Prepared for

DelDOT

New Castle County Transportation Operations Management Plan (TOMP) 2010

Prepared by
AECOM
University of Delaware

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Note: Due to the extensive amount of data included in the following appendices, these appendices (with more than five thousand pages) are only provided electronically on the project specific TOMP Site portal under the "Project Reports" tab. The TOMP Site can be accessed using the following details:

http://tompsite.info/
Username: tompuser
Password: Deldot 2011

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Executive Summary

The 2010 New Castle County Transportation Operations Management Plan (TOMP) was performed to serve as an operational inventory of the major roadways and intersections in New Castle County, Delaware. An assessment of this kind was originally performed in 2001; this update has performed analysis of each roadway segment and intersection analyzed in 2001 for comparison purposes, as well as analyzed several new segments and intersections in 2010. The report is meant to be utilized by stakeholders with interest in transportation planning and operations and can be referenced as a starting point for identifying areas for relatively low-budget improvements or larger scale capital improvements.

Recommendations have been organized into six types for further action:

1. Traffic signal optimization/coordination for the following roadway segments classified as arterial or multi-lane highways:
    - DE-52 from Hillside Rd. to Campbell Rd[1]
    - DE-7 from DE-72 to Stoney Batter Rd.
    - DE-4 from DE-273 to DE-7.[1]
    - DE-141 from Commons Blvd. to US-13.[1]
    - DE-4 from DE-896 to DE-273 (this is included in a current DelDOT signal timing project).[1]
    - DE-273 from I-95 to Old Baltimore Pike.[1]
    - DE-273 from Prangs Rd. to Pleasant Dr.[1]
    - DE-2 from Milltown Rd. to St. James Church Rd.[1]
    - US-13 from the US-13/US-40 Split to Hamburg Rd.[1]
    - Foulk Rd. from US-202 to DE-92.[1]
2. Reassessment of no-passing zones on the following roadway segments classified as two-lane highways:
    - DE-92 from Woodlawn Rd. to Beaver Valley Rd.
    - Grubb Rd. from Foulk Rd. to Marsh Rd.
    - Wilson Rd. from Shipley Rd. to Marsh Rd.
    - DE-41 from Hercules Rd. to DE-34.
    - DE-72 from DE-40 to Reybold Rd.
    - DE-71 from DE-7 to DE-72.
    - DE-896 from US-301 to US-13.
    - US-301 from Old School House Rd. to Marl Pitt Rd.
    - DE-299 from Broad St. to DE-1.[1]
    - DE-41 from the PA Line to Old Lancaster Pike.[1]
3. Lane use configuration changes utilizing the existing roadway geometry at the intersection of DE-7 & Milltown Rd.[1]
4. Traffic signal phasing changes at the intersection of DE-2 & DE-41.[1]

5. Possible larger-scale capital improvements at the intersections of:
    - Newport Pike (DE-4) & DE-7.[1]
    - DE-2 & Milltown Rd.[1]
    - DE-2 & DE-7.[1]
6. Monitoring performance levels of the following intersections, which experience border-line unacceptable LOS in the PM peak hour, but healthy LOS in the AM peak hour:
    - Foulk Rd. & Silverside Rd[1].
    - US-202 & DE-92.[1]
    - DE-4 & DE-7 (Near Churchmans Rd.).[1]
    - US-202 & Silverside Rd.[1]

The following chapters present detailed information and results of data collection, analysis, and levels of service for the 43 roadway segments and 31 signalized intersections included in this assessment.

[1] Roadway Segment or Intersection serves DART Bus Route

Chapter 1: Introduction

1.1 Background - Previous New Castle County Data Collection Study (2001)

New Castle County is the most populous county in the state of Delaware, with a diverse landscape from the largest city in the state, Wilmington, to numerous small towns and communities, historic estates and farmlands. The county hosts several major employment generators ranging from the University of Delaware's main campus in Newark to major financial institutions, pharmaceutical companies, and headquarters of many other major companies. These characteristics generate a significant amount of traffic, loading the county's transportation network with a variety of users including commuters, shoppers, and tourists. In addition, due to its unique location wedged between the states of New Jersey, Pennsylvania and Maryland with a major national transportation corridor, I-95, traversing the northern portion of the county, the county also carries significant pass-through traffic connecting the New York and Philadelphia metropolitan areas with the Baltimore and Washington, DC metropolitan areas. Thus, as the county experiences a lot of traffic with significant potential and evidence of recurring congestion, the Delaware Department of Transportation (DelDOT) initiated an effort in 2001 to establish baseline transportation data associated with New Castle County's transportation network.

1.1.1 Goals and Objectives

The goal of the 2001 Data Collection Study was to collect countywide baseline transportation data along key corridors and locations. In addition to five key permanent counting sites in the New Castle County, 24-hour control count traffic data was collected for seven consecutive days at thirty-one (31) key locations throughout the county. In addition, turning movement intersection counts were conducted for a 12-hour period at 23 key intersections.

The objective of this data collection effort was to allow DelDOT to examine the County's transportation issues as a system and to consider effects of various transportation initiatives as a whole.

1.1.2 Analyses Performed

In the 2001 New Castle County Data Collection Study, the following analyses were performed with the data collected to understand network performance and issues:

1.1.2.1 Analyses performed with the control count data collected:

1. Geographic trends analysis to understand average daily traffic volumes along key corridors in the county.
2. Temporal trends analysis to determine variation in traffic volumes based on day of week and also between weekdays and weekends.
3. Spot speed analysis to examine the relationship between posted speed limits and 85th percentile of the observed speed measurements along the key transportation corridors.
4. Peak hour capacity analysis to establish operating performance under existing conditions.

1.1.2.2 Analyses performed with the intersection count data collected:

1. Temporal trends analysis to determine variation in intersection traffic volumes based on time of day.
2. Critical Movement Summations (CMS) analysis to understand peak hour performance of signalized intersections.
3. Highway Capacity Software (HCS) analysis to understand peak hour performance of unsignalized intersections.

1.1.3 Key Findings and Lessons Learned

The following were some of the key findings based on the 2001 Data Collection effort and associated analyses performed:

1. Most of the corridors in the county did not show variation in weekday daily traffic volumes (Mon-Fri), except for a slight increase on Fridays.
2. Weekend volumes were generally less compared to weekdays, suggesting that commuter traffic was the main component along most of these corridors.
3. 85th percentile speed observed along most of the corridors was more than the posted speed limits. However, the excess speed was generally not more than 10 mph above the posted limit.
4. For the most part, the freeway segments analyzed (I-95, I-495, DE-141 and DE-1) showed acceptable performance LOS during peak hours except at one analysis location, which showed failing LOS during the AM peak.
5. The rural multilane highway segments analyzed showed acceptable performance LOS during peak hours but all five two-lane highway locations analyzed showed unacceptable LOS during peak hours.
6. All the arterial roadway segments analyzed showed acceptable performance LOS during peak hours.
7. Seven of the twenty-three intersections analyzed showed a CMS volume over 1300 (LOS D) during peak hours.

1.2 The 2010 TOMP Study Goals and Objectives

"Transportation Management and Operations" has long been a priority for DelDOT and has advanced as a major emphasis in the national transportation program. The 2001 data collection effort discussed earlier proved to be very useful throughout DelDOT.

The first decade of the 21st century witnessed significant variations in national housing, economic, and demographic trends. While the first half of the decade experienced housing market boom, which supported suburban sprawl, the latter half experienced a major housing market decline coupled with a prolonged economic recession. These national economic, housing and demographic trends had direct impacts on the extent and nature of travel on Delaware's transportation infrastructure. In addition, the significant increase in fuel cost also altered the extent of travel and modal choices. Thus, to understand and assess recent transportation trends and their impacts on the Delaware transportation infrastructure, DelDOT decided to undertake the 2010 Transportation Operations Management Plan (TOMP) for New Castle County to compile/collect recent traffic data, analyze transportation performance, and determine changes in traffic trends between 2001 and 2010.

1.2.1 Evolution of TOMP

While the 2001 data collection study required collecting new data at almost all the study locations, the 2010 TOMP could tap into recent and relevant data available from various sources like DelDOT and WILMAPCO. Thus, the new data collection requirement was reduced in 2010. With efforts currently underway at DelDOT and supported by this study for an integrated data storage and retrieval platform, the new data collection requirement will further diminish in future. Also, increasing coverage of the Transportation Management Center's (TMC's) real-time traffic monitoring devices will significantly help in increased availability of traffic data going forward.

The 2010 TOMP also focused on increasing geographic coverage of the study locations in New Castle County compared to the 2001 data collection study based on the recommendations in the 2001 study, as well as feedback from the project stakeholder committee and partnering agencies like WILMAPCO. The 2010 TOMP had 20% more control count locations and 33% more intersection locations compared to the 2001 study. Details of the 2010 study locations are discussed later in this chapter.

In addition to the TOMP data collection and analysis using measures of effectiveness (MOEs) like Critical Movement Summary (CMS) and Highway Capacity Methodology (HCM), the 2010 study introduced qualitative and quantitative performance assessment of the Integrated Transportation Management System (ITMS). The qualitative assessment focused on collecting feedback from the users of the system on the effectiveness of ITMS and determining policies in various county and state plans that support effective implementation of ITMS. The quantitative performance assessment focused on three MOEs - Reliability, Air Quality and Incident Management - to determine how ITMS can help improve these MOEs in Delaware. The findings of performance assessment analysis are documented in a separate report.

The 2001 Data Collection Study report was available in hard copy format. A significant value addition in 2010 was introduced by creation of a project-specific electronic, web-based data storage and retrieval platform, the TOMP Site. The TOMP Site hosts all the data, analyses, maps, appendices, and reports associated with the 2010 TOMP and Performance Assessment Study, which can be easily reviewed and retrieved by appropriate transportation professionals for their use. The TOMP Site can be accessed using the following details:

http://tompsite.info/
Username: tompuser
Password: Deldot 2011

1.2.2 Goals and Objectives

The goal of the 2010 TOMP is to collect countywide baseline transportation data along key corridors and locations to assess performance of the transportation infrastructure and to determine varying transportation trends in comparison with 2001.

The objective of the 2010 TOMP is to allow DelDOT to examine County's transportation issues as a complete system and to consider effects of various transportation initiatives as a whole.

1.2.3 Project Stakeholder Committee

Since the goals and objectives of this study focused on establishing countywide baseline transportation data and examining county's transportation issues as a complete system, a project committee of appropriate stakeholders and transportation professionals was put together to seek inputs on various aspects like appropriate study locations and data collection and analysis methodologies. The project stakeholder committee included transportation professionals from the various departments of DelDOT including Traffic, Planning, DTC and Project Development, and also included representatives from the partner agencies including WILMAPCO and New Castle County. The project team, including AECOM and University of Delaware, also participated in this committee.

Two Stakeholder Committee meetings were held with this group of professionals – one at the beginning of the project in August 2010 and the second at the end of this project in June 2011. In the first meeting, the project outline was presented to this group to seek inputs on study locations and project approach. The study findings were shared with the committee during the second meeting along with a demonstration of the project specific TOMP Site where all the baseline data, maps, appendices, and reports have been stored electronically for easy access and retrieval by the stakeholders for their review and future use.

1.3 Scope of Data Collection

1.3.1 Control Counts

Control counts were collected to understand average daily traffic volume levels, determine the composition of traffic flow by vehicle classification, display traffic patterns (by day of week, weekday vs. weekend, etc), collect speed data, and validate intersection counts in the vicinity.

1.3.1.1 Identification of Control Count Locations

Since one of the goals of this study is to understand traffic trends, the project stakeholder committee recommended analyzing the same control count locations included in the 2001 data collection study. WILMAPCO, which was an active partner agency in this study effort, also suggested a couple of new control count locations in New Castle County. Also, the project team utilized the relevant 2010 freeway traffic data compiled by the real-time traffic monitoring devices. The list of the 2010 control count study locations is provided in the sections below.

1.3.1.2 Availability of Existing Control Count Data – Permanent Count Stations and Wavetronix Count Locations

For Interstate freeways, the project team obtained data from DelDOT due to the impracticality of laying temporary ATRs on those facilities. The October 2010 permanent counting station data was available at the following three permanent stations (also used in the 2001 Data Collection Study):

1. US-13 @ DE-71 (ID#8034)
2. I-95 just south of PA line (ID#8038)
3. I-495 just south of PA line (ID#8039)

In addition to the above permanent counting stations, the project team obtained relevant October 2010 control count data from DelDOT's real-time traffic monitoring Wavetronix devices at the following freeway locations:

1. I-95 between Maryland State Line and Toll Plaza (ID#4471)
2. I-95 between DE-896 (Exit 1) and Delaware House Service Area (ID#4467)
3. I-95 between Delaware House Service Area and Rt. 273 (ID#4470)
4. I-95 between DE-273 (Exit 3) and DE-1/DE-7 (ID#4940)
5. I-95 between Route 1/7 (Exit 4) and DE-58 (ID#1111)
6. I-95 between DE-58 and DE-141 (ID#3531)
7. I-495 between northbound I-95/I-495 Split to US-13/DuPont Highway (ID#0034)

1.3.1.3 List of Control Count Locations with New Count Data

During Fall 2010 and Spring 2011, one-week temporary ATR count data was collected at 33 locations. The first 31 locations were also counted in the 2001 Data Collection study:

1. US-202 South of PA State Line
2. DE-92 (Naamans Road) between Grubb Road & Brandywine Town Center
3. DE-92 North of Woodlawn Road
4. US-202 South of Naamans Road
5. Grubb Road East of Foulk Road
6. Wilson Road East of Shipley Road
7. DE-261 (Foulk Road) North of US-202
8. DE-52 North of Hillside Road
9. US-202 South of Foulk Road
10. DE-48 East of Centerville Road
11. DE-41 South of Hercules Road
12. DE-7 South of DE-72
13. DE-72 South of DE-7
14. DE-141 South of Boxwood Road
15. US-13 between I-295 & I-495
16. DE-273 between Red Mill Road & Ogletown Road
17. DE-4 East of Harmony Road
18. DE-141 South of I-95
19. DE-4 East of Gender Road
20. DE-273 between I-95 & Old Baltimore Pike
21. DE-273 between Prangs Road & Pleasant Drive
22. US-13 South of US-13/US-40 Split
23. DE-896 North of DE-40
24. DE-72 North of DE-40
25. DE-71 West of DE-7
26. DE-896 West of US-13
27. US-301 South of Old School House Road
28. DE-299 East of Middletown
29. US-13 South of DE-1/US-13 Split
30. DE-1 South of DE-1/US-13 Split
31. DE-2 (Kirkwood Hwy.) West of Street James Church Road
32. DE-41 near PA State Line (North of McGovern Road)
33. DE-4 between Elkton Road and DE-896

This new data collection effort included one or more locations on all the major north-south and east-west routes in New Castle County as follows:

DE-1	DE-7	DE-72	DE-71	US-13
DE-4	DE-896	US-202	DE-92	DE-261
US-301	US-202	DE-273	DE-48	DE-141
DE-299	DE-41			

Figure 1 shows all the control count locations.

1.3.2 Intersection Turning Movement Counts

Intersection counts were collected to capture turning movements at intersections during peak periods.

1.3.2.1 Identification of Study Intersections

Based on the recommendation of the project stakeholder committee, the project team selected 22 of the 23 intersections analyzed in the 2001 Data Collection Study. The Intersection of Elkton Road and Delaware Avenue was the only location not analyzed in 2010 due to the following reasons:

a. It is not a signalized intersection and thus, CMS analysis cannot be performed for this intersection.
b. The intersection was undergoing utility construction impacting the normal traffic flows and thus, intersection traffic counts would not have reflected normal traffic conditions.

The 2001 study had recommended nine additional intersections for analysis for future efforts. All these nine intersections were included in the 2010 TOMP Study.

1.3.2.2 List of Study Intersections

The project team collected/compiled AM and PM peak period intersection turning movement counts to understand operational performance of key New Castle County intersections during worst case conditions. The following is a complete list of intersections analyzed in the 2010 TOMP Study (Figure 1 shows all the intersection locations):

1. Foulk Road & Silverside Road
2. Main Street & South College Avenue
3. Newport Pike (DE-4) & DE-7
4. DE-4 & Salem Church Road
5. DE-2 & Milltown Road
6. DE-7 & Milltown Road
7. Pennsylvania Avenue & North Union Street
8. DE-2 & DE-41
9. DE-7 & New Linden Hill Road

10. DE-273 (Delaware Avenue) & South College Avenue
11. Naamans Road (DE-92) & Philadelphia Pike
12. DE-2 & Pike Creek Road
13. New Linden Hill Road & Upper Pike Creek Road
14. DE-273 & Churchmans Road
15. *Elkton Road & Delaware Avenue*[1]
16. DE-4 & South Dupont Road
17. DE-4 & Race Street
18. DE-273 & DE-141
19. Old Baltimore Pike & DE-72
20. Polly Drummond Hill Road & New Linden Hill Road
21. Sunset Lake Road (DE-72) & Chestnut Hill Road (DE-4)
22. US-202 & Naamans Road
23. DE-896 & Hillside Road
24. DE-4 & DE-7 near Churchmans Road
25. DE-2 & DE-7
26. Foulk Road & DE-92
27. Foulk Road & US-202
28. US-202 & Silverside Road
29. DE-896 & DE-71
30. DE-7 & DE-72
31. West Main Street and Hillside Road (Newark)
32. Milltown Road & McKennans Church Road

1.3.2.3 Availability of Existing Intersection Counts: 2007-2009

The project team made all efforts to gather available recent peak hour turning movement traffic counts from various sources like DelDOT and WILMAPCO to utilize recent available data and avoid duplication of efforts. Based on the discussion with DelDOT's Planning Division, the project team decided to use available intersection counts collected during or after 2007 with application of appropriate growth factors (explained in the next section) to estimate 2010 traffic volumes for intersection analysis. Table 1.1 shows available data retrieved from various sources.

[1] This intersection was not counted and analyzed in the 2010 TOMP Study for the reasons stated in section 1.3.2.1. However, to ensure similar intersection IDs between 2001 and 2010, location # 15 is still assigned to this intersection.

Table 1.1 – Existing Available Turning Count Data

Location #	Location Description	Year of Latest Available Data
5	DE-2 & Milltown Road	2007
10	DE-273 (Delaware Avenue) & South College Avenue	2007
25	DE-2 & DE-7	2007
2	Main Street & South College Avenue	2008
7	Pennsylvania Avenue & North Union Street	2008
3	Newport Pike (DE-4) & DE-7	2009
4	DE-4 & Salem Church Road	2009
6	DE-7 & Milltown Road	2009
8	DE-2 & DE-41	2009
9	DE-7 & New Linden Hill Road	2009
11	Naamans Road (DE-92) & Philadelphia Pike	2009
14	DE-273 & Churchmans Road	2009
15	Elkton Road & Delaware Avenue	2009
16	DE-4 & South DuPont Road	2009
18	DE-273 & DE-141	2009
19	Old Baltimore Pike & DE-72	2009
21	Sunset Lake Road (DE-72) & Chestnut Hill Road (DE-4)	2009
23	DE-896 & Hillside Road	2009
28	US-202 & Silverside Road	2009
29	DE-896 & DE-71	2009
31	West Main Street and Hillside Road (Newark)	2009
32	Milltown Road & McKennans Church Road	2009
27	Foulk Road & US-202	2010

1.3.2.4 Methodology: Existing Intersection Count Growth to 2010

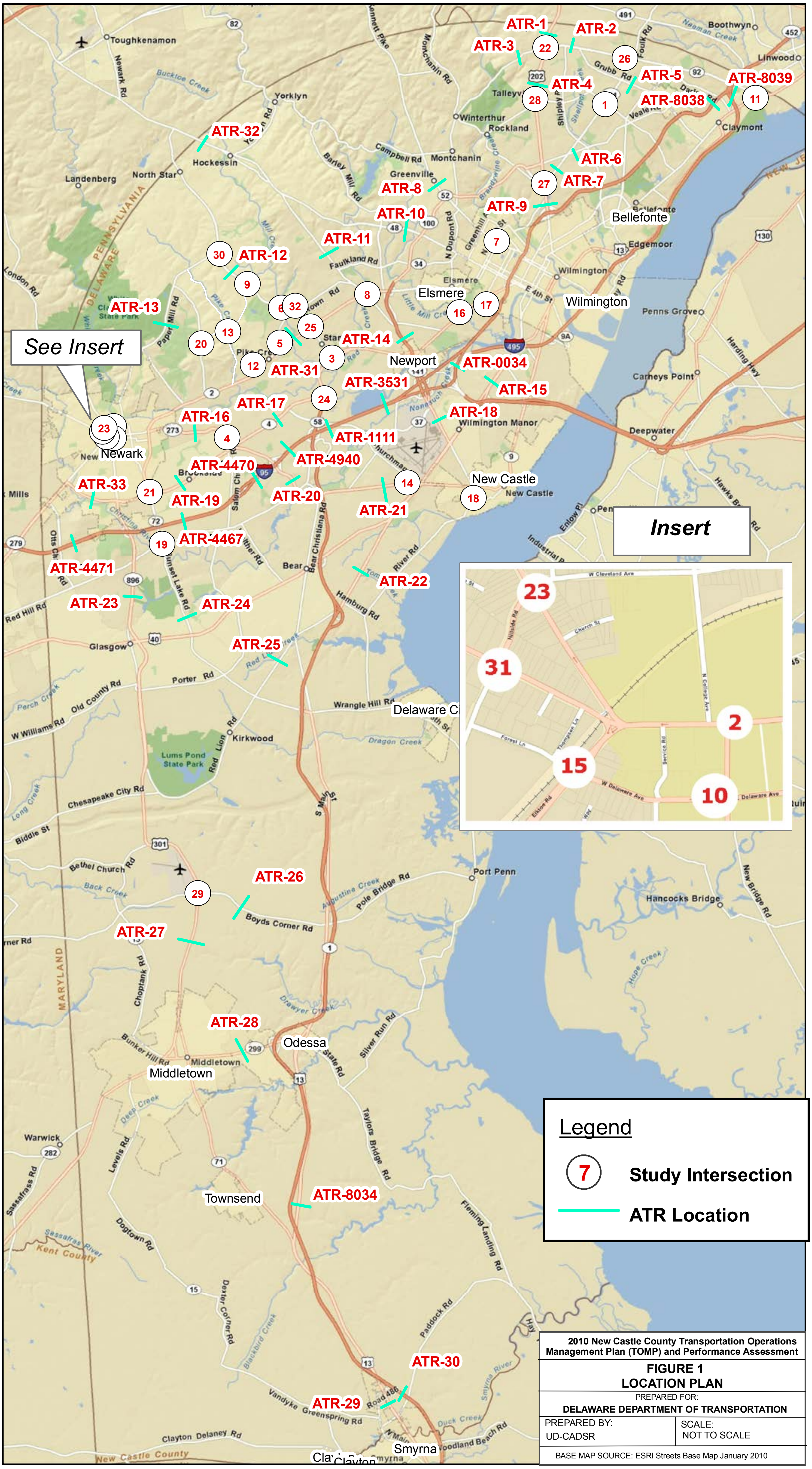
Based on the guidance provided by DelDOT's Planning Division, the project team applied countywide HPMS growth factors to convert available 2007, 2008 and 2009 intersection counts to 2010 estimated intersection counts. The HPMS growth factor methodology considers comparison of countywide average daily VMT every year and determines annual growth factors to grow traffic volumes. The following factors were used based on review of HPMS VMT data:

1. Intersections with available 2007 count data – counts were used as is because daily VMT levels reduced significantly in 2008 due to economic slowdown and recession. The 2009 daily VMT numbers showed some increase compared to 2008, which if continued will bring 2010 daily VMT levels comparable to 2007 daily VMT levels.

2. Intersections with available 2008 count data - used annual growth factor of 0.5% for all approaches.
3. Intersections with available 2009 count data - used annual growth factor of 0.5% for all approaches.

1.3.2.5 Travel Time Runs

Similar to 2001, travel time runs were not conducted as a part of the 2010 TOMP Study, because the University of Delaware routinely collects morning and afternoon travel time information for segments of major transportation corridors within New Castle County. The project team used these reported segment travel times in 2010 for conducting arterial performance analysis using HCM methodology and reviewed the University's report for any findings related to the TOMP roadway segments.



2010 New Castle County Transportation Operations Management Plan (TOMP) and Performance Assessment

FIGURE 1
LOCATION PLAN

PREPARED FOR:
DELAWARE DEPARTMENT OF TRANSPORTATION

PREPARED BY: UD-CADSR

SCALE: NOT TO SCALE

BASE MAP SOURCE: ESRI Streets Base Map January 2010

Chapter 2: Roadway Segment Data Collection and Performance Analysis

This chapter summarizes the data collection and performance analysis of the 43 roadway segments included in this assessment. Detailed data is available in Appendices 1-45.

2.1 ADT Trends

This section serves to summarize the daily traffic volume data collected and presents a look at how traffic volumes at these locations have changed since 2001.

2.1.1 Current Geographic Trends – Typical Weekday ADT

Table 2.1 shows typical weekday ADT by roadway segment and direction for each of the thirty-three temporary control count locations as well as seven freeway Wavetronix detector locations (also see Figure 2). For purposes of this report, typical weekday ADT is defined as the average daily traffic total during the days of Tuesday, Wednesday, and Thursday. In the very few instances where either partial or no data was available for one of these days of the week, the value represents the average of the typical weekdays where complete 24-hour data was available.

Table 2.1 – 2010 Typical Weekday ADT

#	Link Description	2010		
		NB/EB Daily	SB/WB Daily	ADT
1	US-202 From PA Line to DE-92	22,338	22,903	45,241
2	DE-92 From Grubb Rd. to Shipley Rd.	16,518	16,260	32,778
3	DE-92 From Woodlawn Rd. to Beaver Valley Rd.	3,976	3,857	7,833
4	US-202 From Naamans Rd. to Silverside Rd.	27,909	27,153	55,062
5	Grubb Rd. From Foulk Rd. to Marsh Rd.	5,433	5,526	10,959
6	Wilson Rd. From Shipley Rd. to Marsh Rd.	5,189	4,978	10,167
7	Foulk Rd. From US-202 to DE-92	10,898	10,270	21,168
8	DE-52 From Hillside Rd. to Campbell Rd.	8,284	7,466	15,750
9	US-202 From Foulk Rd. to Augustine Cutoff	6,813	11,807	18,620
10	DE-48 From Centerville Rd. to DE-141	14,926	15,786	30,712
11	DE-41 From Hercules Road to DE-34	6,883	6,907	13,790
12	DE-7 From DE-72 to Stoney Batter Rd.	16,759	16,920	33,679
13	DE-72 From DE-7 to Possum Park Rd.	8,240	7,613	15,853
14	DE-141 From Boxwood Rd. to DE-4	23,984	26,365	50,349
15	US-13 From I-295 to I-495	21,494	21,156	42,650
16	DE-273 From Red Mill Rd. to Ogletown Rd.	16,492	16,006	32,498
17	DE-4 From DE-273 to DE-7	16,249	16,836	33,085
18	DE-141 From Commons Blvd. to US-13	24,875	26,164	51,039
19	DE-4 From DE-896 to DE-273	16,258	15,977	32,235
20	DE-273 From I-95 to Old Baltimore Pike	21,592	21,634	43,226
21	DE-273 From Prangs Rd. to Pleasant Dr.	10,584	10,226	20,810

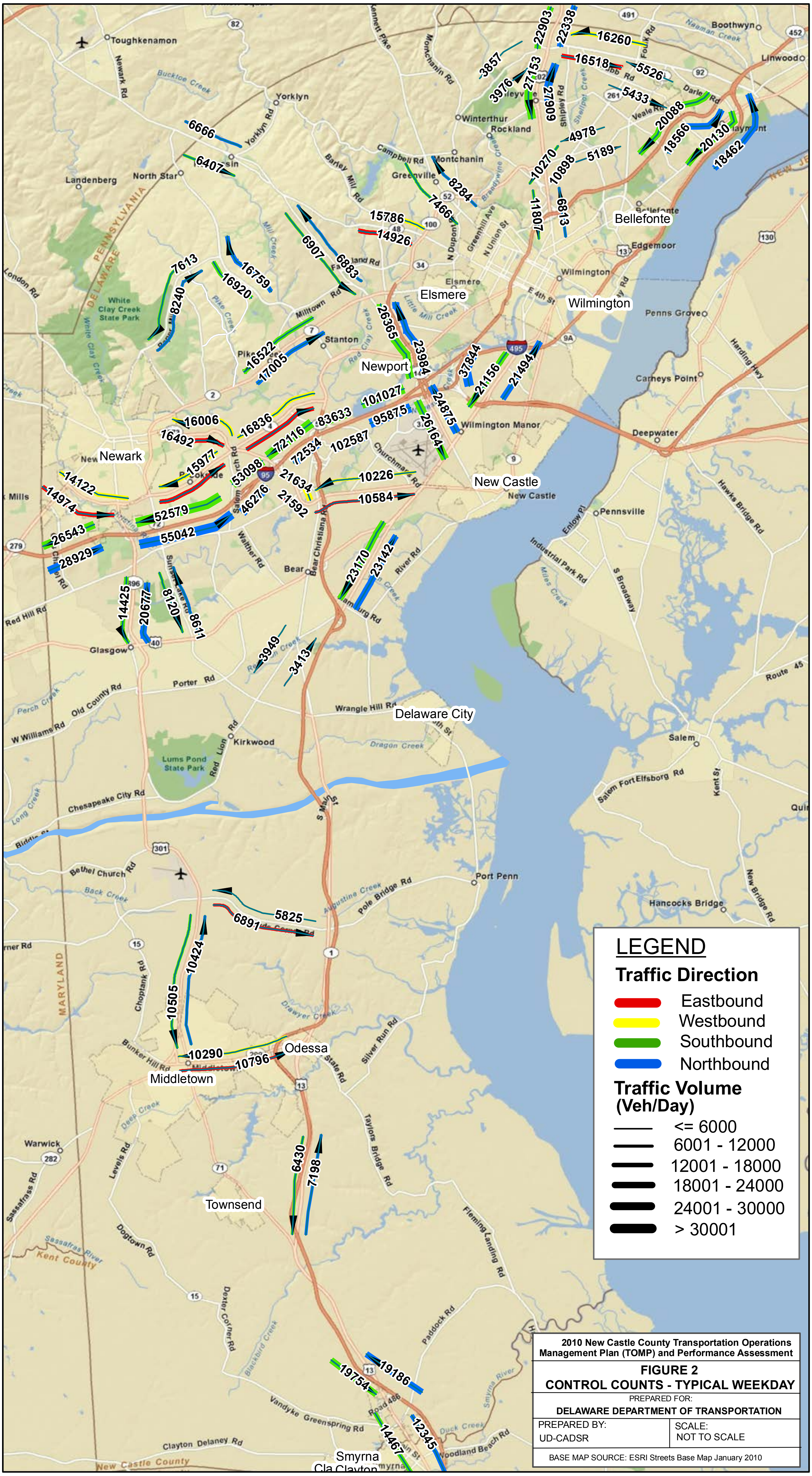
Table 2.1 – 2010 Typical Weekday ADT (cont.)

#	Link Description	2010		
		NB/EB Daily	SB/WB Daily	ADT
22	US-13 From US-13/US-40 Split to Hamburg Rd.	23,142	23,170	46,312
23	DE-896 From US-40 to Old Baltimore Pike	20,677	14,425	35,102
24	DE-72 From DE-40 to Reybold Rd.	8,611	8,120	16,731
25	DE-71 From DE-7 to DE-72	3,413	3,949	7,362
26	DE-896 From US-301 to US-13	6,891	5,825	12,716
27	US-301 From Old School House Rd. to Marl Pitt Rd.	10,424	10,505	20,929
28	DE-299 From Broad St. to DE-1	10,796	10,290	21,086
29	US-13 From Exit 119B to Paddock Rd.	12,345	14,467	26,812
30	DE-1 From DE-1/US-13 Split to NCC Line	19,186	19,754	38,940
31	DE-2 From Milltown Rd. to St. James Church Rd.	17,005	16,522	33,527
32	DE-41 From PA Line to Old Lancaster Pike	6,666	6,407	13,073
33	DE-4 From DE-896 to Elkton Rd.	14,974	14,122	29,096
4471*	I-95 From MD Line to Newark Toll Plaza	28,929	26,543	55,472
4467*	I-95 From DE-896 to Delaware House Service Area	55,042	52,579	107,621
4470*	I-95 from Delaware House Service Area to DE-273	46,276	53,098	99,374
4940*	I-95 From DE-273 to DE-1/DE-7	72,534	72,116	144,650
1111*	I-95 From DE-1/DE-7 to DE-58	102,587	83,633	186,220
3531*	I-95 From DE-58 to DE-141	95,875	101,027	196,902
ND0034*	I-495 From I-95/I-495 Split to US-13	37,844	N/A	37,844
8039**	I-495 South of PA Line	18,568	20,088	38,656
8034**	US-13 & DE-71	7,198	6,430	13,628
8038**	I-95 South of PA Line	18,568	20,088	38,656

** Denotes data obtained from Wavetronix detector.*

*** Denotes data obtained from permanent ATR count stations.*

As one would expect, the freeways in New Castle County (I-95, I-495, and DE-1) carry more vehicles per day than most other roads in New Castle County. Excluding the freeways, the most highly traveled roadways include segments of US-202, DE-141, US-13, and DE-273, which each carry more than 40,000 vehicles per day on a typical weekday.



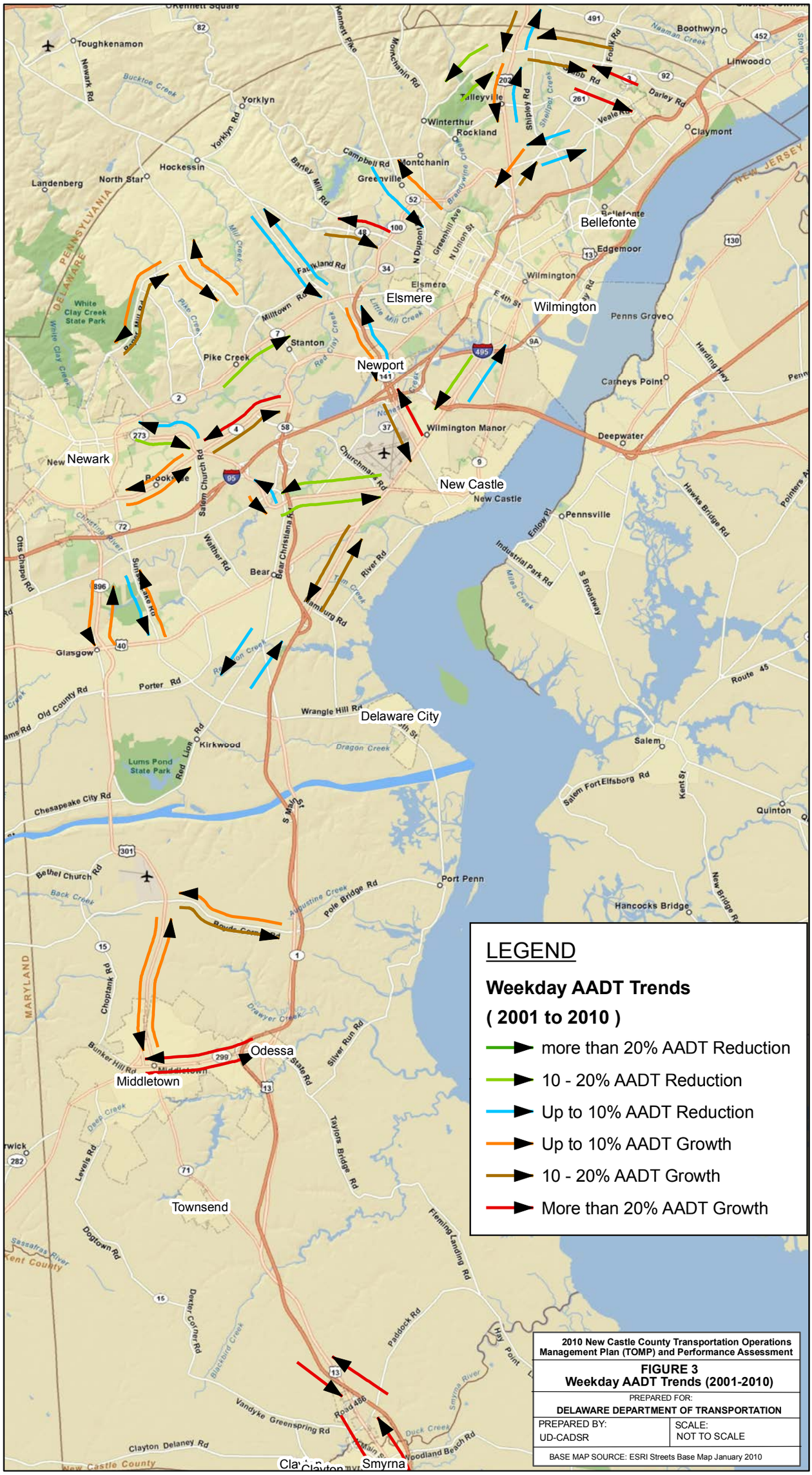
2010 New Castle County Transportation Operations Management Plan (TOMP) and Performance Assessment

FIGURE 2
CONTROL COUNTS - TYPICAL WEEKDAY

PREPARED FOR:
DELAWARE DEPARTMENT OF TRANSPORTATION

PREPARED BY:	SCALE:
UD-CADSR	NOT TO SCALE

BASE MAP SOURCE: ESRI Streets Base Map January 2010


Bellefonte
Elsmere
Wilmington
Newport
New Newark
New Castle
Delaware City
Odessa
Middletown
Townsend
Smyrna
LEGEND
Weekday AADT Trends
(2001 to 2010)
more than 20% AADT Reduction
10 - 20% AADT Reduction
Up to 10% AADT Reduction
Up to 10% AADT Growth
10 - 20% AADT Growth
More than 20% AADT Growth
2010 New Castle County Transportation Operations Management Plan (TOMP) and Performance Assessment
FIGURE 3
Weekday AADT Trends (2001-2010)
PREPARED FOR:
DELAWARE DEPARTMENT OF TRANSPORTATION
PREPARED BY:
UD-CADSR
SCALE:
NOT TO SCALE
BASE MAP SOURCE: ESRI Streets Base Map January 2010

2.1.2 2010 Typical Weekday ADT vs. 2001 Typical Weekday ADT

The 2010 TOMP Study conducted 7-day ATR counts at the same locations that were included in the 2001 Data Collection Report to understand changing traffic trends in the past decade. Table 2.2 shows how 2010 typical weekday ADT has changed in New Castle County for each control count location since 2001 (also see Figure 3). A value in parentheses represents a percentage decrease.

In general, it can be seen that study locations south of the C & D Canal have shown growing percentile traffic volume trends whereas study locations north of the C & D Canal show mixed trends of traffic growth and traffic reduction based on type/functional classification and spatial location of the roadways.

Table 2.2 – Typical Weekday ADT: 2001 vs. 2010

#	Link Description	2001 ADT	2010 ADT	% Change
1	US-202 From PA Line to DE-92	43,013	45,241	5
2	DE-92 From Grubb Rd. to Shipley Rd.	27,898	32,778	17
3	DE-92 From Woodlawn Rd. to Beaver Valley Rd.	9,193	7,833	(15)
4	US-202 From Naamans Rd. to Silverside Rd.	53,476	55,062	3
5	Grubb Rd. From Foulk Rd. to Marsh Rd.	8,905	10,959	23
6	Wilson Rd. From Shipley Rd. to Marsh Rd.	11,003	10,167	(8)
7	Foulk Rd. From US 202 to DE-92	18,739	21,168	13
8	DE-52 From Hillside Rd. to Campbell Rd.	15,088	15,750	4
10	DE-48 From Centerville Rd. to DE-141	26,024	30,712	18
11	DE-41 From Hercules Road to DE-34	14,427	13,790	(4)
12	DE-7 From DE-72 to Stoney Batter Rd.	30,638	33,679	10
13	DE-72 From DE-7 to Possum Park Rd.	14,137	15,853	12
14	DE-141 From Boxwood Rd. to DE-4	52,156	50,349	(3)
15	US-13 From I-295 to I-495	47,568	42,650	(10)
16	DE-273 From Red Mill Rd. to Ogletown Rd.	35,942	32,498	(10)
17	DE-4 From DE-273 to DE-7	27,323	33,085	21
18	DE-141 From Commons Blvd. to US-13	41,377	51,039	23
19	DE-4 From DE-896 to DE-273	32,114	32,235	1
20	DE-273 From I-95 to Old Baltimore Pike	43,321	43,226	(1)
21	DE-273 From Prangs Rd. to Pleasant Dr.	24,475	20,810	(15)
22	US-13 From US-13/US-40 Split to Hamburg Rd.	40,047	46,312	16
23	DE-896 From US-40 to Old Baltimore Pike	33,127	35,102	6
24	DE-72 From DE-40 to Reybold Rd.	16,601	16,731	1
25	DE-71 From DE-7 to DE-72	7,658	7,362	(4)

Table 2.2 – Typical Weekday ADT: 2001 vs. 2010 (cont.)

#	Link Description	2001 ADT	2010 ADT	% Change
26	DE-896 From US-301 to US-13	11,426	12,716	11
27	US-301 From Old School House Rd. to Marl Pitt Rd.	20,260	20,929	3
28	DE-299 From Broad St. to DE-1	12,807	21,086	65
29	US-13 From Exit 119B to Paddock Rd.	20,621	26,812	30
30	DE-1 From DE-1/US-13 Split to NCC Line	26,885	38,940	45
31	DE-2 From Milltown Rd. to St. James Church Rd.	40,814	33,527	(18)

Note: Location #9 omitted from comparison because count location differed in 2010 vs. 2001. Locations #32 and #33 omitted because they were not counted in 2001. I-95 and I-495 locations omitted because they differ from the I-95 and I-495 locations counted in 2001.

2.1.2.1 Segments with Significant ADT Growth

The following roadway segments have experienced significant increases (more than 20%) in typical weekday ADT since 2001:

- Grubb Road: Foulk Rd. to Marsh Rd.
- DE-4: DE-273 to DE-7
- DE-141: Commons Blvd. to US-13
- DE-299: Broad St. to DE-1
- US-13: Exit 119B to Paddock Rd.
- DE-1: DE-1/US-13 Split to New Castle County Line

The roadway segments of DE-299 (Broad St. to DE-1), US-13 (Exit 119B to Paddock Rd.) and DE-1 (DE-1/US-13 Split to New Castle County Line) are especially noteworthy, as they experienced ADT growth of 65%, 30%, and 45%, respectively, between 2001 and 2010. It is hypothesized that the ADT growth along DE-299 stems from the growth in residential and commercial development in the Middletown area between 2001 and 2010; this roadway segment provides direct access from Middletown to DE-1. Similar to the developmental growth in Middletown during the same period, it is hypothesized that the residential growth in Kent County has driven increased levels of ADT along segments of US-13 and DE-1, as these roadways are the main routes between Kent and New Castle Counties.

Note: This assessment has identified the subject segment of DE-299 to be operating at an unacceptable level, while the subject segments of US-13 and DE-1 are operating at acceptable levels. See section 2.3, "Segment Performance", of this assessment for more information.

2.1.2.2 Segments with Moderate ADT Growth

The following roadway segments have experienced moderate increases (between 10% and 20%) in typical weekday ADT since 2001:

- DE-92: Grubb Rd. to Shipley Rd.
- Foulk Rd.: US-202 to DE-92
- DE-48: Centerville Rd. to DE-141
- DE-7: DE-72 to Stoney Batter Rd.
- DE-72: DE-7 to Possum Park Rd.
- US-13: US-13/US-40 Split to Hamburg Rd.
- DE-896: US-301 to US-13
- DE-273: I-95 to Old Baltimore Pike
- DE-71: DE-7 to DE-72

2.1.2.3 Segments with Moderate ADT Reduction

The following roadway segments have experienced moderate decreases (between 10% and 20%) in typical weekday ADT since 2001:

- DE-92: Woodlawn Rd. to Beaver Valley Rd.
- DE-273: Prangs Rd. to Pleasant Dr.
- DE-2: Milltown Rd. to St. James Church Rd.

2.1.2.4 Segments with Significant ADT Reduction

There were no roadway segments that have experienced significant decreases (more than 20%) in typical weekday ADT since 2001.

2.1.3 Temporal Trends – Daily Traffic Variation

Figures 4a through 4f display graphically the daily traffic volume totals for the temporary control count locations and Wavetronix detector locations. This information displays how traffic volumes vary throughout the week and how weekday volumes differ from weekend volumes. The figures group roadway segments by the HCM classification in which they were analyzed.

Most roadway segments analyzed as part of this assessment are similar in the sense that they generally show consistent daily volumes Monday through Thursday, slight peaks on Friday, and lower daily volumes on Saturday and Sunday. This is an indication of mostly commuter traffic. Several exceptions to this rule are:

- The freeways in Delaware (see Figure 4a) generally see steady daily volumes of traffic throughout the week which do not drop off on the weekends. I-95 and I-495 generally show a significant rise in Saturday volumes compared to the rest of the week while Sunday counts along these freeways are generally similar or slightly higher than the weekday counts. This is mainly because the I-95/I-495 corridors in Delaware, which connect the New York and Philadelphia metro areas on the north with

the Baltimore and Washington DC metro areas to the south, carry significant leisure traffic over the weekends.

- Daily traffic volumes along Delaware Route 1 remain almost similar for all seven days of the week as the commuter activity during weekdays is replaced by leisure travel activity over the weekend as Route 1 serves the key north-south connection in Delaware. It should be noted that this observation is based on volumes in Fall 2010. Every year during summer season, Delaware Route 1 experiences significant weekend resort traffic.

- East of US 202, DE-92 (an arterial segment – see Figure 4b) actually sees its highest daily volume on Saturday, as this segment serves as a link between highly residential areas to the east and the commercial properties located on US 202.

Figure 4a
Temporal Traffic Variation - Freeways

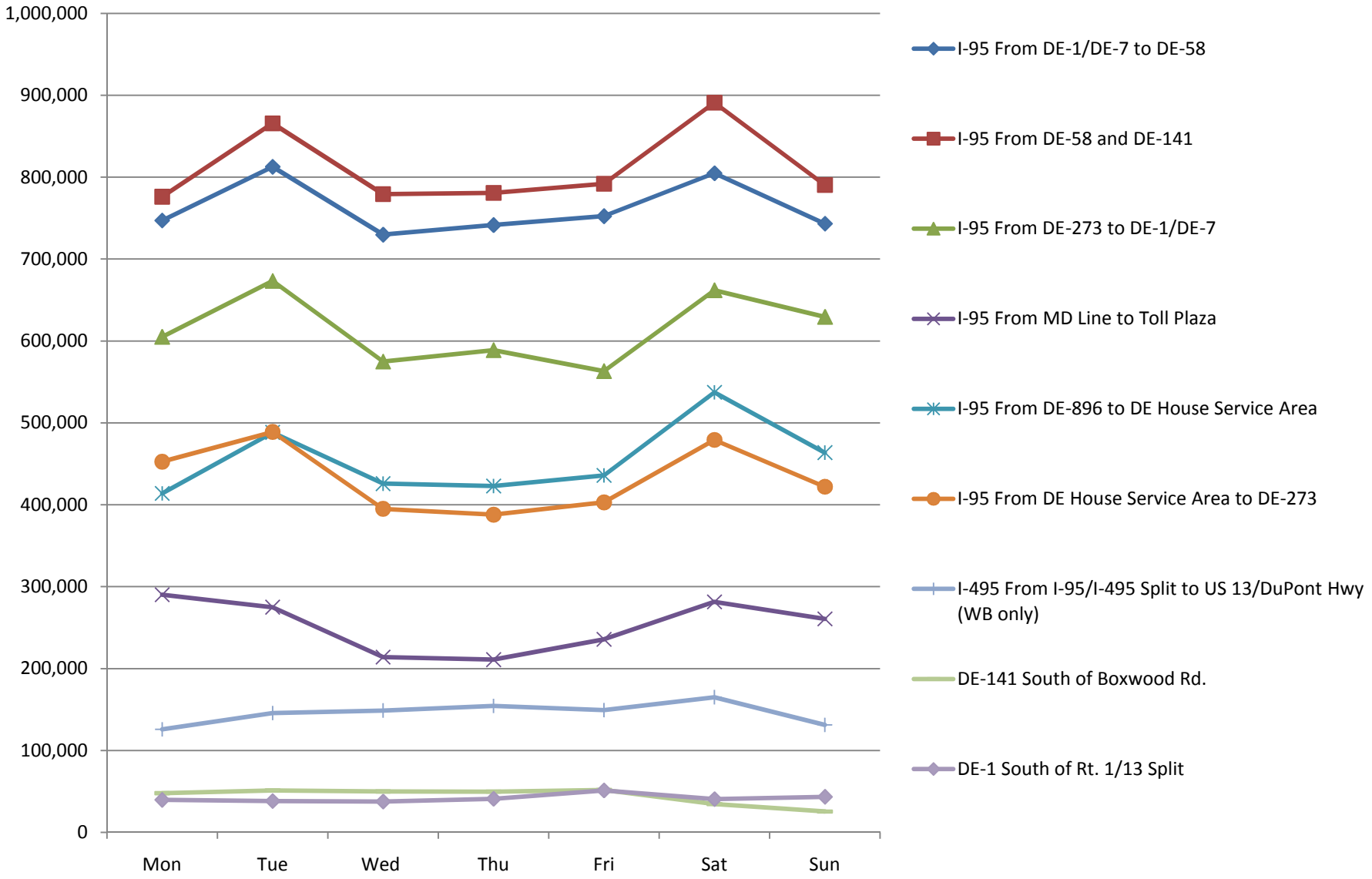


Figure 4b
Temporal Traffic Variation - Arterial Highways (1)

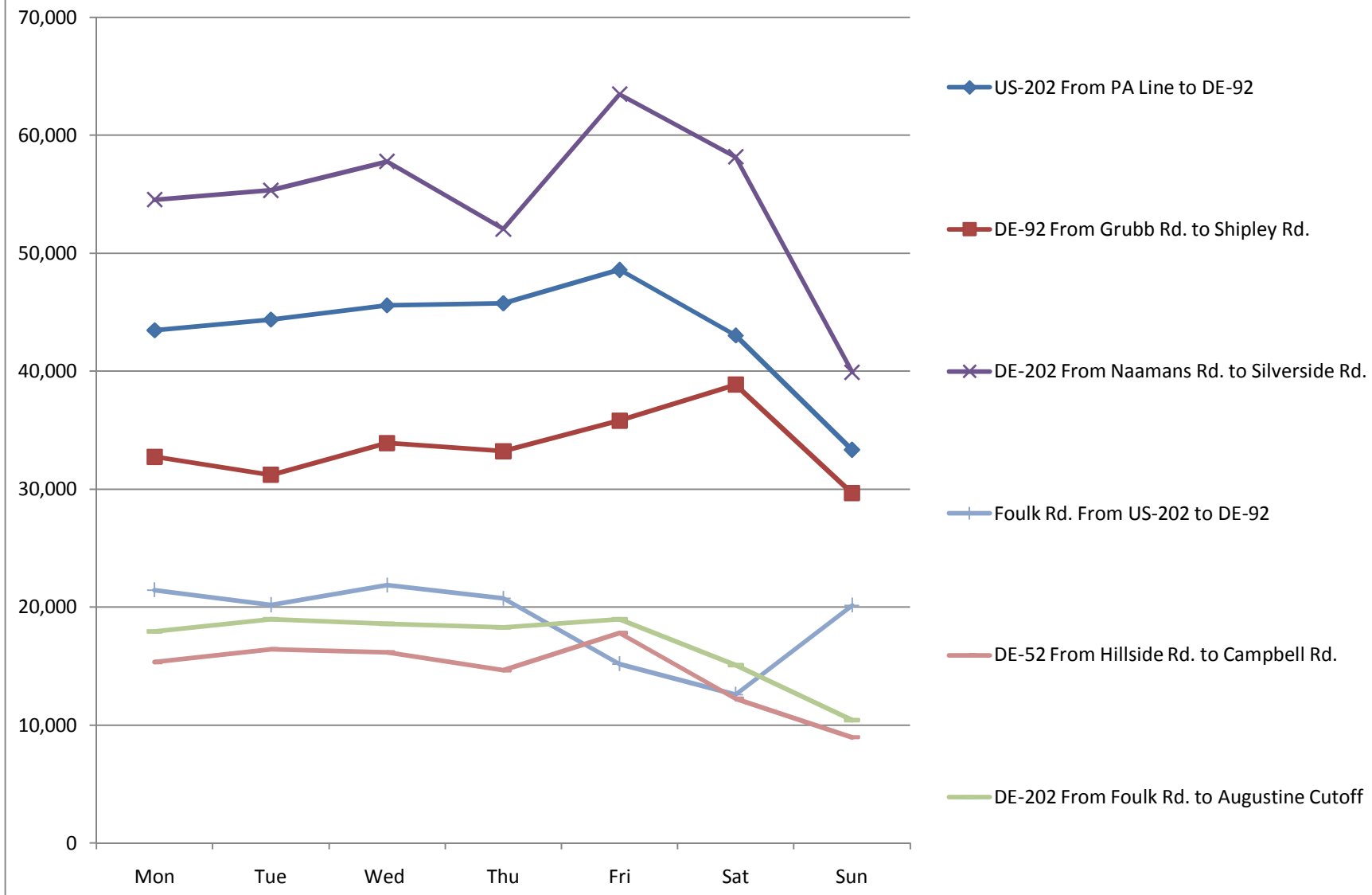


Figure 4c
Temporal Traffic Variation - Arterial Highways (2)

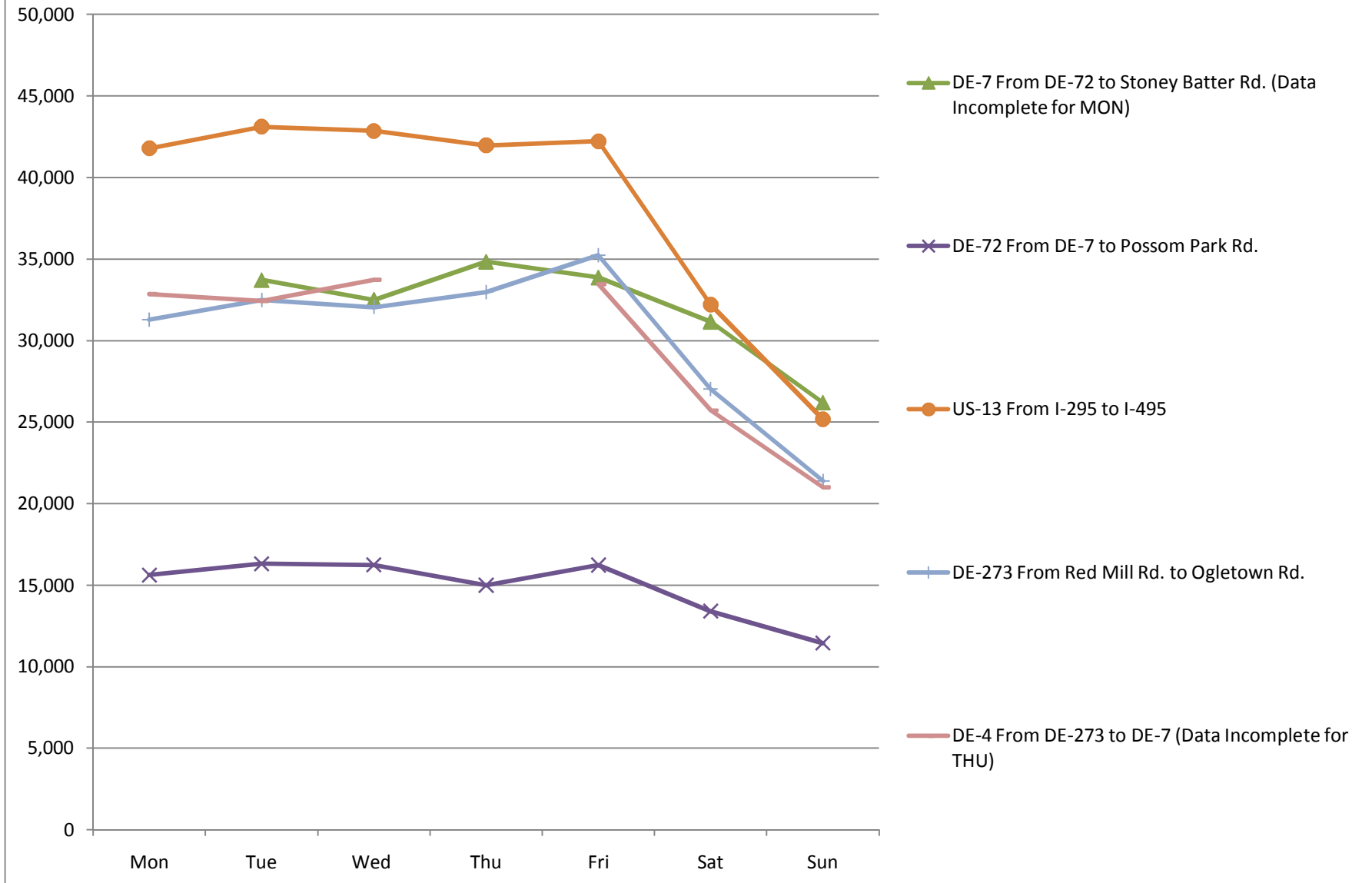


Figure 4d
Temporal Traffic Variation - Arterial Highways (3)

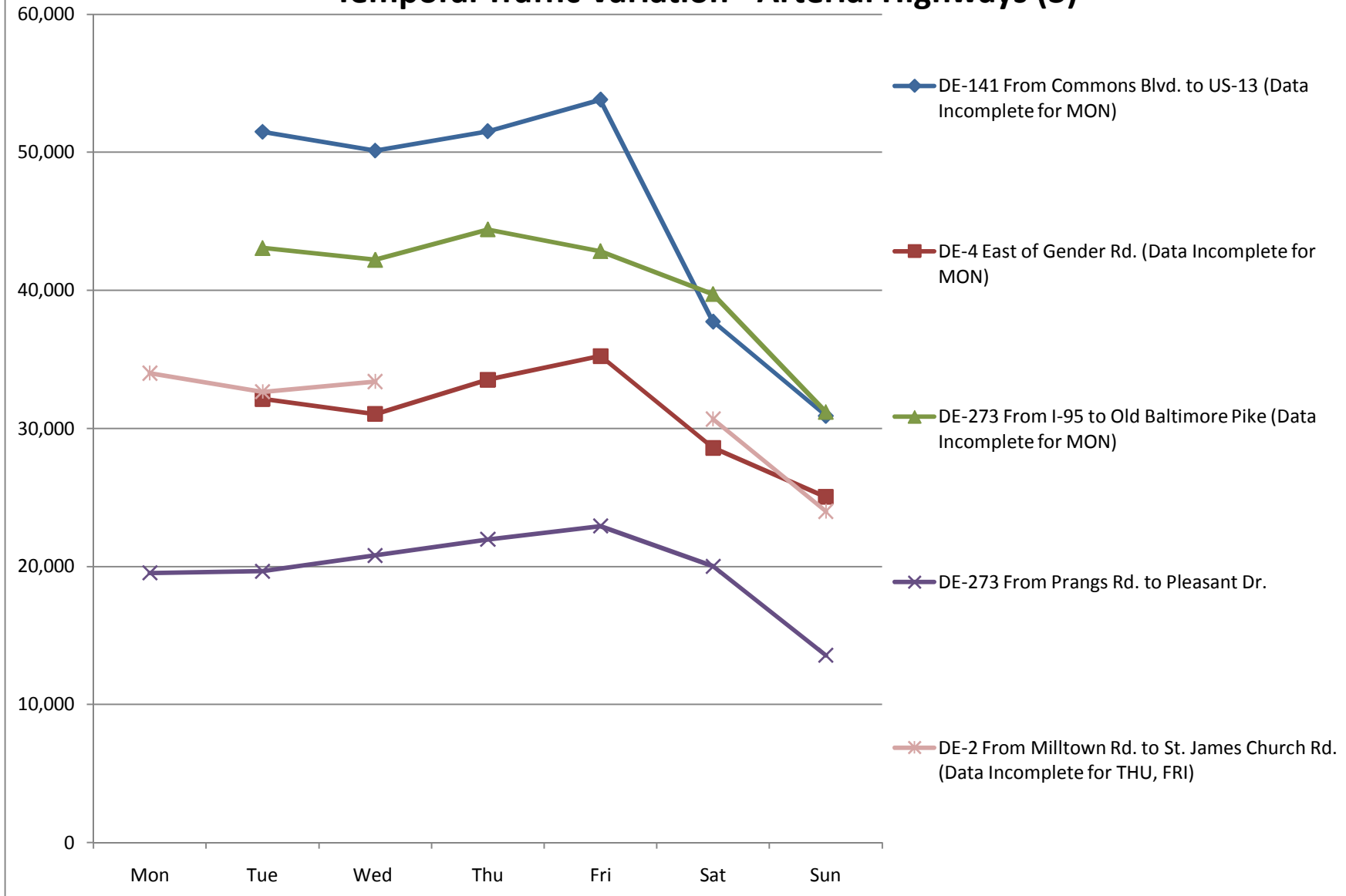


Figure 4e
Temporal Traffic Variation - Multi-lane Highways

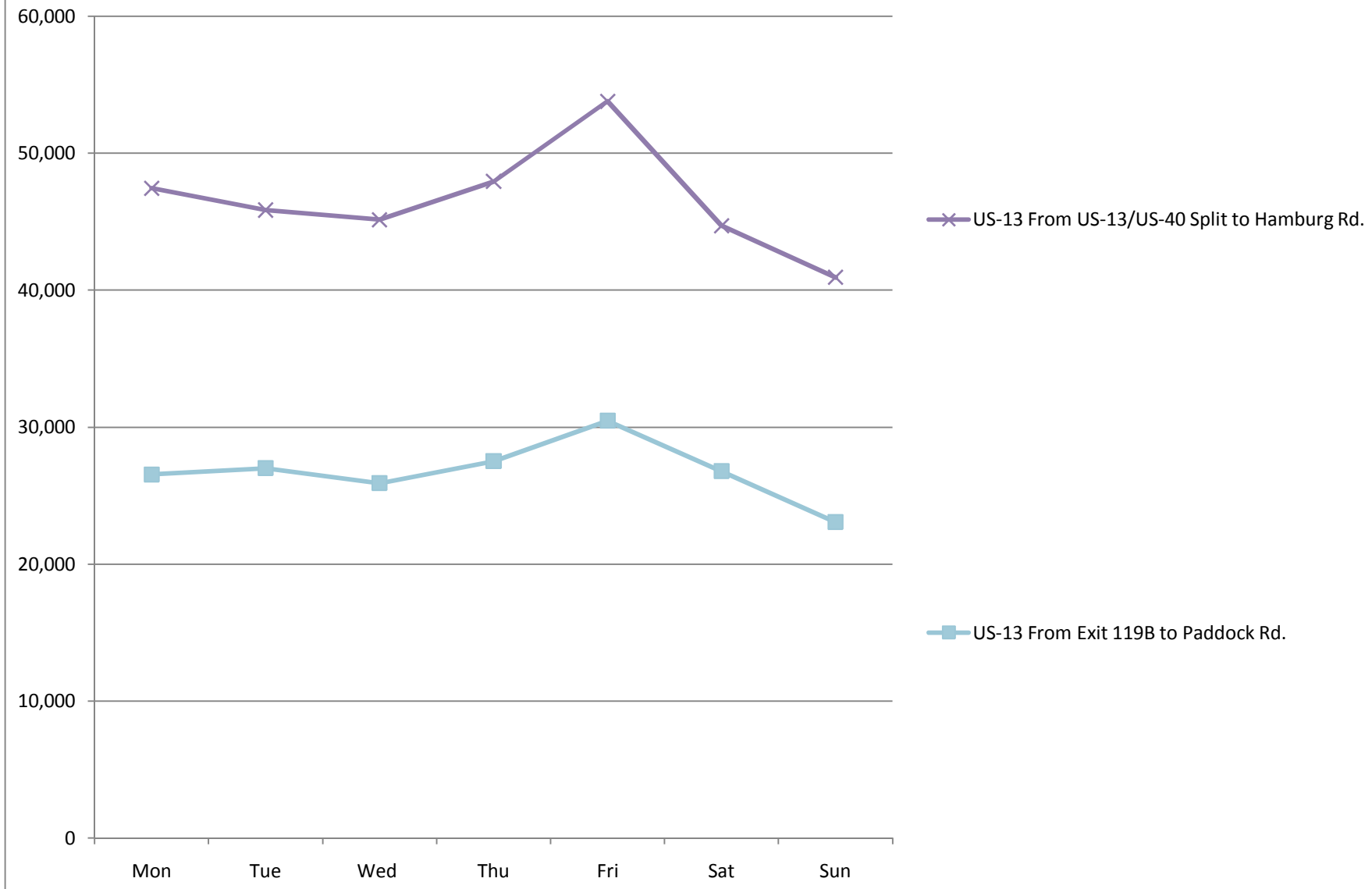
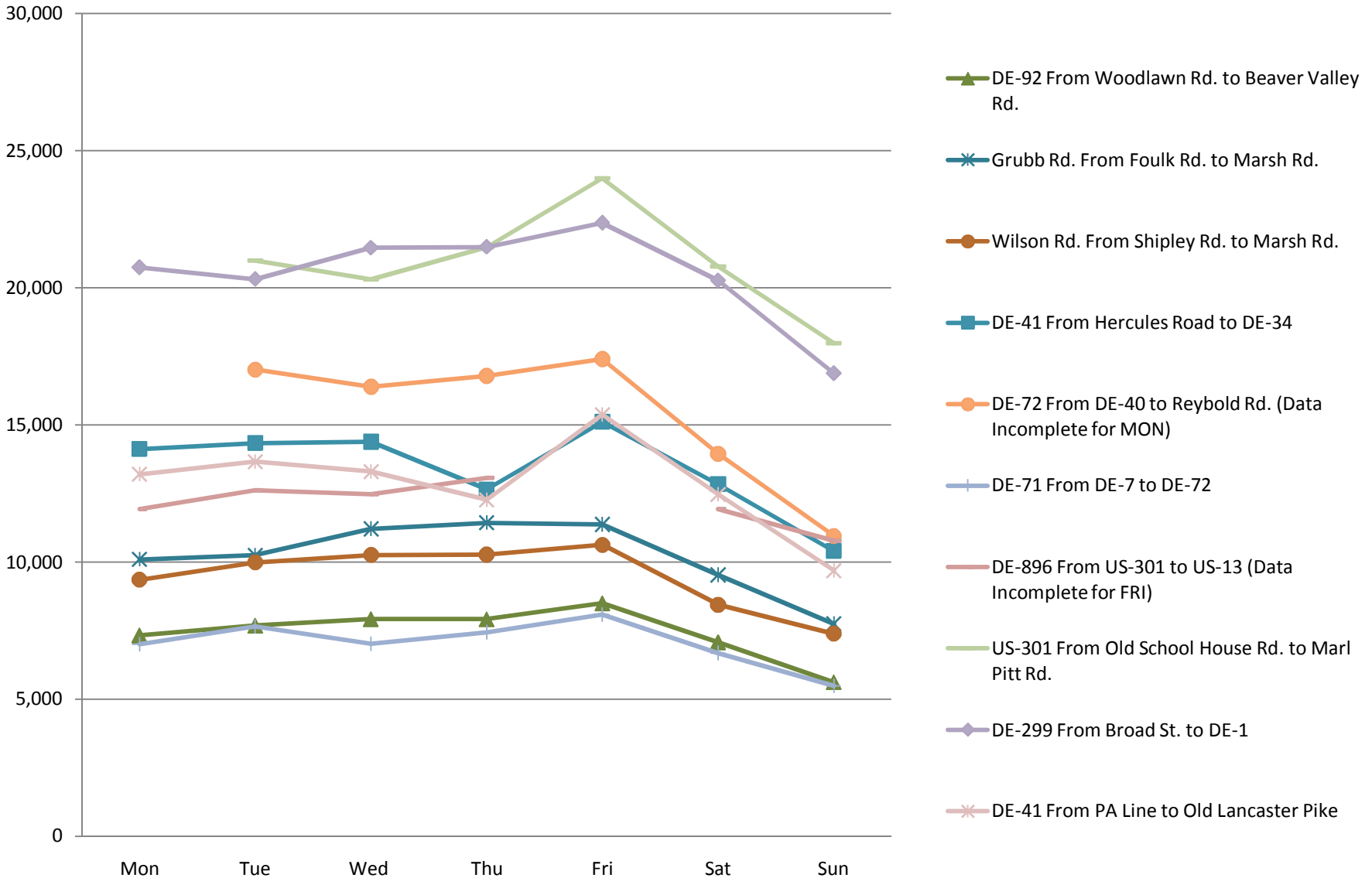


Figure 4f
Temporal Traffic Variation - Two-lane Highways



2.2 Speed Assessment

Appendices 2 through 34 present directional daily traffic volumes collected by FHWA vehicle classification and by vehicle speed at subject roadway segments over a period of seven days for each of the thirty-three temporary control count locations. Data for the seven Wavetronix detector locations can be found in Appendices 38 through 44. The vehicular speed data was used to calculate 85th percentile speeds at each control count location. Off-peak hour spot speed data was also used to determine free flow speeds for level of service analysis. This section serves to summarize the 85th percentile speed data at the control count locations and presents a look at how vehicular speeds at these locations have changed since 2001.

The 85th percentile speed represents the speed along a corridor at which only 15% of vehicles travel faster. This speed is generally referred to as a good estimate of the corridor's operating speed. It is calculated from 24 hour data and takes into account both peak periods and off-peak period speeds.

2.2.1 Comparison of 85th Percentile Speed vs. Posted Speed Limits by Segment

Table 2.3 shows the 85th percentile speed of vehicles at each of the thirty-three temporary control count locations and how they compare to the roadway's posted speed limit at those locations (also see Figure 5). This information is very useful in determining how a roadway segment is operating. For example, if a roadway's 85th percentile vehicular speed is below the posted speed limit, this condition may point to the corridor being congested or the subject of improperly timed traffic signals. If a roadway's 85th percentile speed is above the posted speed limit, vehicles may either be operating at a speed not suited for the geometrics of the roadway or the posted speed is not designated according to the speed permitted by roadway geometrics. In either case traffic calming measures may be required to reduce vehicle speeds for safety concerns. MUTCD guidance also states that posted speed limits should be within 5 mph +/- of the 85th percentile speed, unless the speed limit is constrained by statutory speed limits based on roadway classification. As roadway improvement projects on these corridors take place, the speed limits should be reviewed to comply with MUTCD guidance.

In general, it was observed that at about two thirds of the studied locations the 85th percentile speed was much higher than the posted speed limit, prompting a need to initiate stricter speed enforcement or other traffic calming measures especially during off-peak hours.

Table 2.3 –2010 85th Percentile Speed vs. Posted Speed Limit, mph

	NB/EB		SB/WB		5 mph Above Posted		85th Within 5 mph of Posted		5 mph Below Posted	
Link Description	85th	Posted	85th	Posted	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
US-202 From PA Line to DE-92	53	50	56	50	-	X	X	-	-	-
DE-92 From Grubb Rd. to Shipley Rd.	47	40	48	40	X	X	-	-	-	-
DE-92 From Woodlawn Rd. to Beaver Valley Rd.	42	35	41	35	X	X	-	-	-	-
US-202 From Naamans Rd. to Silverside Rd.	55	50	53	50	-	-	X	X	-	-
Grubb Rd. From Foulk Rd. to Marsh Rd.	40	35	42	35	-	X	X	-	-	-
Wilson Rd. From Shipley Rd. to Marsh Rd.	48	40	47	40	X	X	-	-	-	-
Foulk Rd. From US-202 to DE-92	37	45	41	45	-	-	-	X	X	-
DE-52 From Hillside Rd. to Campbell Rd.	48	35	48	35	X	X	-	-	-	-
US-202 From Foulk Rd. to Augustine Cutoff	48	35	55	45	X	X	-	-	-	-
DE-48 From Centerville Rd. to DE-141	53	45	52	45	X	X	-	-	-	-
DE-41 From Hercules Road to DE-34	45	45	48	45	-	-	X	X	-	-
DE-7 From DE-72 to Stoney Batter Rd.	50	50	51	50	-	-	X	X	-	-
DE-72 From DE-7 to Possum Park Rd.	52	50	56	50	-	X	X	-	-	-
DE-141 From Boxwood Rd. to DE-4	62	50	62	50	X	X	-	-	-	-
US-13 From I-295 to I-495	55	50	56	50	-	X	X	-	-	-
DE-273 From Red Mill Rd. to Ogletown Rd.	53	45	58	35	X	X	-	-	-	-
DE-4 From DE-273 to DE-7	45	50	43	50	-	-	X	-	-	X
DE-141 From Commons Blvd. to US-13	53	50	50	50	-	-	X	X	-	-
DE-4 From DE-896 to DE-273	48	50	53	50	-	-	X	X	-	-
DE-273 From I-95 to Old Baltimore Pike	43	50	51	50	-	-	-	X	X	-
DE-273 From Prangs Rd. to Pleasant Dr.	51	45	48	45	X	-	-	X	-	-
US-13 From US-13/US-40 Split to Hamburg Rd.	58	55	53	55	-	-	X	X	-	-
DE-896 From US-40 to Old Baltimore Pike	62	50	61	50	X	X	-	-	-	-
DE-72 From DE-40 to Reybold Rd.	55	45	56	45	X	X	-	-	-	-
DE-71 From DE-7 to DE-72	52	50	52	50	-	-	X	X	-	-
DE-896 From US-301 to US-13	58	50	57	50	X	X	-	-	-	-
US-301 From Old School House Rd. to Marl Pitt Rd.	54	50	56	50	-	X	X	-	-	-
DE-299 From Broad St. to DE-1	45	40	43	40	-	-	X	X	-	-
US-13 From Exit 119B to Paddock Rd.	56	55	58	55	-	-	X	X	-	-
DE-1 From DE-1/US-13 Split to NCC Line	73	65	74	65	X	X	-	-	-	-
DE-2 From Milltown Rd. to St. James Church Rd.	48	45	51	45	-	X	X	-	-	-
DE-41 From PA Line to Old Lancaster Pike	53	45	53	45	X	X	-	-	-	-
DE-4 From DE-896 to Elkton Rd.	58	45	56	45	X	X	-	-	-	-
I-95 From MD Line to Newark Toll Plaza*	59	55	63	55	-	X	X	-	-	-
I-95 From DE-896 to Delaware House Service Area*	69	55	68	55	X	X	-	-	-	-
I-95 from Delaware House Service Area to DE-273*	68	55	68	55	X	X	-	-	-	-
I-95 From DE-273 to DE-1/DE-7*	68	55	69	55	X	X	-	-	-	-

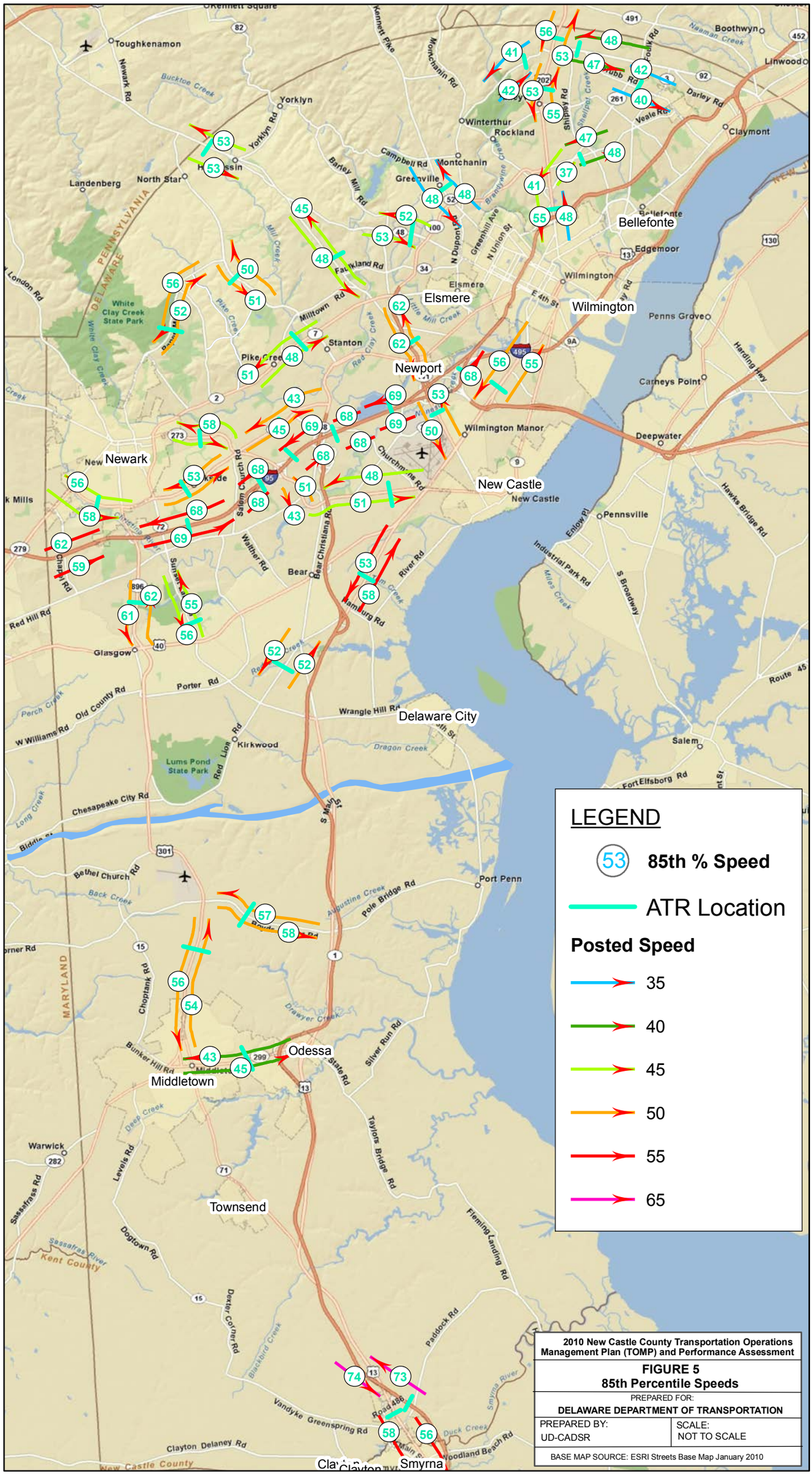
Table 2.3 –2010 85th Percentile Speed vs. Posted Speed Limit, mph (cont.)

	NB/EB		SB/WB		5 mph Above Posted		5 mph of Posted		5 mph Below Posted	
Link Description	85th	Posted	85th	Posted	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
I-95 From DE-1/DE-7 to DE-58*	68	55	68	55	X	X	-	-	-	-
I-95 From DE-58 to DE-141*	69	55	69	55	X	X	-	-	-	-
I-495 From I-95/I-495 Split to US-13*	68	65**	N/A***	65**	-	-	X	-	-	-

** Denotes data obtained from Wavetronix detector.*

*** Denotes speed limit may vary due to variable speed limit system.*

**** Denotes data available only in NB/EB direction.*



2010 New Castle County Transportation Operations Management Plan (TOMP) and Performance Assessment

FIGURE 5
85th Percentile Speeds

PREPARED FOR:
DELAWARE DEPARTMENT OF TRANSPORTATION

PREPARED BY:	SCALE:
UD-CADSR	NOT TO SCALE

BASE MAP SOURCE: ESRI Streets Base Map January 2010

2.2.2 Comparison of 2010 85th Percentile Speed vs. 2001 85th Percentile Speed

Table 2.4 shows how 85th percentile speeds have changed in 2010 compared to 2001, for roadway segments analyzed in 2001.

The table shows that, in 2010, none of the roadway segments experienced 85th percentile speeds 5 mph higher than the corresponding 85th percentile speeds in 2001. While there were segments that experienced 85th percentile speeds lower compared to 2001 most segments fall into the category in which the 2010 speeds are within 5 mph +/- of the corresponding 2001 speeds. Of the roadway segments that have experienced a reduction in speeds from 2001, almost all have experienced increases in ADT, with the exceptions being segments of DE-92 and DE-273.

Table 2.4 – 2010 85th Percentile Speed vs. 2001 85th Percentile Speed

Link Description	NB/EB		SB/WB		2010 5 mph Above 2001		2010 w/in 5 mph of 2001		2010 5 mph Below 2001	
	2001	2010	2001	2010	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
US-202: PA Line to DE-92	59	53	60	56	-	-	-	X	X	-
DE-92: Grubb Rd. to Shipley Rd.	51	47	50	48	-	-	X	X	-	-
DE-92: Woodlawn Rd. to Beaver Valley	48	42	47	41	-	-	-		X	X
US-202: DE-92 to Silverside Rd.	56	55	57	53	-	-	X	X	-	-
Grubb Rd.: Foulk Rd. to Marsh Rd.	41	40	39	42	-	-	X	X	-	-
Wilson Rd.: Shipley Rd. to Marsh Rd.	47	48	45	47	-	-	X	X	-	-
Foulk Rd.: US 202 to DE-92	49	37	55	41	-	-	-		X	X
DE-52: Hillside Rd. to Campbell Rd.	50	48	51	48	-	-	X	X	-	-
US-202: Foulk Rd. to Augustine Cutoff	48	48	55	55	-	-	X	X	-	-
DE-48: Centerville Rd. to DE-141	59	53	57	52	-	-	-	X	X	-
DE-41: Hercules Road to DE-34	48	45	49	48	-	-	X	X	-	-
DE-7: DE-72 to Stoney Batter Rd.	58	50	58	51	-	-	-		X	X
DE-72: DE-7 to Possum Park Rd.	60	52	55	56	-	-	-	X	X	-
DE-141: Boxwood Rd. to DE-4	66	62	64	62	-	-	X	X	-	-
US-13: I-295 to I-495	56	55	56	56	-	-	X	X	-	-
DE-273: Red Mill Rd. to Ogletown Rd.	56	53	57	58	-	-	X	X	-	-
DE-4: DE-273 to DE-7	50	45	50	43	-	-	X		-	X
DE-141: Commons Blvd. to US-13	52	53	53	50	-	-	X	X	-	-
DE-4 From DE-896 to DE-273	59	48	58	53	-	-	-	X	X	-
DE-273: I-95 to Old Baltimore Pike	52	43	54	51	-	-	-	X	X	-
DE-273: Prangs Rd. to Pleasant Dr.	57	51	56	48	-	-	-		X	X
US-13: US-13/US-40 Split to Hamburg Rd.	56	58	54	53	-	-	X	X	-	-
DE-896: DE-40 to Old Baltimore Pike	63	62	63	61	-	-	X	X	-	-
DE-72: DE-40 to Reybold Rd.	59	55	60	56	-	-	X	X	-	-
DE-71: DE-7 to DE-72	55	52	56	52	-	-	X	X	-	-
DE-896: US-301 to US-13	60	58	62	57	-	-	X	X	-	-

Table 2.4 – 2010 85th Percentile Speed vs. 2001 85th Percentile Speed (cont.)

Link Description	NB/EB		SB/WB		2010 5 mph Above 2001		2010 w/in 5 mph of 2001		2010 5 mph Below 2001	
	2001	2010	2001	2010	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
US-301: Old School House Rd. to Marl Pitt Rd.	60	54	59	56	-	-	-	X	X	-
DE-299: Broad St. to DE-1	53	45	51	43	-	-	-	-	X	X
US-13: Exit 119B to Paddock Rd.	65	56	64	58	-	-	-	-	X	X
DE-1: DE-1/US-13 Split to NCC Line	73	73	72	74	-	-	X	X	-	-
DE-2: Milltown Rd. to St. James Church	53	48	55	51	-	-	X	X	-	-

2.3 Segment Performance

Level of service (LOS) analysis was performed using Highway Capacity Manual (HCM2000) methodology for each of the forty-three roadway segments. Peak hour volumes, peak hour factors, and truck percentages were calculated from the vehicle classification volume tables while free flow speeds were calculated from the vehicle speed tables included in the appropriate appendices. Physical roadway data (percent no-passing zones, access points per mile, etc.) were estimated from the combination of field visits and computer applications such as Google Earth.

Each roadway segment is further described and discussed in the following sections. In several locations, the directional bias of the roadway is apparent, as significant directional differences in LOS mirror each other in the AM and PM peak hours. Also apparent is that the PM peak hour is usually more concentrated than the AM peak hour, as the PM peak hour level of service is sometimes worse than the AM peak hour level of service on the same roadway.

2.3.1 Roadway Classification Details

Consistent with the 2001 Report, roadways north of US-40 (excluding freeway segments) have been identified as urban; therefore roadways north of US-40 were classified as arterials. Roadways south of US-40 were classified as freeway, arterial, multi-lane highway, or two-lane highway according to HCM2000 guidance. The following subsections describe each roadway segment analyzed, grouped by roadway classification, and its level of service in the AM and PM peak hours according to HCM2000 methods.

2.3.2 Freeways

The Highway Capacity Manual (HCM2000) describes freeways as divided highways with full control of access and two or more lanes for the exclusive use of traffic in each direction. There are no signalized or stop-controlled at-grade intersections, and direct access to and from adjacent property is not permitted. Access to and from the freeway is limited to ramp locations. Opposing directions of flow are continuously separated by a raised barrier, an at-grade median, or a continuous raised median. Operating conditions on a freeway primarily result from interactions among vehicles and drivers in the traffic stream and among vehicles, drivers, and the geometric characteristics of the freeway. The density (pc/mi/in) of the freeway is used to estimate its level of service (LOS). LOS thresholds are outlined in Table 2.5.

Table 2.5 – Freeway Level of Service Criteria

LOS	Density Range (pc/mi/ln)
A	0-11
B	> 11-18
C	> 18-26
D	> 26-35
E	> 35-45
F	> 45

2.3.2.1 Freeway Segment Descriptions

The following describes roadway segments analyzed as freeways for this assessment.

Interstate 95 (I-95)

I-95 facilitates mainly north-south travel along the eastern seaboard of the United States. Through Delaware, I-95 operates as a two, three, four and sometimes five lane freeway with a speed limit of 55 mph (excluding toll area approximately 1 mile south of the I-95/DE-896 interchange). It is classified as an interstate by DelDOT's Functional Classification Map and is surrounded by varying urban, rural, commercial, and industrial land uses. Directional travel lanes are separated by grassed medians or concrete barriers. I-95 was analyzed as a freeway for the following segments in this assessment:

- From the Maryland state line to I-95 Newark Toll Plaza
- From the DE-896 interchange to the Delaware House Service Area
- From the Delaware House Service Area and the DE-273 interchange
- From the DE-273 interchange and the DE-1/DE-7 interchange
- From the SB off ramp to DE-58 to the DE-141 interchange

Interstate 495 (I-495)

I-495 facilitates mainly north-south travel as an alternate route to I-95 through the City of Wilmington. It operates mostly as a three lane roadway with variable speed limits (mainly 55 or 65 mph) and provides access to ports and businesses located along the Delaware River. It is classified as an interstate by DelDOT's Functional Classification Map and is bordered mostly by industrial and transportation facilities. Directional travel lanes are separated by grassed medians or concrete barriers. I-495 NB was analyzed as a freeway between the I-95/I-495 split and the US-13 interchange as part of this assessment.

Delaware Route 1 (DE-1)

DE-1 facilitates mainly north-south travel for almost the entire length of the State of Delaware, providing access from Sussex to Kent to New Castle Counties and vice versa. In New Castle County, it operates as a two lane freeway with a speed limit of 65 mph and is classified in parts as a freeway and in parts as a principal arterial by DelDOT's Functional Classification Map. Directional travel lanes are separated by a

grassed median. The section of DE-1 between the DE-1/US-13 split and the New Castle/Kent Count line was analyzed as a freeway as part of this assessment.

Delaware Route 141 (DE-141)

Between Boxwood Road and DE-4, DE-141 is a four-lane roadway and is classified as a principal arterial by DelDOT's Functional Classification Map. It facilitates mainly north-south travel with a speed limit of 50 mph. Directional travel lanes are separated by a median with a concrete barrier or guardrail. This section of DE-141 was analyzed as a freeway as part of this assessment.

2.3.2.2 2010 Freeway Peak Hour Level of Service Analysis

The freeway segments described in the previous section were analyzed for 2010 Level of Service results using the Highway Capacity Software (HCS), based on Highway Capacity Manual (HCM2000) methods. Traffic volume and speed data for segments of I-95 and I-495 were obtained from continuously operating DelDOT Wavetronix detectors, while such data for segments of DE-1 and DE-141 were collected via temporary control counts, employed specifically for this assessment. Vehicle classification data for DE-1 and DE-141 was also collected via the control counts, however, vehicle classification data at the Wavetronix locations (I-95 and I-495) was unavailable. Therefore, a default value of 5% trucks and busses was assumed.

Table 2.6 presents the results of 2010 AM and PM peak hour LOS analysis based on HCM2000 methodology performed on the aforementioned freeway segments.

Table 2.6 – 2010 Freeway LOS Results

			2010 Level of Service			
			NB/EB		SB/WB	
Route	From	To	AM	PM	AM	PM
I-95*	MD State Line	Newark Toll Plaza	B	B	A	B
I-95*	DE-896	Delaware House Service Area	C	B	B	B
I-95*	Delaware House Service Area	DE-273	B	B	A	B
I-95*	DE-273	DE-1/DE-7	D	C	B	C
I-95*	DE-1/DE-7	DE-58	E	D	C	C
I-95*	DE-58	DE-141	D	C	D	D
I-495 (NB Only)*	I-95/I-495 Split	US-13	B	B	NA	NA
DE-1	DE-1/US-13 Split	NCC Line	B	B	B	B
DE-141	Boxwood Road	DE-4	C	C	B	C

**Denotes data obtained from DelDOT Wavetronix detectors.*

Generally, the sections of freeways analyzed as part of this assessment are operating at acceptable levels of service (LOS A, B, or C). Areas of concern include segments of I-95 between the DE-273 and DE-141 interchanges. These segments display LOS D or E in several directions during the respective peak hour, and

would quickly deteriorate with moderate increases in volume; these segments should be closely monitored for changes in performance levels.

2.3.3 Arterial Highways

The Highway Capacity Manual (HCM2000) describes arterials (a sub-class of urban streets) as roads that primarily serve longer through trips while also providing access to abutting commercial and residential land uses. There is typically a high density of access points, with signalized intersections spaced less than two miles apart. An urban street's functional classification, either a principal arterial or a minor arterial, is defined by the type of traffic service the street provides. A principal arterial serves major through movements between important centers of activity and connects freeways with major traffic generators – service to abutting land is subordinate to the function of moving through traffic. A minor arterial connects and augments the principal arterial system – more emphasis is placed on access to abutting land than a principal arterial and distributes traffic to smaller geographic areas.

Arterials are further defined by their design category – high speed, suburban, intermediate, or urban – which is defined by an arterial's access density, separation of turn lanes, signal density, speed limit, pedestrian activity, and amount of roadside development.

The level of service (LOS) of an arterial highway is based on the through-vehicle travel speed and urban street class for the segment under consideration. The average travel speed is computed from the running times on the arterial and the control delay of through movements at signalized intersections. The urban street class (Type I, II, III, or IV) is based on the arterial's functional and design categories. Table 2.7 presents the arterial LOS criteria.

Table 2.7 – Arterial Highway Level of Service Criteria

Urban Street Class	I	II	III	IV
Range of Free-flow Speeds (FFS), mph	45 – 55	35 – 45	30 – 35	25 – 35
Typical FFS, mph	50	40	35	30
LOS	Average Travel Speed, mph			
A	> 42	> 35	> 30	> 25
B	> 34 – 42	> 28 – 35	> 24 - 30	> 19 – 25
C	> 27 – 34	> 22 – 28	> 18 – 24	> 13 – 19
D	> 21 – 27	> 17 – 22	> 14 – 18	> 9 – 13
E	> 16 – 21	> 13 – 17	> 10 – 14	> 7 – 9
F	≤ 16	≤ 13	≤ 10	≤ 7

2.3.3.1 Arterial Highway Segment Descriptions

The following describes roadway segments analyzed as arterials for this assessment.

US Route 202 (US-202)

Between the Pennsylvania state line and I-95, US-202 is a six-lane highway and is classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly north-south travel with speed limits between 35 and 50 mph. Directional travel lanes are separated by a concrete/grassed median of varying width and are bordered mostly by commercial land uses. US 202 was analyzed as a Class II arterial for the following segments in this assessment:

- From the Pennsylvania state line to DE-92
- From DE-92 to Foulk Road
- From Foulk Road to I-95

Delaware Route 2 (DE-2)

Between DE-273 and DE-48, DE-2 a four-lane roadway east of DE-141, a six -lane roadway between DE-141 and Griffin Drive, and a two-lane roadway between Griffin Drive and DE-273. It is classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly east-west travel with a speed limit of 45 mph. Directional travel lanes are separated by a concrete/grassed median of varying width are bordered by mostly commercial land uses. This segment of DE-2 was analyzed as a Class II arterial in this assessment.

Delaware Route 92 (DE-92)

Between US-202 and I-95, DE-92 is a four-lane roadway and is classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly east-west travel with a speed limit of 40 mph. Directional travel lanes are separated by a raised/grassed median. It is bordered by commercial and residential land uses. This segment of DE-92 was analyzed as a Class II arterial in this assessment.

Foulk Road

Between US-202 and DE-92, Foulk Road is a four-lane roadway and is classified as a minor arterial by DelDOT's Functional Classification Map, facilitating mainly north-south travel with a speed limit of 45 mph. Directional travel lanes are separated intermittently by a raised median. It is bordered mostly by residential land uses with some commercial land uses. This section of Foulk Road was analyzed as a Class II arterial in this assessment.

Delaware Route 48 (DE-48)

Between the DE-48/DE-41 split and DE-2, DE-48 is a two-lane and sometimes three-lane roadway between the split and Hercules Road and a four-lane roadway between Hercules Road and DE-2. It is classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly east-west travel with a speed limit of 45 mph. Directional travel lanes are separated intermittently by a raised/grassed median. It is

bordered mainly by residential and commercial land uses with a fair amount of open space west of DE-141. This section of DE-48 was analyzed as a Class III arterial in this assessment.

Delaware Route 7 (DE-7)

Between the Pennsylvania line and DE-2, DE-7 is a two-lane highway from the Pennsylvania line to Valley Road and generally a four-lane highway from Valley Road to DE-2. It classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly north-south travel with a speed limit of 50 mph. Directional travel lanes are separated by a raised/grassed median mainly south of Valley Road. It is bordered mainly by residential land uses with some commercial land uses. This section of DE-7 was analyzed as a Class II arterial in this assessment.

US Route 13 (US-13)

Between I-495 and the US-13/US-40 split, US-13 is an eight-lane roadway from the split to School Lane and generally a six-lane roadway from School Lane to I-495. It is classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly north-south travel with a speed limit of 50 mph. Directional travel lanes are separated by a wide grassed median. It is bordered by mainly high density commercial and retail properties, with access points to residential areas. This section of US-13 was analyzed as a Class II arterial in this assessment.

Delaware Route 273 (DE-273)

Between DE-2 and DE-141, DE-273 is a four-lane roadway from DE-2 to Quigley Road and a two-lane roadway from Quigley Road to DE-141. It is classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly east-west travel with speed limits between 45 and 50 mph. Directional travel is separated by a raised/grassed median west of Quigley Road. It is bordered by a variety of land uses including commercial, industrial, and residential. DE-273 was analyzed as a Class II arterial for the following segments in this assessment:

- From DE-2 to I-95
- From I-95 to DE-1
- From DE-1 to DE-141

Delaware Route 4 (DE-4)

Between Elkton Road and DE-7, DE-4 is a four-lane roadway and is classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly east-west travel with speed limits between 45 and 50 mph. It is bordered mainly by commercial land uses with some residential and industrial land uses as well as the University of Delaware's athletic facilities and Christiana Hospital. Directional travel lanes are separated by a raised/grassed median. DE-4 was analyzed as a Class II arterial for the following segments in this assessment.

- From Elkton Road to DE-896
- From DE-896 to DE-273
- From DE-273 to DE-7

Delaware Route 141 (DE-141)

Between DE-37 and DE-273, DE-141 is a four-lane roadway and is classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly north-south travel with a speed limit of 50 mph. Directional travel lanes are separated by a raised/grassed median. It is bordered by residential and commercial land uses, the Delaware Airpark, and William Penn High School. This section of DE-141 was analyzed as a Class II arterial in this assessment.

Delaware Route 52 (DE-52)

Between the Pennsylvania state line and DE-141, DE-52 is a two-lane roadway from the Pennsylvania state line to Hillside Road and a four lane roadway from Hillside Road to DE-141. It is classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly north-south travel with a speed limit of 35 mph. Directional traffic is separated by a raised median south of Hillside Road. It is bordered by mostly commercial land uses near its intersection with DE-141 and mostly residential land uses and open space north of Campbell Road. This section of DE-52 was analyzed as a Class III arterial in this assessment.

Delaware Route 72 (DE-72)

Between DE-7 and DE-2, DE-72 is a two-lane roadway and is classified as a minor arterial by DelDOT's Functional Classification Map, facilitating mainly north-south travel with a speed limit of 50 mph. It is bordered by mostly residential land uses and open space. This section of DE-72 was analyzed as a Class II arterial in this assessment.

2.3.3.2 2010 Arterial Highway Peak Hour Level of Service Analysis

The arterial highway segments described in the previous section were analyzed for 2010 Level of Service results using the Highway Capacity Software (HCS), based on Highway Capacity Manual (HCM2000) methods. Traffic volume, speed, and vehicle classification data for each segment was collected via temporary control counts employed specifically for this assessment. Table 2.8 presents the results of 2010 AM and PM peak hour LOS analysis based on HCM2000 methodology performed on the aforementioned arterial road segments. The University of Delaware's Fall 2010 GPS Travel Time and Delay Report was referenced for roadway segment travel times.

Table 2.8 – 2010 Arterial Highway LOS Results

			2010 Level of Service			
			NB/EB		SB/WB	
Route	From	To	AM	PM	AM	PM
US-202	DE-92	Foulk Rd.	B	C	A	C
US-202	Foulk Rd.	I-95	B	A	A	A
DE-2	DE-273	DE-48	C	C	D	D
DE-92	US-202	US-13	B	B	B	B
Foulk Rd.	US-202	DE-92	A	C	C	B
DE-48	DE-41	DE-2	C	C	C	C
DE-7	PA Line	DE-2	C	D	C	C
US-13	US-40	I-495	B	A	B	C
DE-273	DE-2	I-95	B	C	B	B
DE-273	I-95	DE-1	C	F	E	D
DE-273	DE-1	DE-141	C	B	C	D
DE-4	Elkton Rd.	DE-896	C	A	A	A
DE-4	DE-896	DE-273	C	C	C	D
DE-4	DE-273	DE-7	B	D	B	C
DE-141	DE-37	DE-273	B	A	B	D
DE-52	PA Line	DE-141	B	B	D	A
DE-72	DE-7	DE-2	C	C	C	B

Generally, arterial roadway segments analyzed as part of this assessment are operating at Levels of Service A, B, or C. An area of immediate concern is the segment of DE-273 between the I-95 and DE-1 interchanges. The SB/WB travel direction is operating at LOS E in the AM peak hour, while the NB/WB travel direction is operating at LOS F in the PM peak hour, an indication of high commuter volumes.

There are also several arterial roadway segments operating at LOS D during the AM peak hour, PM peak hour, or both, in either direction of travel. These include segments of DE-2, DE-7, DE-273, DE-4, DE-141, and DE-52. Arterial roadway segments operating at LOS D could quickly deteriorate with a moderate increase in volume; these segments should be closely monitored for changes in performance levels.

Recommendations for mitigating arterial highway segments experiencing borderline LOS (LOS D) and unacceptable LOS (LOS E or F) are made in Section 2.3.7 of this report.

2.3.4 Multilane Highways

The Highway Capacity Manual (HCM2000) describes multilane highways as usually having a total of four or six lanes, counting both directions, with speed limits generally between 40 and 55 mph. Directional travel can be undivided or divided by medians or two-way left-turn lanes (TWLTL). They are located in suburban communities, typically connecting two cities or two significant activities.

Multilane highways are not completely access controlled as they can have at-grade intersections and occasional traffic signals. However, traffic signals spaced less than 2.0 miles apart typically create urban street conditions.

The level of service (LOS) criteria of a multilane highway is outlined below, in Table 2.9. LOS F is characterized by highly unstable and variable flow – prediction of accurate density at LOS F is considered difficult. Because of the nature of the mathematical relationship between density and volume to capacity ratio (v/c) is not always maintained at LOS boundaries (because of the use of rounded values), density (pc/mi/in) is the primary determinant for LOS. FFS can be measured through engineering study or estimated using a base free flow speed (BFFS) in conjunction with appropriate reduction factors based on roadway characteristics.

Table 2.9 – Multilane Highway Level of Service Criteria

FFS (mph)	Criteria	LOS				
		A	B	C	D	E
60	Maximum density (pc/mi/ln)	11	18	26	35	40
	Average speed (mph)	60.0	60.0	59.4	56.7	55.0
	Maximum volume to capacity ratio (v/c)	0.30	0.49	0.70	0.90	1.00
	Maximum service flow rate (pc/h/ln)	660	1080	1550	1980	2200
55	Maximum density (pc/mi/ln)	11	18	26	35	41
	Average speed (mph)	55.0	55.0	54.9	52.9	51.2
	Maximum volume to capacity ratio (v/c)	0.29	0.47	0.68	0.88	1.00
	Maximum service flow rate (pc/h/ln)	600	990	1430	1850	2100
50	Maximum density (pc/mi/ln)	11	18	26	35	43
	Average speed (mph)	50.0	50.0	50.0	48.9	47.5
	Maximum volume to capacity ratio (v/c)	0.28	0.45	0.65	0.86	1.00
	Maximum service flow rate (pc/h/ln)	550	900	1300	1710	2000
45	Maximum density (pc/mi/ln)	11	18	26	35	45
	Average speed (mph)	45.0	45.0	45.0	44.4	42.2
	Maximum volume to capacity ratio (v/c)	0.26	0.43	0.62	0.82	1.00
	Maximum service flow rate (pc/h/ln)	490	810	1170	1550	1900

2.3.4.1 Multilane Highway Segment Descriptions

The following describes roadway segments analyzed as multilane highways for this assessment.

US Route 13 (US-13)

Between the US-13/US-40 split and Hamburg Road, US-13 is a four-lane roadway and is classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly north-south travel with speed limits of 50 and 55 mph. It is bordered mainly by residential and commercial land uses. Directional travel lanes are separated by a raised/grassed median. This section of US-13 was analyzed as a multilane highway in this assessment.

Between Exit 119B and Paddock Road, US-13 is a four-lane roadway and is classified as a minor arterial by DelDOT's Functional Classification Map, facilitating mainly north-south travel with speed limits of 35, 45, and 55 mph. It is bordered mainly by open space and several commercial land uses. Directional travel lanes are separated by a grassed median. This section of US-13 was analyzed as a multilane highway in this assessment.

Delaware Route 896 (DE-896)

Between Old Baltimore Pike and US-40, DE-896 is a four-lane roadway and is classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly north-south travel with a speed limit of 55 mph. It is bordered mainly by residential and commercial land uses. Directional travel lanes are separated by a grassed median. This section of DE-896 was analyzed as a multilane highway in this assessment.

2.3.4.2 2010 Multilane Highway Peak Hour Level of Service Analysis

The multilane highway segments described in the previous section were analyzed for 2010 Level of Service results using the Highway Capacity Software (HCS), based on Highway Capacity Manual (HCM2000) methods. Traffic volume, speed, and vehicle classification data for each segment was collected via temporary control counts employed specifically for this assessment.

Table 2.10 presents the results of 2010 AM and PM peak hour LOS analysis based on HCM2000 methodology performed on the aforementioned multilane highway road segments.

Table 2.10 – Multilane Highway LOS Results

			2010 Level of Service			
			NB/EB		SB/WB	
Route	From	To	AM	PM	AM	PM
US-13	US-13/US-40 Split	Hamburg Road	D	B	B	D
US-13	Exit 119B	Paddock Road	B	A	A	B
DE-896	Old Baltimore Pike	US-40	C	B	A	B

Generally, the three New Castle County roadway segments that were analyzed as multilane highways are operating at acceptable levels of service. The segment of US-13 between the US-13/US-40 split and Hamburg Road experiences LOS D in the NB/EB direction in the AM peak hour and LOS D in the SB/WB direction in the PM peak hour, an indication of high commuter volumes. As multilane highway segments operating at LOS D could quickly deteriorate with a moderate increase in volume; recommendations for mitigating this segment of US-13 are made in Section 2.3.7 of this report.

2.3.5 Two-lane Highways

The Highway Capacity Manual (HCM2000) describes two-lane highways as an undivided highway with two lanes, one for use in each direction, where efficient mobility is the primary function. Two-lane highways are defined as Class I or Class II. Class I defines those in which motorists expect to travel at relatively high speeds, such as major intercity routes, primary arterials connecting major traffic generators, or daily commuter routes. Class I two-lane highways generally serve relatively long trips. Class II defines those in which motorists do not necessarily expect to travel at a high rate of speed, such as those that serve to access Class I facilities or scenic and recreational routes that are not primary arterials. Class II two-lane highways generally serve relatively short trips, or are the beginning or end segments of long trips.

As traffic volumes grow in the direction of travel, passing demand increases. On a two-lane highway, this requires use of the opposing travel lane as sight distance and gaps in the traffic stream allow. In this sense, two-lane highways are unique from other uninterrupted flow facilities in that normal traffic flow in one direction influences flow in the opposite direction.

As traffic volumes increase, speed declines and passing demand increases. Passing capacity in the opposing lane declines as opposing volumes increases. For these reasons, Class I two-lane highway level of service (LOS) is defined by average travel speed as well as percent time-spent-following. Since mobility is less critical on Class II two-lane highways, LOS is defined only in terms of percent time-spent-following. LOS for Class I and Class II two-lane highways are outlined in Table 2.11 and Table 2.12 respectively, below:

Table 2.11 – Two-lane Highway Level of Service Criteria (Class I)

Class I LOS	Percent Time-Spent-Following	Average Travel Speed (mph)
A	≤ 35	> 55
B	> 35 – 50	> 50 - 55
C	> 50 – 65	>45 – 50
D	> 65 – 80	> 40 – 45
E	> 80	≤40

Note: LOS F applies whenever the flow rate exceeds the segment capacity

Table 2.12 – Two-lane Highway Level of Service Criteria (Class II)

Class II LOS	Percent Time-Spent-Following
A	≤ 40
B	> 40 – 55
C	> 55 – 70
D	> 70 – 85
E	> 85

Note: LOS F applies whenever the flow rate exceeds the segment capacity

2.3.5.1 Two-lane Highway Segment Description

The following describes roadway segments analyzed as two-lane highways for this assessment.

Delaware Route 92 (DE-92)

Between Woodlawn Road and Beaver Valley Road, DE-92 is a two-lane roadway classified as a major collector by DelDOT's Functional Classification Map, facilitating mainly east-west travel with a speed limit of 35 mph. It is bordered by open space. This section of DE-92 was analyzed as a Class I two-lane highway for this assessment.

Grubb Road

Between Foulk Road and Marsh Road, Grubb Road is a two-lane roadway classified as a major collector by DelDOT's Functional Classification Map, facilitating mainly east-west travel with a speed limit of 35 mph. It is bordered by mostly residential land uses. This section of Grubb Road was analyzed as a Class I two-lane highway for this assessment.

Wilson Road

Between Shipley Road and Marsh Road, Wilson Road is a two-lane roadway classified as a major collector by DelDOT's Functional Classification Map, facilitating mainly east-west travel with a speed limit of 40 mph. It is bordered by mostly residential land uses. This section of Wilson Road was analyzed as a Class I two-lane highway for this assessment.

Delaware Route 41 (DE-41)

Between Hercules Road and DE-34, DE-41 is a two-lane roadway classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly north-south travel with a speed limit of 45 mph. It is bordered by mostly residential land uses. This section of DE-41 was analyzed as a Class I two-lane highway for this assessment.

Between the Pennsylvania State Line and Old Lancaster Pike, DE-41 is a two-lane roadway classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly north-south travel with speeds of 45 mph. It is bordered mostly by residential and commercial land uses. This section of DE-41 was analyzed as a Class I two-lane highway for this assessment.

Delaware Route 72 (DE-72)

Between DE-40 and Reybold Road, DE-72 is a two-lane roadway classified as a minor arterial by DelDOT's Functional Classification Map, facilitating mainly north-south travel with a speed limit of 45 mph. It is bordered by mostly open space with small a small amount of residential land use. This section of DE-72 was analyzed as a Class I two-lane highway for this assessment.

Delaware Route 71 (DE-71)
Between DE-7 & DE-72, DE-71 is a two-lane roadway classified as a major collector by DelDOT's Functional Classification Map, facilitating mainly north-south travel with a speed limit of 50 mph. It is bordered by mostly by open space and residential land uses. This section of DE-71 was analyzed as a Class I two-lane highway for this assessment.

Delaware Route 896 (DE-896)
Between US-301 and US-13, DE-896 is a two lane roadway classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly east-west travel with a speed limit of 50 mph. It is bordered by mostly open space. This section of DE-896 was analyzed as a Class I two-lane highway for this assessment.

US Route 301 (US-301)
Between Old School House Road and Marl Pitt Road, US-301 is a two-lane roadway classified as a principal arterial by DelDOT's Functional Classification Map, facilitating mainly north-south travel with a speed limit of 50 mph. It is bordered by mostly open space. This section of US-301 was analyzed as a Class I two-lane highway for this assessment.

Delaware Route 299 (DE-299)
Between Broad Street and DE-1, DE-299 is a two-lane roadway classified as a minor arterial by DelDOT's Functional Classification Map, facilitating mainly east-west travel with a speed limit of 40 mph. It is bordered by a mix of residential and commercial land uses. This section of DE-299 was analyzed as a Class I two-lane highway for this assessment.

2.3.5.2 Two-lane Highway Peak Hour Level of Service Analysis

The two-lane highway segments described in the previous section were analyzed for 2010 Level of Service results using the Highway Capacity Software (HCS), based on Highway Capacity Manual (HCM2000) methods. Traffic volume, speed, and vehicle classification data for each segment was collected via temporary control counts employed specifically for this assessment.

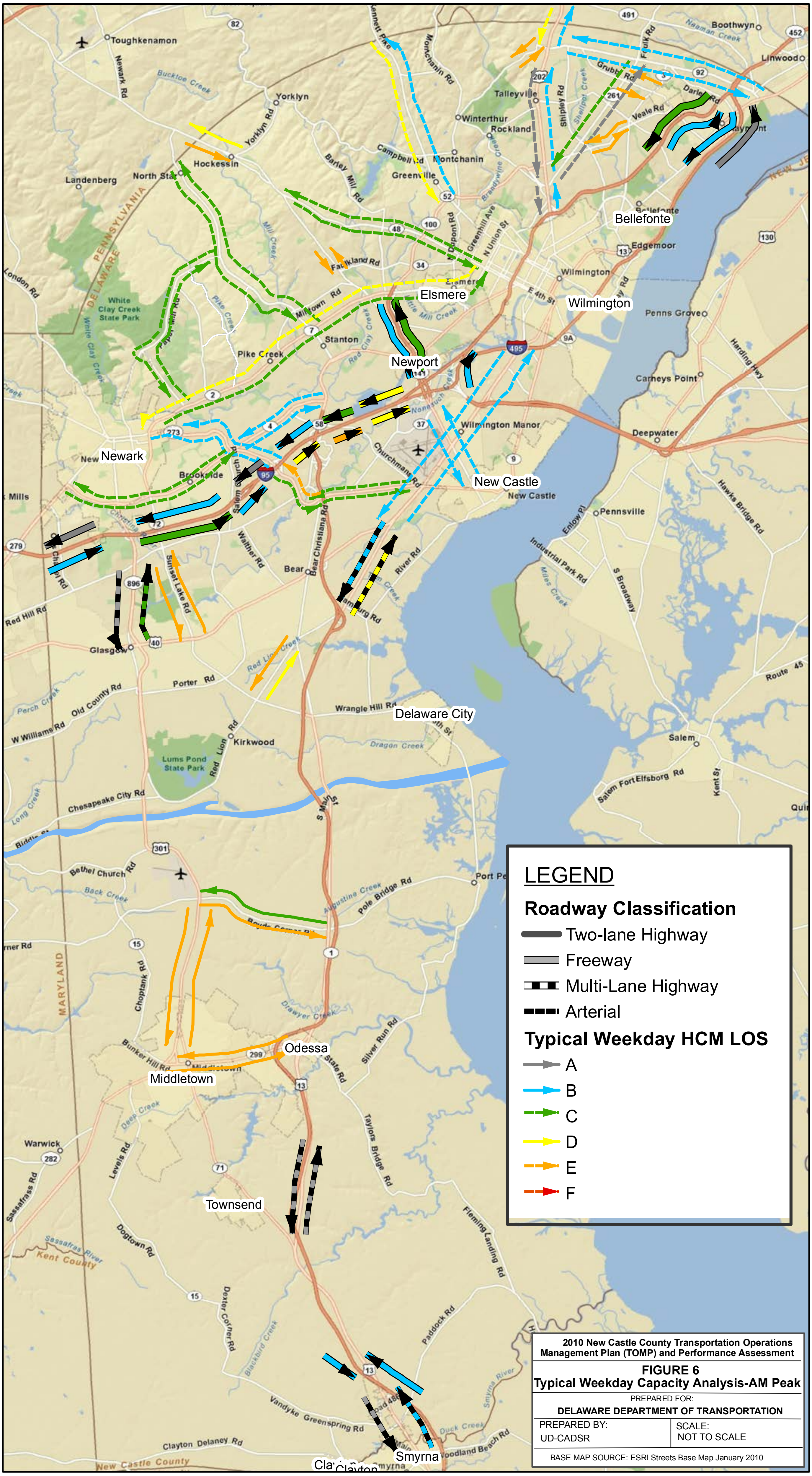
The following Table 2.13 presents the results of AM and PM peak hour LOS analysis based on HCM2000 methodology performed on the aforementioned two-lane highway road segments.

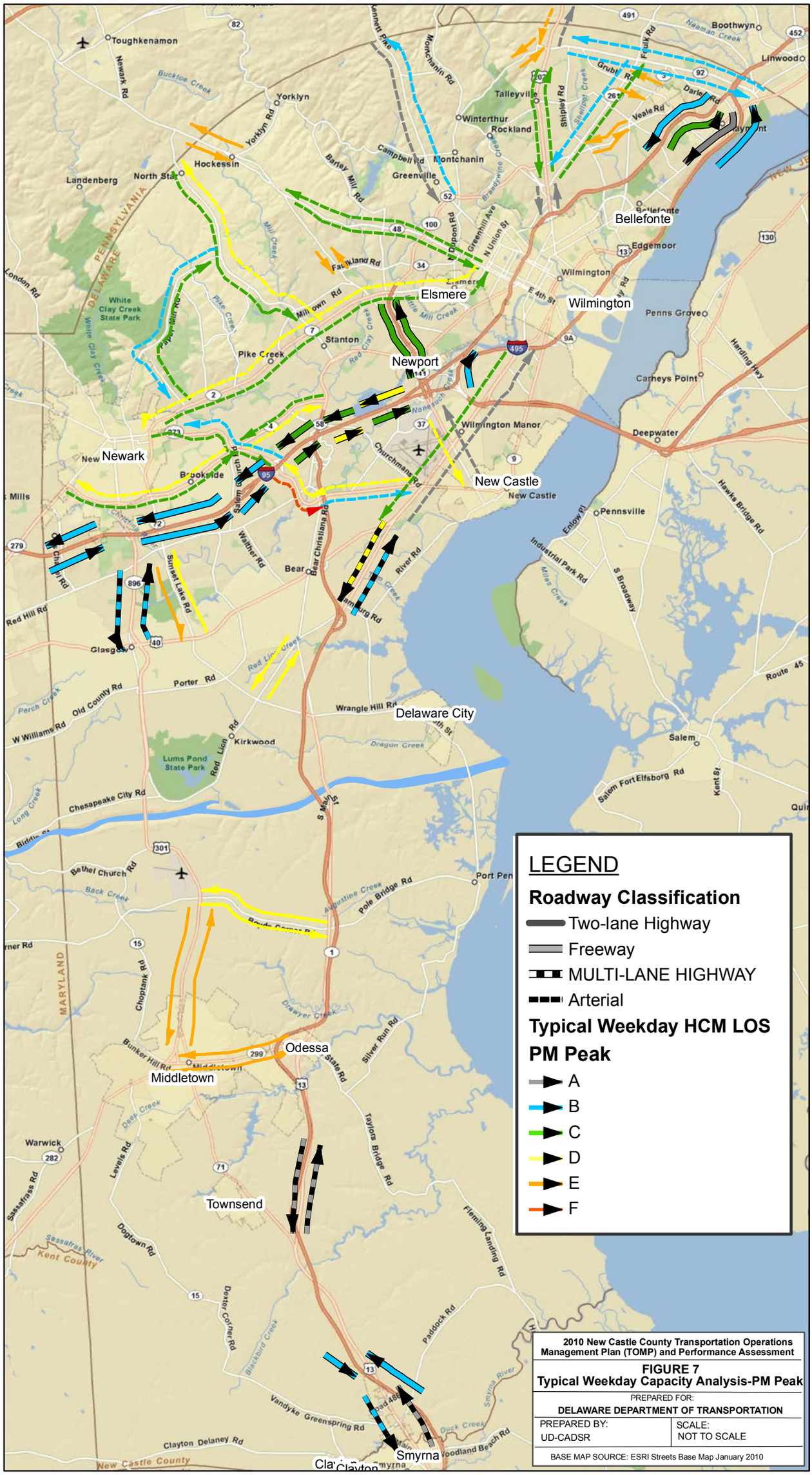
Table 2.13 – Two-lane Highway LOS Results

			2010 Level of Service			
			NB/EB		SB/WB	
Route	From	To	AM	PM	AM	PM
DE-92	Woodlawn Rd.	Beaver Valley Rd.	E	E	E	E
Grubb Road	Foulk Rd.	Marsh Rd.	E	E	E	E
Wilson Road	Shipley Rd.	Marsh Rd.	E	E	E	E
DE-41	Hercules Rd.	DE-34	E	E	E	E
	PA State Line	Old Lancaster Pike	D	E	E	E
DE-72	DE-40	Reybold Rd.	E	D	E	E
DE-71	DE-7	DE-72	D	D	E	D
DE-896	US-301	US-13	E	D	C	D
US-301	Old School House Rd.	Marl Pitt Rd.	E	E	E	E
DE-299	Broad St.	DE-1	E	E	E	E

The roadway segments analyzed as two-lane highways for this assessment are operating at LOS D or below. As each of these segments were analyzed as a Class I two-lane highway, LOS results are a function of volume, speed, as well as the ability to pass. Even though the volume of the roadway may not be excessive, the combination of moderate volumes and a high percentage of no-passing zones along a segment produces poor levels of service in analysis. As segments operating at LOS D could quickly deteriorate with a moderate increase in volume, recommendations for mitigating segments with LOS D and E are made in Section 2.3.7 of this report.

Figures 6 and 7 display AM and PM Peak Hour Level of Service respectively for each roadway segment analyzed, by direction.


LEGEND
Roadway Classification
Two-lane Highway
Freeway
Multi-Lane Highway
Arterial
Typical Weekday HCM LOS
A
B
C
D
E
F
2010 New Castle County Transportation Operations Management Plan (TOMP) and Performance Assessment
FIGURE 6
Typical Weekday Capacity Analysis-AM Peak
PREPARED FOR:
DELAWARE DEPARTMENT OF TRANSPORTATION
PREPARED BY:
UD-CADSR
SCALE:
NOT TO SCALE
BASE MAP SOURCE: ESRI Streets Base Map January 2010
Bellefonte
Wilmington
Elsmere
Newport
Newark
New Castle
Delaware City
Odessa
Middletown
Townsend
Smyrna
Clayton


Toughkenamon
Yorklyn
Hockessin
Landenberg
North Star
Greenville
Montchanin
Winterthur
Rockland
Talleyville
Boothwyn
Linwood
Bellefonte
Edgemoor
Wilmington
Elsmere
Newport
Stanton
Pike Creek
Newark
Brookside
New Castle
Wilmington Manor
Carneys Point
Deepwater
Penns Grove
Pennsville
Delaware City
Salem
Kirkwood
Glasgow
Bear
Odessa
Middletown
Townsend
Smyrna
Clayton
Warwick
Port Penn
White Clay Creek State Park
Lums Pond State Park
PENNSYLVANIA
DELAWARE
MARYLAND
Kent County
New Castle County
LEGEND
Roadway Classification
Two-lane Highway
Freeway
MULTI-LANE HIGHWAY
Arterial
Typical Weekday HCM LOS
PM Peak
A
B
C
D
E
F
2010 New Castle County Transportation Operations Management Plan (TOMP) and Performance Assessment
FIGURE 7
Typical Weekday Capacity Analysis-PM Peak
PREPARED FOR:
DELAWARE DEPARTMENT OF TRANSPORTATION
PREPARED BY:
UD-CADSR
SCALE:
NOT TO SCALE
BASE MAP SOURCE: ESRI Streets Base Map January 2010

2.3.6 Comparison of Performance: 2010 LOS vs. 2001 LOS

For purpose of comparison to 2001 conditions, this report has analyzed all roadway segments analyzed in the 2001 TOMP Report for AM and PM peak hour level of service. Generally, LOS A-C has been considered acceptable, LOS E and F has been considered unacceptable, and LOS D has been considered acceptable, but needing proactive attention. The following presents criteria used in this report to identify significant changes between 2010 LOS and 2001 LOS.

1. LOS A-C in 2001 deteriorates to LOS D-F in 2010
2. LOS D-F in 2001 improves to LOS A-C in 2010
3. LOS D-F in 2001 remains at LOS D-F in 2010

2.3.6.1 Freeways: 2010 LOS vs. 2001 LOS

In some instances, the 2001 TOMP report reported levels of service for freeway segments that spanned long lengths in an attempt to define an entire corridor. However, these segments were considered to be too long to effectively measure a corridor as a sum of its components. In this report, segments on I-95 and I-495 were defined independent of what was defined in 2001. Therefore, no attempt to compare 2010 LOS to 2001 LOS is made for I-95 and I-495.

Each segment of DE-141 and DE-1 that was analyzed as part of this assessment showed results of LOS A, B, or C. There were no significant changes in LOS on these segments from 2001 to 2010.

2.3.6.2 Arterial Highways: 2010 LOS vs. 2001 LOS

Tables 2.14, 2.15, and 2.16 summarize arterial highway segments that have experienced significant changes in LOS or have continued to experience LOS D, E, or F since 2001.

Table 2.14 – Arterial Highways: LOS A-C in 2001 Deteriorates to LOS D-F in 2010

Route	Direction	Peak Period	From	To	2001 LOS	2010 LOS
DE-52	SB/WB	AM	Hillside Rd.	Campbell Rd.	B	D
DE-4	NB/EB	PM	DE-273	DE-7	B	D
DE-141	SB/WB	PM	Commons Blvd	US-13	C	D
DE-4	SB/WB	PM	DE-896	DE-273	B	D
DE-273	SB/WB	AM	I-95	Old Balt. Pike	B	E
DE-273	NB/EB	PM	I-95	Old. Balt. Pike	C	F
DE-273	SB/WB	PM	I-95	Old Balt. Pike	B	D
DE-273	SB/WB	PM	Prangs Rd.	Pleasant Dr.	C	D
DE-2	SB/WB	AM	Milltown Rd.	St. James Church Rd.	B	D
DE-2	SB/WB	PM	Milltown Rd.	St. James Church Rd.	C	D

Table 2.15 – Arterial Highways: LOS D-F in 2001 Improves to LOS A-C in 2010

Route	Direction	Peak Period	From	To	2001 LOS	2010 LOS
US-202	NB/EB	PM	Foulk Rd.	Augustine Cutoff	D	A
US-202	NB/EB	PM	Prangs Rd.	Pleasant Dr.	D	B

Table 2.16 – Arterial Highways: LOS D-F in both 2001 and 2010

Route	Direction	Peak Period	From	To	2001 LOS	2010 LOS
DE-7	NB/EB	PM	DE-72	Stoney Batter Rd.	D	D

2.3.6.3 Multilane Highways: 2010 LOS vs. 2001 LOS

Table 2.17 summarizes multilane highway segments that have experienced significant changes in LOS since 2001.

Table 2.17 – Multilane Highways: LOS A-C in 2001 Deteriorates to LOS D-F in 2010

Route	Direction	Peak Period	From	To	2001 LOS	2010 LOS
US-13	NB/EB	AM	US-13/US-40 Split	Hamburg Rd.	C	D
US-13	SB/WB	PM	US-13/US-40 Split	Hamburg Rd.	C	D

2.3.6.3 Two-lane Highways: 2010 LOS vs. 2001 LOS

Tables 2.18 and 2.19 summarize two-lane highway segments that have experienced significant changes in LOS or have continued to experience LOS D, E, or F since 2001.

Table 2.18 – Two-lane Highways: LOS D-F in 2001 Improves to LOS A-C in 2010

Route	Direction	Peak Period	From	To	2001 LOS	2010 LOS
DE-896	SB/WB	AM	US-301	US-13	E	C

Table 2.19 – Two-lane Highways: LOS D-F in both 2001 and 2010

Route	Direction	Peak Period	From	To	2001 LOS	2010 LOS
DE-72	NB/EB	AM	DE-40	Reybold Rd.	E	E
DE-72	SB/WB	AM	DE-40	Reybold Rd.	E	E
DE-72	NB/EB	PM	DE-40	Reybold Rd.	E	D
DE-72	SB/WB	PM	DE-40	Reybold Rd.	E	E
DE-71	NB/EB	AM	DE-7	DE-72	E	D
DE-71	SB/WB	AM	DE-7	DE-72	D	E
DE-71	NB/EB	PM	DE-7	DE-72	D	D
DE-71	SB/WB	PM	DE-7	DE-72	E	D
DE-896	NB/EB	AM	US-301	US-13	E	E
DE-896	NB/EB	PM	US-301	US-13	E	D
DE-896	SB/WB	PM	US-301	US-13	D	D
US-301	NB/EB	AM	Old School House Rd.	Marl Pitt Rd.	E	E
US-301	SB/WB	AM	Old School House Rd.	Marl Pitt Rd.	E	E
US-301	NB/EB	PM	Old School House Rd.	Marl Pitt Rd.	E	E
US-301	SB/WB	PM	Old School House Rd.	Marl Pitt Rd.	E	E
DE-299	NB/EB	AM	Broad St.	DE-1	E	E
DE-299	SB/WB	AM	Broad St.	DE-1	E	E
DE-299	NB/EB	PM	Broad St.	DE-1	E	E
DE-299	SB/WB	PM	Broad St.	DE-1	E	E

2.3.7 Potential Improvements to Roadway Segments with LOS D-F

Table 2.20 summarizes each roadway segment analyzed as part of this assessment experiencing LOS D-F and potential improvements to mitigate these conditions.

Table 2.20 – Roadway Segments Experiencing LOS D-F in 2010

Route	From	To	Roadway Type	Potential Improvement
I-95	DE-273	DE-1/DE-7	Freeway	I-95 Capital Improvement Project*
I-95	DE-1/DE-7	DE-58	Freeway	I-95 Capital Improvement Project*
I-95	DE-58	DE-141	Freeway	I-95 Capital Improvement Project*
DE-52	Hillside Rd.	Campbell Rd.	Arterial	Signal Optimization
DE-7	DE-72	Stoney Batter Rd.	Arterial	Signal Optimization
DE-4	DE-273	DE-7	Arterial	Signal Optimization*
DE-141	Commons Blvd.	US-13	Arterial	Signal Optimization
DE-4	DE-896	DE-273	Arterial	Signal Optimization*
DE-273	I-95	Old Baltimore Pike	Arterial	Signal Optimization
DE-273	Prangs Rd.	Pleasant Dr.	Arterial	Signal Optimization
DE-2	Milltown Rd.	St. James Church Rd.	Arterial	Signal Optimization
Foulk Rd.	US-202	DE-92	Arterial	Signal Optimization**
US-13	US-13/US 40 Split	Hamburg Rd.	Multilane Highway	Signal Optimization
DE-92	Woodlawn Rd.	Beaver Valley Rd.	Two-lane Highway	Assess “No-passing” Zones
Grubb Rd.	Foulk Rd.	Marsh Rd.	Two-lane Highway	Assess “No-passing” Zones
Wilson Rd.	Shipley Rd.	Marsh Rd.	Two-lane Highway	Assess “No-passing” Zones
DE-41	Hercules Rd.	DE-34	Two-lane Highway	Assess “No-passing” Zones
DE-72	DE-40	Reybold Rd.	Two-lane Highway	Assess “No-passing” Zones
DE-71	DE-7	DE-72	Two-lane Highway	Assess “No-passing” Zones
DE-896	US-301	US-13	Two-lane Highway	Assess “No-passing” Zones
US-301	Old School House Rd.	Marl Pitt Rd.	Two-lane Highway	Assess “No-passing” Zones
DE-299	Broad St.	DE-1	Two-lane Highway	Assess “No-passing” Zones
DE-41	PA Line	Old Lancaster Pike	Two-lane Highway	Assess “No-passing” Zones

**Denotes current DelDOT project.*

***While this segment was found to be operating at LOS C or above in each direction for both the AM and PM peak periods, the 85th percentile speeds were found to be below the speed limit, which is an indication that traffic signal timing along the corridor could be improved.*

Construction of the DE-1 & I-95 interchange improvements, which include the addition of high speed connecting ramps from NB DE-1 to NB I-95 as well as SB I-95 to SB DE-1, is currently underway and is expected to be completed by 2014. These major improvements will have a direct impact on improving the level of service on the segment of I-95 between DE-1/DE-7 and DE-58, where LOS is the worst (LOS E). Segments of I-95 between DE-273 & DE-1/DE-7 and DE-58 & DE-141, which are directly upstream and downstream of the DE-1 & I-95 interchange, will also experience improvements in traffic operations due to these improvements.

Several of the arterial highways, coupled with one multilane highway segment, assessed are experiencing LOS D, E, or F, most of which have deteriorated since 2001. Traffic signal timing directly affects LOS along

these segments; this is reinforced by the University of Delaware's Fall 2010 GPS Travel Time and Delay Report, which identified each of the segments listed in Table 2.18 as subject to significant delay due to traffic signals. These corridors are recommended for traffic signal timing optimization and coordination review as a relatively low-budget approach to improving operations, compared to relatively high-budget capital improvements. The segment of DE-7 between DE-72 & Stoney Batter Road is considered a prime candidate, because while the roadway segment experiences LOS D in the PM peak hour (NB/EB direction), intersections directly influencing this segment (DE-7 & DE-72 and DE-7 & New Linden Hill Rd.) experience LOS B in the PM peak hour, according to CMS analysis (see Chapter 3). This is a sign that the traffic signals could be timed more efficiently.

Each of the two-lane highways assessed is experiencing LOS D, E, or F, which has not changed from 2001. LOS for Class I two-lane highways is based on the average travel speed as well as the percentage of time that a vehicle spends following another vehicle. The latter characteristic is heavily influenced by the percentage of the roadway segment in which passing is prohibited (percent no passing zone). A relatively low-budget project aimed to increase LOS on these roadways would be to analyze available horizontal and vertical sight distance along the segment in each direction and decide if some areas designated as "no-passing zones" could have this restraint removed. If so, there would be a positive effect on LOS for the given segment.

Chapter 3: Intersection Data Collection and Performance Analysis

This chapter summarizes the data collection and performance analysis of the 31 signalized intersections included in this assessment. Appendix 46 and Appendix 49 can be referenced for intersection signal data and Critical Movement Summations (CMS), respectively.

3.1 Typical Weekday Peak Hour Intersection Volume

Typical weekday intersection turning movement volumes were collected/compiled during AM and PM peak periods at each of the 31 intersections included in this assessment. If a recent turning movement count was available at a subject intersection, an appropriate growth factor was applied to estimate 2010 peak hour volumes (methodology explained in Chapter 1). If a recent turning movement count was unavailable at a subject intersection, new turning movement counts were performed in the AM and PM peak periods to determine the peak hour intersection volumes.

3.1.1 2010 Peak Hour Intersection Volumes

Table 3.1 presents 2010 typical weekday AM and PM peak hour overall intersection volumes. Note, Intersection #15, Elkton Road & Delaware Avenue, was under significant construction at the time of this report, and therefore was not included in the 2010 data collection or analysis program.

Table 3.1 – 2010 Typical Weekday Peak Hour Intersection Volume

Int #	Intersection	2010 Peak Hour Volume	
		AM Peak Hour	PM Peak Hour
1	Foulk Rd. & Silverside Rd.	2,403	3,072
2	Main St. & South College Ave.	1,289	1,965
3	DE-4 & DE-7	4,522	5,529
4	DE-4 & Salem Church Rd.	3,585	4,385
5	DE-2 & Milltown Rd.	3,342	4,125
6	DE-7 & Milltown Rd.	3,843	4,448
7	Pennsylvania Ave. & North Union St.	2,269	2,609
8	DE-2 & DE-41	5,708	6,662
9	DE-7 & New Linden Hill Rd.	3,407	3,969
10	DE-273 (Delaware Ave.) & South College Ave.	1,569	1,451
11	DE-92 & Philadelphia Pike	1,023	1,542
12	DE-2 & Pike Creek Rd.	3,213	3,898
13	New Linden Hill Rd. & Upper Pike Creek Rd.	1,553	1,810
14	DE-273 & Churchmans Rd.	2,331	2,634
15	Elkton Rd. & Delaware Ave.	NA	NA
16	DE-4 & South DuPont Rd.	2,166	2,465
17	DE-4 & Race St.	1,870	2,239
18	DE-273 & Rt. 141	2,106	2,464
19	Old Baltimore Pike & DE-72	3,196	3,665

Table 3.1 – 2010 Typical Weekday Peak Hour Intersection Volume (cont.)

Int #	Intersection	2010 Peak Hour Volume	
		AM Peak Hour	PM Peak Hour
20	Polly Drummond Hill Rd. & New Linden Hill Rd.	2,035	2,178
21	DE-4 & DE-72	4,206	4,781
22	US-202 & DE-92	4,553	5,990
23	DE-896 & Hillside Rd.	1,713	2,134
24	DE-4 & DE-7 near Churchmans	5,264	6,130
25	DE-2 & DE-7	5,724	7,002
26	Foulk Road & DE-92	2,484	3,608
27	Foulk Road & DE-202	2,665	2,653
28	DE-202 & Silverside Road	4,693	5,895
29	DE-896 & DE-71	2,101	2,202
30	DE-7 & DE-72	3,237	3,605
31	West Main St. and Hillside Rd. (Newark)	1,687	1,606
32	McKennans Church Rd. & Milltown Rd.	1,949	2,255

As the table shows, the intersections with the heaviest peak hour volumes in New Castle County include those along DE-2, DE-4, DE-7, and US-202 in the Pike Creek Area of the county. Peak hour volumes are also typically higher in the PM peak hour, an indication that the PM peak hour usually carries additional non-commuter traffic volumes.

3.1.2 2010 Peak Hour Volumes vs. 2001 Peak Hour Volumes

Figures 8, 9, and 10 present 2010 peak hour intersection volumes and their relation to corresponding 2001 peak hour intersection traffic volume levels. Intersections are grouped together by location (Newark area, Pike Creek area, and the Northeast area) to get an idea of spatial distribution of traffic volumes in New Castle County. Table 3.2 presents these positive and negative percentile changes for the 22 intersections that were included in both the 2001 and 2010 assessments (excluding the intersection of Elkton Road and Delaware Avenue). Overall, peak hour volumes were lower in 2010 compared to 2001, by 3.8% and 1.7% in the AM and PM peak hours respectively as shown in the table below.

Table 3.2 – 2010 Intersection Peak Hour Volume vs. 2001 Intersection Peak Hour Volume

Int #	Intersection	AM Peak Hour			PM Peak Hour		
		2001 Volume	2010 Volume	% Change	2001 Volume	2010 Volume	% Change
1	Foulk Rd. & Silverside Rd.	2401	2403	0.1%	2994	3072	2.6%
2	Main St. & South College Ave.	1502	1289	-14.2%	2507	1965	-21.6%
3	DE-4 & DE-7	4470	4522	1.2%	5187	5529	6.6%
4	DE-4 & Salem Church Rd.	4227	3585	-15.2%	5015	4385	-12.6%
5	DE-2 & Milltown Rd.	3268	3342	2.3%	4232	4125	-2.5%
6	DE-7 & Milltown Rd.	4303	3843	-10.7%	4042	4448	10.0%
7	Pennsylvania Ave. & N. Union St.	2198	2269	3.2%	2326	2609	12.2%
8	DE-2 & DE-41	4941	5708	15.5%	5617	6662	18.6%
9	DE-7 & New Linden Hill Rd.	3569	3407	-4.5%	3851	3969	3.1%
10	DE-273 & South College Ave.	1462	1569	7.3%	1843	1451	-21.3%
11	US-13 & DE-92	1000	1023	2.3%	1666	1542	-7.4%
12	DE-2 & Pike Creek Rd.	3492	3213	-8.0%	4325	3898	-9.9%
13	New Linden Hill Rd. & Upper Pike Creek Rd.	1665	1553	-6.7%	1864	1810	-2.9%
14	DE-273 & Churchmans Rd.	2400	2331	-2.9%	3035	2634	-13.2%
15	Elkton Rd. & Delaware Ave.	1659	NA	NA	1741	NA	NA
16	DE-4 & South DuPont Rd.	2235	2166	-3.1%	2264	2465	8.9%
17	DE-4 & Race St.	2181	1870	-14.3%	2065	2239	8.4%
18	DE-273 & Rt. 141	2055	2106	2.5%	2454	2464	0.4%
19	Old Baltimore Pike & DE-72	3192	3196	0.1%	3223	3665	13.7%
20	Polly Drummond Hill Rd. & New Linden Hill Rd.	2079	2035	-2.1%	2411	2178	-9.7%
21	DE-72 & DE-4	4439	4206	-5.2%	4952	4781	-3.5%
22	US-202 & DE-92	3949	4553	15.3%	5757	5990	4.0%
23	DE-896 & Hillside Rd.	1666	1713	2.8%	1933	2134	10.4%
Totals		**64,353**	**61,902**	**-3.8%**	**75,304**	**74,015**	**-1.7%**

Figure 8a
AM Pike Creek Area Total Volume

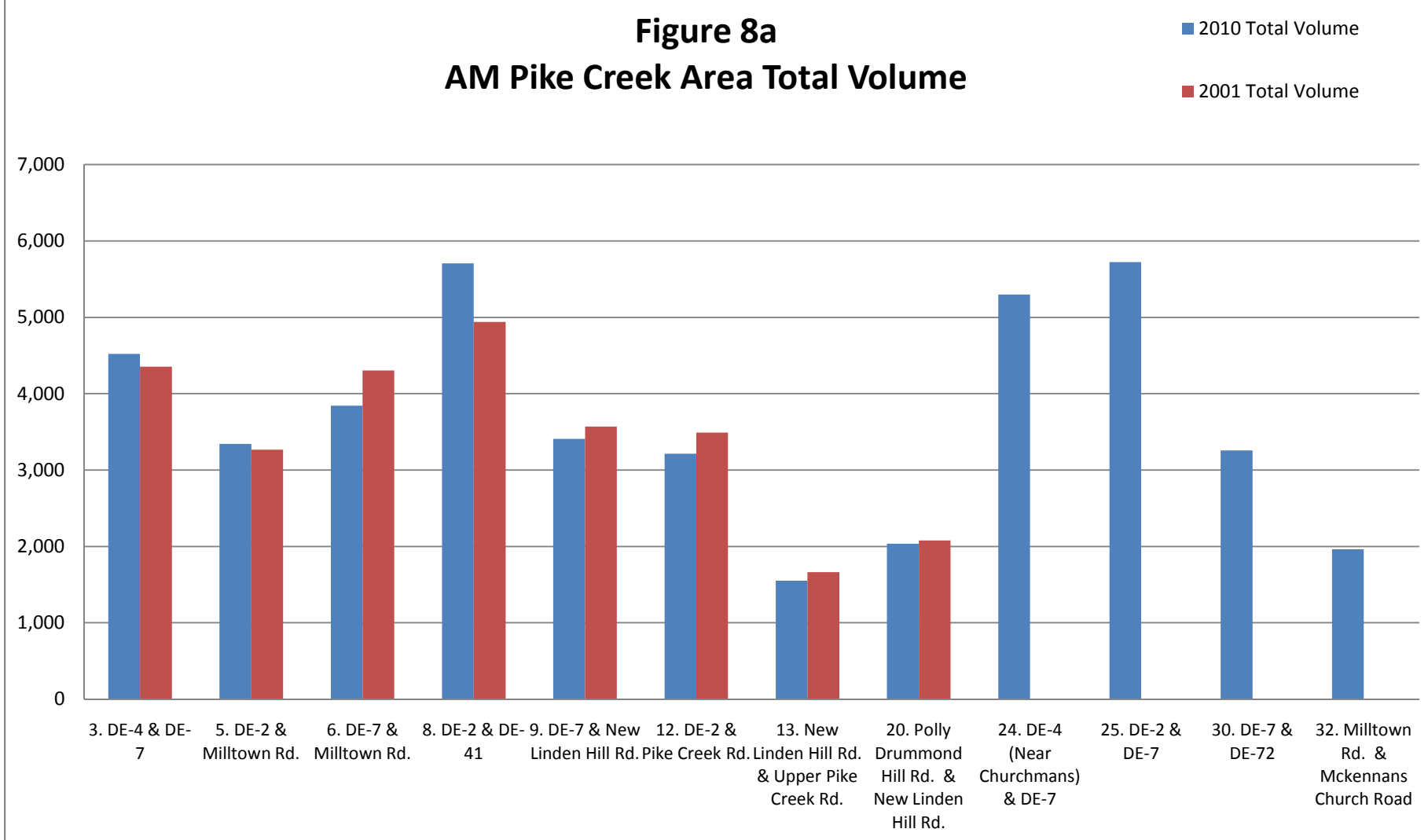


Figure 8b
PM Pike Creek Area Total Volume

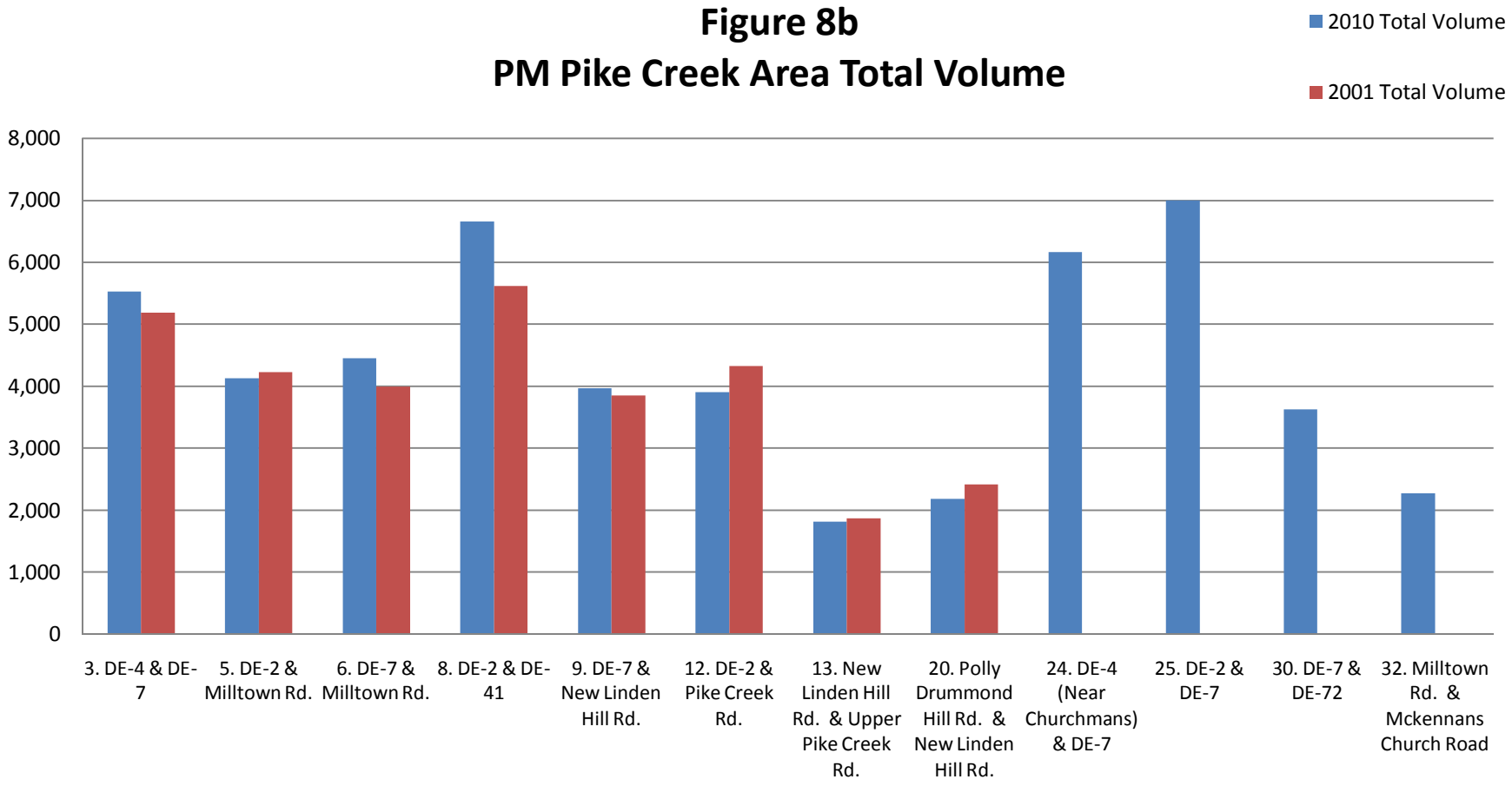


Figure 9a
AM Newark Area Total Volume

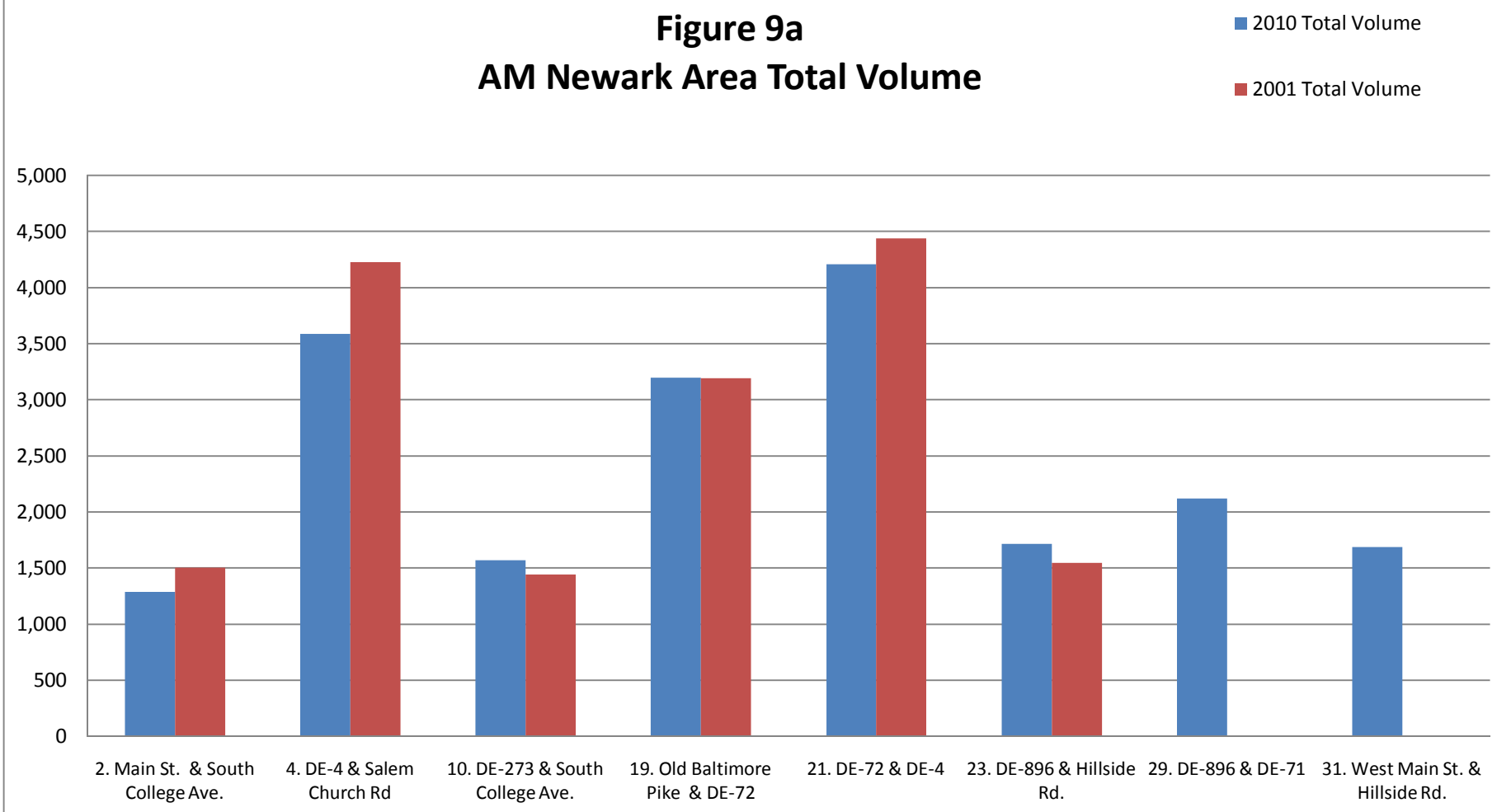


Figure 9b
PM Newark Area Total Volume

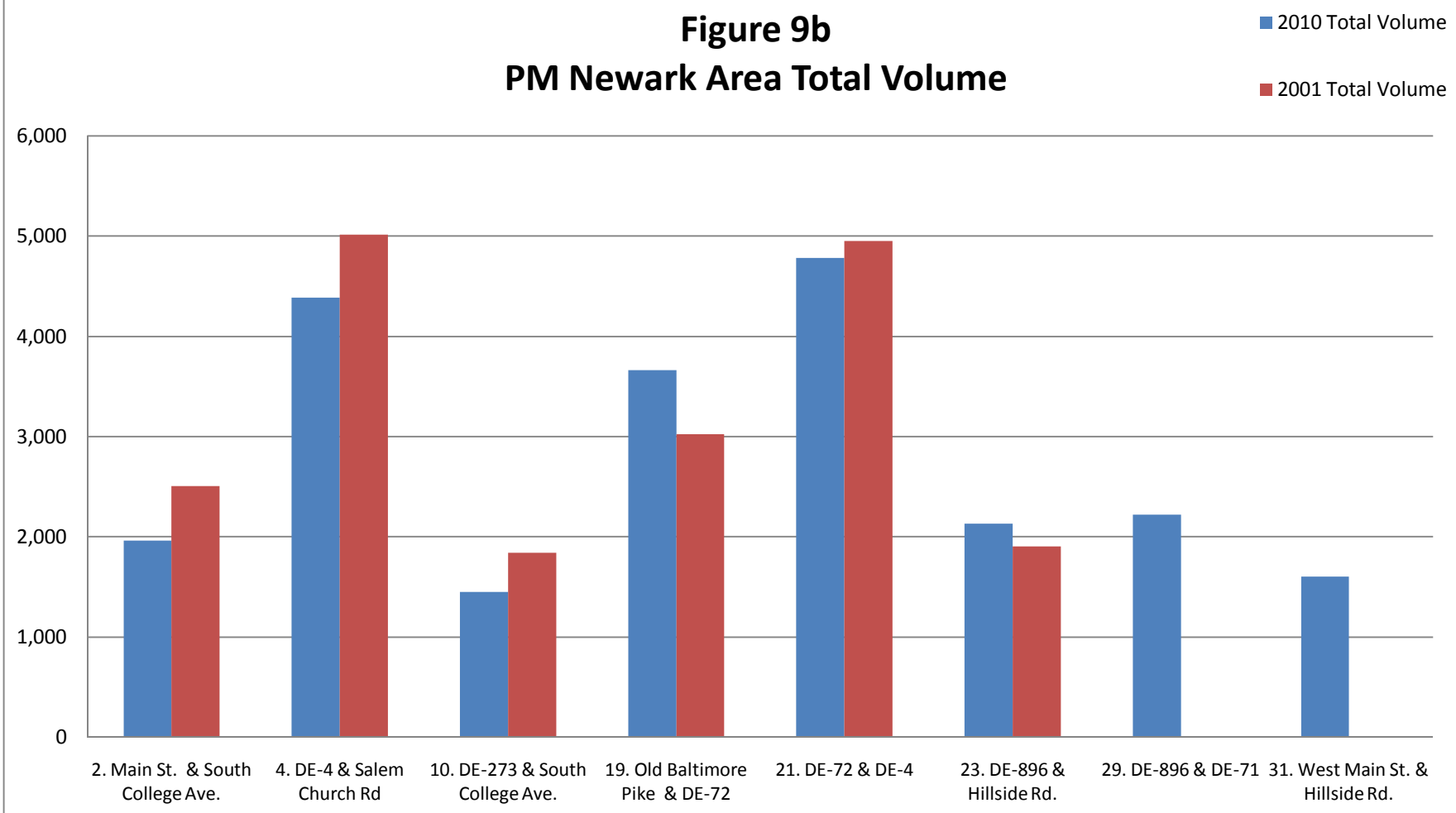


Figure 10a
AM Northeast Area Total Volume

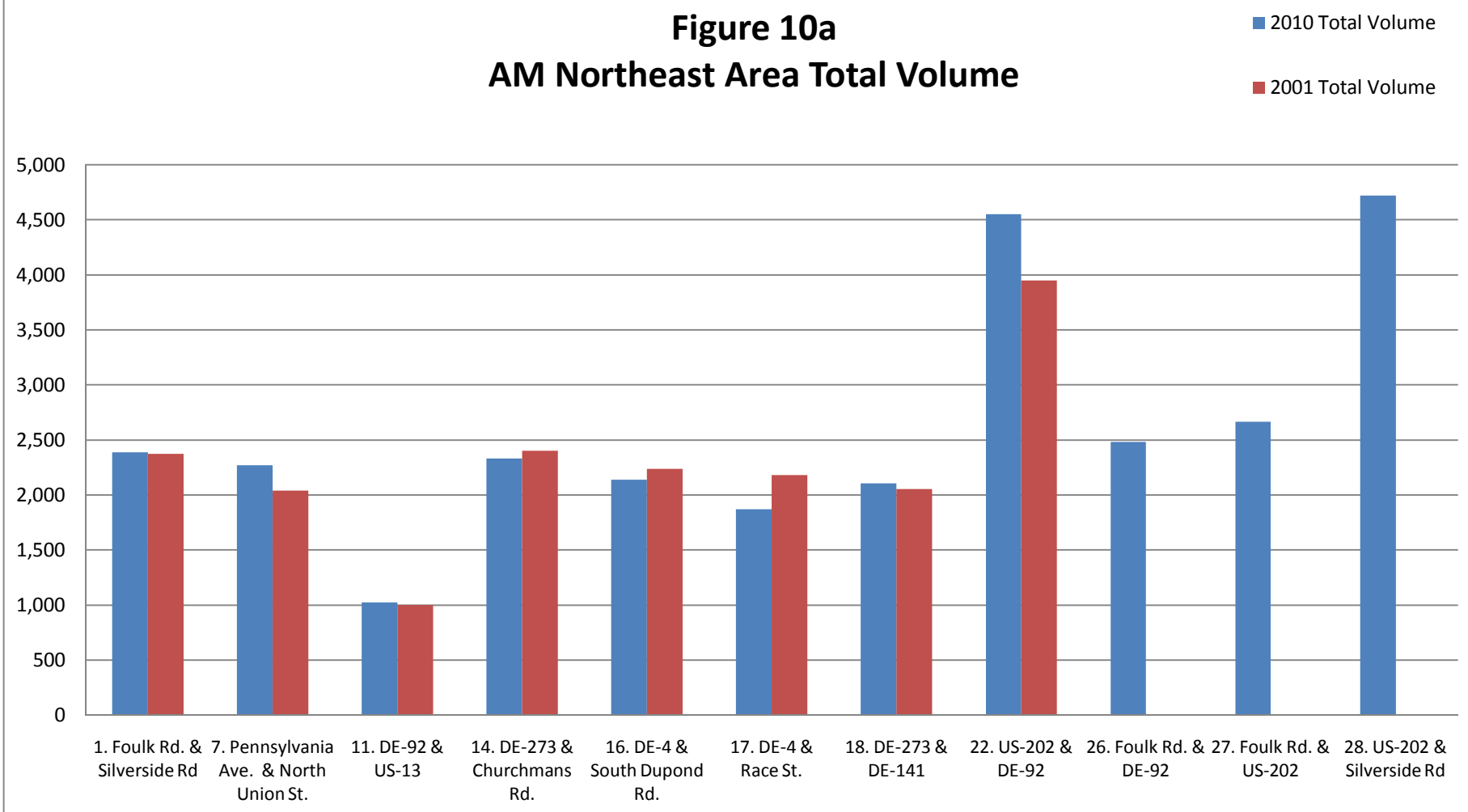
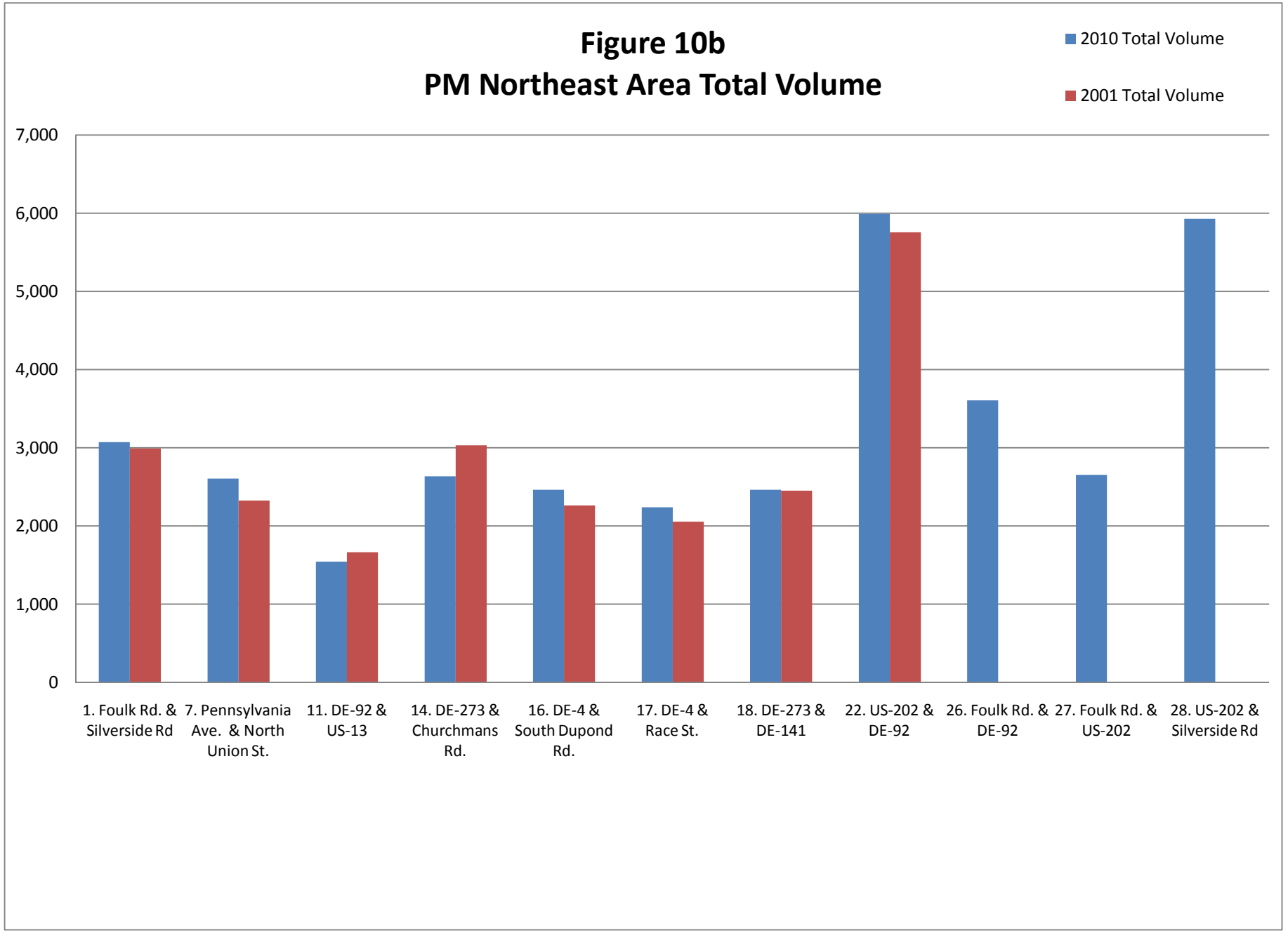


Figure 10b
PM Northeast Area Total Volume



3.1.2.1 Intersections with > 10% Growth in Peak Hour Volume Since 2001

The following intersections have experienced significant increases (>10%) in 2010 peak hour volume compared to 2001 volumes.

AM Peak Hour

- DE-2 & DE-41
- US-202 & DE-92

PM Peak Hour

- Pennsylvania Ave. & N. Union St.
- DE-2 & DE-41
- Old Baltimore Pike & DE-72
- DE-896 & Hillside Rd.

3.1.2.2 Intersections with >10% Decrease in Peak Hour Volume Since 2001

The following intersections are those that have experienced significant decreases (> 10%) in 2010 peak hour volume compared to 2001 volumes.

AM Peak Hour

- Main St. & South College Ave.
- DE-7 & Milltown Rd.
- DE-4 & Salem Church Rd.
- DE-4 & Race St.

PM Peak Hour

- Main St. & S. College Ave.
- DE-4 & Salem Church Rd.
- DE-273 & S. College Ave.
- DE-273 & Churchmans Rd.

3.2 Typical Weekday Peak Hour Level of Service

DelDOT's Critical Movement Summation (CMS) method was used to assign each intersection a level of service grade in the AM and PM peak hours. This method is detailed in DelDOT's *Standards and Regulations for Subdivision Streets and State Highway Access (Appendix P)* and "focuses on 'raw' intersection capacity, that is, the ability to process a given traffic demand with a given lane use configuration and given phase sequence". In this method, volumes of intersection critical movements are summed and provide the level of service based on specific critical movement volume thresholds. LOS criteria is listed in Table 3.3.

Table 3.3 – CMS LOS Criteria

Level of Service	Critical Movement Volume
A	Less than 1,000 veh/hr
B	1,000 to 1,150 veh/hr
C	1,151 to 1,300 veh/hr
D	1,301 to 1,450 veh/hr
E	1,451 to 1,600 veh/hr
F	More than 1,600 veh/hr

3.2.1 2010 Intersection Peak Hour Level of Service

Table 3.4 and Figures 11-15 present peak hour intersection CMS levels of service for the 31 intersections analyzed as part of this assessment. Note, Intersection #15, Elkton Road & Delaware Avenue, was under significant construction at the time of this report, and therefore was not included in the 2010 data collection or analysis program.

Table 3.4 – Intersection Peak Hour Level of Service

Int #	Intersection	2010	
		AM Peak Hour LOS	PM Peak Hour LOS
1	Foulk Rd. & Silverside Rd.	B	D
2	Main St. & South College Ave.	A	B
3	DE-4 & DE-7	C	E
4	DE-4 & Salem Church Rd.	B	B
5	DE-2 & Milltown Rd.	B	E
6	DE-7 & Milltown Rd.	C	F
7	Pennsylvania Ave. & North Union St.	A	C
8	DE-2 & DE-41	F	F
9	DE-7 & New Linden Hill Rd.	B	B
10	DE-273 (Delaware Ave.) & South College Ave.	A	A
11	DE-92 & Philadelphia Pike	A	A
12	DE-2 & Pike Creek Rd.	B	C
13	New Linden Hill Rd. & Upper Pike Creek Rd.	B	B
14	DE-273 & Churchmans Rd.	A	A
15	Elkton Rd. & Delaware Ave.	N/A	N/A
16	DE-4 & South DuPont Rd.	B	A
17	DE-4 & Race St.	A	A
18	DE-273 & Rt. 141	B	B
19	Old Baltimore Pike & DE-72	B	C
20	Polly Drummond Hill Rd. & New Linden Hill Rd.	C	C
21	DE-4 & DE-72	B	B
22	US-202 & DE-92	D	D
23	DE-896 & Hillside Rd.	B	B

Table 3.4 – Intersection Peak Hour Level of Service (cont.)

Int #	Intersection	2010	
		AM Peak Hour LOS	PM Peak Hour LOS
24	DE-4 & DE-7 near Churchmans	A	D
25	DE-2 & DE-7	D	E
26	Foulk Road & DE-92	A	C
27	Foulk Road & US-202	B	B
28	US-202 & Silverside Road	B	D
29	DE-896 & DE-71	B	B
30	DE-7 & DE-72	A	B
31	West Main St. and Hillside Rd. (Newark)	B	B
32	Milltown Road & McKennans Church Road	A	A

Figure 11a
AM Peak Hour Pike Creek Area CMS

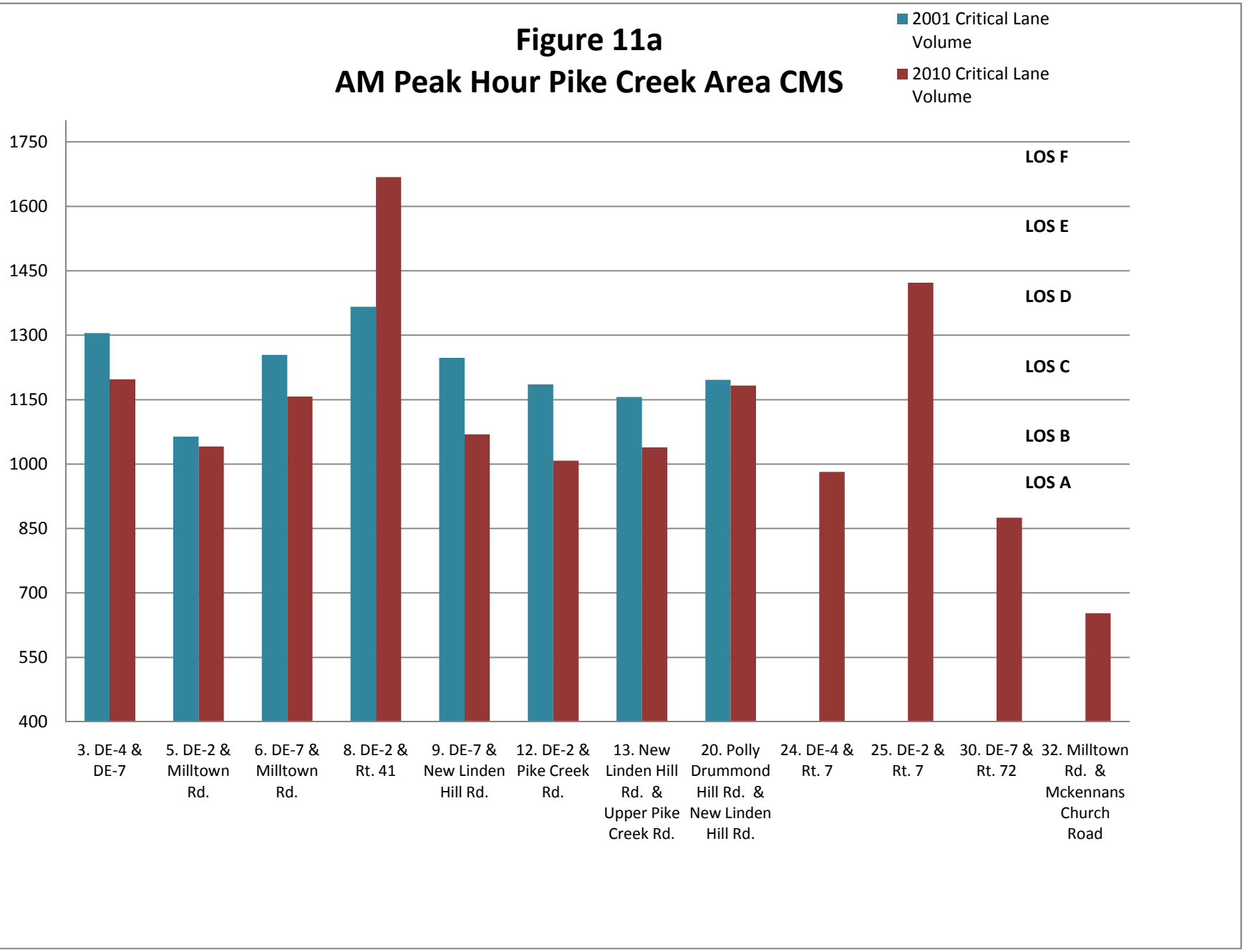


Figure 11b
PM Peak Hour Pike Creek Area CMS

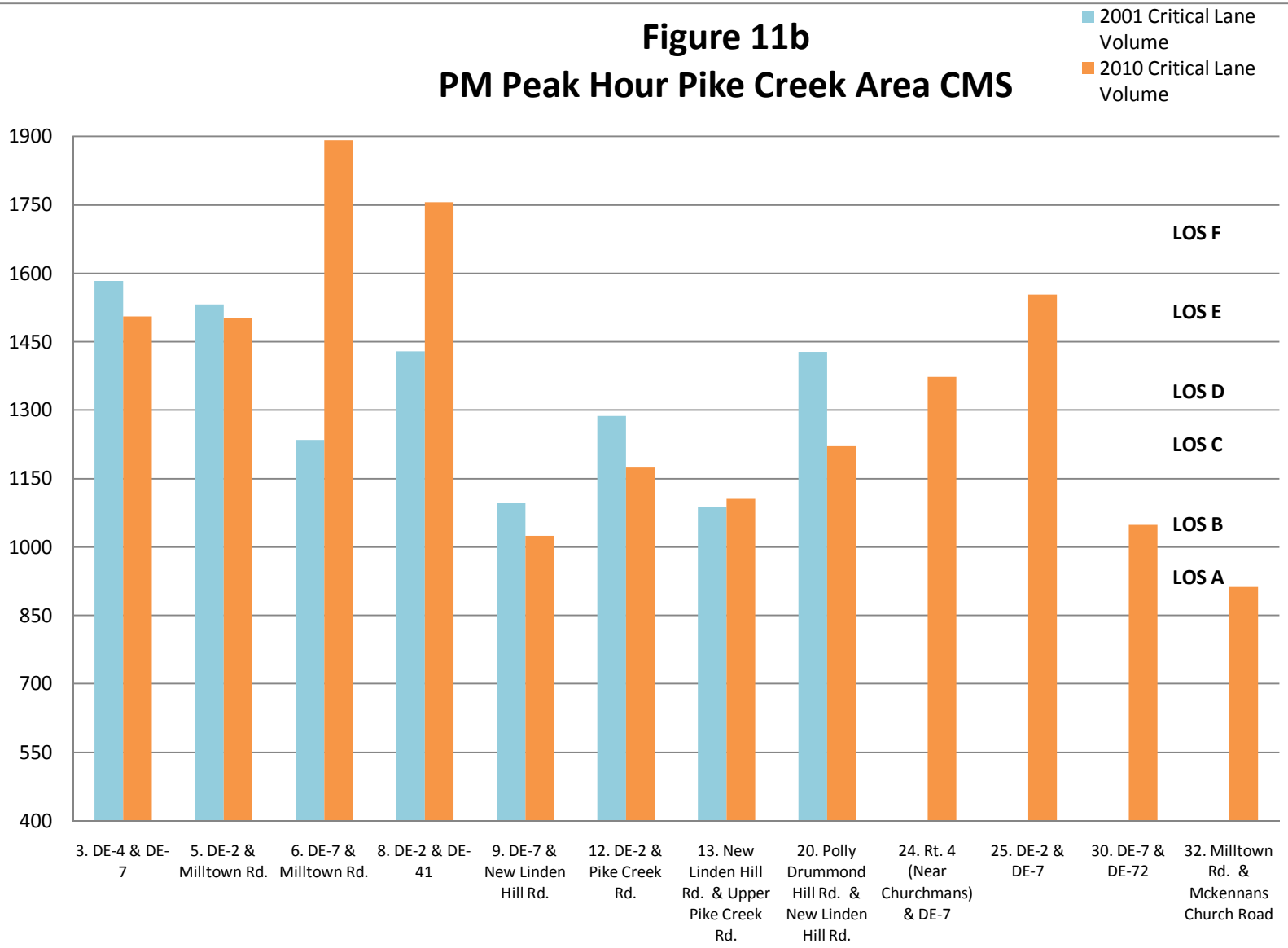


Figure 12a
AM Peak Hour Newark Area CMS

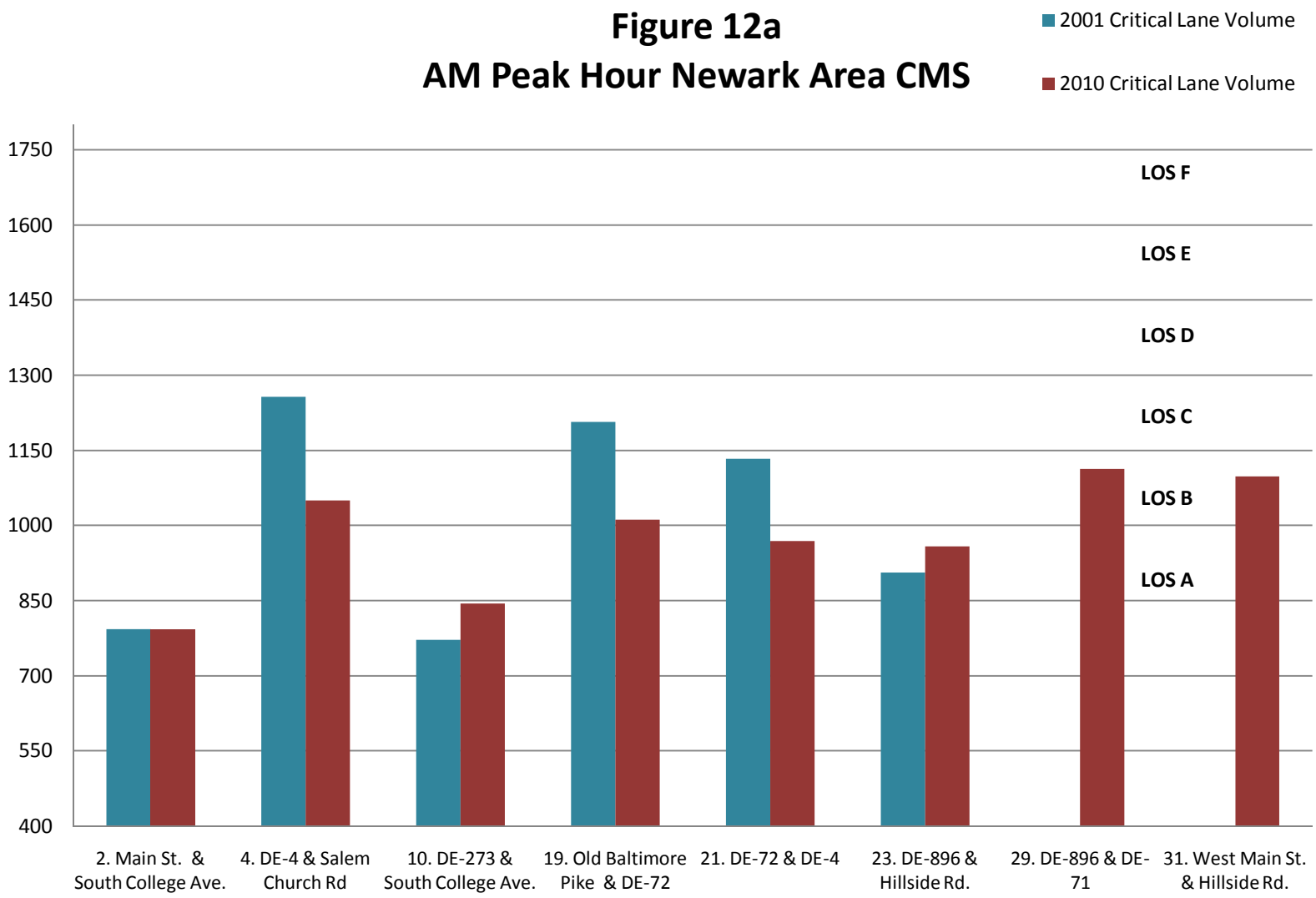


Figure 12b
PM Peak Hour Newark Area CMS

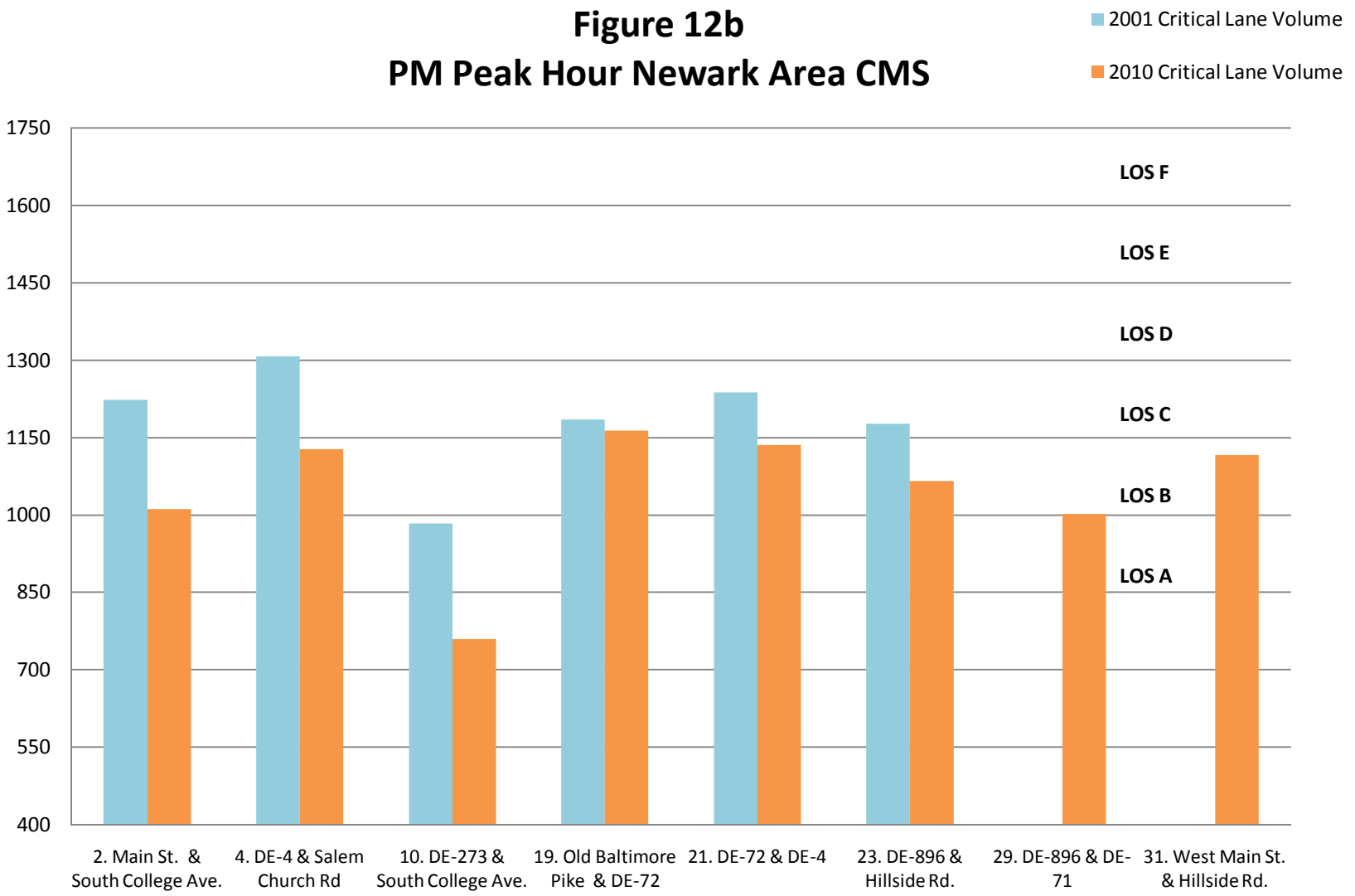


Figure 13a
AM Peak Hour Northeast Area CMS

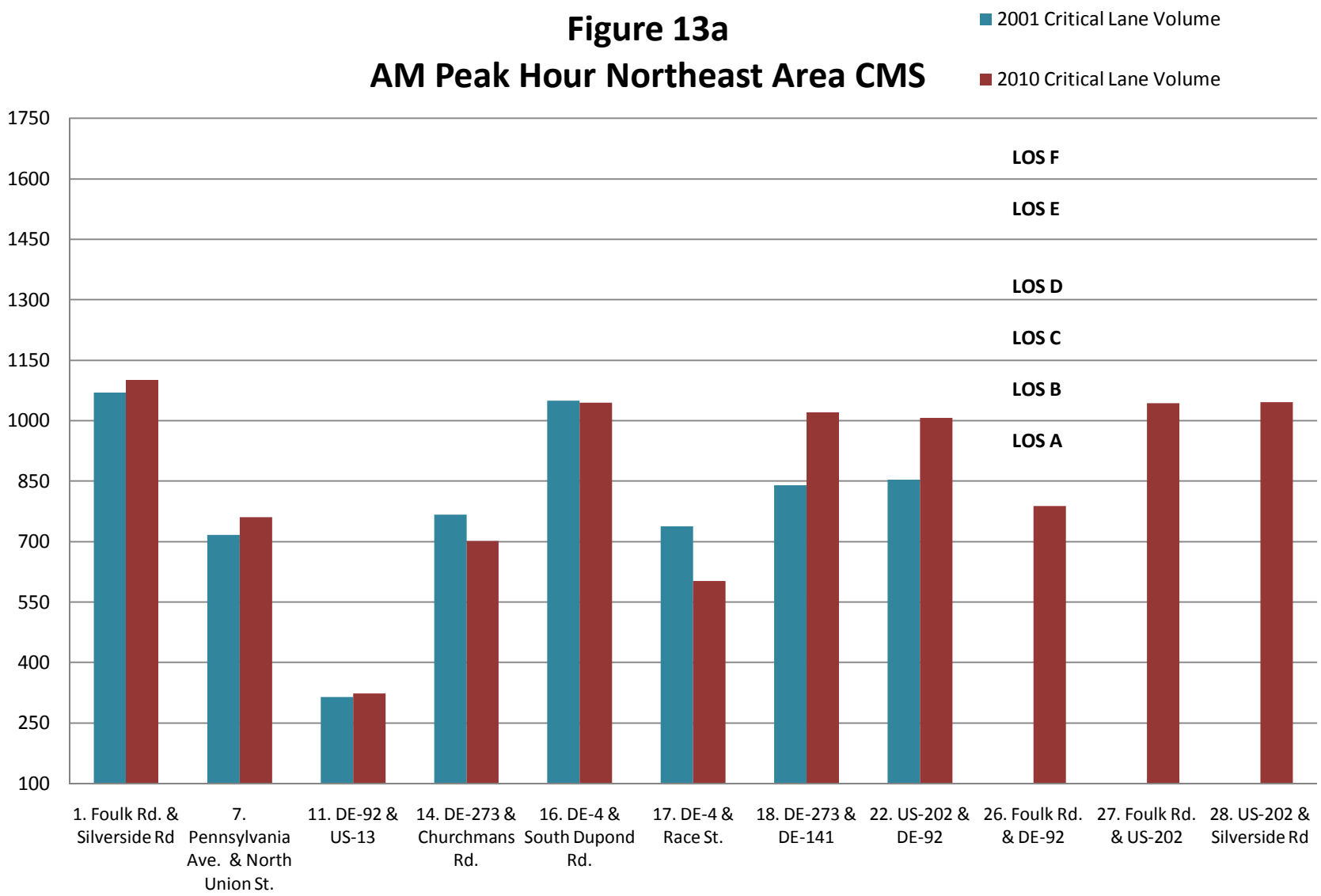
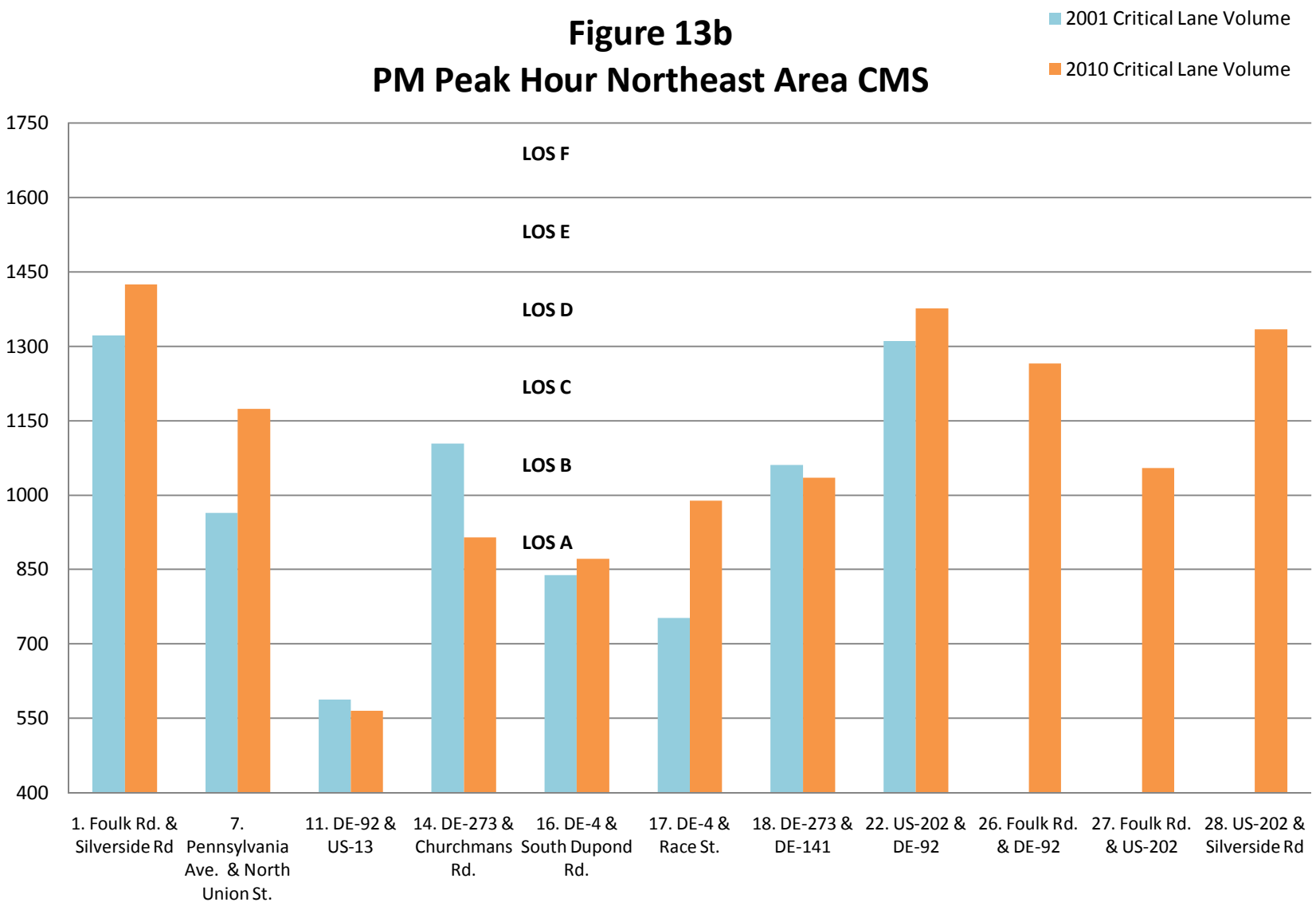
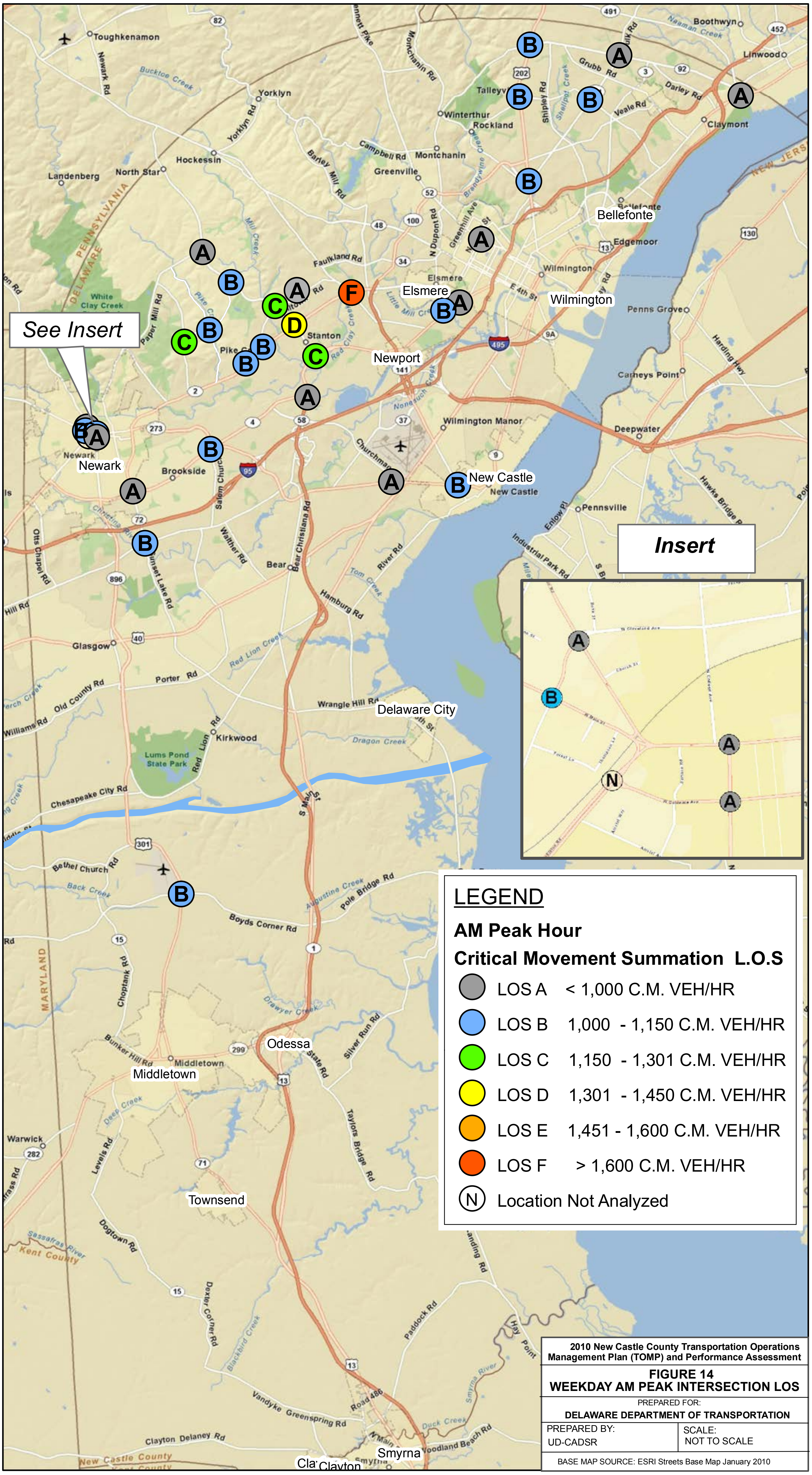


Figure 13b
PM Peak Hour Northeast Area CMS





2010 New Castle County Transportation Operations Management Plan (TOMP) and Performance Assessment

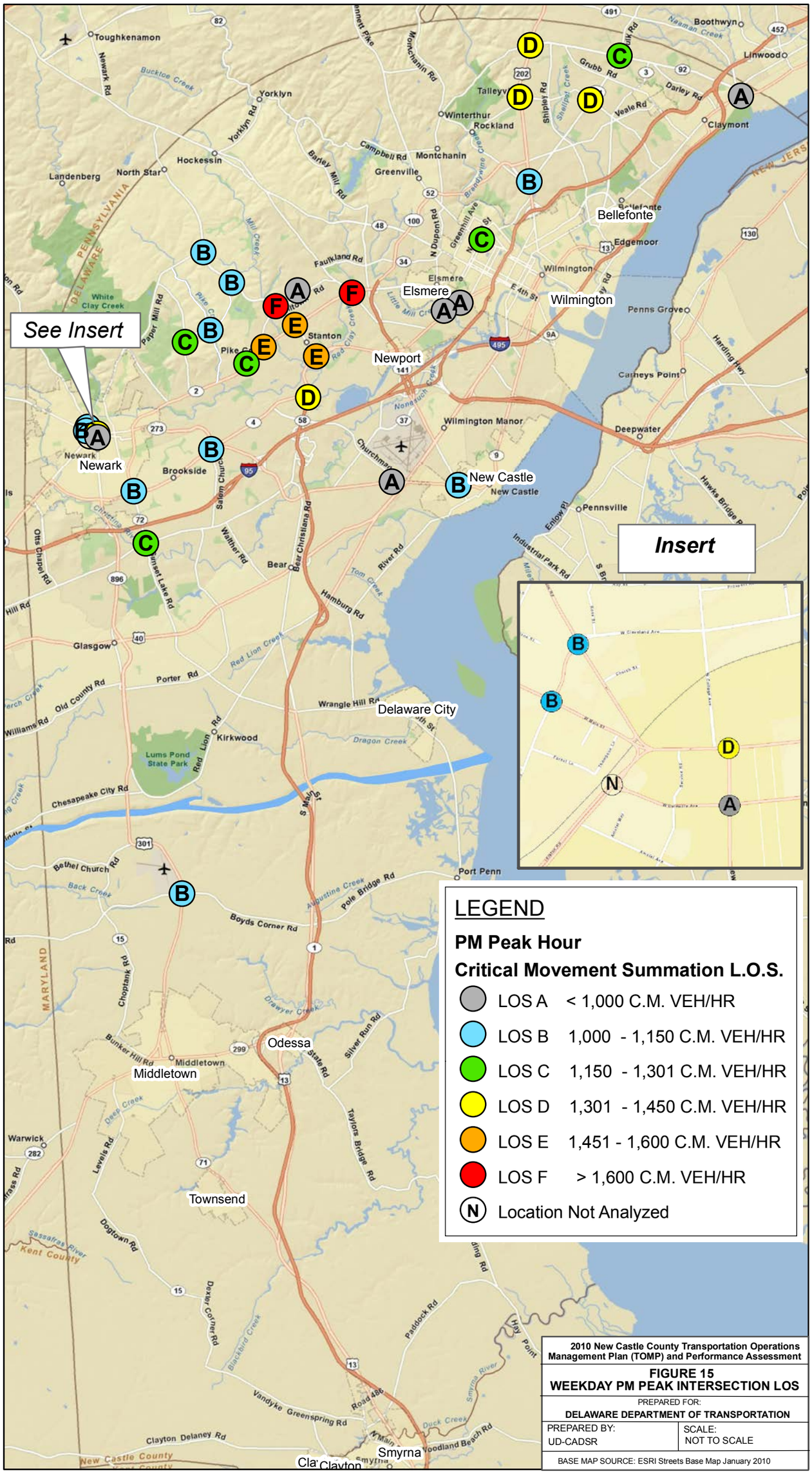
FIGURE 14
WEEKDAY AM PEAK INTERSECTION LOS

PREPARED FOR:
DELAWARE DEPARTMENT OF TRANSPORTATION

PREPARED BY: UD-CADSR

SCALE: NOT TO SCALE

BASE MAP SOURCE: ESRI Streets Base Map January 2010


See Insert
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Newark
Elsmere
Wilmington
Bellefonte
New Castle
Delaware City
Middletown
Odessa
Townsend
Smyrna
Clayton
Newport
Stanton
Glasgow
Kirkwood
Port Penn
Pennsville
Deepwater
Wilmington Manor
Carneys Point
Penns Grove
Claymont
Boothwyn
Linwood
Edgemoor
Hockessin
Landenberg
North Star
Yorklyn
Greenville
Montchanin
Winterthur
Rockland
Talleyville
Brookside
Bear
Newark
Toughkenamon
Lums Pond State Park
PENNSYLVANIA
DELAWARE
MARYLAND
LEGEND
PM Peak Hour
Critical Movement Summation L.O.S.
LOS A < 1,000 C.M. VEH/HR
LOS B 1,000 - 1,150 C.M. VEH/HR
LOS C 1,150 - 1,301 C.M. VEH/HR
LOS D 1,301 - 1,450 C.M. VEH/HR
LOS E 1,451 - 1,600 C.M. VEH/HR
LOS F > 1,600 C.M. VEH/HR
Location Not Analyzed
2010 New Castle County Transportation Operations Management Plan (TOMP) and Performance Assessment
FIGURE 15
WEEKDAY PM PEAK INTERSECTION LOS
PREPARED FOR:
DELAWARE DEPARTMENT OF TRANSPORTATION
PREPARED BY:
UD-CADSR
SCALE:
NOT TO SCALE
BASE MAP SOURCE: ESRI Streets Base Map January 2010

3.2.2 2010 Intersection LOS vs. 2001 Intersection LOS

A methodology was utilized to compare the AM and PM peak hour levels of service (LOS) at the intersections analyzed in both the 2010 and 2001 assessments. Generally, LOS A-C has been considered acceptable, LOS E and F has been considered unacceptable, and LOS D has been considered acceptable, but needing proactive attention. The following presents criteria used in this report to identify significant changes between 2010 LOS and 2001 LOS (see Figures 16 and 17).

1. LOS A-C in 2001 deteriorates to LOS D-F in 2010
2. LOS D-F in 2001 improves to LOS A-C in 2010
3. LOS D-F in both 2001 and 2010

3.2.2.1 LOS A-C in 2001 Deteriorates to LOS D-F in 2010

In the PM peak hour, one intersection had a level of service that deteriorated from LOS A-C in 2001 to LOS D-F in 2010 (there were none that fell under this category in the AM peak hour).

Table 3.5 – Intersections with LOS A-C in 2001 Deteriorates to LOS D-F in 2010 (PM Peak Hour)

Int #	Intersection	2001 PM LOS	2010 PM LOS
6	DE-7 & Milltown Rd.	C	F

3.2.2.2 LOS D-F in 2001 Improves to LOS A-C in 2010

In the AM peak hour, one intersection had a level of service that improved from LOS A-C in 2001 to LOS D-F in 2010.

Table 3.6 – Intersections with LOS D-F in 2001 Improves to LOS A-C in 2010 (AM Peak Hour)

Int #	Intersection	2001 AM LOS	2010 AM LOS
3	Newport Pike (DE-4) & DE-7	D	C

In the PM peak hour, two intersections had levels of service that showed similar significant improvement.

Table 3.7 – Intersections with LOS D-F in 2001 Improves to LOS A-C in 2010 (PM Peak Hour)

Int #	Intersection	2001 PM LOS	2010 PM LOS
4	DE-4 & Salem Church Rd.	D	B
20	Polly Drummond Hill Rd. & New Linden Hill Rd.	D	C

3.2.2.3 LOS D-F in both 2001 and 2010

In the AM peak hour, one intersection continued to experience LOS D-F in 2010, as it had in 2001.

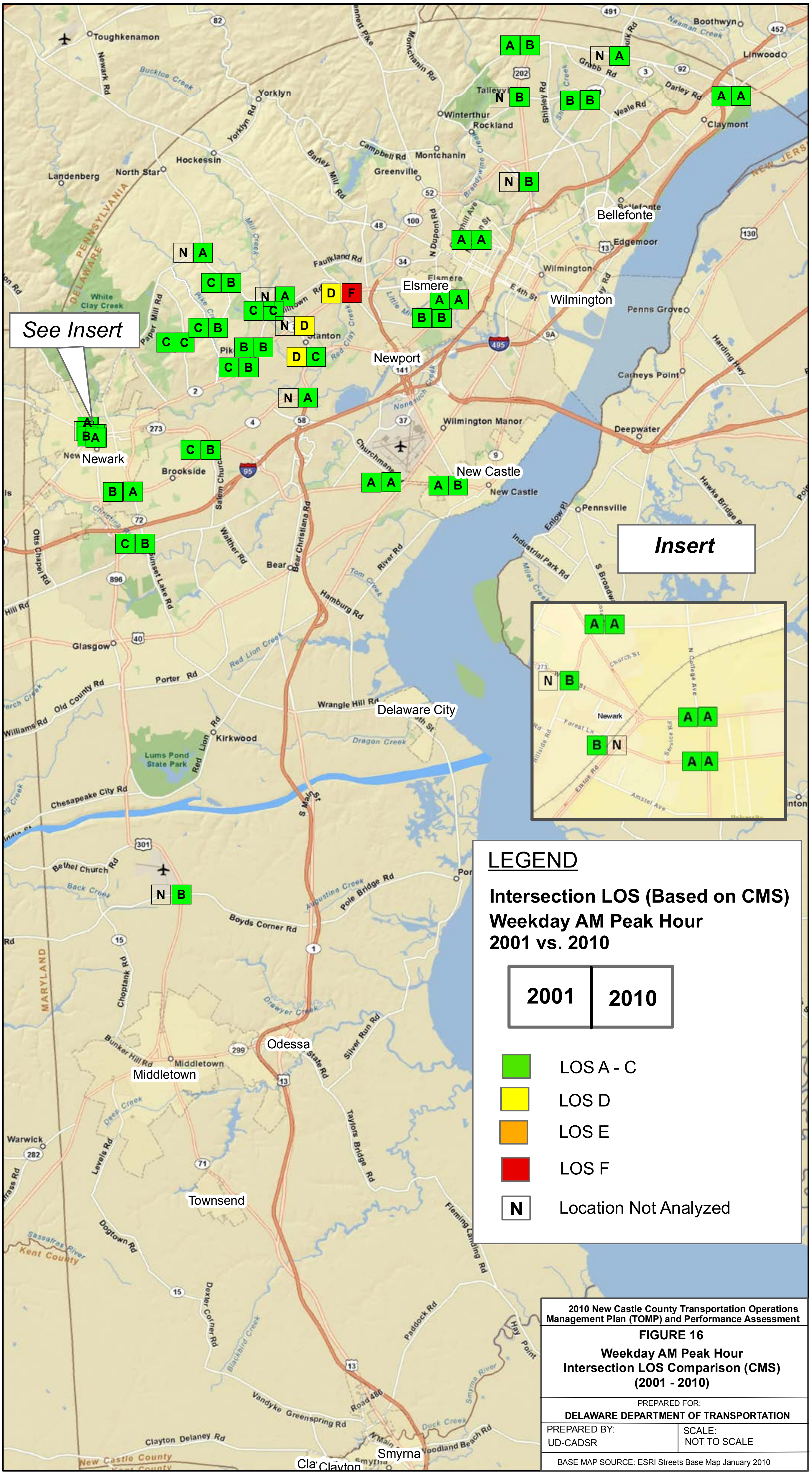
Table 3.8 – Intersections with LOS D-F in both 2001 and 2010 (AM Peak Hour)

Int #	Intersection	2001 AM LOS	2010 AM LOS
8	DE-2 & DE-41	D	F

In the PM peak hour, five intersections continued to experience LOS D-F in 2010, as they had in 2001.

Table 3.9 –Intersections with LOS D-F in both 2001 and 2010 (PM Peak Hour)

Int #	Intersection	2001 PM LOS	2010 PM LOS
1	Foulk Rd. & Silverside Rd.	D	D
3	Newport Pike (DE-4) & DE-7	E	E
5	DE-2 & Milltown Rd.	E	E
8	DE-2 & DE-141	D	F
22	US-202 & DE-92	D	D


See Insert
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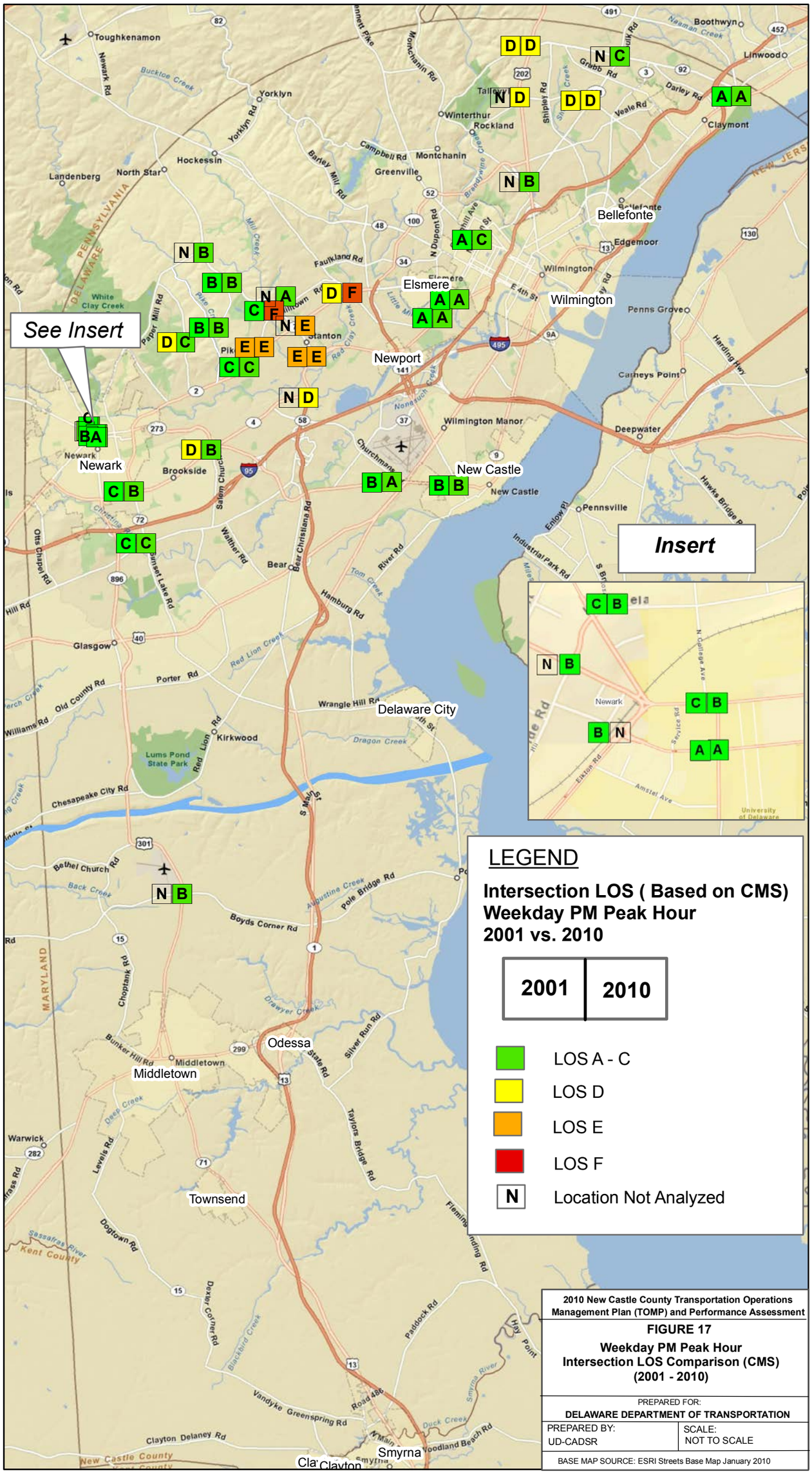
LEGEND
Intersection LOS (Based on CMS)
Weekday AM Peak Hour
2001 vs. 2010
2001
2010
LOS A - C
LOS D
LOS E
LOS F
N
Location Not Analyzed
2010 New Castle County Transportation Operations Management Plan (TOMP) and Performance Assessment
FIGURE 16
Weekday AM Peak Hour
Intersection LOS Comparison (CMS)
(2001 - 2010)
PREPARED FOR:
DELAWARE DEPARTMENT OF TRANSPORTATION
PREPARED BY:
UD-CADSR
SCALE:
NOT TO SCALE
BASE MAP SOURCE: ESRI Streets Base Map January 2010



2010 New Castle County Transportation Operations Management Plan (TOMP) and Performance Assessment

FIGURE 17

Weekday PM Peak Hour Intersection LOS Comparison (CMS) (2001 - 2010)

PREPARED FOR:
DELAWARE DEPARTMENT OF TRANSPORTATION

PREPARED BY:	SCALE:
UD-CADSR	NOT TO SCALE

BASE MAP SOURCE: ESRI Streets Base Map January 2010

3.2.3 Potential Improvements to Intersections with LOS D-F

Table 3.10 summarizes intersections analyzed as part of this assessment experiencing LOS D-F.

Table 3.10 – Intersections Experiencing LOS D-F in 2010

Int #	Intersection	2010 AM LOS	2010 PM LOS	Potential Improvement
1	Foulk Rd. & Silverside Rd.	B	D	Monitor for Deterioration
3	Newport Pike (DE-4) & DE-7	C	E	Possible Capital Improvements
5	DE-2 & Milltown Rd.	B	E	Possible Capital Improvements
6	DE-7 & Milltown Rd.	C	F	Revised Lane Configuration
8	DE-2 & DE-41	F	F	Revised Signal Phasing
22	US-202 & DE-92	B	D	Monitor for Deterioration
24	DE-4 & DE-7 (Near Churchmans)	A	D	Monitor for Deterioration
25	DE-2 & DE-7	D	E	Possible Capital Improvements
28	US-202 & Silverside Rd.	B	D	Monitor for Deterioration

The project team has taken a close look at each of these intersections' CMS analysis, for purpose of identifying relatively low-budget improvement projects that would have a positive effect on LOS. Examples include re-configuration of lane use (without necessitating roadway widening) and signal phasing revisions.

For the intersections of DE-7 & Milltown Road and DE-2 & DE-41, analyzed alternatives yielded improvements in LOS. These are described further in the following sections.

3.2.3.1 DE-7 & Milltown Road – Lane Configuration Recommendations

East-west through traffic has increased significantly at this intersection since 2001. In the westbound direction, there exists only one through lane to serve 1,313 vehicles in the peak hour, while there are two dedicated left-turn lanes to serve only 53 vehicles in the peak hour. CMS analysis confirms that if one of the dedicated left-turn lanes were changed to a through lane, thus providing two through lanes to serve the 1,313 vehicles in the peak hour, LOS would increase from F to D in the PM peak hour. The AM peak hour LOS would not be affected, according to CMS, as the WB through movement is not a critical movement – however the AM peak hour is already shown to operate at an acceptable level of service.

Two receiving lanes exist on the western leg of the intersection, which could accommodate the lane use change proposed above. The lanes merge into one shortly after the intersection; should these lane use changes be implemented, it is recommended that further analysis of the extension of the second receiving be included.

3.2.3.2 DE-2 & DE-41

This intersection currently operates as split phased in the northbound and southbound directions. Review of CMS analysis shows that if the northbound and southbound movements were phased concurrently, as are the eastbound and westbound directions, then LOS would increase from F to E in the AM and PM peak hours.

Several intersections were found to experience LOS D in the PM peak hour, while they experience LOS A or B in the AM peak hour. Since LOS D is only approaching unacceptable levels, and the AM peak hour LOS is healthy, capital improvements are not recommended at this time. However, these intersections should be closely monitored for future deterioration, at which point larger scale capital improvements may be necessary.

Several intersections experiencing LOS E-F were unable to show improvement through alternatives analyzed via CMS. This leads to the tentative conclusion that these intersections may be overwhelmed and may be candidates for larger scale capital improvements.

Chapter 4: Summary and Conclusions

This inventory of Delaware roadway segment and intersection analyses is expected to be utilized as a tool for identifying areas of the roadway network that can/should be improved. With pre-defined budgets for transportation infrastructure improvements, this document can certainly aid in the prioritization of projects to receive funding and can be referenced as a quantitative view of areas of the transportation network that need attention and the number of users that are affected.

Control counts collected by FHWA vehicle classification as part of this effort can also be used by transportation planners. One of the many relevant planning applications of this data is for updating and validating travel demand models. Intersection analysis can be referenced for prioritizing traffic signal optimization projects.

The following presents key findings from the 2010 TOMP data collection and analysis program as well as lessons learned during the experience.

4.1 Roadway Segment Analysis Assessment

Overall, the 31 roadway segments analyzed both in 2001 and 2010 in New Castle County have shown a 6% increase in 2010, considering combined ADT at all these locations. While some segments were subject to moderate to significant ADT increases, these were somewhat balanced out by those segments that were subject to moderate to significant ADT decreases.

The 85th percentile speeds along these roadway segments have not shown a significant change since 2001.

New Castle County **freeway** segments are operating at mostly acceptable levels. A specific area to monitor closely in the near future is I-95 between the DE-273 and DE-141 interchanges, as analysis resulted in 2010 LOS of D and E in specific instances (currently, major interchange improvements are being constructed on this section of I-95). WILMAPCO is currently developing a special I-95 Operations Monitoring report, due to be complete in Spring 2012 and updated annually.

Several of the **arterial** highways, coupled with one **multi-lane** highway segment, assessed are experiencing LOS D-F, most of which have deteriorated since 2001. Traffic signal timing directly affects LOS along these segments; these corridors are recommended for traffic signal timing optimization and coordination review as a relatively low-budget approach to improving operations, compared to relatively high-budget capital improvements.

Each of the two-lane highways assessed is experiencing LOS D-F, which has not changed from 2001. For two-lane highway performance analysis, LOS results are a function of volume, speed, and the ability to pass. Even though volume along these two-lane roadway segments may not be excessive, a combination of lower speed limit and high percentage of no-passing zones along a segment produces poor levels of service in analysis. The segments with unacceptable level of service warrant an individual in-depth assessment to

determine location specific improvements like modification of no-passing zones and elimination of vertical and horizontal sight distance issues.

4.2 Intersection Analysis Assessment

Analysis for 31 signalized intersections was performed as part of this assessment using DelDOT's Critical Movement Summation (CMS) method. This method differs from the Highway Capacity Manual's method of assigning intersection LOS in that, instead of basing LOS on vehicle delay through the intersection, the CMS method bases LOS on the volume of critical movements. This allows for an assessment of a signalized intersection's "potential" to serve its demand during high volume peak hours. An intersection's lane use configuration, signal phasing, cycle length, and green-time allocation can be modified/optimized to maximize the ability of the signalized intersection to meet its demand. In turn, the CMS LOS analysis can be used as a tool to identify which intersections may be in need of retiming:

- An intersection that is qualitatively perceived as a problem intersection by users, but has an acceptable CMS LOS is a good candidate for signal retiming/corridor coordination.
- An intersection with unacceptable CMS LOS should be evaluated for lane improvements such as restriping or additional capacity.

Several intersections experience LOS D-F in either the AM or PM peak hour. These intersections are mostly confined within the Pike Creek Area of New Castle County. They are:

- Foulk Rd. & Silverside Rd.
- Newport Pike (DE-4) & DE-7
- DE-2 & Milltown Rd.
- DE-7 & Milltown Rd.
- DE-2 & DE-41
- US-202 & DE-92
- DE-4 & DE-7 (Near Churchmans Rd.)
- DE-2 & DE-7
- US-202 & Silverside Rd.

These intersections are discussed in the body of this report and are recommended for detailed traffic studies and possibly capital improvements.

4.3 TOMP and Transit (DART)

This assessment reviewed DART bus routes in relation to roadway segment and intersection level-of-service. Roadway segments and intersections identified with operational and performance issues impact the DART bus system in the same manner as they impact automobile mode since these roads are shared by all vehicular modes. As project prioritization is planned in the future, consideration should be given to those segments and intersections which have direct impact on DART operation to promote transit efficiency.

Table 4.1 and 4.2 summarize the DART bus routes that are directly affected by roadway segments and intersections, respectively, experiencing LOS D or worse.

Table 4.1 – DART on Roadway Segments Experiencing LOS D-F

Segment Description	DART Bus Route	Peak Hour with LOS D or Worse
I-95 From DE-273 to DE-1/DE-7	16,33,34,39,40,41,42,54,55,59,301	NB/EB AM
I-95 From DE-1/DE-7 to DE-58	16,33,34,39,40,41,42,54,55,59,301	NB/EB AM, NB/EB PM
I-95 From DE-58 to DE-141	16,33,34,39,40,41,42,54,55,59,301	NB/EB AM, SB/WB AM, SB/WB PM
DE-52 From Hillside Rd. to Campbell Rd.	10	SB/WB PM
DE-4 From DE-273 to DE-7	5,33,39,62,63	NB/EB PM
DE-141 From Commons Blvd. to US-13	15	SB/WB PM
DE-4 From DE-896 to DE-273	33,39,55	SB/WB PM
DE-273 From I-95 to Old Baltimore Pike	23,34	NB/EB PM, SB/WB AM, SB/WB PM
DE-273 From Prangs Rd. to Pleasant Dr.	22,27	SB/WB PM
DE-2 From Milltown Rd. to St. James Church Rd.	6,36	SB/WB AM, SB/WB PM
US-13 From US-13/US-40 Split to Hamburg Rd.	25	NB/EB AM, SB/WB PM
DE-299 From Broad St. to DE-1	43	NB/EB AM, NB/EB PM, SB/WB AM, SB/WB PM
DE-41 From PA Line to Old Lancaster Pike	20	NB/EB AM, NB/EB PM, SB/WB AM, SB/WB PM

Table 4.2 – DART at Intersections Experiencing LOS D-F

Intersection Description	DART Bus Route	Peak Hour with LOS D or Worse
Foulk Rd. & Silverside Rd.	21	PM
Newport Pike (DE-4) & DE-7	5 30	PM
DE-2 & Milltown Rd.	6,36	PM
DE-7 & Milltown Rd.	19,30,36	PM
DE-2 & DE-41	6,19,36	AM,PM
US-202 & DE-92	2,35,61	PM
DE-4 & DE-7 (Near Churchmans Rd.)	5,62	PM
DE-2 & DE-7	6,19,30	AM,PM
US-202 & Silverside Rd.	2,35	PM

4.4 Lessons Learned

The following presents several lessons learned by the project team in the completion of this report.

4.1.1 Data Collection Period

While the 2001 Data Collection Study collected intersection turning movement counts for a period of consecutive twelve hours, the 2010 TOMP study focused on AM and PM peak periods only to analyze worse case conditions with an intention to make maximum utilization of the recent available data from various sources like DelDOT and WILMAPCO. Through the analysis process it was determined that while midday peak period may not be worse compared to PM peak period, data collection for midday peak should be included in future efforts to facilitate creation of time-of-day specific signal timing plans.

4.1.2 Effective Use of Real-Time Data

With expansion of real-time traffic monitoring device coverage across the county, this important information source should be effectively tapped to compile traffic data in appropriate formats which will significantly reduce the need for new data collection in future. The 2010 TOMP study effectively used data from Wavetronix detectors to conduct freeway performance analysis. DelDOT's "Integration of Operations and Planning" committee has recently been tasked with developing method to capture truck percentages with Wavetronics detectors, which will make the real-time data even more useful in a study like this.

4.1.3 Multi-Modal Focus

The stakeholder committee for the 2010 TOMP Study provided a confirmation that Transportation Operations Management should have a multimodal focus. While the 2010 TOMP Study went a step forward (compared to the 2001 Data collection Study) to include correlation between transit routes (DART) and infrastructure performance, future efforts should continue to consider performance criteria and operational strategies to benefit transit as well as other modes like bicycles and pedestrians.

4.1.4 Intersection Analysis Methodology

To facilitate comparison of intersection performance between 2001 and 2010, the 2010 TOMP Study utilized the CMS method to conduct LOS analysis for signalized intersections. The stakeholder committee for the 2010 TOMP Study provided feedback that in future HCS may be an additional assessment option to use for intersection analysis to understand the complete picture, with an intersection delay assessment.