in summer/fall 2010
- Intersection #5: Plans for a grade separated interchange at this location are part of the state Consolidated Transportation Plan. Engineering is underway although construction funds have been deferred.
- Intersection #8: Intersection improvements are in the design phase.
- Intersection #9: Slated for improvements as part of the BRAC process – construction is scheduled to begin in summer/fall 2010

The intersections are ranked by CLV and not CLV/LATR ratio because the CLV is a better determinant of congestion throughout the County. For example, an intersection with a CLV of 1500 is generally considered to be congested regardless of policy area, but would not have a high CLV/LATR ranking in a Central Business District where the LATR standard is 1800. Intersections new to the top ten list in 2009 are described in more detail below:

- Connecticut Avenue (MD 185) at Plyers Mill Road (#4) : This intersection is the first of two along MD 185 in the Kensington/Wheaton Policy Area, and is a new count in the database. Changes at this location are also associated with Kensington Sector Plan efforts.
- Rockville Pike (MD 355) at Edmonston Drive (#6) : This intersection is just south of Rockville Town Center and is likely a recipient of volume related to ongoing construction in the area. The most recent count here was in 2004 where the CLV was 1590. Edmonston Drive serves as a connection for those that cross between Veirs Mill Road to Wooton Parkway, and may serve as a work around for those wishing to avoid delays at First Street or Veirs Mill Road.
- Connecticut Avenue (MD 185) at Randolph Road (#7) :This is the second of the top ten intersections on MD 185 in the Kensington/Wheaton Policy Area. The most recent CLV for this location is 2004 when the figure was 1631, just above the LATR standard.
- Rockville Pike (MD 355) at East-West Highway (MD 410)/Old Georgetown Road (#10) : This intersection is within the Bethesda CBD and was last counted in 2007. This intersection was not on the top ten list in 2008 because its CLV did not exceed the LATR standard. The CLV at this location is high, however, and the intersection would have been ranked among the top twenty intersections in 2008 if rank was based on solely on the basis of the CLV figure.

Figure 2.4: Map of the 10 Most Congested Intersections



Tables 2.3 and 2.4 rank the next 55 intersections in the MNCPPC Traffic Count Database by CLV. A majority of these intersections have CLV values that are above their LATR standard. Although the standard is a key planning tool, many intersections appear to be congested despite having a CLV below the standard. Many of these intersections are part of master planned studies, or have ongoing construction to improve their performance. Notes pertaining to these construction projects are listed below the associated table.

Table 2.3: Intersections with CLV Ranked 11-30

Ranking							
2009	2008	2006	INTERSECTION NAME	COUNT DATE	CLV	LATR STD.	Policy Area
11	*	*	E Gude Dr at Crabbs Branch/Cecil	3/24/2009	1742	1475	Derwood
12	55	23	Georgia Ave at Emory Ln	10/23/2007	1738	1450	Olney
13	*	39	Hungerford Ln (MD 355) at Gude Dr	5/6/2009	1723	1500	Rockville City
14	*	*	Rockville Pike at Jones Bridge/Center	5/6/2009	1714	1600	Bethesda/Chevy Chase
15	47	61	Shady Grove Rd at Epsilon/Tupelo	2/11/2009	1704	1475	Derwood
16	40	58	Frederick Rd at Montgomery Village Ave	5/5/2009	1697	1450	Gaithersburg City
17	8	14	Connecticut Ave at East West Hwy	4/16/2009	1693	1600	Bethesda/Chevy Chase
18	*	58	E Gude Dr at Southlawn Ln	3/5/2009	1692	1500	Rockville City
19	*	*	Wisconsin Ave at Bradley Blvd	11/9/2006	1681	1800	Bethesda CBD
20	*	32	Piney Branch Rd at Philadelphia Ave	1/21/2009	1680	1600	Silver Spring/Takoma Park
21	*	12	Colesville Rd at University Blvd (S)	1/22/2009	1680	1600	Kensington/Wheaton
22	26	*	Key West Ave at Broschart/Diamondback	10/3/2007	1666	1475	R&D Village
23	27	*	Montrose Rd at Tower Oaks Blvd	11/14/2006	1663	1550	North Bethesda
24	*	*	Bradley Blvd at Wilson Ln	3/12/2009	1660	1600	Bethesda/Chevy Chase
25	*	*	River Rd at Falls Rd	3/31/2009	1657	1475	Potomac
26	2	*	Georgia Ave at Randolph Rd	3/31/2009	1657	1800	Glenmont
27	*	*	Frederick Rd at Shady Grove Rd	3/10/2005	1649	1800	Shady Grove
28	*	*	Colesville Rd at Dale Dr	2/26/2009	1645	1600	Silver Spring/Takoma Park
29	1	3	Great Seneca Hwy at Muddy Branch Rd	4/15/2009	1647	1450	Gaithersburg City
30	28	25	Key West Ave at Shady Grove Rd	9/25/2007	1640	1500	Rockville City

Comments (by rank) for Table 2.3 entries in italic font are listed below:
#17 Connecticut Ave. at East West Highway: Capacity improvements were made in 2006. 2009 CLV is down by approximately 150 from 2008.
#26 Georgia Avenue at Randolph Road: This was the second most congested intersection in the 2008 HMR. The 2009 CLV is down significantly from 2008. A new interchange at this location is in the engineering stage with the State Highway Administration.
#29 Great Seneca Highway at Muddy Branch Road: Operational improvements along Great Seneca Highway may have influenced the 2009 CLV.

Table 2.4: Intersections with CLV Ranked 31-65

Ranking							
2009	2008	2006	INTERSECTION NAME	COUNT DATE	CLV	LATR STD.	Policy Area
31	15	21	Old Georgetown Rd at Tuckerman Ln	1/22/2009	1640	1550	North Bethesda
32	29	57	Columbia Pike at Fairland Rd	9/6/2007	1636	1500	Fairland/White Oak
33	*	*	Montgomery Village Ave at Stedwick	10/4/2007	1633	1450	Montgomery Village/Airpark
34	*	*	Ridge Road at Skylark Rd	4/16/2009	1629	1350	Goshen
35	*	*	Georgia Ave at Forest Glen Rd	7/2/2008	1626	1600	Kensington/Wheaton
36	32	11	Colesville Rd at Sligo Crk Pkwy/St Andre	3/6/2008	1624	1600	Silver Spring/Takoma Park
37	31	44	Georgia Ave at Columbia Blvd/Seminary Ln	1/8/2009	1613	1600	Silver Spring/Takoma Park
38	20	*	Norbeck Rd at Muncaster Mill Rd	1/29/2009	1609	1500	Aspen Hill
39	33	27	Connecticut Ave at Veirs Mill Rd	6/6/2007	1607	1600	Kensington/Wheaton
40	34	60	Columbia Pike at Greencastle Rd	11/15/2006	1607	1500	Fairland/White Oak
41	12	15	Veirs Mill Rd at First St	3/5/2009	1605	1500	Rockville City
42	*	33	Columbia Pike at Lockwood Dr	4/2/2009	1603	1500	Fairland/White Oak
43	*	*	Randolph Rd at Parklawn Dr (W)	2/11/2009	1601	1550	North Bethesda
44	36	5	Columbia Pike at Southwood	3/5/2008	1601	1600	Kensington/Wheaton
45	35	52	First St at Baltimore Rd	1/22/2009	1601	1500	Rockville City
46	*	*	Democracy Blvd at Falls Rd/S Glen Rd	4/1/2009	1594	1475	Potomac
47	*	*	New Hampshire Ave at Oakview	1/24/2006	1591	1600	Silver Spring/Takoma Park
48	*	12	Colesville Rd at University Blvd (N)	9/13/2006	1589	1600	Kensington/Wheaton
49	*	*	Rockville Pike at Tuckerman Ln (N)	5/10/2005	1586	1800	Grosvenor
50	*	*	Muncaster Rd at MD 108	3/11/2009	1579	1400	Patuxent
51	*	*	River Rd at I-495 (E)	3/10/2009	1579	1600	Bethesda/Chevy Chase
52	37	*	Layhill Rd at Ednor Rd/Norwood Rd	10/17/2006	1577	1475	Olney
53	*	*	Connecticut Ave at Bradley Ln	3/17/2004	1577	1600	Bethesda/Chevy Chase
54	*	*	East West Hwy at Jones Mill/Beach	3/5/2009	1574	1600	Bethesda/Chevy Chase
55	24	34	Colesville Rd at Franklin Ave	2/3/2009	1571	1600	Silver Spring/Takoma Park
56	16	28	Norbeck Rd at Bauer Dr	1/21/2009	1571	1500	Aspen Hill
57	38	*	Muddy Branch Rd at Diamondback Dr	10/9/2007	1563	1450	Gaithersburg City
58	*	*	River Rd at Wilson Ln	4/23/2009	1563	1600	Bethesda/Chevy Chase
59	*	*	River Rd at Bradley Blvd	1/24/2008	1562	1475	Potomac
60	41	*	Parklawn Dr at Boiling Brook Pkwy	9/12/2006	1554	1550	North Bethesda
61	31	44	Georgia Ave at Seminary	6/11/2008	1544	1600	Silver Spring/Takoma Park
62	*	*	Frederick Rd at Redland Rd	10/19/2004	1542	1800	Shady Grove
63	42	50	Georgia Ave at Connecticut Ave	5/31/2006	1539	1500	Aspen Hill
65	3	3	Frederick Rd (MD 355) at King Farm Blvd	1/6/2008	1538	1800	Shady Grove

Comments (by rank) for Table 2.3 entries in italic font are listed below:
#32: Columbia Pike at Fairland Road: A new interchange at this location is in the engineering stage
34 Columbia Pike at Greencastle Road: Master plan recommended grade separated interchange is in the engineering stage but is on hold due to funding constraints
#41 Veirs Mill Road and First Street: Intersection capacity improvements are in the planning phase
#56 Norbeck Road and Bauer Drive: Intersection improvements are currently recommended in the master plan

Significant progress has already been made at a number of the county's congested intersections. Comparisons with previous CLV counts illustrate the impact of recent infrastructure improvements. Table 2.5 lists those intersections where the most recent CLV decreased when compared with previous counts. The largest of these decreases was observed at the intersection of Rockville Pike (MD 355) Pooks Hill Road. At this location, improvements by the State Highway Administration helped to decrease the CLV by more than 35 percent between 2004 and 2009. Other notable interchange improvements are noted in Table 2.5.

Table 2.5: Intersections with a Decrease in CLV greater than 15% Between 2006 and 2009

INTERSECTION NAME	CLV	COUNT DATE	Previous CLV	Previous Count Date	PCT CHG	COMMENTS
Rockville Pike (MD 355) at Pooks Hill Rd	1248	2/24/2009	1923	6/8/2004	-35.1%	SHA improvements associated with Beltway ramps
Frederick Rd (MD 355) at Indianola/Watkins Pond	1040	2/11/2009	1421	6/6/2007	-28.9%	Traffic patterns may be affected by ICC construction activity
Great Seneca Highway (MD 119) & Muddy Branch	1647	5/12/2009	2179	3/5/2008	-29.1%	
Montgomery Village Ave at Russell Ave	1218	4/22/2009	1755	3/6/2008	-30.6%	
Ridge Rd (MD 27) at Observation Dr	1065	3/29/2007	1433	1/6/2005	-25.7%	There was an intersection improvement after the 2005 count.
Norbeck (MD 28) at Bel Pre Rd	1464	1/8/2008	1834	5/31/2006	-20.2%	
Norbeck (MD 28) at Avery Rd	1511	1/8/2008	1815	10/12/2005	-16.8%	
Rockville Pike (MD 355) at Congressional Ln	1282	1/14/2009	1538	6/3/2004	-16.6%	Traffic patterns may be affected by Montrose Parkway and MD 355 interchange construction
Darnestown Rd (MD 28) at Darnestown-Germantown Rd (MD 118)	1077	3/31/2009	1291	10/5/2005	-16.6%	
Darnestown Rd (MD 28) at Muddy Branch Rd	1417	1/21/2009	1697	10/23/2007	-16.5%	Intersection improvements in 2006 may take a couple of years to see the results of the lowered traffic patterns.
New Hampshire Ave (MD 650) at Lockwood Dr	1151	6/3/2008	1353	3/23/2006	-14.9%	Intersection capacity improvement completed in '06.

Table 2.6 identifies those with the largest percent increases in CLV when compared with previous data. Intersections with CLV increases are located in several policy areas throughout the County. Some of these increases are not surprising given that the previous count is significantly older. All previous counts are at least two years old, and one is five years old. Changes in development and infrastructure projects near these intersections are likely the cause of most of the increase in CLV.

Table 2.6: Intersections with an Increase in the CLV of more than 15% Between 2006 and 2009

INTERSECTION NAME	CLV	COUNT DATE	Previous CLV	Previous Count Date	PCT CHG	COMMENTS
Redland Rd at Somerville	1092	2/25/2009	765	6/6/2007	42.8%	Traffic patterns may be affected by ICC construction activity
Rockville Pike (MD 355) at Security Ln	1295	8/14/2008	994	3/8/2005	30.3%	
E Gude at Crabbs Branch Rd	1742	3/24/2009	1395	10/27/2005	24.9%	
Hungerford Dr at Beall St	1197	9/16/2008	965	10/14/2004	24.0%	Changes due to Rockville Town Center
Piney Branch At Philadelphia Ave	1680	1/21/2009	1363	12/19/2007	23.3%	
Randolph Rd at Parklawn Dr (W)	1601	2/11/2009	1332	6/1/2005	20.2%	Traffic patterns may be affected by Montrose Parkway and MD 355 interchange construction
Georgia Ave (MD 97) at Emory Ln	1738	10/23/2007	1461	6/1/2006	19.0%	Impact at this intersection was to be addressed with restriping of the eastbound Emory Lane approach.

Intersection Volume Analysis

Even the most congested intersections in the County are uncongested during some times of the day or night. One congestion management tool is to encourage the distribution of traffic away from the busiest hour to adjacent hours (often described as "the shoulder of the peak"). This strategy, often described as "peak-spreading", increases efficiency in the utilization of a scarce resource, in this case roadway pavement, by spreading the demand over time. Travel demand management strategies such as flex-time at the workplace and congestion pricing (already in place in the Metrorail system and being implemented on the Intercounty Connector) help achieve this efficiency.

However, flex time strategies are only effective if there is available capacity outside of the peak hour to accommodate the temporal shift in demand. The analysis of travel demand within the three-hour AM and PM peak periods indicates that the peak hour is a bit longer than one hour, but that

- peak period capacity remains available during the shoulder hours, and
- the peak hour remains within the three-hour peak periods designated by County policy.

In addition to the CLV figures discussed in the previous sections, information about volume is also contained within the MNCPPC intersection database. Traffic volume data includes information not just about overall congestion, but also, when viewed in relation to time, the duration and temporal patterns of traffic at a given intersection.

The volume patterns of 2009 traffic counts at three intersections are depicted in Figure 2.5 below. The intersections represent distinct conditions in the County. Middlebrook Road and Observation Drive is in Germantown between I-270 and Frederick Road (MD 355), New Hampshire Avenue (MD 650) and Randolph Road is north of I-495 in White Oak, and Connecticut Avenue (MD 185) and East West Highway (MD 410) is inside I-495 in Bethesda-Chevy Chase.

The traffic volumes at Observation Drive and Middlebrook Road exhibit characteristics of intersections farther from employment centers, with an AM peak before 8:00 am. The other two intersections in the graph are closer to employment centers and illustrate weekday morning volumes with a peak period between 8:00 and 9:00 am.

The derivation of the percentage of peak period travel during the peak hour is demonstrated in Figure 2.5. Each intersection in Figure 2.5 exhibits similar but distinct evening rush characteristics. Generally, the volume curves for the afternoon peak period exhibit a flatter shape than the morning curves, and contain several peaks with similar volumes. Table 2.7 provides a comparison of traffic volumes at these three intersections.

Figures 2.6 and 2.7 illustrate the relationship between volume and peak hour in the morning and afternoon for signalized intersections included in 2009 counts. The peak hour ratio is the ratio of the highest one hour volume at a given intersection to the total volume during the three hour peak period. There does not seem to be a relationship between CLV and peak hour. That is, congested intersections (with a higher CLV value) do not have distinct temporal patterns of volume, nor do those that are less congested. What is evident from the peak hour graphs is that volume is more evenly distributed in the afternoon peak hours than it is in the morning.

A peak hour ratio of 0.33 would reflect an even distribution of demand across all three hours in the peak period; peak hour ratios lower than 0.33 are not possible. Conversely, a peak hour ratio of 0.50 would indicate that the busiest hour handles as much traffic as the other two hours combined; none of the intersections sampled have so uneven a temporal demand pattern.

In the morning peak period, between 37% and 41% of the peak period traffic occurs in the peak hour at most intersections. Demand is more evenly spread out during the evening peak period, with most intersections having between 35% and 39% of the peak period traffic during the peak hour.

Conventional wisdom suggests that those intersections that are most congested would have a lower peak hour ratio as demand in excess of peak hour capacity would “spill over” into adjacent hours. The fact that there is no observed relationship between the intersection CLV and the peak hour ratios indicates that motorist travel patterns are not significantly affected by delays at individual intersections, but rather are determined by broader travel needs that demonstrate some peak spreading likely due both to regional network constraints and to independent travel needs.

CLV and intersection volume data are useful for identifying levels of congestion and evaluating temporal patterns of traffic at signalized intersections. However, these data do not necessarily describe the issue of congestion at the link or roadway segment level. In some cases, an intersection may be performing at an acceptable level relative to the LATR standard. However, if the intersection approach volumes are being impeded or diminished because of reduced mobility along the approaching links, then the issue of congestion can be attributed to conditions along the link. The next section of this report discusses the results of GPS travel time and speed runs samples that were collected in February and March of 2009 in support of this document. This type of traffic monitoring data is needed in order to assess the location, extent, duration, intensity, and relative magnitudes of observable congested conditions along roadway links.

Figure 2.5: Diurnal Analysis of Traffic Volume at Three Signalized Intersections

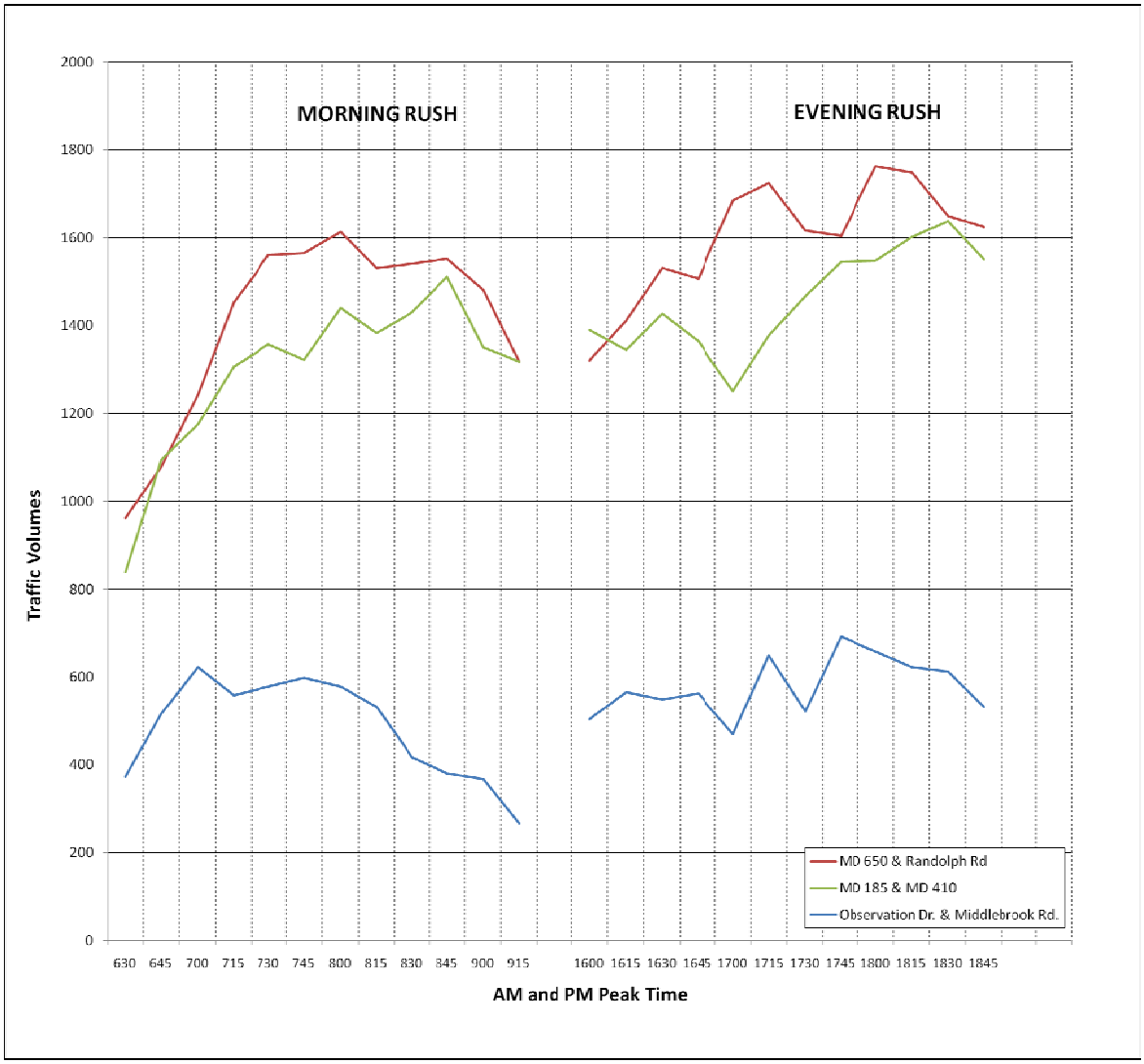


Table 2.7: PM Peak Volume Analysis

Intersection	Total PM Peak Volume	Busiest PM Hour (Four Successive 15 Minute Intervals)	Busiest PM Hour Volume	Busiest Hour Volume as % of Total PM Peak Volume
MD 650 & Randolph Rd.	19,200	5:45 – 6:30	6,800	35%
MD 185 & MD 410	17,500	5:30 – 6:15	6,200	36%
Observation Dr. & Middlebrook Rd.	6,900	5:15 – 6:00	2,573	37%

Figure 2.6: AM Peak Hour Ratios for Traffic Counts at Signalized Intersections in 2009

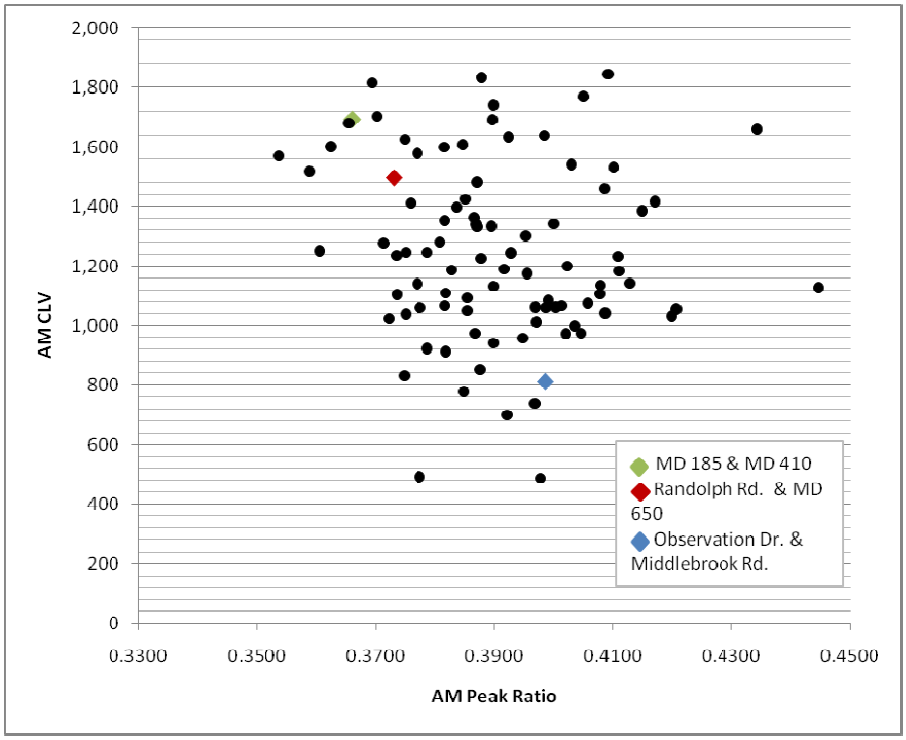
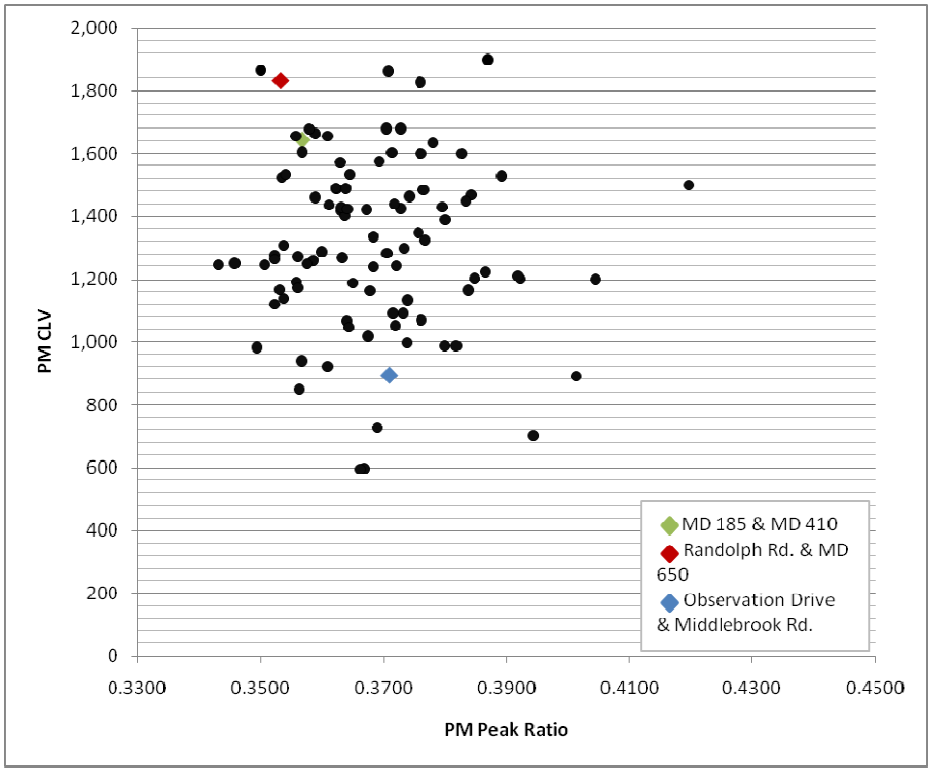


Figure 2.7: PM Peak Hour Ratios for Traffic Counts at Signalized Intersections in 2009



Arterial Travel Times and Speeds

Selected Priority Analysis Corridors

Staff initially summarized results for corridors that were determined to be the "priority analysis corridors". The priority analysis corridors were selected based on their: (1) degree of interest and visibility to the public and elected officials, (2) location and history of congested conditions, and/or (3) relevance to current or future planning studies. In addition to the five corridors included in the 2008 report, the 2009 analysis described in this document also includes Veirs Mill Road (MD route 586). The complete list of Priority Corridors included in the 2009 study is as follows:

1. Wisconsin Ave/Rockville Pike/Hungerford Dr/Frederick Rd (MD 355)
2. Georgia Ave (MD 97)
3. Veirs Mill Road (MD 586)
4. Norbeck Rd (MD 28)/ Spencerville Rd (MD 198)
5. Colesville Rd/Columbia Pike (MD 384/US 29)
6. Connecticut Ave (MD 185)

With two exceptions, travel along the full length of each corridor was collected in a distinct data set. The long corridors of MD 355 and MD 97 were parsed into segments (three and two respectively) to facilitate analysis for roadways with consistent conditions and allow graphic representations of congested areas in a manageable scale. The 2008 report includes analysis of 2007 travel time data which was collected in smaller segments by Policy Area. Although Policy Areas are useful boundaries for analysis, it was determined that longer segments are best for corridor analysis, so longer segments were used in 2009 field work.

Discussion of results from the 2009 measurements along these corridors is accompanied by graphics which illustrate comparative speed, historical analysis and geographic parameters of travel time along each corridor. A detailed discussion of the sampling approach and methodology used for the purposes of this report can be found in Appendix 4.3. Datasets for PM peak period weekday conditions along each corridor are depicted three ways in this report.

1. **Corridor Maps**: Corridor maps highlight key areas of congestion and depict the slowest movements (e.g. north-south or east-west) along each corridor. Corridors are grouped by area into two maps, one for the Priority Corridors, and another for the up-county or I-270 corridor.

2. **Travel Time Versus Distance Profiles**: These graphs show where along a corridor congested conditions were found as well as the intensity and extent of those congested conditions. The profiles compare various measurements along each corridor, typically in the direction of slowest movement (northbound for most segments). The colors of each point along each line, the trajectory of the probe vehicle, indicate the speed range of the probe at that point (green is faster while yellow, red and browns are incrementally slower). The slope of the line between any two points along the trajectory gives the average speed between those points. Thus stopped traffic is shown by vertical lines.

3. **Travel Time Versus Time of Day Graphs**: These graphs show the results of several independent samples and indicate when during the day the faster and slower travel times were observed. When feasible, historical data is compared with 2009 data samples to compare travel time on each corridor at each of the recorded starting times. As noted previously, 2007 samples were collected at the Policy

Area level. In order to make comparisons along the full length of the longer 2009 samples, several 2007 trajectories were combined obtain samples of equal length. Each of these graphs also provides a view of all recorded travel time samples in the peak direction for a given corridor, highlighting peak travel times.

Arterial Mobility

Although each corridor is unique, travel conditions between roadways can be compared using a calculated measure called "Arterial Mobility". Arterial Mobility is expressed as the ratio (expressed here as a percentage) of the slowest travel time along a given corridor to the speed limit travel time for that same corridor. Arterial Mobility data can also help to provide a means of comparison between samples on a given roadway from year to year. The County's Growth Policy assigns Level of Service (LOS) letter-grades to Arterial Mobility based on the urban street delay level of service in the 2000 Highway Capacity Manual published by the Transportation Research Board. Arterial LOS A (the best grade) conditions occur if the congested travel speed is at least 85 percent of the free flow travel speed. Arterial LOS F conditions occur when the congested speed is less than 25 percent of the free flow speed. At LOS F conditions, travel during congested times of day takes more than four times the amount of time than travel at free flow speeds.

LOS A represents the best system performance for the customer. However, the highest levels of throughput occur at LOS E, which means it is the most efficient use of the transportation resource. The County's current Growth Policy requires area wide conditions to be LOS D or better, although this area wide policy recognizes that individual roadway segments will operate worse than the standard.

Table 2.8 ranks sections of the six priority corridors by their respective mobility ranking.

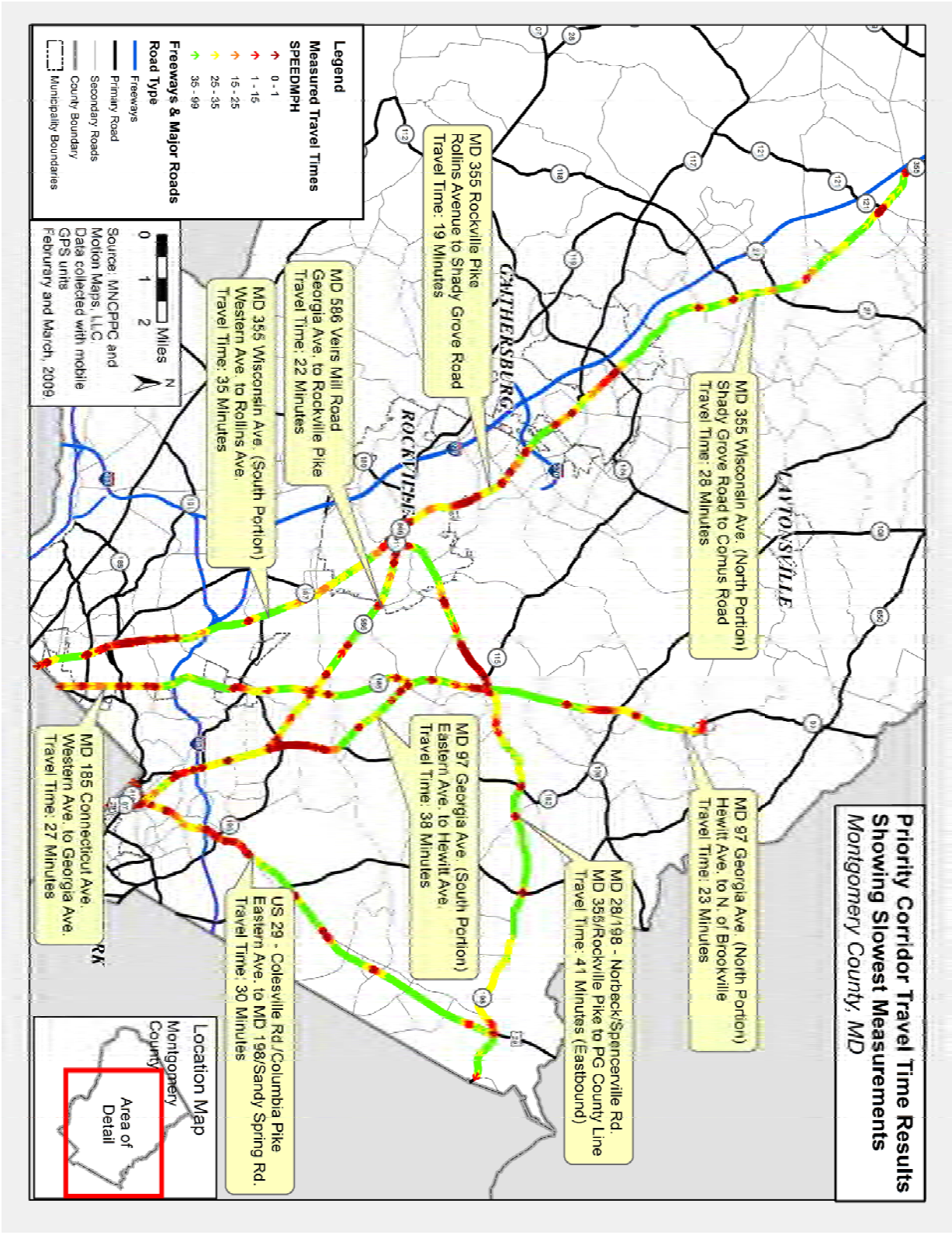
Among travel time samples for 2009, Frederick Road (the northernmost portion of MD 355) has the highest Arterial Mobility rating at 62 percent, a 15 percent increase from 2007 samples. The southern portion of Georgia Avenue (MD 97) had the lowest Arterial Mobility figure at 29 percent, just two percent lower than 2007 samples. Overall comparisons of the 2007 and 2009 samples reveals that change in Arterial Mobility was evenly mixed among the priority corridors; four corridors increased their arterial mobility, two corridors had little change (less than 3 percent) and three corridors had 2009 Arterial Mobility figures less than 2007.

The PM peak survey results (in the peak direction) are shown in Figure 2.8 and discussed in the following paragraphs for the six corridors measured in the 2009 study.

Table 2.8: Arterial Mobility Measures for Priority Corridors

Route	Direction	From	To	Travel Time (Min.) Slowest 2009 Travel Time	Travel Time @ Speed Limit	2009 Arterial Mobiltiy	2009 LOS	2007 Arterial Mobility	Percent Change
MD 355	NB	Shady Grove Road	Comus Rd.	27.68	17.28	**62.4%**	**C**	54.2%	15.3%
MD185	NB	Western Ave	MD 97	26.73	13.82	**51.7%**	**D**	36.4%	42.0%
MD 28/198	EB	Rockville Pike	PG County Line	41.30	20.92	**50.6%**	**D**	57.9%	-12.5%
MD355	NB	Rollins Ave.	Shady Grove Road	19.30	9.45	**49.0%**	**D**	55.3%	-11.5%
MD 97	NB	Hewitt Ave.	N. of Brookville	22.92	11.15	**48.7%**	**D**	41.6%	17.0%
MD 384/US 29	NB	Eastern Ave.	Sandy Spring Rd.	29.65	12.85	**43.3%**	**D**	35.1%	23.6%
MD586	NB	MD 97	MD 355	22.22	8.07	**36.3%**	**E**	36.3%	0.0%
MD355	NB	Western Ave	Rollins Ave	34.62	12.18	**35.2%**	**E**	45.3%	-22.3%
MD 97	NB	Eastern Ave.	Hewitt Ave.	37.68	10.98	**29.1%**	**E**	29.8%	-2.2%

Figure 2.8: Congestion in Peak Direction (Weekday PM Peak) for 2009 Priority Analysis Corridors



Wisconsin Avenue/Rockville Pike (MD 355) from Western Avenue to Rollins Avenue

Description: The southern portion of MD 355 to Rollins Avenue at the edge of the Rockville City Policy Area is 7.11 miles. Information about travel times along MD 355 through Rockville, and in policy areas north of Rockville follow this section. Approximately one half of this portion of MD 355 lies in the Bethesda/Chevy Chase Policy Area with the balance in the North Bethesda Policy Area. Speed limits range from 25 miles per hour to 45 miles per hour in this segment of Wisconsin Avenue, yielding a travel time at the speed limit of 731 seconds or 12.2 minutes.

2009 Observations: A total of 35 travel time measurements (18 northbound and 17 southbound) were made along this portion of Wisconsin Avenue on Tuesday February 24, 2009. Data was collected with runs beginning at 3:56 pm and continuing through to the last run which departed Western Avenue northbound at 7:41 pm. Travel times ranged from 18.5 minutes for the fastest measurement to 34.6 minutes for the slowest. The slowest recorded time left Western Avenue at about 5:55 pm and experienced delays throughout much of the Bethesda/Chevy Chase Policy Area, particularly north of Bradley Lane. Delays at Montrose Road were also common among northbound samples, with slower trips experiencing delays through to Rollins Avenue. Average speed for this slowest trip was just over 12 miles per hour. Travel time was nearly three times the speed limit travel time for the segment, while the Arterial Mobility was 35.2 percent, (12.2 minutes divided by 34.6 minutes). See the Travel Time versus Distance Comparison graphic for details of where along the corridor congestion was observed and how intense (slow) was the congestion for the representative set of three 2009 observed travel times shown there. A comparison to the slowest 2007 sample is also given in that graph.

Historical Comparison of Travel Times: Among the 2009 priority corridors, the southern section of Wisconsin Avenue/Rockville Pike through Bethesda and North Bethesda is the one that most closely matches 2007 observations. With peak travel time occurring near 5:30 pm, and higher travel times between 4:00 and 5:00 pm when compared to those in the 6:00 to 7:00 hours, the travel time by time of day graph (Figure 2.10) appears to be one shouldered rather than bell curved. The slowest 2009 sample was roughly seven minutes longer than the slowest 2007 sample, but both experienced similar patterns of delay. The increased number of samples in between the peak 5:30 to 6:30 pm hour in 2009 reduced the Arterial Mobility measure for this portion of MD 355 in 2009 to 45.6 percent in 2007 to 35.2 percent in 2009.

Figure 2.9: Travel Time-Distance Profile for Northbound Wisconsin Ave./Rockville Pike (MD 355)

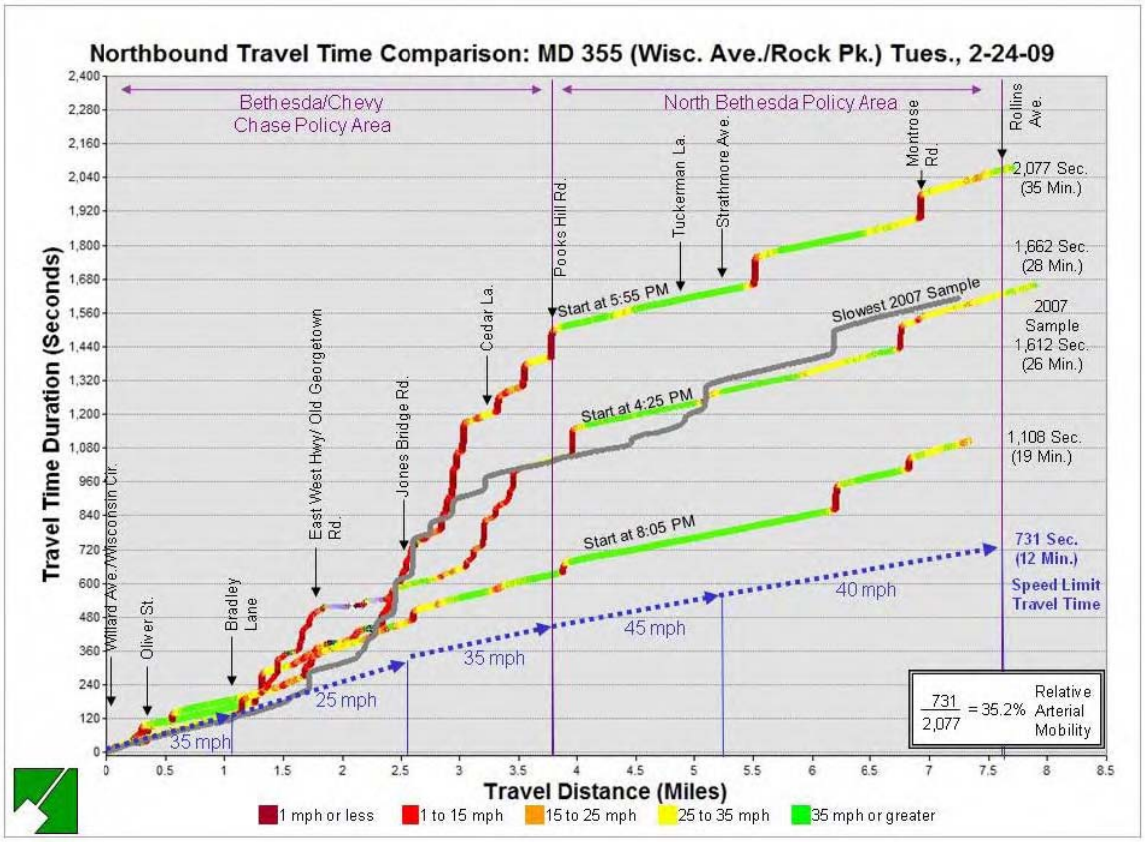
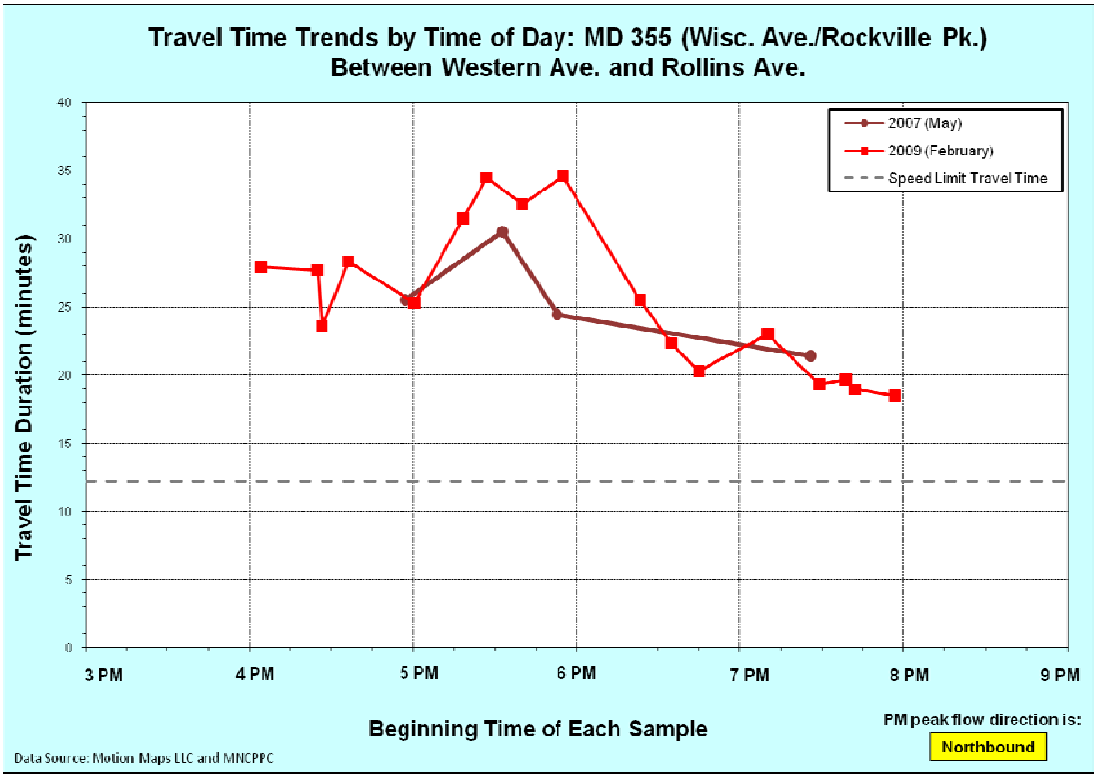


Figure 2.10: Travel Time - Time of Day Profile for Wisconsin Ave./Rockville Pike (MD 355)



Rockville Pike/Hungerford Drive (MD 355) from Rollins Avenue to Shady Grove Road

Description: This portion of MD 355 through Rockville is roughly 5.5 miles long. Speed limits begin at 40 miles per hour and drop to 30 miles per hour at Veirs Mill Road through to Gude Drive where the speed limit returns to 40 miles per hour. The travel time at the speed limit for this section of road in the Rockville City Policy Area is 567 seconds or about 9.5 minutes.

2009 Observations: Eight northbound and eight southbound travel time measurements were recorded along this corridor on Wednesday February 25, 2009. Samples began at 3:49 pm and continued through the eight o'clock hour with the last southbound sample leaving Shady Grove Road at 8:33 pm. Although peak travel during this time is in the northbound direction, northbound and southbound samples recorded very similar travel times throughout the sampling period. The fastest travel time was a northbound sample that began at 7:35 pm with a run time of 653 seconds or 10.9 minutes. The fastest southbound sample was at 7:14 pm and took 724 seconds or just over 12 minutes. The slowest travel time was in the northbound direction beginning at Rollins Avenue at 5:27 pm and lasting 1,158 seconds or 19.3 minutes, nearly twice the estimated speed limit travel time. The inverse, arterial mobility, was 49.0 percent (19.3 minutes divided by 9.5 minutes) . Travel time delays along this portion of MD 355 occurred primarily at Wootten Parkway, and again leading up to Gude Drive. The slowest sample experienced a large queue at Gude Drive, lasting six minutes and extending south from Gude Drive for approximately three quarters of a mile. The fastest travel time observed minor delays at signalized intersections and traveled at speed at the speed limit through much of the corridor.

Historical Comparison of Travel Times: Comparisons with 2007 samples for this portion of Rockville Pike indicate that conditions did not change dramatically over the past two years. The 2009 observations (as depicted in Figure xx) follow a similar curve when compared with the 2007 data. Although the peak travel time is more pronounced in 2009, travel times before 5:00 pm and after 6:00 pm were not slower than those in 2007. The slowest 2007 trip (depicted in figure xx) indicated that moderate delays were more evenly spaced though the sampling distance than those in 2009. Rather than large delays at Gude Drive, 2007 travel was slow before Edmonston Drive, Middle Lane and King Farm Road. Due to the increase in travel time for the slowest trip, Arterial Mobility for this corridor has declined from 55.3 percent in 2007 to 49 percent in 2009.

Figure 2.11: Travel Time-Distance Profile for Northbound Rockville Pike/Hungerford Dr. (MD 355)

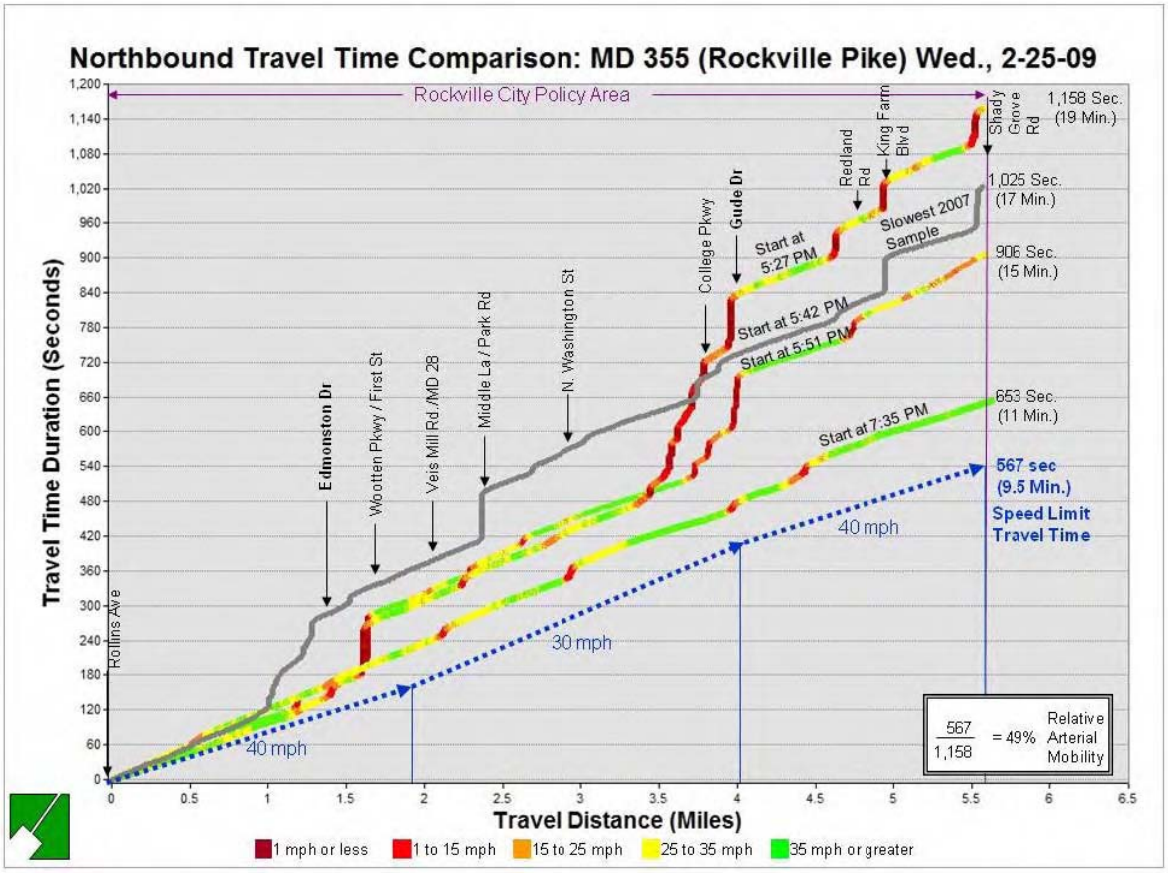
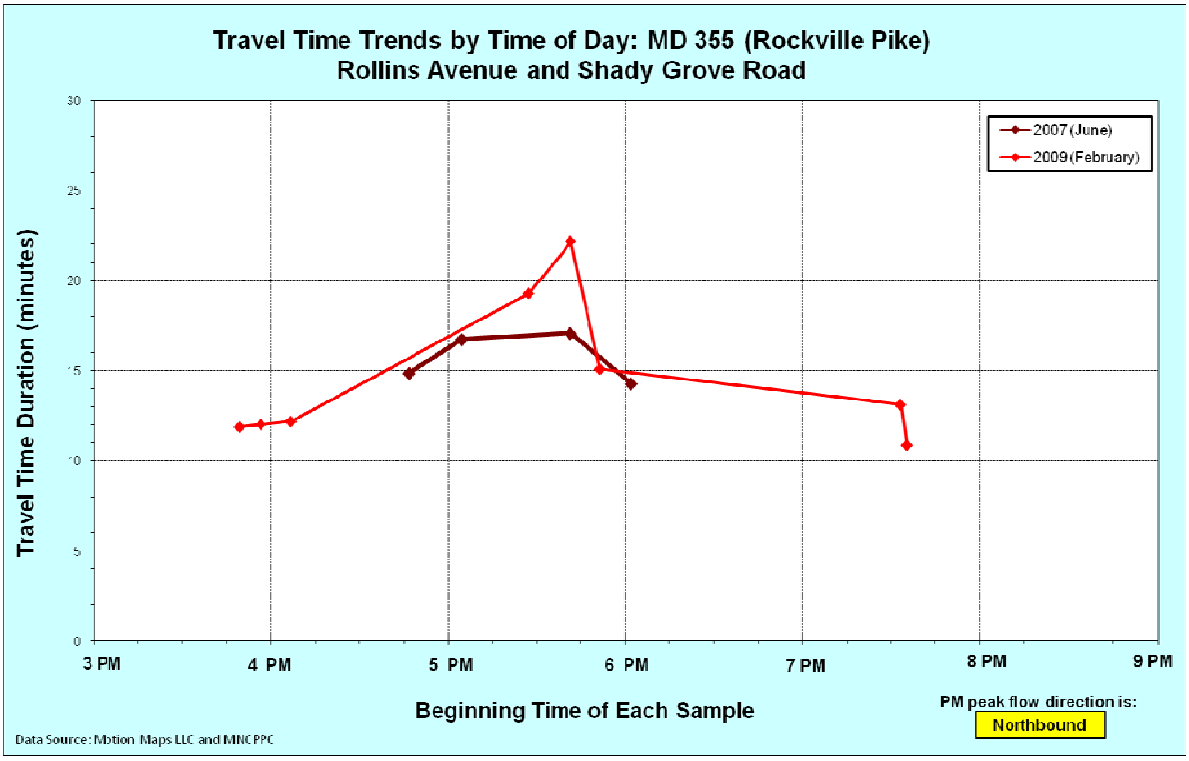


Figure 2.12: Travel Time - Time of Day Profile for Rockville Pike/Hungerford Dr. (MD 355)



Frederick Road (MD 355) from Shady Grove Road to Comus Road

Description: This is the northernmost portion of MD 355 (Frederick Road) that was sampled in 2009. The segment between Shady Grove Road and Comus Raod is 11.3 miles long and is within three Montgomery County Policy Areas, Gaithersburg City, Germantown West and Clarksburg. Each of these policy areas shares about one third of the length of the roadway. Speed limits vary along this portion of Frederick Road from 30 miles per hour up to 50 miles per hour. Calculated travel time at the speed limit is 17.3 minutes.

2009 Observations: Due to a major incident that incurred major delays along the route, travel time samples were recorded on two separate days (Wednesday February 25 and Wednesday March 11). The second set of these samples on March 11 experienced incident free conditions. During the second sample set, 12 northbound and 12 southbound travel time measurements were made. Samples began at 3:56 pm in the northbound direction and concluded with the last southbound trip leaving Comus Road at 6:54 pm. Travel times in the northbound direction (peak) ranged from 21 to 27 minutes, with the slowest trip measured from 6:13 pm at an average speed of 24 miles per hour. The most significant delays in the travel time measurements on March 11 were recorded between Summit Avenue and Montgomery Village Avenue in the Gaithersburg Policy Area. Travel times north of Montgomery Village Avenue moved at speed with minor congestion at Germantown Road and Clarksburg Road, although these delays were not observed in each sample. The incident observed on February 25 affected nearly all samples that day. The following Travel Time vs. Distance graph depicts one of the slowest of these travel times. Large delays are observed leaving Gaithersburg due to the major accident just south of Game Preserve Road for which the police closed all three northbound lanes for nearly four hours and detoured traffic around the incident site. The graphs on the following page show that the incident added about 15 to 20 minutes of delay and the queue extended south about two miles to south of Odenhall Avenue in Gaithersburg, while the downstream traffic in Germantown and Clarksburg was less congested than usual due to the constriction at the incident site.

Historical Comparison of Travel Times: Travel time samples in 2009 were greatly affected by the February 25 incident. The travel time vs. time of day graph on the following page depicts the impact that the delay had on travel samples. Compared with 2007 samples, 2009 measurements on March 11 were faster. Calculated Arterial Mobility for the segment increased from 54 percent in 2007 to 62 percent in 2009. The travel time measurements for this corridor segment depict a pattern that is expected for up-county roadways with an afternoon peak travel time after 6:00 pm, as the earlier rush further south filters up through the road network. Travel times by time of day exhibit a flatter curve than other roadways with a nearly consistent travel time from 5:00 pm through 6:30 pm, rather than a defined peak.

Figure 2.13: Travel Time-Distance Profile for Northbound Frederick Road (MD 355)

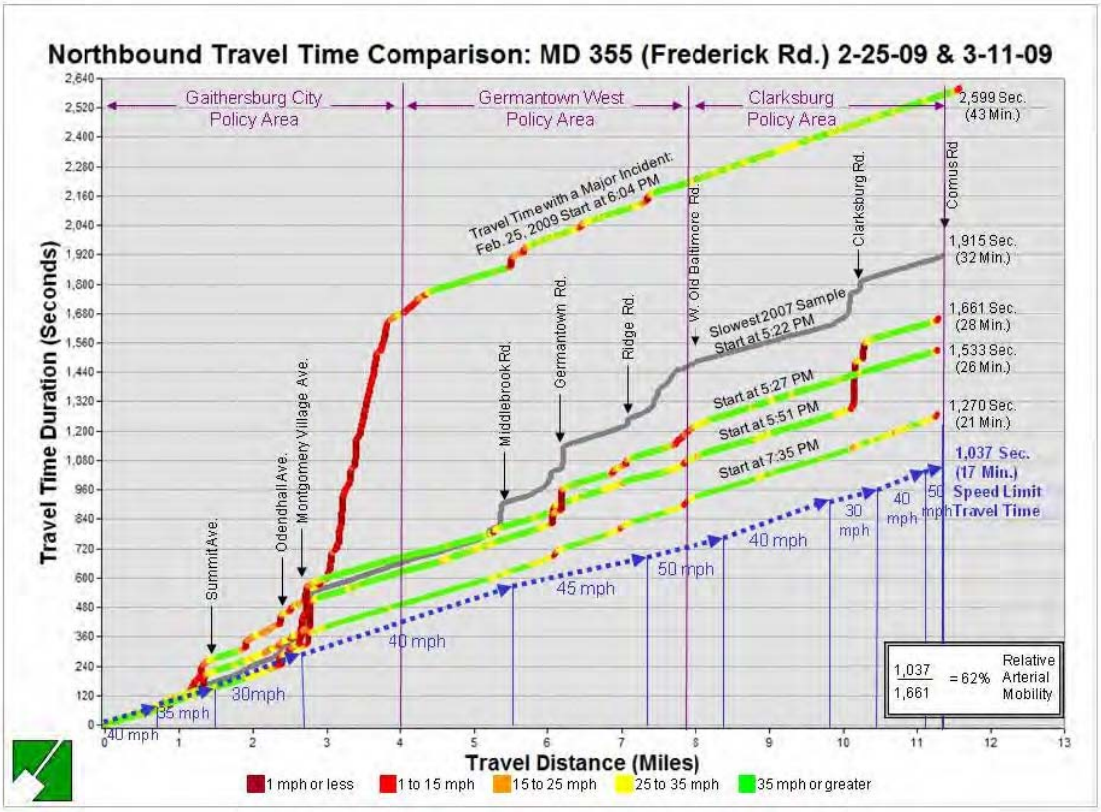
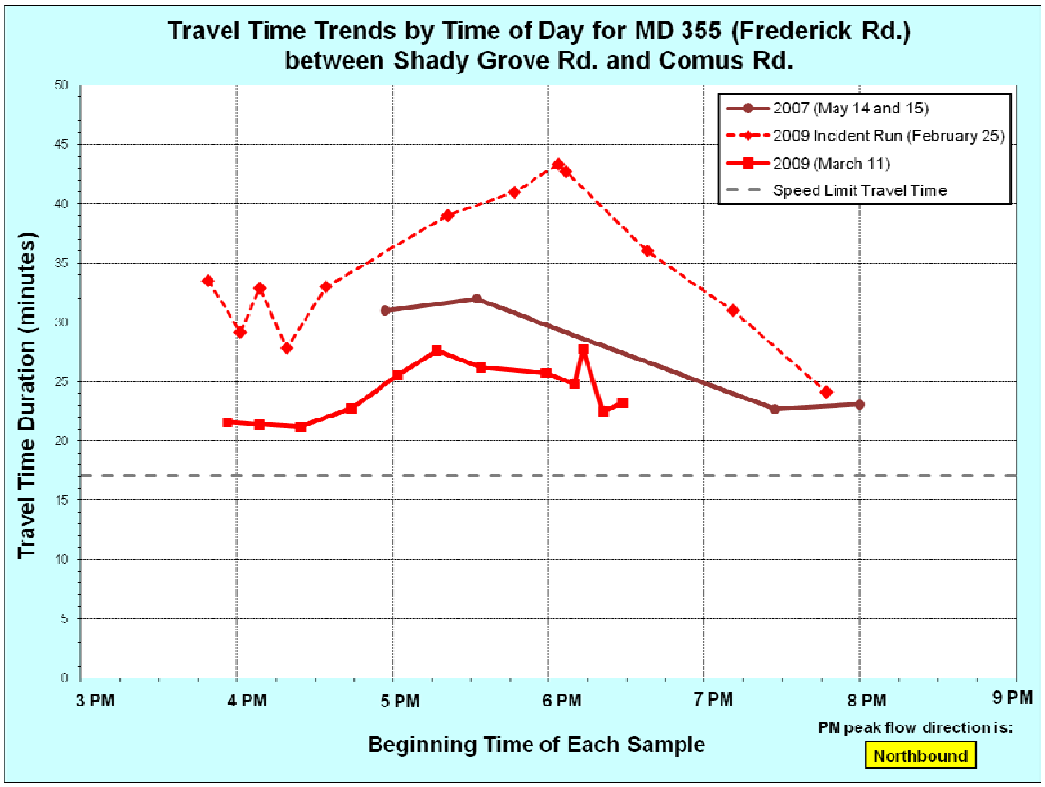


Figure 2.14: Travel Time - Time of Day Profile for Frederick Road (MD 355)



Georgia Avenue (MD 97) from Eastern Avenue to Hewitt Avenue

Description: Sampling along Georgia Avenue was parsed into two segments, one south of Hewitt Avenue in the Silver Spring/Takoma Park and Kensington/Wheaton Policy Areas, and another running from Hewitt Avenue north to Brookville. Analysis of the northern section can be found immediately after this section. The trip from Eastern Avenue to Hewitt Avenue is roughly 7.5 miles, with one third of its length in the Silver Spring/Takoma Park Policy Area and the balance of its length in the Kensington/ Wheaton Policy Area. Speed limits along this stretch of Georgia Avenue range from 30 miles per hour in Silver Spring to 45 miles per hour near Hewitt Avenue. Calculated travel time at the speed limit is 11.0 minutes.

2009 Observations: 23 northbound and 18 southbound travel time measurements were recorded on this stretch of Georgia Avenue on March 3, 2009. Data collection began with the first northbound run at 3:39 pm and concluded with the last northbound run at 8:15 pm. Recorded travel times ranged from 17.6 minutes to 37.7 minutes for northbound trips while southbound times ranged from 15.5 minutes to 25.9 minutes. The slowest northbound sample began at 5:24 pm and took more than three times the travel time according to posted speed limits. Arterial Mobility calculations for 2007 and 2009 are nearly the same at 29.8 percent and 29.1 percent respectively. The figure on the following page depicts travel time along the corridor. Notable delays can be observed in the Silver Spring business district as well as the central part of Kensington/Wheaton north of University Boulevard through Randolph Road. The fastest measured travel time incurred minor delays at the main signalized intersection throughout this segment corridor, but experienced none of the long delays observed in the five and six o'clock hours.

Historical Comparison of Travel Times: The slowest travel time for this section of Georgia Avenue nearly matches the timing for a similar run in 2007. The locations of the observed delays between the two years are different, however. The 2007 sample recorded more significant delays in the Silver Spring area leading up to the Capital Beltway. The Travel Time by Time of Day graph on the following page compares northbound 2007 measurements with the northbound 2009 samples. Although there were many more samples in 2009, the peak for both the 2007 and 2009 samples continues to be in the five to six o'clock hour. The 2009 samples appear to have a peak travel time at approximately 5:30, with a steady decline in travel time through the six o'clock hour. Although the 2007 sample at 5:53 pm appears to be much slower than a comparable 2009 sample, earlier and later runs in 2007 are just a few minutes apart from their counterparts in 2009.

Figure 2.15: Travel Time-Distance Profile for Northbound Georgia Avenue (MD 97) (Southern)

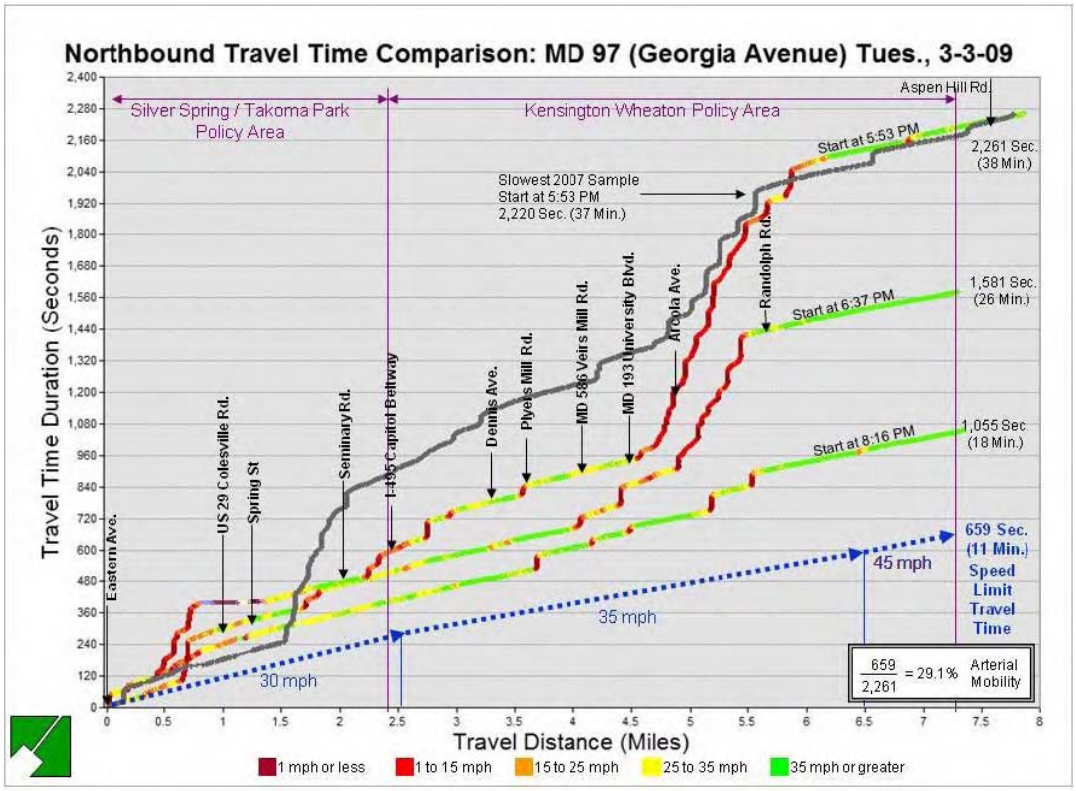
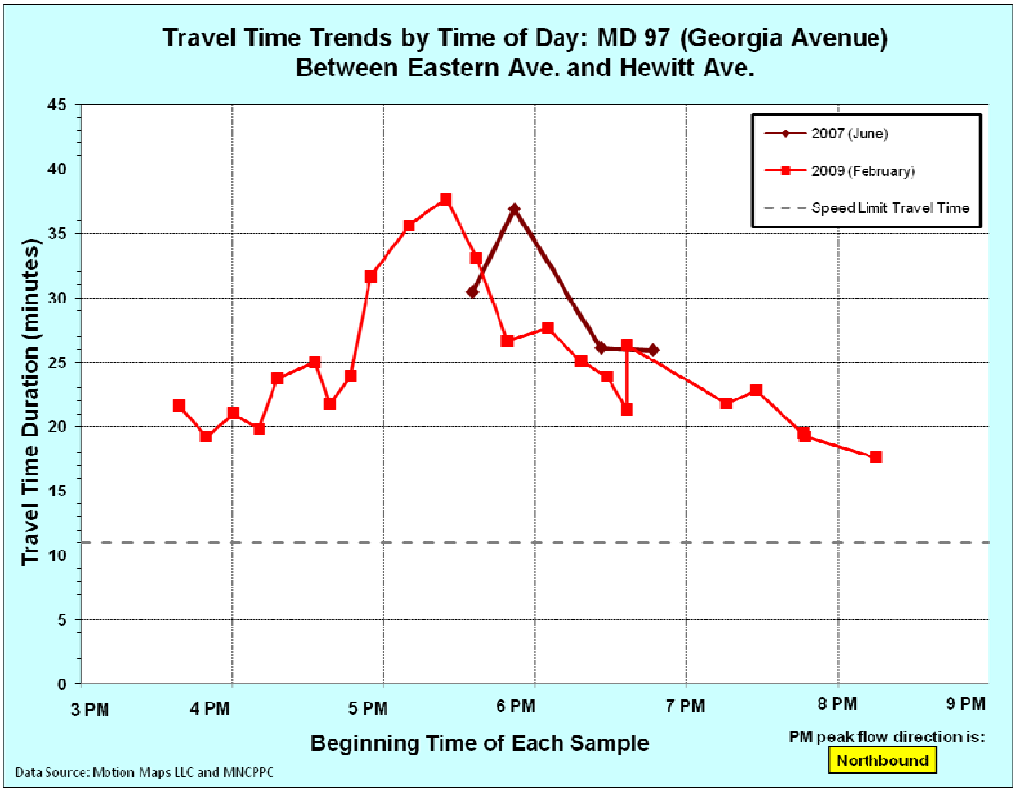


Figure 2.16: Travel Time - Time of Day Profile for Georgia Avenue (MD 97) (Southern)



Georgia Avenue (MD 97) from Hewitt Avenue to Brookville Road

Description: The northern section of Georgia Avenue in the Aspen Hill and Olney Policy Areas between Hewitt Avenue and Brookville Road is slightly longer than its southern counterpart at 7.66 miles. Roughly 2.5 miles north of Hewitt Avenue, Georgia Avenue crosses Norbeck Road, leaving the Aspen Hill Policy Area and entering the Olney Policy Area. Speed limits range from 30 to 50 miles between the two endpoints. Calculated travel time at the speed limit is 669 seconds or 11.2 minutes.

2009 Observations: A total of 39 travel time samples, 20 in the northbound direction and 19 in the southbound direction, were recorded on Wednesday March 4, 2009. Data collection occurred between 3:52 pm and 7:22 pm. Northbound travel times were slower than southbound travel times and ranged from 14.5 and 22.9 minutes. Southbound travel times ranged from 14.9 minutes to 18 minutes. The slowest northbound sample took 1,375 seconds or 23 minutes, roughly double the speed limit travel time. Figure 2.16 depicts a sample of northbound travel times for this section of Georgia Avenue. The slowest sample experienced a queue of about five minutes approaching Norbeck Road (MD 28) and then a series of delays between Prince Phillip Drive and Queen Elizabeth Drive. The fastest measured northbound sample took 867 seconds or approximately 14 minutes, and experienced minor delays at signalized intersections.

Historical Comparison of Travel Times: Northbound travel times along this section were consistently faster than the smaller number of 2007 samples. As is the case with most of the corridors in this study, samples that began in the five to six o'clock hour were the slowest. The same is true for the 2007 data as depicted in Figure 2.17. Both the 2009 and 2007 data depict a decline in travel time after 6:00 pm, and similar observations in the period between 6:00 and 7:00 pm. The slowest 2007 sample (from 5:32 pm) experienced delays similar to the slowest 2009 sample with additional delays upon entering Brookville. The travel times for the slowest 2007 and 2009 samples were very similar, with the exception of the last half mile approaching and passing through Brookville. The calculated Arterial Mobility for this segment of the corridor improved just slightly from about 42 percent in 2007 to about in 49 percent in 2009, reflecting the faster observed travel times.

Figure 2.17: Travel Time-Distance Profile for Northbound Georgia Avenue (MD 97) (Northern)

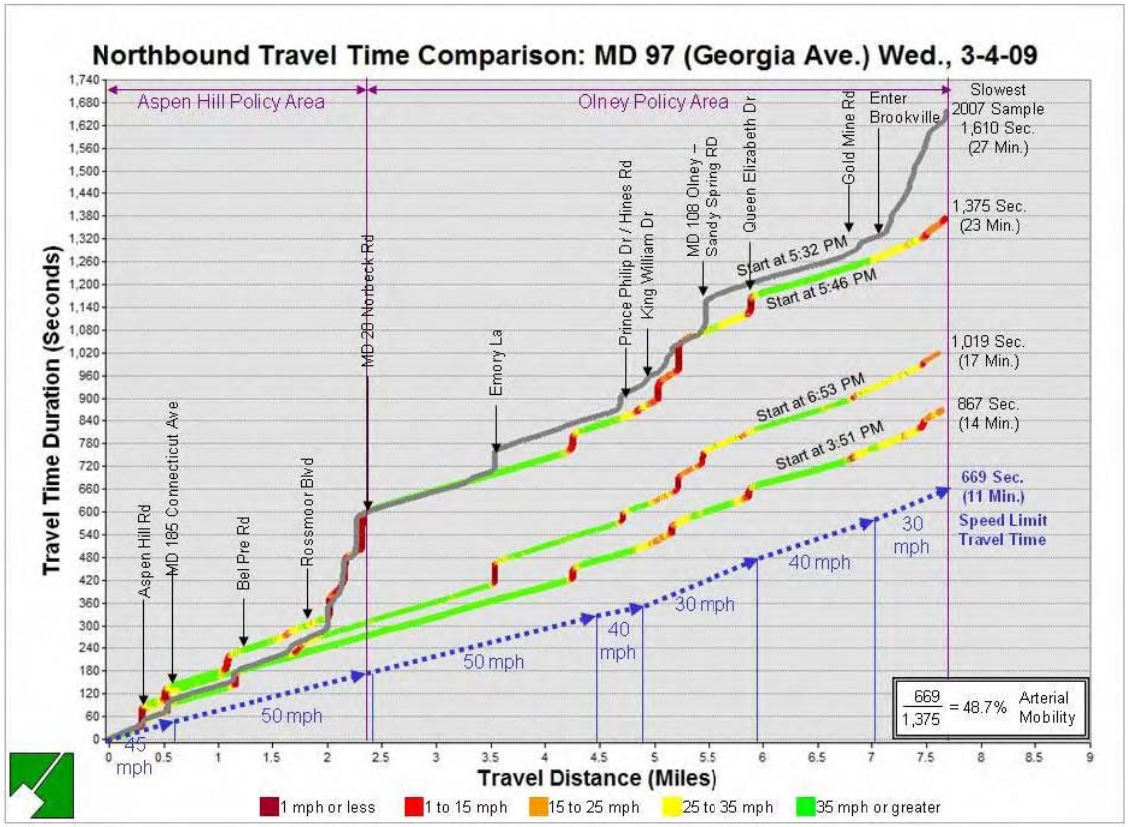
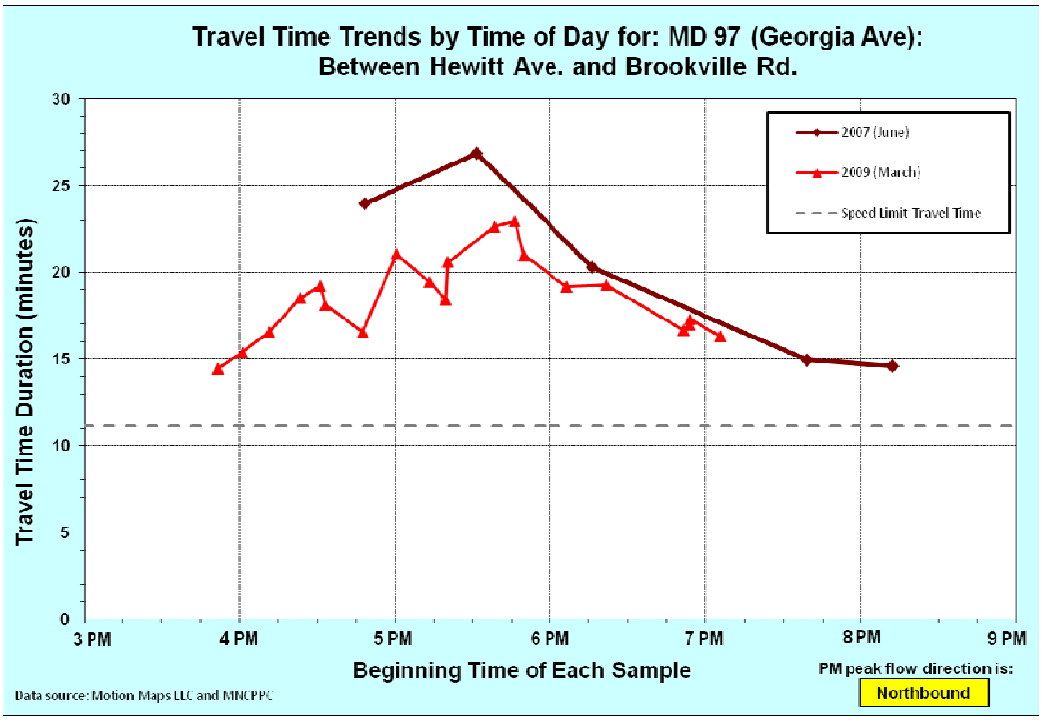


Figure 2.18: Travel Time - Time of Day Profile for Georgia Avenue (MD 97) (Northern)



Veirs Mill Road (MD 586) from Georgia Avenue (MD 97) to Norbeck Road (MD 28)

Description: Travel time samples were collected along the 5.78 mile length of Viers Mill Road from Georgia Avenue in the south to a northern terminus at Norbeck Road. The route travels through three of Montgomery County's Policy areas, Wheaton CBD, Kensington/Wheaton, Aspen Hill (from south to north), and terminates in the city of Rockville. Speed limits along Viers Mill Road range from 35 miles in Rockville to 40 and 45 miles south of Twinbrook Parkway. Travel time at the posted speed limits is 484 seconds or 8.1 minutes.

2009 Observations: Twelve northbound and twelve southbound samples were collected along this segment on February 23, 2009. Travel time measurements were conducted roughly between 4:00 pm and 7:45 pm with the first recorded trajectory beginning at 3:58 pm and the last at 7:46 pm. Northbound travel times were slower than the southbound times and ranged from about 13 to 22 minutes. Southbound travel times ranged from 13 minutes to 19 minutes. The slowest trip took 1,333 seconds or 22.2 minutes, nearly three times the speed limit travel time, with an average speed of 15.6 miles per hour. This trip was in the northbound direction and left the southern terminus of Georgia Avenue at 5:56 pm. As with most of the sampled roadways, delays occurred at signalized intersections along the route, most notably between Georgia Avenue (MD 97) and University Boulevard (MD 193), at Connecticut Avenue (MD 185), Aspen Hill Road, and Twinbrook Parkway. The largest delay was experienced by northbound trips in the five to six o'clock hour was in a queue that began near Claggett Drive and continued for approximately one mile to the First Street/MD 28/Norbeck Road intersection.

Historical Comparison of Travel Times: Samples from 2007, 2005 and 2004 provide points of comparison for travel time along this corridor. Unlike other corridors in this study, plotted travel times depicted in the graph on the following page, reveal a pattern without a sharp peak. With one observation from 2004 as an outlier, the previous year samples display a similar pattern. 2004, 2005 and 2009 samples show travel times within three minutes between 5:00 and 5:15 pm. Peaks in the 2004 data suggest that incidents along the route (or nearby routes) affected travel time. The peak time of travel in 2005 was just before 5:00 pm while the peak in 2009 was just before 6:00 pm. The 2007 and 2009 peak travel times were essentially identical at 22.2 minutes, yielding consistent Arterial Mobility figures of 36.3 percent.

Figure 2.19: Travel Time-Distance Profile for Northbound Veirs Mill Road (MD 586)

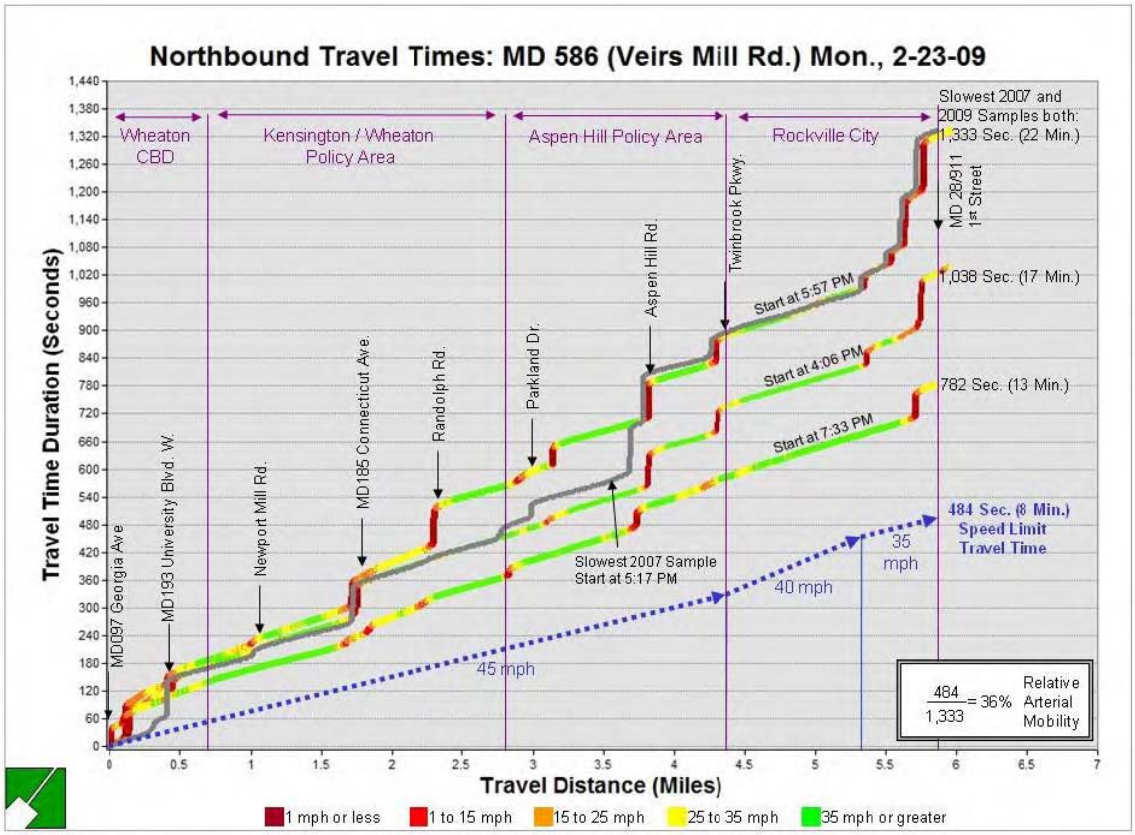
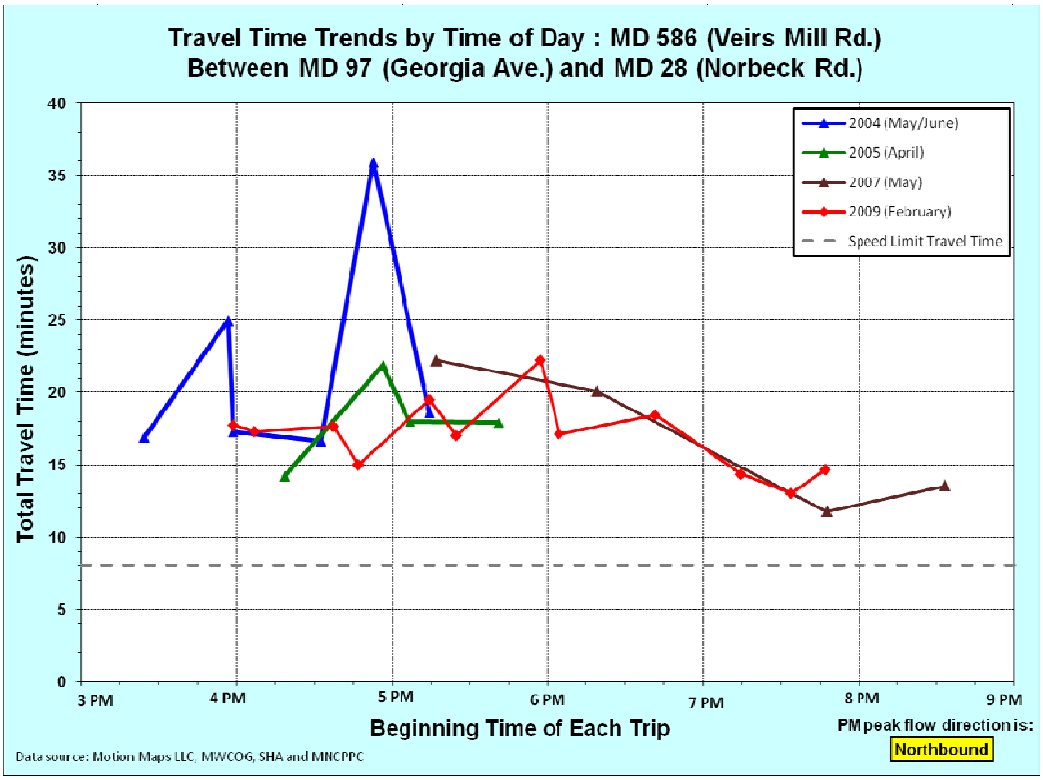


Figure 2.20: Travel Time - Time of Day Profile for Veirs Mill Road (MD 586)



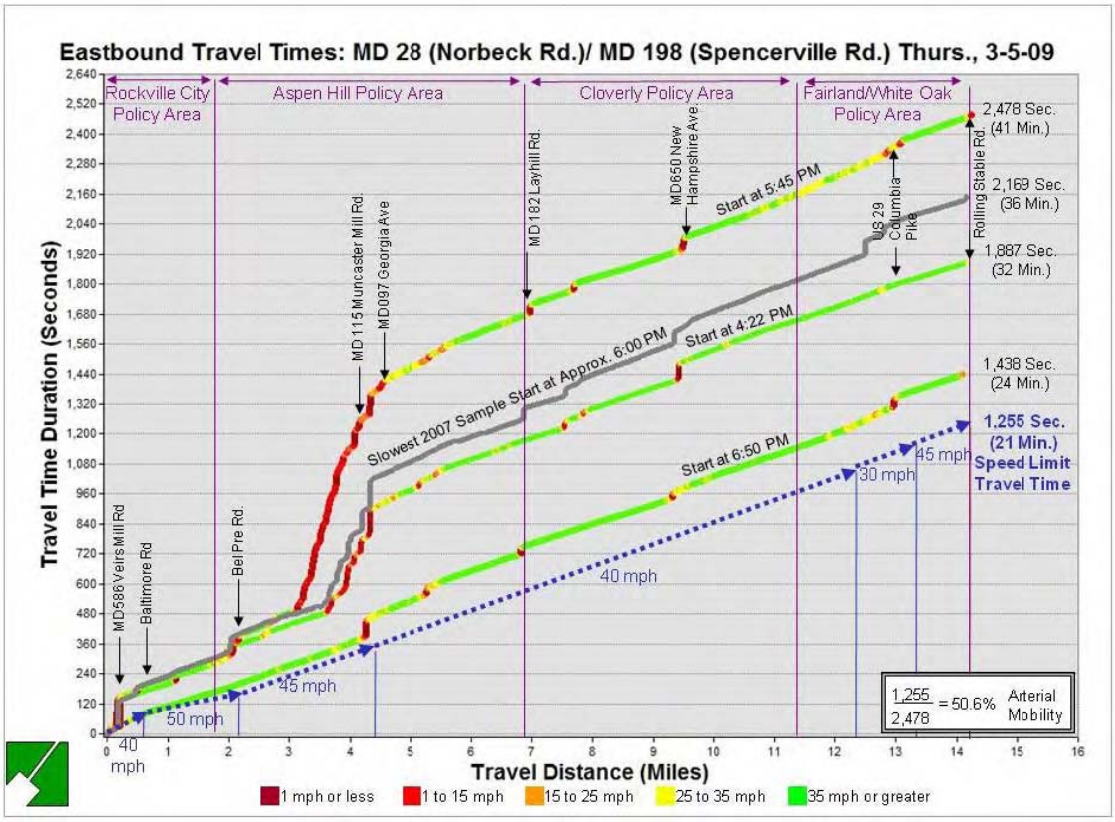
Norbeck Road (MD 28)/ Spencerville Road (MD 198) from Rockville Pike (MD 355) to Prince George's County Line

Description: This 14.3 mile stretch of roadway from Rockville Pike (MD 355) in the west to the Prince George's County line in the east is one of the longest of the priority corridors. It is the only corridor that runs in a west-east direction rather than north to south (with the possible exception of Veirs Mill Road which runs south-east to north-west). The combined Norbeck Road and Spencerville Road runs through four Policy Areas: Rockville City, Aspen Hill, Cloverly and Fairland. This corridor has posted speed limits which range from 30 miles per hour to 50 miles per hour, and a calculated speed limit travel time of 1,255 seconds or 20.9 minutes.

2009 Observations: Fourteen eastbound and thirteen westbound samples were collected for this route on Thursday March 5, 2009. Recorded samples began at in the eastbound direction at 3:35 pm and concluded with the last westbound trip leaving the Prince George's County line at 7:48 pm. Eastbound travel times were slower than their westbound counterparts and ranged from 24 minutes to 41.3 minutes. Westbound travel times ranged from 24.4 minutes to 35.7 minutes. The slowest trip of 41.3 minutes began at 5:45 pm and took roughly double the speed limit travel time of 20.9 minutes. Several eastbound samples experienced significant queues approaching Georgia Avenue. The longest of these queues was experienced by the slowest sample of the day and lasted approximately 16 minutes and extended roughly one mile in length. The approach to Georgia Avenue was by far the slowest section of the corridor aside from minor delays at signalized intersections between the two endpoints.

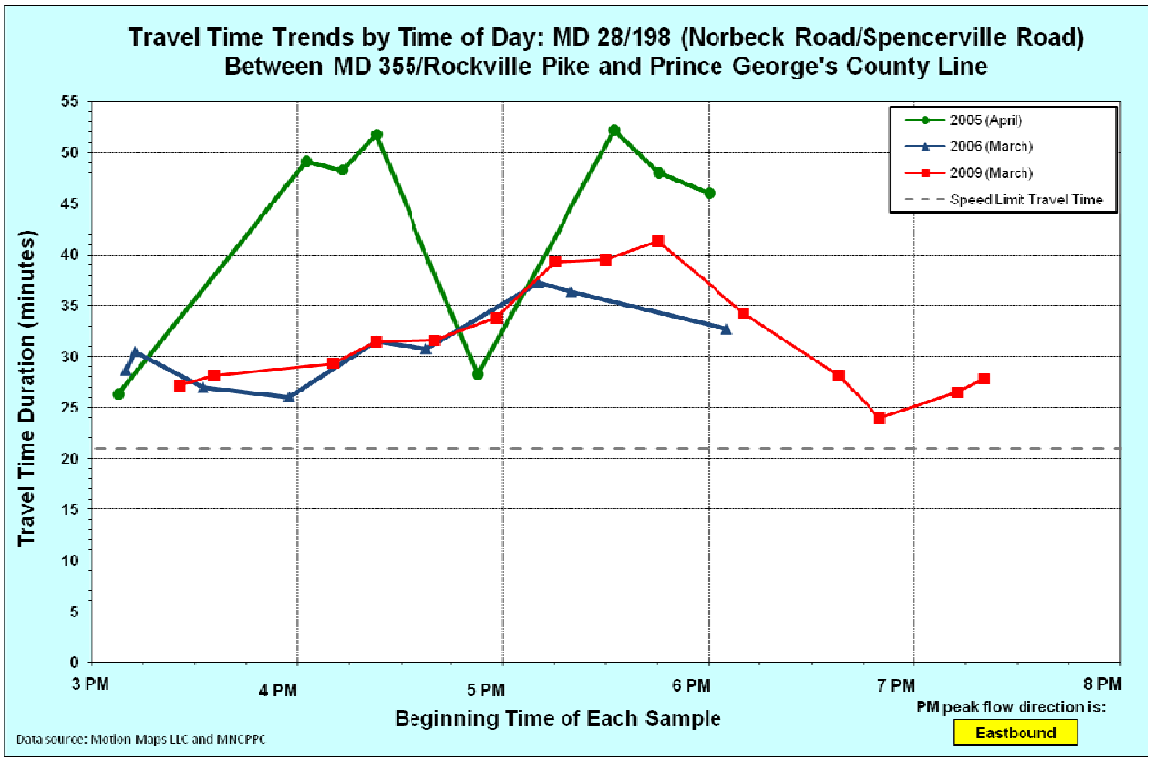
Historical Comparison of Travel Times: The slowest travel time among 2009 observations was five minutes slower than the combined 2007 samples (2007 data was split into MD 28 and MD 198 segments). This increase in travel time lowered the calculated Arterial Mobility for this corridor to about 51 percent from the figure of approximately 58 percent in 2007. Despite this decline, this corridor is one of the better performing corridors by the Arterial Mobility measure, and is just one of a few Priority Corridors (or associated segments) that have an Arterial Mobility above 50 percent. Historical samples from 2005 and 2006 indicate that peak hour eastbound travel in 2009 was comparable to previous travel time samples. Notes from the 2005 observations indicate that samples after 6:00 pm experienced slower than usual traffic due to an incident. The peak travel time for this roadway is consistent with other corridors. Peak travel time in 2009 was observed during a sample that departed at 5:45 pm. Subsequent travel observations after 6:00 pm were much faster. One sample, at 6:50 pm was just about three minutes slower than the speed limit travel time of 20.9 minutes.

Figure 2.21: Travel Time-Distance Profile for Eastbound Norbeck Rd. (MD 28)/Spencerville Rd. (MD198)



Note: 2007 Sample is a composite of two runs, one beginning at 5:45PM on MD28 and the second at 6:20PM on MD 198

Figure 2.22: Travel Time - Time of Day Profile for Eastbound Norbeck Rd. (MD 28)/ Spencerville Rd. (MD198)



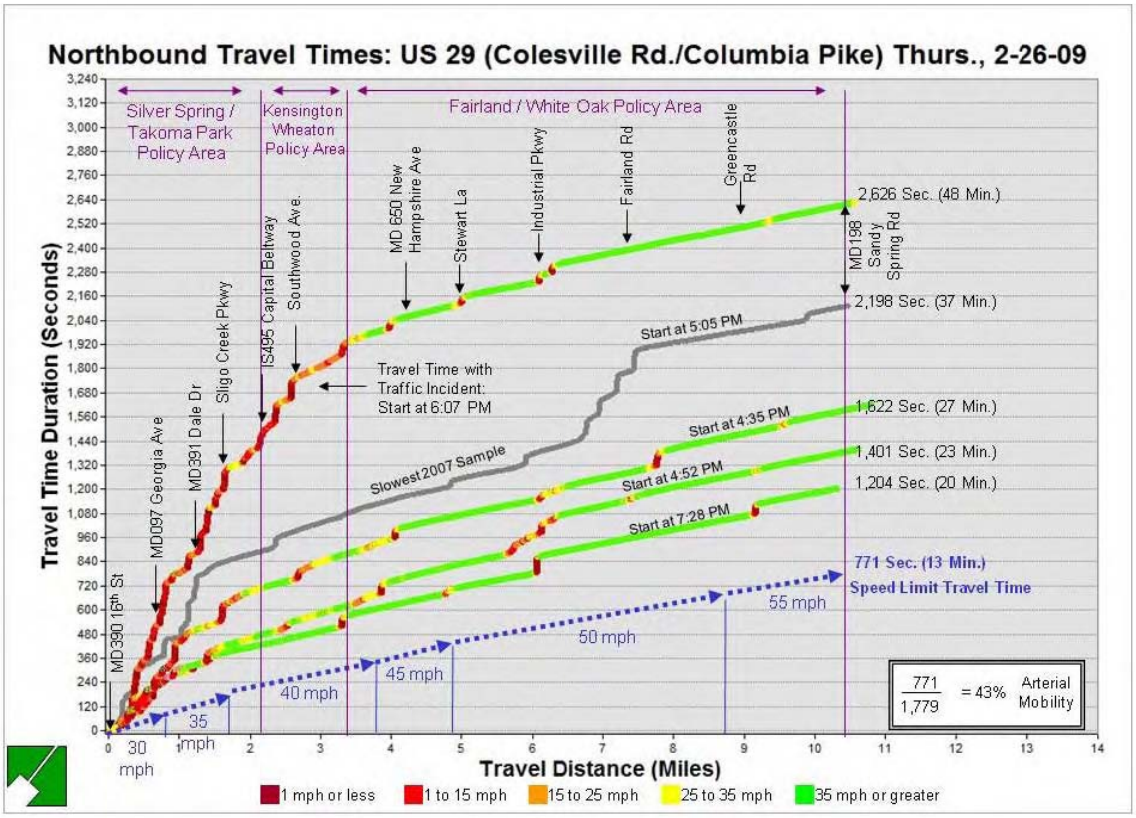
Colesville Road/Columbia Pike (MD 384/US 29) from Eastern Avenue to Sandy Spring Road (MD 198)

Description: This corridor extends 10.4 miles traversing nearly the full southeastern portion of Montgomery County from Eastern Avenue on the border with the District of Columbia to Sandy Spring Road, just short of the Howard County line. Travelling from south to north, the corridor begins in downtown Silver Spring in the Silver Spring/Takoma Park Policy Area and then passes through the Kensington/Wheaton Policy Area before reaching its northern terminus in the Fairland/White Oak Policy Area. Speed limits along this corridor range from 30 miles per hour in the urban portions of Silver Spring's central business district and increase to 55 miles per hour for the final two miles. Calculated travel time at the speed limit is 771 seconds or 12.9 minutes.

2009 Observations: There were 14 northbound and 11 southbound travel time measurements along this corridor in 2009. Data was collected on Thursday March 26 with time measurements beginning at increments from 3:34 pm through 8:05 pm. Northbound recorded travel times ranged from 20 minutes to 51 minutes although the tracking devices did not record trajectories for some samples. Travel along this corridor on the date of sampling was influenced by two incidents, one traffic related and the other due to police activity near Briggs Chaney Road. The first of these incidents occurred just before 5:00 pm at Lockwood Road and caused significant delays south into downtown Silver Spring through the six o'clock hour. Delays for this incident can be clearly seen in the long queue depicted for the 6:07 pm sample on the following Travel Time versus Distance graph. The second incident occurred late in the sampling and affected travel times between Randolph Road and Briggs Cheney Road for the sample that left Eastern Avenue at 8:05 pm. Roughly one third of the northbound samples were affected by these incidents, yielding lack of clarity with regard to an accurate slowest, incident free, travel time for the corridor. Samples before 5:00 pm and between 7:00 and 8:00 pm represent typical conditions and recorded notably slow travel speeds in the Silver Spring/Takoma Park Policy Area through Dale Drive, with another delay of roughly one half mile leading up to Industrial Parkway. Moderate delays at major signalized intersections were observed throughout the remainder of the samples for these time periods. The slowest representative sample (and that used in the 2009 Arterial Mobility calculation) began at 6:53 pm and took 1,779 seconds or nearly 30 minutes to reach MD 198.

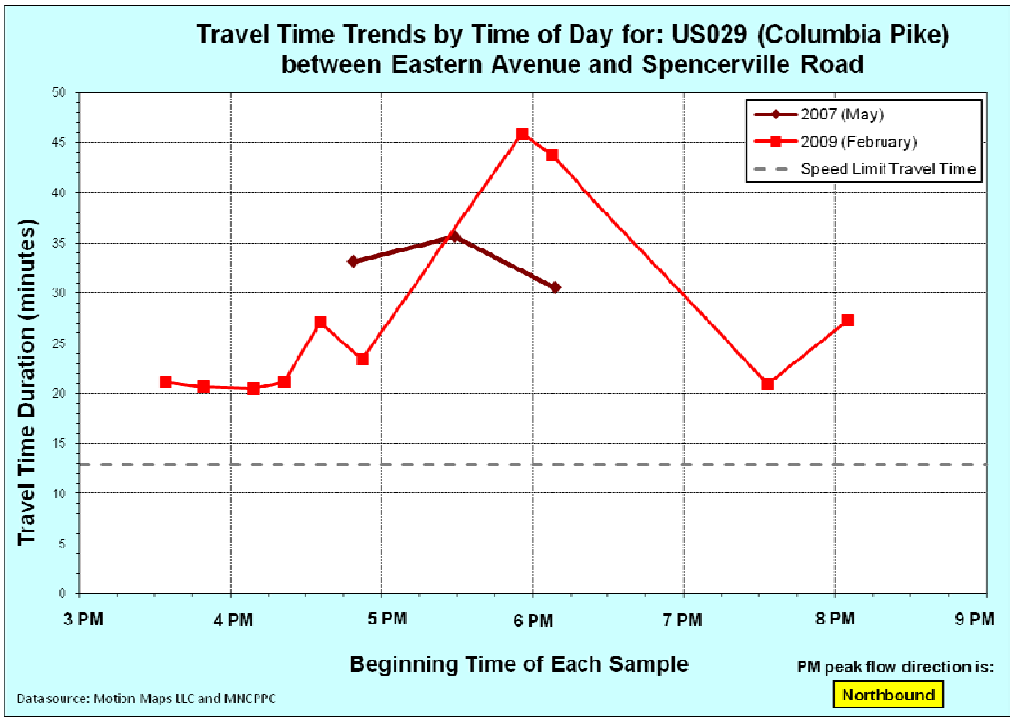
Historical Comparison of Travel Times: Travel time samples from 2007 provide an indication of what travel time might have been like between 5:00 pm and 6:00 pm if the incident at Lockwood Road had not occurred in 2009. The slowest 2007 sample recorded delays in Silver Spring south of Dale Drive as well as in Fairland/White Oak before Fairland Road. Travel time samples in 2009 before 5:00 pm and after 7:00 pm display very similar travel times of 20 to 25 minutes, an indication that the 2007 samples after 5:00 pm are indicative of the typical peak hour conditions.

Figure 2.23: Travel Time-Distance Profile for Northbound Colesville Rd./Columbia Pike (US 29)



Note: 2007 Sample is a composite of two runs, one beginning at 5:05PM at 16th Street and the second at 5:28 PM at the Fairland/While Oak Policy Area boundary.

Figure 2.24: Travel Time - Time of Day Profile for Northbound Colesville Rd./Columbia Pike (US 29)



Connecticut Avenue (MD 185) from Western Avenue to Georgia Avenue (MD 97)

Description: Travel time samples were collected along the full 8.4 mile length of Connecticut Avenue in Montgomery County, from Western Avenue in the south to its northern terminus at Georgia Avenue (MD 97). The route commences in the Bethesda Chevy Chase Policy Area and ends in the Aspen Hill Policy Area. The middle section of this route, and roughly half its length, lies in the Kensington/Wheaton Policy Area. Speed limit travel time for this segment is 829 seconds or 13.8 minutes, with posted speed limits ranging from 30 miles per hour in the Bethesda Chevy Chase Policy Area to 45 miles per hour north of Randolph Road in the Kensington-Wheaton and Aspen Hill Policy Areas.

2009 Observations: Eight northbound and seven southbound samples were collected along this corridor on February 23, 2009. Measurements began at roughly 4:00 pm and concluded with the last run leaving Western Avenue at approximately 7:30 pm. Southbound travel times were faster on the whole than northbound measurements. Southbound times ranged from 16.8 minutes to 20.3 minutes while northbound travel times ranged from 17.2 minutes to 26.7 minutes. The slowest trip of 26.7 minutes averaged 18.6 miles per hour and occurred on the northbound sample that left Western Avenue at about 5:20 pm. This time was about 13 minutes (roughly double) more than the calculated speed limit travel time. See Figure 2.25 for a depiction of the slowest north and southbound travel time samples. Measurable delays in travel times were fairly consistent among the samples and occurred at many of the signalized intersections with other main arterials on the route including East West Highway (MD 410), Knowles Road (MD 547), Veirs Mill Road (MD 586), Randolph Road and Georgia Avenue (MD 97).

Historical Comparison of Travel Times: The 2009 Connecticut Avenue travel time samples were uniformly faster than the most recent travel time samples in 2007 as depicted in this corridor's Travel Time by Time of Day Graph. Sample times were also faster than many of the 2004 measurements but were comparable to 2005 measurements. Decreased travel time measurements in 2009 samples when compared with 2007 samples is largely due to the absence of long, slow queues observed throughout the 2007 samples. In 2007 the most significant of these long queues occurred in the Bethesda Chevy Chase Policy Area from Western Ave to the Capital Beltway and in the Kensington Wheaton Policy Area in the vicinity of University Boulevard. Faster travel times in the 2009 samples yielded a significantly faster (i.e. improved) Arterial Mobility measurement of 51.7 percent in 2009 compared with 36.4 percent in 2007.

Figure 2.25: Travel Time-Distance Profile for Northbound Connecticut Avenue (MD 185)

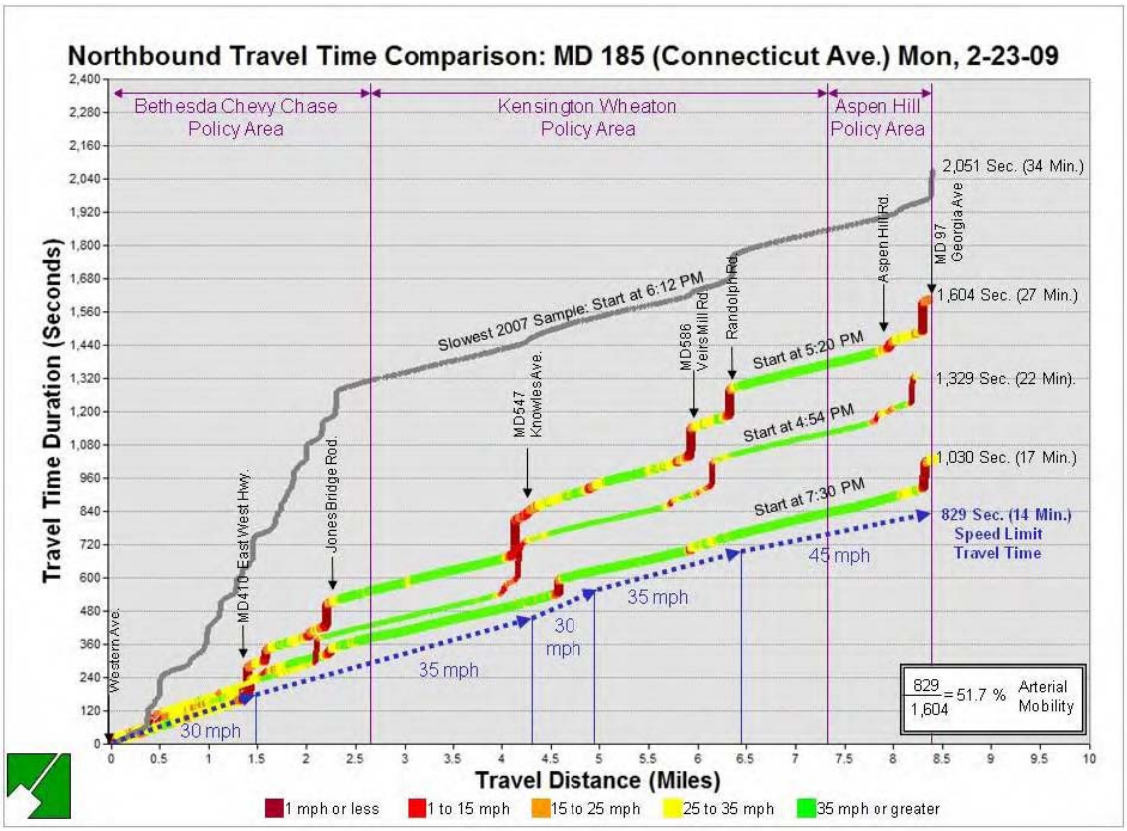
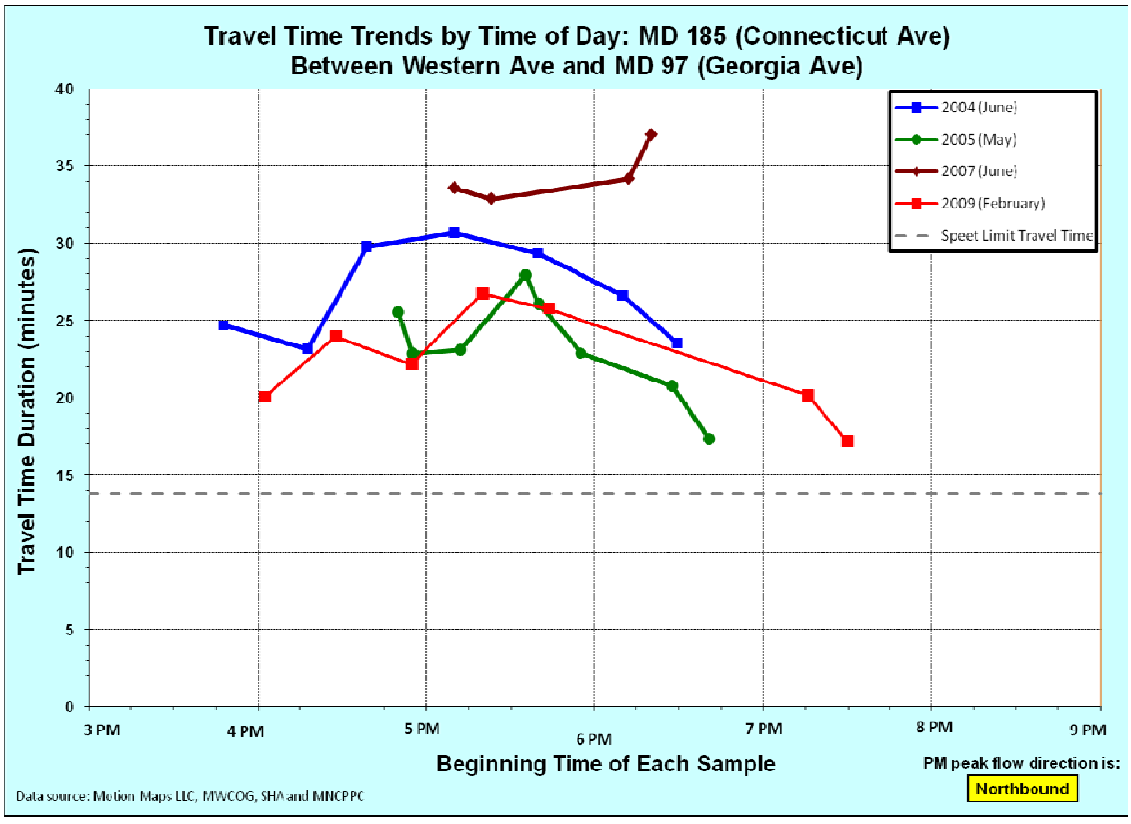


Figure 2.26: Travel Time - Time of Day Profile for Northbound Connecticut Avenue (MD 185)



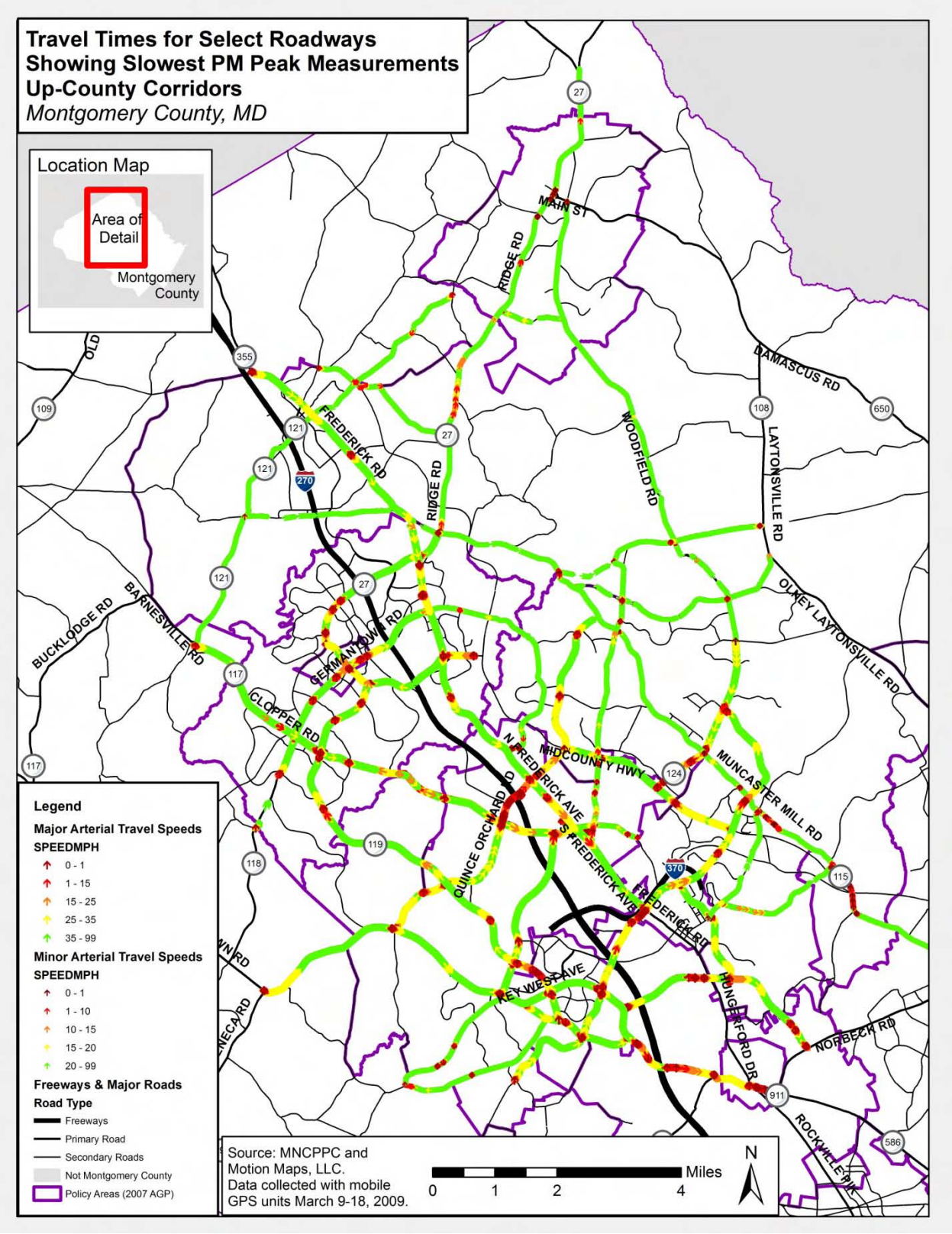
Mobility within Select Policy Areas of the AGP (I-270/North Areas)

Description: In addition to the six main priority corridors described in the previous section, a network of more than 30 additional road segments was sampled in the Up-County policy areas along and adjacent to the I-270 corridor. The MD 355 Priority Corridor samples are also show again on this graphic. Collectively these roadways form an extensive network of north-south and east-west travel routes between such policy areas from Rockville City to Clarksburg and Damascus. Travel time samples were collected throughout this area between March 9 and March 18, 2009.

2009 Observations: Unlike the priority corridors described earlier in this report, the travel time samples in the Up-County policy areas depict a broader spatial picture of transportation congestion patterns. When combined together as in Figure 2.24, two or more directions are depicted at major intersections. Such density of coverage allows for a more complete picture and assessment of localized and systemic congestion. In 2009, traffic delays were observed in a number of locations. In Rockville Town Center, traffic queues were observed along MD 28 (West Montgomery Ave) eastbound. A bit further north, notable delays in the pm peak hour were observed in R&D Village along MD 119 (Great Seneca Highway) and at the intersection of Shady Grove Road and MD 355 (Frederick Avenue). The longest delay among the 2009 data set occurred in the eastbound direction along Montgomery Village Avenue between MD 117 (Clopper Road) and MD 355 (Frederick Avenue). Significant delays also occurred in Germantown Town Center at the intersection of Father Hurley Boulevard and Middlebrook Road. Among the minor arterial roads in the 2009 sample, MD 27 (Ridge Road) and MD 115 (Muncaster Mill Road) also experienced delays along several portions of their recorded length.

Historical Comparisons: When compared with maps and data from the 2007 Highway Mobility Report, the 2009 data seems to be significantly less congested. This is largely due to advancement in the processing capability of the data, which provided the option of major arterial as well as minor arterial road classifications. Because minor arterial roads have lower speed limits, their travel speeds appeared congested when mapped using symbols that corresponds with higher speeds on the major arterial routes. However, discounting that technical distinction, observed delays in 2009 were generally fewer and less severe than those in 2007, most notably along MD 117 and MD 119 northbound entering the Germantown West Policy Area. With just two years of data samples, it is too early to determine if this is a trend or merely normal variation among data observations. These two data sets will form a solid base for comparisons in future Highway Mobility Reports.

Figure 2.27: Congestion in the Peak Direction (Weekday PM Peak) for Up-County Corridors



Congested Corridors

Synthesis of this year's intersection count data and travel time analysis yields a picture of the County's congested corridors. Congested corridors are identified by large numbers of high volume, often perennially congested intersections, coupled with reduced travel speeds, frequent delays and low mobility measurements. The list of 2009 congested corridors includes:

- MD 355 (Wisconsin Avenue/Rockville Pike/Hungerford Drive/Frederick Road) particularly from Western Avenue north to I-495 and from Rockville north through Gaithersburg,
- MD 185 (Connecticut Avenue), from Western Avenue to I-495 and in the vicinity of MD 586 (Veirs Mill Road)
- MD 97 (Georgia Avenue) from Eastern Avenue to MD 182 (Layhill Road), and MD 185 to MD 108 (Olney Laytonsville Road)
- US 29 (Colesville Road/Columbia Pike) particularly inside I-495 but also north to MD 198 (Sandy Spring/Spencerville Road)
- MD 28 (Norbeck Road) between Bel Pre Road and MD 182 (Layhill Road)
- MD 586 (Veirs Mill Road)

More than half of the top 60 CLV counts at intersections in this year's report are located along these corridors which are all state routes. Many of these intersections exceed, or are close to exceeding their LATR standard. Details of the conditions along several of these corridors and discussion of infrastructure improvements (both near term and in long term planning stages) are listed below. (Please note that all travel time comments refer to travel between 4:00 and 7:00 pm in the peak direction).

- **Wisconsin Avenue/Rockville Pike (MD 355)** from Bradley Lane to Pooks Hill Road. Three intersections in this corridor, W. Cedar Lane, MD 410 (East West Highway) and Jones Bridge Road are among the top 15 most congested intersections in 2009. Both the intersections at Cedar Lane and Jones Bridge Drive have CLV values that exceed their standard. The intersection with MD 410 is at its standard in 2007 (this intersection was not counted in 2009). Travel time during the peak pm hours was heavily delayed in this stretch of MD 355 beginning at Bradley Lane and continuing for the length of the corridor segment. At the height of the pm rush (6:00 pm), the delay for this segment lasted roughly two and ½ miles and added more than 15 minutes to travel above posted speed limits.

- **Rockville Pike (MD 355)** particularly from Edmonston Drive to Veirs Mill Road (just south of the Rockville Town Center). The intersection of MD 355 and Edmonston Drive is the sixth most congested in the County, with a CLV that exceeds the LATR standard by 20 percent. Proximate intersections with high volumes include Veirs Mill at First Street and First Street at Baltimore Road, both of which exceed their LATR standard. Travel time samples along this route experienced delays of nearly four mintues at the Wooten Parkway/First Street/MD 355 intersection in the peak period between 5:00 and 7:00 pm. Continued development in Rockville Town Center will alter traffic conditions here in the near term although development in the vicinity of the Rockville Metrorail station may increase transit ridership in the area.

- **Frederick Rd (MD 355)** from Shady Grove Road to Montgomery Village Avenue in Gaithersburg. The intersection with MD 355 and Montgomery Village Avenue is among the most congested in the county. The 2009 CLV for this intersection is more than 15 percent above the standard. Travel time analysis for this corridor in 2009 revealed continued congestion from south of

Summit Avenue through to Montgomery Village Avenue. Travel time through much of this section averaged below 15 miles per hour with delays at intersections totaling eight minutes. This corridor may be a candidate for Bus Rapid Transit (BRT) treatments.

- **Georgia Avenue (MD 97)** from University Boulevard to Norbeck Road (MD 28). Three intersections in this segment (Connecticut Ave, Bel Pre Rd, Norbeck Rd (MD 28)) each have CLVs that exceed their LATR standard. Major travel queues were observed on this segment between University Boulevard and Randolph Road and again in the half mile leading south of Norbeck Road. The delay from University Boulevard peaked at 16 minutes around 6:00 pm over roughly one mile of roadway. An intersection capacity improvement is currently in project planning for the Norbeck Rd intersection, and a grade-separated interchange has been recommended for this intersection in the master plan. Capacity improvements have also been recommended in the master plan for the Bel Pre Rd. The County Executive and County Council have indicated that the Georgia Avenue Busway is a priority for future study in the state's CTP.

- **Connecticut Ave (MD 185)** from Western Ave (DC Line) to the Capital Beltway (I-495). Two intersections in this corridor are among the top 20 most congested in the county. MD 185 at Jones Bridge Road has been among the top ten congested intersections in three successive Highway Mobility Reports. The 2009 count at this location showed that the intersection exceeded its LATR standard by 10 percent. The MD 185 intersection with East West Highway (MD 410) has also been one of the most congested in the county for some time and also exceeds it LATR standard. Traffic from Western Avenue to I-495 moves close to the speed limits of 30 and 35 miles per hour in this area except when in queues of roughly ¼ mile at each of the intersections described above, causing delays of nearly three minutes each. Improvements associated with the BRAC process at MD 185 and Jones Bridge Road are currently in the planning stages. Work is scheduled to be complete by 2011.

- **Colesville Road / Columbia Pike (US 29)** from Silver Spring CBD to Industrial Parkway. There are eight intersections along US 29 with CLV figures in the top 60 most congested in the county. Six of these intersections are within this most congested section of US 29; Dale Drive, Sligo Creek Parkway/St. Andrews, Southwood, University Boulevard (North and South) and Franklin Avenue. The intersections at Dale Drive, Sligo Creek Parkway and Southwood are all above their LATR standard. Travel time along this corridor is routinely stopped near these intersections, particularly in Silver Spring approaching Dale Drive. Travel speeds for this most southern portion of the corridor are routinely below 15 miles per hour, ½ the posted speed limit. Several intersections along US 29 are targeted for interchange improvements by the State Highway Administration, although construction funding has been withdrawn during the recent economic downturn.

- **Norbeck Rd/First St (MD 28)** from Veirs Mill Rd (MD 586) to Georgia Ave (MD 97). Conditions in this corridor have improved since 2008 when seven intersections (Veirs Mill Rd, Baltimore Rd (at First St), Avery Rd, Baltimore Rd, Bel Pre Rd, Muncaster Mill Rd, Georgia Ave) each have CLVs that exceed their LATR standard. Current data indicate that the intersections at Georgia Avenue, Muncaster Mill Road and Norbeck Boulevard are the only intersections above their LATR standard in 2009. Travel time results, however, indicate that drivers in the afternoon peak hours still experience significant delay between Bel Pre Road and Georgia Avenue where delays

can be nearly two miles and extend travel time above the speed limit by roughly 15 minutes. As noted above, the intersection with Georgia Avenue is scheduled for capacity improvements, and ultimately, a grade-separation.

- **Veirs Mill Road (MD 586)** from Georgia Avenue (MD 97) to First Street/Norbeck Road (MD 28). This is one of the most congested corridors in the County, largely because it crosses several east-west arteries and runs in between the heavily traveled MD 97 and MD 355 corridors. The intersections at Twinbrook Parkway (ranked eighth in this year's most congested list) and First Street both exceed their LATR standard. Travel time along this corridor is periodically marked by delays at major intersections including University Boulevard, MD 185, Randolph Road, Aspen Hill Road and First Street. As noted above, the intersection at First Street is part of a State Highway Administration intersection improvement study. The Veirs Mill Road corridor is currently under study as a candidate for Bus Rapid Transit.

III. TRANSPORTATION TRENDS

Vehicle Miles Traveled

National trend data collected by the Federal Highway Administration indicate that the nation is in the midst of a decline in national vehicle miles traveled (VMT) that began in 2005 (U.S. DOT *Traffic Volume Trends*, years 2006-2009). February 2009 VMT data indicate a decline of 1.9 billion vehicle miles, or 0.9 percent, when compared with February 2008. A slumping economy and fluctuating gas prices are likely causes of the national decline. This national decline in VMT is not uniform across the country, however. Depending on the time of year, and seasonal flows, quadrants of the country experience different changes in VMT. While the South Atlantic States (a group of eight states and the District of Columbia, which includes Maryland) saw a VMT decline of 2.2 percent from February 2008 to February 2009, the North Central states (12 states in the upper Midwest) saw an increase in VMT of 1.3 percent.

Both the state of Maryland and Montgomery County are affected by the recent downturn in the economy, and VMT analysis for these areas also show recent declines. Job losses, a common indicator of economic malaise, began to appear in Montgomery County in 2007. An estimated 4,800 jobs have been lost in the County since the end of 2006 (MNCPPC Research Team estimates, April 2009). Figure 3.1 provides a comparison of the decline in VMT at the national, state and county level. Although Maryland VMT has fluctuated somewhat over the past three years, Montgomery County VMT data reveal decreases in the past two years. Figure 3.2 depicts Montgomery County VMT totals since the year 2000 and illustrates the dramatic decrease in VMT since 2005.