Traffic Quality on the Metropolitan Washington Area Freeway System

Spring 2014 Report

Prepared by
Skycomp, Inc. (Columbia, Maryland)

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DRAFT

NATIONAL CAPITAL REGION TRANSPORTATION PLANNING BOARD
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Skycomp

ABSTRACT

TITLE: Traffic Quality on the Metropolitan Area Freeway System, Spring 2014 Report

DATE: TBD

AGENCY: The Metropolitan Washington Council of Governments is the regional planning organization of the Washington area's major local governments. COG works on finding solutions to regional problems, especially those related to regional growth, transportation, housing, human services, and the environment.

ABSTRACT: This report presents findings of the Spring 2014 survey of the metropolitan Washington region's limited access highway system. The findings include the system performance represented by levels of service and the changes to the system performance over time by comparing the 2014 results with 1993, 1996, 1999, 2002, 2005, 2008 and 2011 survey data.

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EXECUTIVE SUMMARY

Findings of the FY 2014 Freeway Congestion Monitoring Program (SKYCOMP aerial survey)

The number of lane miles of congestion (level-of-service F) in the region in 2014 was slightly less than that recorded during the 2011 survey.

2014 (2249 congested lane miles)

2011 (2369 congested lane miles)

Improvements

There were two major capacity increases to the highway system since the 2011 aerial survey.

The completion of the Intercounty Connector (ICC) linking Prince George's County and Montgomery County provided an alternate east-west route for commuters. Levels-of-service A and B were documented on the ICC throughout the morning and evening survey periods.

On I-495 in Virginia, the HOV/HOT facility between the I-95/395 and VA 267 Interchanges was completed. This four-lane facility for the most part operated at levels of service A and B. Commuters in the non-HOV/HOT lanes appeared to benefit to some degree as an improvement in levels of congestion along the corridor were documented. In the evening, conditions on the outer loop along this corridor resembled those documented during the 2008 survey before construction began; severe congestion and extensive delays were found here during the 2011 survey while under construction.

Degradations

Degraded levels of service were found on several of the major facilities during the morning and evening commuter periods. In most cases, the primary cause was likely an increase in the volume of traffic.

Morning / I-495 (Beltway)

Traffic congestion on the northwest west side of the Beltway (Inner Loop) traveling from Virginia into Maryland was more severe; one factor contributing to the degradation was the left-side merge associated with the termination of the Beltway's HOV facility downstream of VA 267. Another significant increase in congestion on the Beltway was renewed congestion found on the Inner Loop in Maryland approaching to the rebuilt Woodrow Wilson Bridge; however, the level of service tables on page 106 show less severe congestion in 2014 vs. historical levels, likely resulting in reduced travel times. Note: Congestion was not found along this section of the Inner Loop during the 2011 aerial survey (see level-of-service table on page 106).

Morning / MD 295, DC 295

A significant decrease in levels of service was found in the southbound direction on DC/MD 295 between Bladensburg and the Anacostia River crossing at Pennsylvania Ave. Improved flow along this section of DC 295 was documented in the 2011 report (attributed to completed construction improvement projects); the 2014 findings show the return of level-of-service F conditions for each of the 3-hours surveyed.

Evening / I-495 (Beltway)

A new zone of congestion was found on the outer loop of the Beltway in Prince George's County, Maryland. After crossing into Maryland on the Woodrow Wilson Bridge, traffic flowed freely until encountering congestion in the vicinity of St Barnabas Rd; congestion typically persisted 4-6 miles downstream to MD 4 (Pennsylvania Ave).

Evening / I-95 Virginia

A significant degradation of level of service on I-95 in Virginia was documented during the evening surveys in 2014. This may have been partly attributable to a construction zone where the HOV facility was being extended from Dumfries Blvd to Garrisonville Rd (approximately 10 miles); while all lanes were open during the evening commuter period, the presence of Jersey Barriers may have exacerbated the congestion. Farther south in Stafford County, recurring congestion on the approach to the Rappahannock River increased in both severity and extent since the 2011 survey.

Note

Historically, the aerial survey program conducted every three years since 1993 included four morning and four evening flights covering each of the roadways in the region. In 2014 it was decided to allocate some resources to conduct a pilot study of selected locations in the region using Skycomp's WAV (wide area video) service. As a result, coverage of the highway system in 2014 included three morning and three evening flights.

TABLE OF CONTENTS

Chapter I

Introduction

a. BACKGROUND

The purpose of this ongoing mobility-monitoring program is to rate the performance of the regional Washington, D.C. highway system on a recurring basis, and provide the information it produces to regional planners, stakeholders, and decision-makers. This initiative began in the spring of 1993, at which time approximately 300 centerline miles of limited-access highway in the Washington, D.C. metropolitan area was surveyed. Coverage was repeated every three years (1996, 1999, 2002, 2005, 2008 and 2011), leading to an identification of locations experiencing both improved and degraded mobility. Most recently, coverage of the regional network was repeated in the spring of 2014. This document presents the findings of this last survey.

b. FEATURES OF THE AERIAL SURVEY PROGRAM

The aerial survey methodology takes advantage of the mobility and vantage point of fixed-wing aircraft, permitting data collection across a large highway network that would not be affordable using traditional ground-based survey methods. During the survey flights, overlapping photographic coverage was obtained of each designated highway, repeated once an hour over three morning and three evening commuter periods (this means that, altogether, there were 9 morning and 9 evening observations of each highway segment). The morning times of coverage were 6:00-9:00 a.m. outside the Capital Beltway and 6:30-9:30 a.m. inside the Capital Beltway. The evening times were 4:00-7:00 p.m. inside the Capital Beltway and 4:30-7:30 p.m. outside the Capital Beltway. Survey flights were conducted on weekdays, excluding Monday mornings, Friday evenings and mornings after holidays. Data were extracted from the aerial photographs to measure average recurring daily traffic conditions by link and by time period. Products of the aerial survey program include:

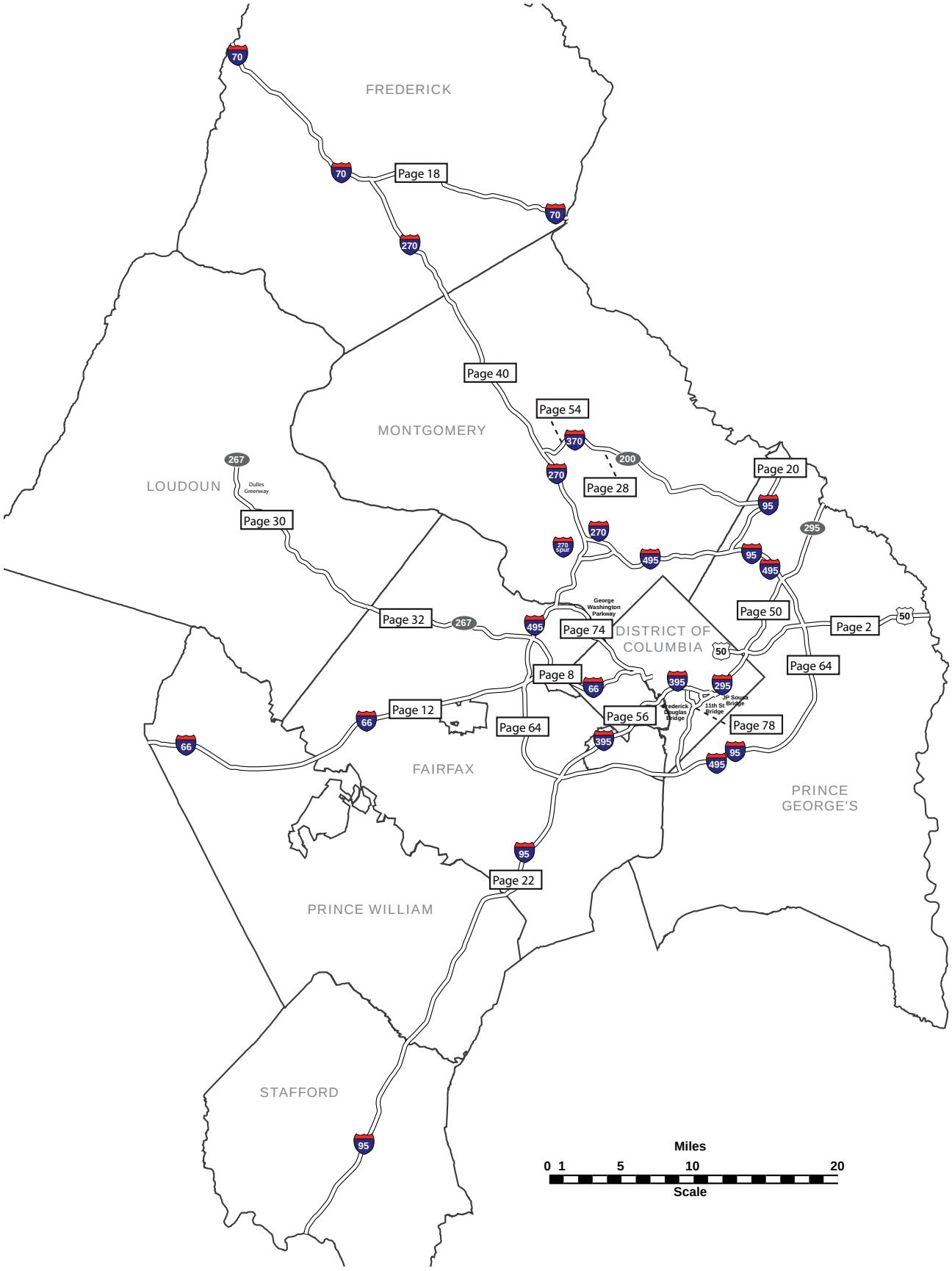
c. SURVEY DATABASE

A primary task for this project is to produce a 2014 Survey Database (built in the Microsoft Access format). This database contains all of the data collected from the 2014 aerial survey, from vehicle counts and road segmentation parameters to survey flight records.

d. PHOTO MATRIX

Another primary task is to assemble a photo matrix that includes all photography from the 2014 survey and the previous survey in 2011. The photo matrix is organized by highway, date and time. In the “pass” mode, the user can advance through overlapping photographs of any highway in the system. At any desired location on a highway, the user can switch to the “site” mode that allows viewing of the same location each and every time it was photographed over the two surveyed years (approximately 42 times).

Map of Surveyed Highways, Spring 2014



Chapter II

Report Layout

Traffic Quality on the Metropolitan Washington Area Freeway System, Spring 2014 report is made up of six chapters and three appendices.

Chapter I provides a background of the aerial survey program and discusses the features of the program.

Chapter II (this chapter) discusses the layout of the report.

Chapter III provides details of individual route levels of service along with narratives of congestion found on the freeway system. For segments with congested conditions, the severity of the congestion is indicated by density of traffic in passenger cars per lane per mile.

Chapter IV of the report provides the following information: 1) 2014 top 10 congested locations in terms of density; 2) a performance metric that indicates the top 5 corridors with the longest delay; and 3) a comparison of lane mile hours at LOS F by facility. Note: The 2011 top 10 congested locations and top 5 congested corridors are presented in Appendix C for reference.

Chapter V provides level-of-service and congestion summaries for the AM and PM peak periods as well as hourly displays for each of the survey periods.

Chapter VI discusses changes to the system over time by comparing 2014 data with prior years' survey data.

Appendix A discusses the methodology used for estimating level of service based on the highway capacity manual (HCM).

Appendix B documents the use of the locally calibrated Van Aerde model used to develop speed estimates from densities.

Appendix C presents graphics for the 2011 top 10 congested locations and top 5 congested corridors.

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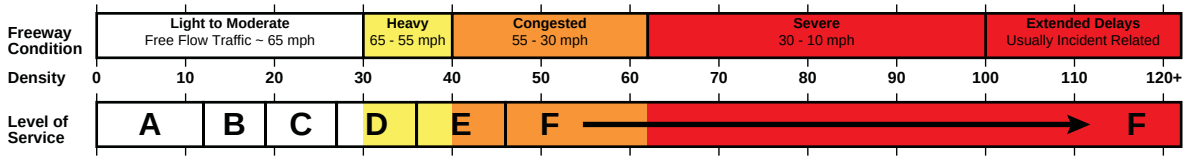
Chapter III

Metropolitan Washington Area Surveyed Highways - Spring 2014

Traffic Quality Rating Tables

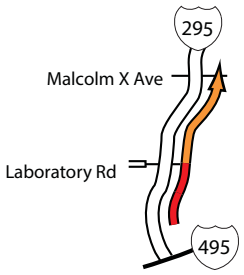
The following pages contain morning and evening traffic quality rating tables for all highways surveyed in the spring of 2014. Traffic quality ratings are presented by segment, hour and direction. Each rating is a composite reflecting all ratings for that hour – usually three –derived from survey flights on three different days, except that ratings affected by incidents or other unusual events were segregated and excluded from consideration.

Traffic Quality Ratings:



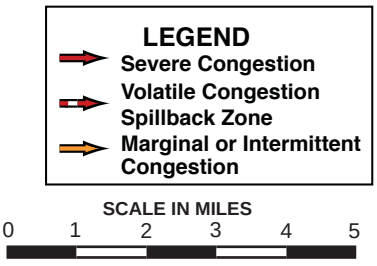
Congested Locations

Each level-of-service table includes arrowheads that depict locations where congestion was found. A narrative that clarifies the frequency and severity of the congestion accompanies each arrowhead; where evident, apparent causes of the problems are also described. See example below:



I-295 / D.C. 295 / Baltimore-Washington Parkway (Morning)

F
Congestion Type: Mainline Congestion
Frequency: Between 7:00 and 8:00 a.m.
Direction: Northbound
Location: Between I-495 and Malcolm X Ave
Queue Length: 2 to 3 miles
Estimated Speed: 30 to 50 mph
Note: The primary bottleneck was the series of lane drops (4 lanes to 3 and 3 lanes to 2) at the Laboratory Rd interchange.



A scale accompanies each rating table in this section of the report.

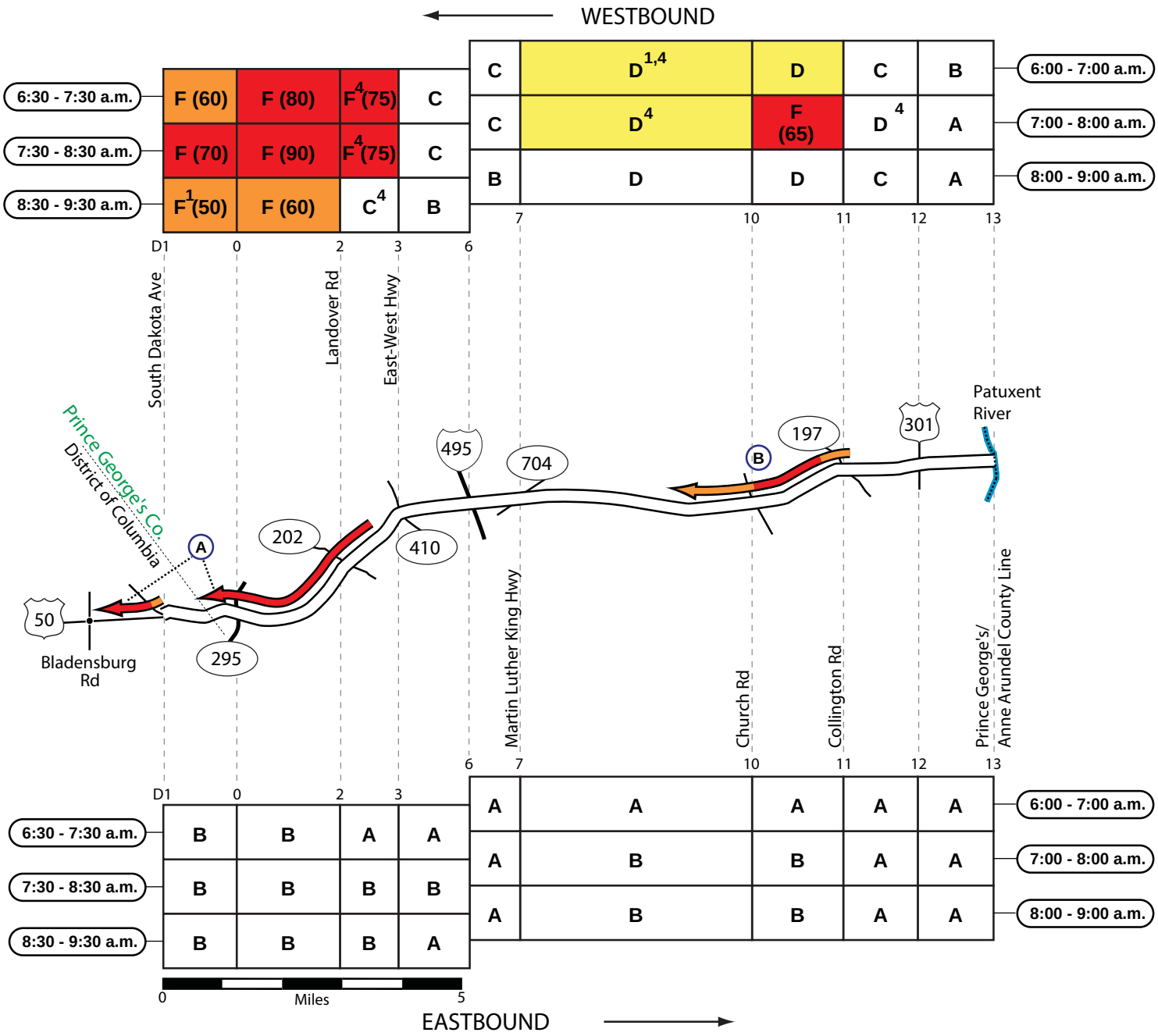
Nested Congestion

Level-of-Service data for some highway segments represent the mathematical average of densities that varied widely; these data have been tagged with a superscript number in the LOS tables. Four types of "nested" congestion that contributes to the variability have been identified as follows:

Descriptions

Type 1 - Congestion present on some days, but not others.
Type 2 - Congestion more severe in left or right-hand lanes.
Type 3 - Congestion present only in the first or second half-hour (hourly averages).
Type 4 - The length of the congested zone within the segment varies.

US 50 (Maryland) - Morning



Traffic Quality Rating

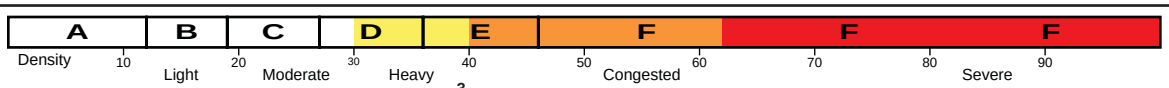
A	B	C	D	E	F	F	F
Density 10	20	30	40	50	60	70	80	90
Light	Moderate	Heavy	Congested	Severe

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

US 50 (Maryland) - Morning

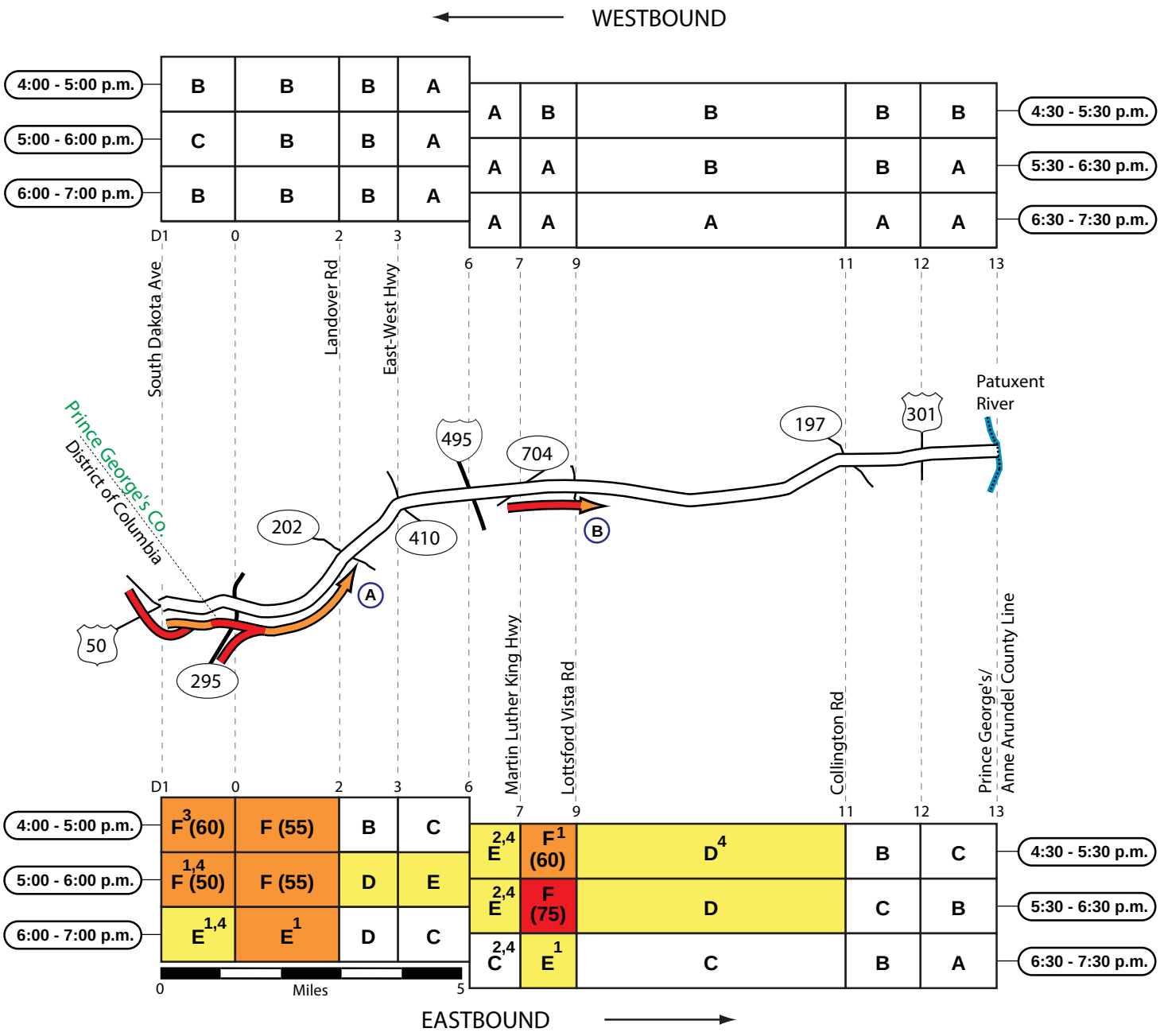
A
Congestion Type: Mainline Congestion
Frequency: All observations during the morning survey period
Direction: Westbound
Location: Between MD 410 (East-West Hwy) and Bladensburg Rd
Queue Length: 3 to 6 miles
Estimated Speed: 15 to 40 mph
Note: Traffic entering from the ramps at MD 202 and MD 295 appeared to exacerbate the congestion. During the peak period, congestion approaching the signal at Bladensburg Rd extended all the way back to the interchange at South Dakota Ave.

B
Congestion Type: Mainline Congestion
Frequency: Most observations before 8:00 a.m.
Direction: Westbound
Location: Between MD 197 and the start of the HOV facility
Queue Length: 1 to 2 miles
Estimated Speed: 30 to 50 mph
Note: Factors contributing to the congestion included: 1) traffic entering the mainline from MD 197; 2) HOV users from MD 197 weaving across three lanes to access the HOV facility; 3) the lane drop (4 lanes to 3) at the start of the HOV facility.



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

US 50 (Maryland) - Evening



Traffic Quality Rating: A B C D E F F F

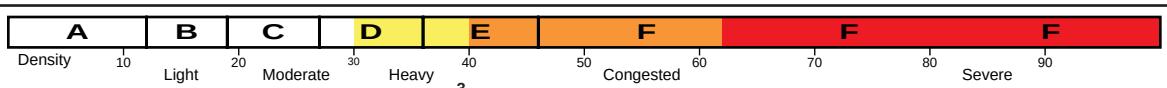
Density: 10 Light, 20 Moderate, 30 Heavy, 40 50 Congested, 60 70 80 Severe, 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

US 50 (Maryland) - Evening

A
Congestion Type: Mainline Congestion
Frequency: Throughout the evening survey period
Direction: Eastbound
Location: Between South Dakota Ave and MD 202
Queue Length: 2 to 4 miles
Estimated Speed: 25 to 50 mph
Note: Congestion was caused or exacerbated by the merging associated with the South Dakota Ave, MD 295 and MD 202 interchanges; traffic flow consistently improved east of MD 202 where the roadway widened from 2 to 3 lanes. Congestion on the South Dakota Ave entrance ramp was particularly severe; the ramp queue typically extended back into the mainline on South Dakota Ave.

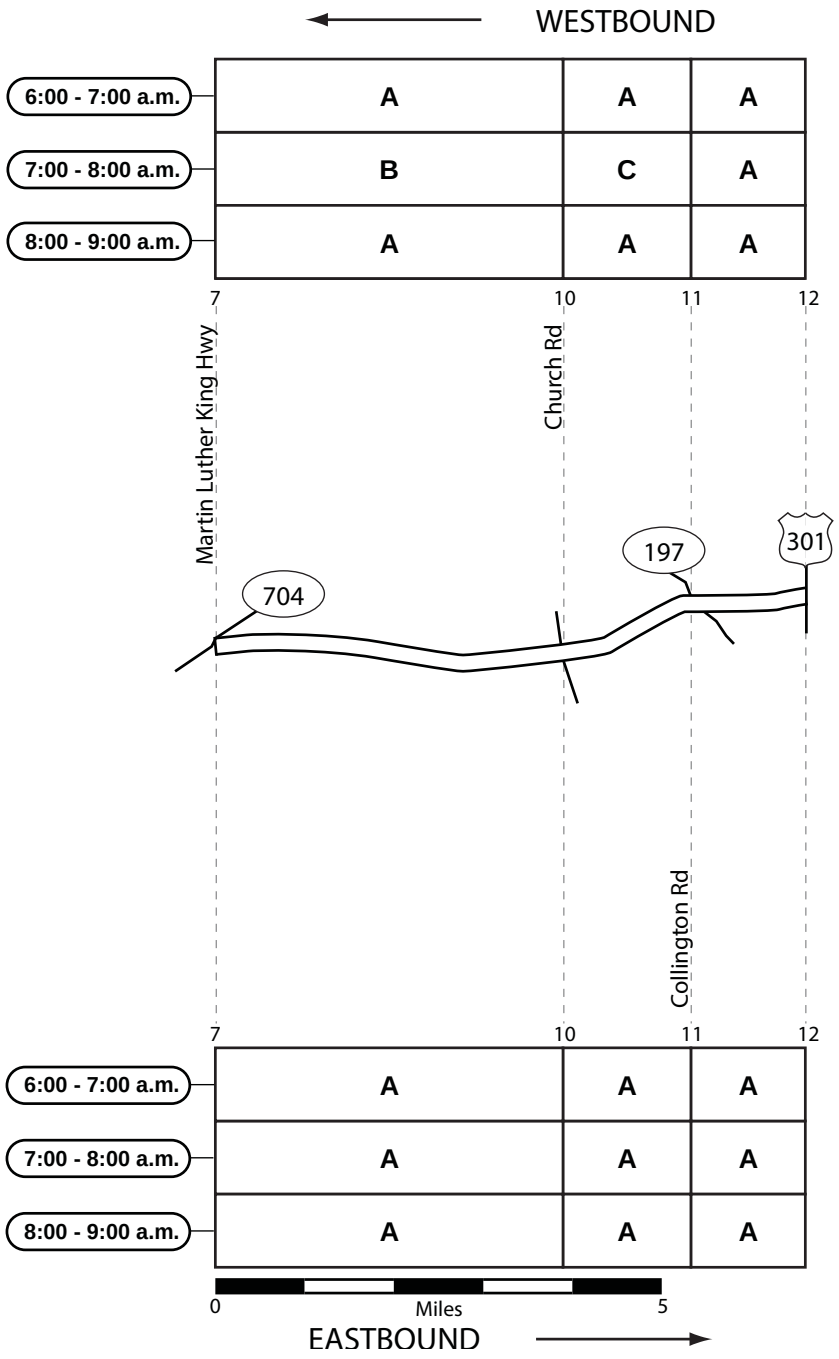
B
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Eastbound
Location: Between I-495 and the lane drop at Lottsford Vista Rd
Queue Length: 1 to 2 miles
Estimated Speed: 20 to 30 mph
Note: The primary bottleneck was found at the lane drop (4 lanes to 3) at the Lottsford Vista Rd overpass; traffic entering from MLK Hwy also appeared to exacerbate the congestion.



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

US 50 HOV (Maryland) - Morning

HOV OPERATIONS
HOV 2
24 HOUR



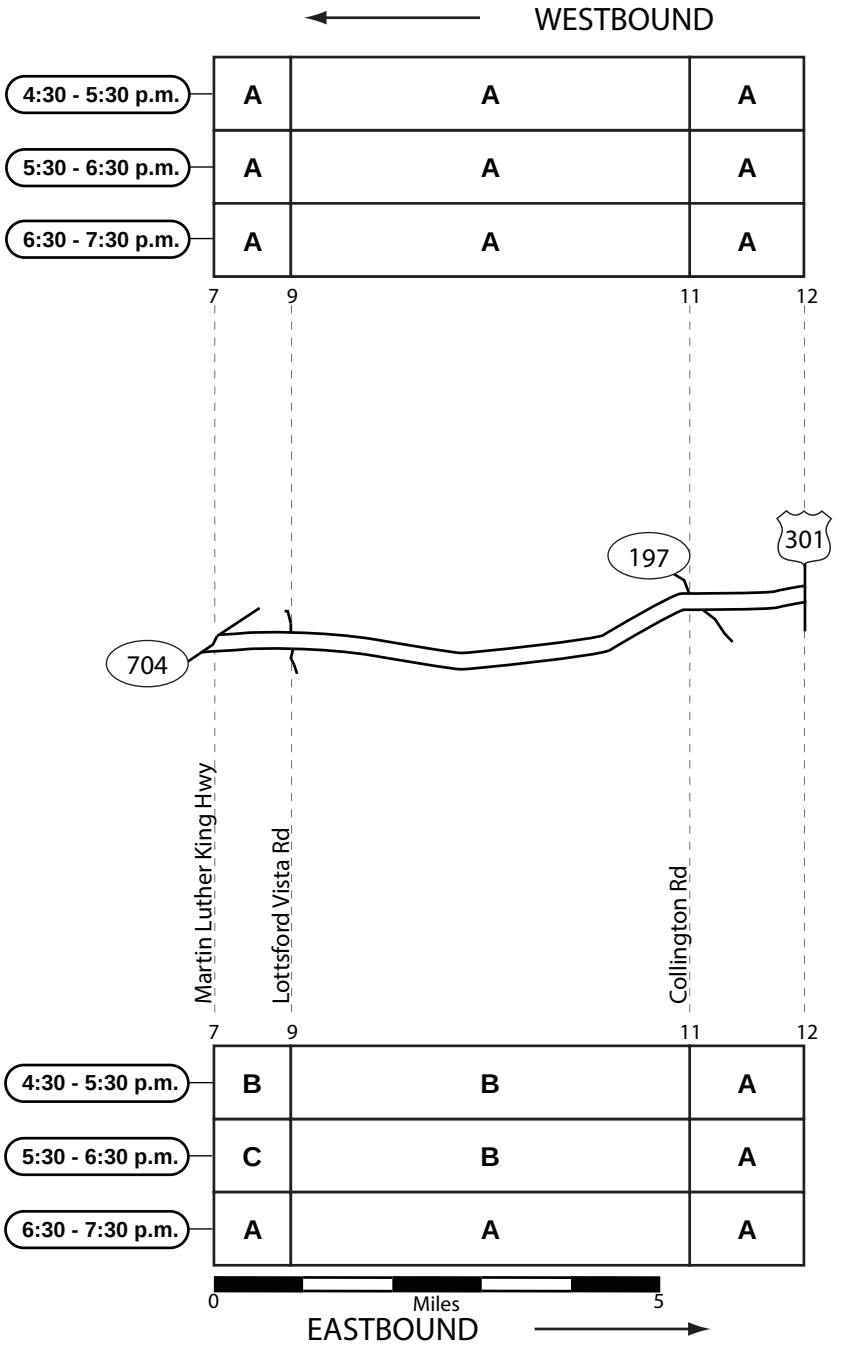
Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

US 50 HOV (Maryland) - Evening

HOV OPERATIONS
HOV 2
24 HOUR



Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
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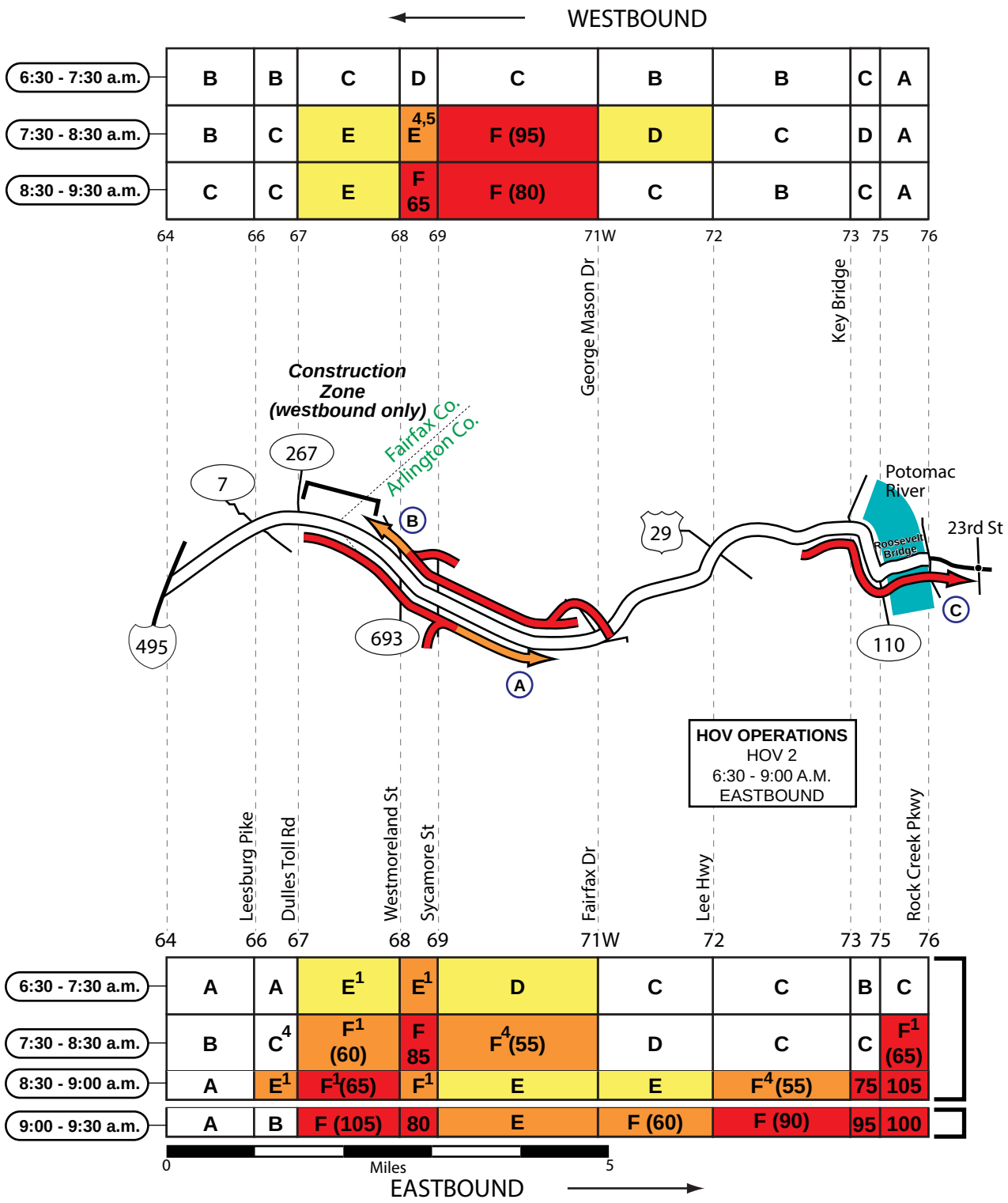
I-66 Inside Beltway (Virginia) - Morning



Traffic Quality Rating

A	B	C	D	E	F	F	F

Density 10 20 30 40 50 60 70 80 90
Light Moderate Heavy Congested Severe

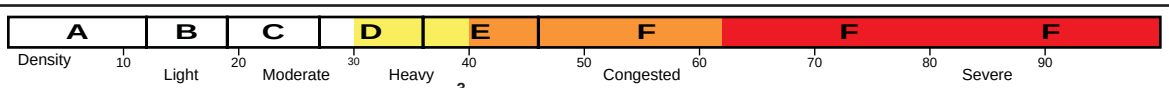
Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-66 Inside Beltway (Virginia) - Morning

A
Congestion Type: Mainline Congestion
Frequency: Most observations after 7:30 a.m.
Direction: Eastbound
Location: Between VA 267 & George Mason Dr / Fairfax Dr
Queue Length: 2 to 4 miles
Estimated Speed: 15 to 50 mph
Note: After 7:30 a.m., moderate to severe eastbound congestion was consistently found on I-66 between VA 267 and George Mason Dr; factors that contributed to the congestion included; 1) the lane drop (3 lanes to 2) at US 29; 2) traffic entering the mainline from Sycamore St; 3) sun glare.

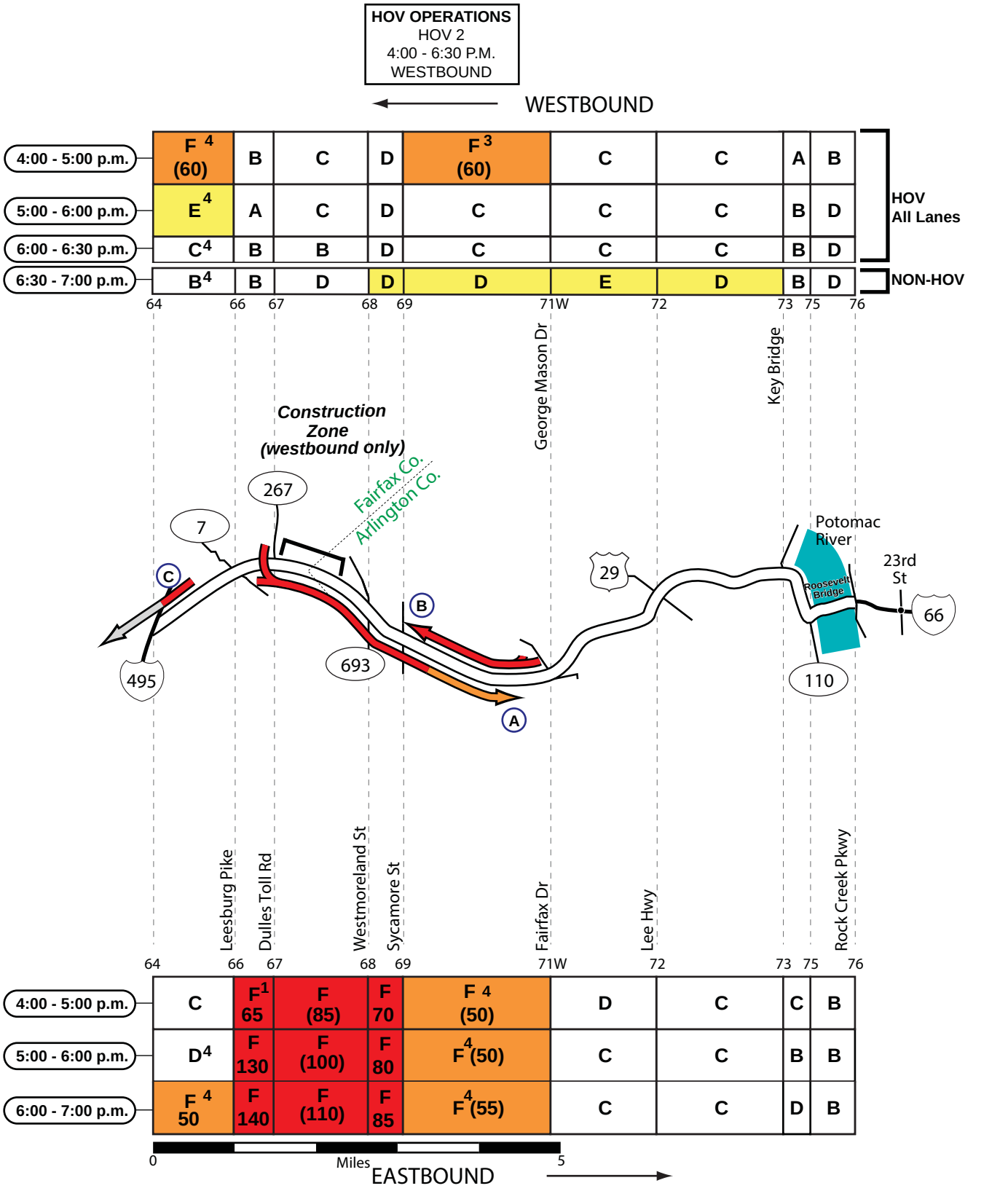
B
Frequency: Most Observations after 7:30 a.m.
Direction: Westbound
Location: Between Fairfax Dr & Westmoreland St
Queue Length: 2 to 3 miles
Estimated Speed: 20 to 50 mph
Note: Westbound congestion on I-66 typically developed after 7:30 a.m.; traffic entering at Washington Blvd and Fairfax Dr / 25th St contributed to the congestion. Westbound congestion was also found in the auxiliary lane between Fairfax Dr and Sycamore St.

C
Congestion Type: Mainline Congestion
Frequency: Most observations after 7:30 a.m.
Direction: Eastbound
Location: Lee Hwy (US 29) and the Roosevelt Bridge
Queue Length: 1 to 1.5 miles
Estimated Speed: 20 to 40 mph
Note: Severe eastbound congestion was found on I-66 approaching the Potomac River crossing at the Roosevelt Bridge; factors contributing to the congestion included: 1) traffic entering from the local streets in Rosslyn; 2) heavy traffic from Arlington Blvd merging onto the bridge span. Eastbound congestion persisted across the Roosevelt Bridge and into Washington D.C.



Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

I-66 Inside Beltway (Virginia) - Evening



Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

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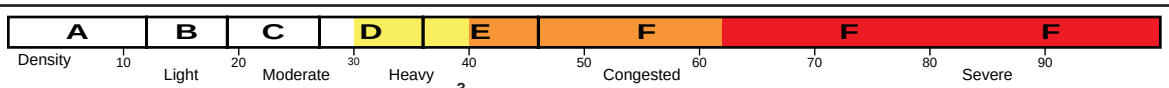
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-66 Inside Beltway (Virginia) - Evening

A
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Eastbound
Location: Between VA 7 and Fairfax Dr
Queue Length: 3 to 4 miles
Estimated Speed: 15 to 50 mph
Note: As was found during previous surveys, severe eastbound congestion persisted on I-66 throughout most of the evening survey period; factors contributing to the congestion included: 1) traffic entering at VA 267 and Sycamore St; 2) the lane drop (3 lanes to 2) at the 25th St Interchange.

B
Congestion Type: Mainline Congestion
Frequency: Early in the evening commuter period
Direction: Westbound
Location: Between George Mason Dr & Sycamore St
Queue Length: 1.5 to 2 miles
Estimated Speed: 25 to 45 mph
Note: Shortly after HOV restrictions begin (4:00 p.m.), westbound congestion was found on I-66 between George Mason Dr and Sycamore St; vehicles entering the thru-lanes from the auxiliary lane along this section of I-66 may have contributed to the congestion.

C
Congestion Type: Mainline Congestion
Frequency: During most observations
Direction: Westbound
Location: Between VA 7 and I-495 (Beltway)
Queue Length: 0.5 to 1 mile
Estimated Speed: 10 to 25 mph
Note: The degree of congestion inside the Beltway was directly related to the severity of westbound congestion on I-66 outside the Beltway; at its maximum observed extent, the queue extended most of the way back to the VA 7 Interchange.



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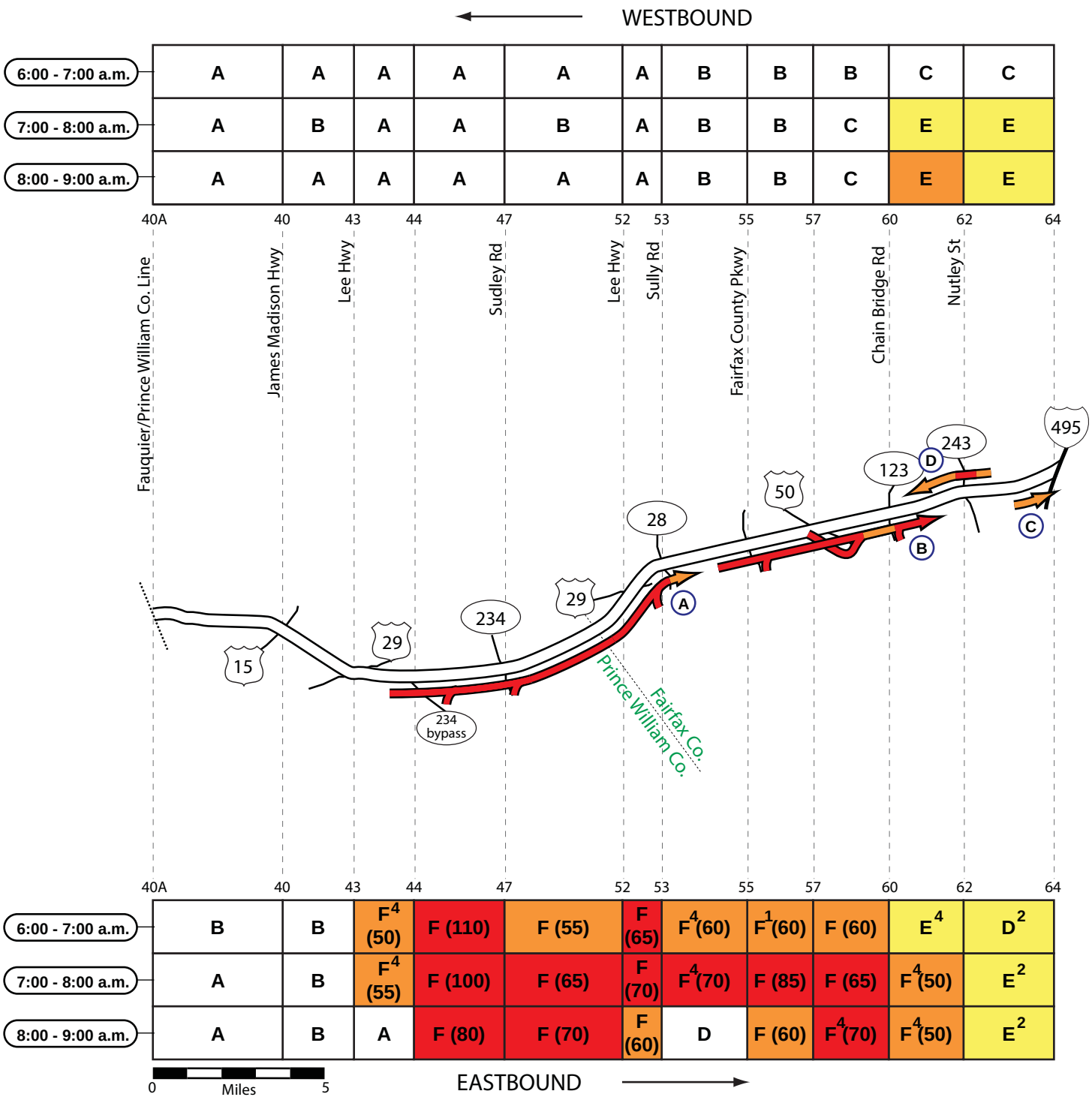
I-66 Outside Beltway (Virginia) - Morning



Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

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[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

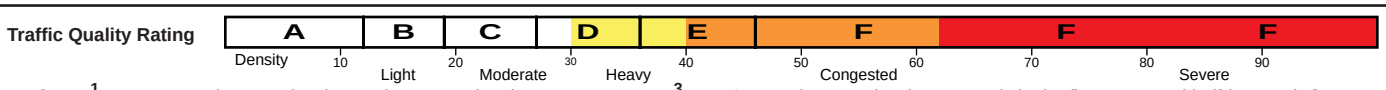
I-66 Outside Beltway (Virginia) - Morning

A
Congestion Type: Mainline Congestion
Frequency: Throughout the morning survey period
Direction: Eastbound
Location: Between VA 234 Bypass and VA 28 (Sully Rd)
Queue Length: 7 to 9 miles
Estimated Speed: 15 to 25 mph
Note: Eastbound congestion along this section of I-66 was exacerbated by traffic entering the mainline at VA 234 Bypass, VA 234 and US 29.

B
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Eastbound
Location: Between VA 28 & Nutley St
Queue Length: 7 to 9 miles
Estimated Speed: 15 to 45 mph
Note: This zone of congestion on I-66 was likely exacerbated by weaving on the approach to the Nutley St Interchange (Metro service begins at Nutley St); traffic entering at Fairfax County Parkway, US 50 and Chain Bridge Rd also contributed to the congestion. East of Nutley St, vehicles consistently resumed free flow speeds.

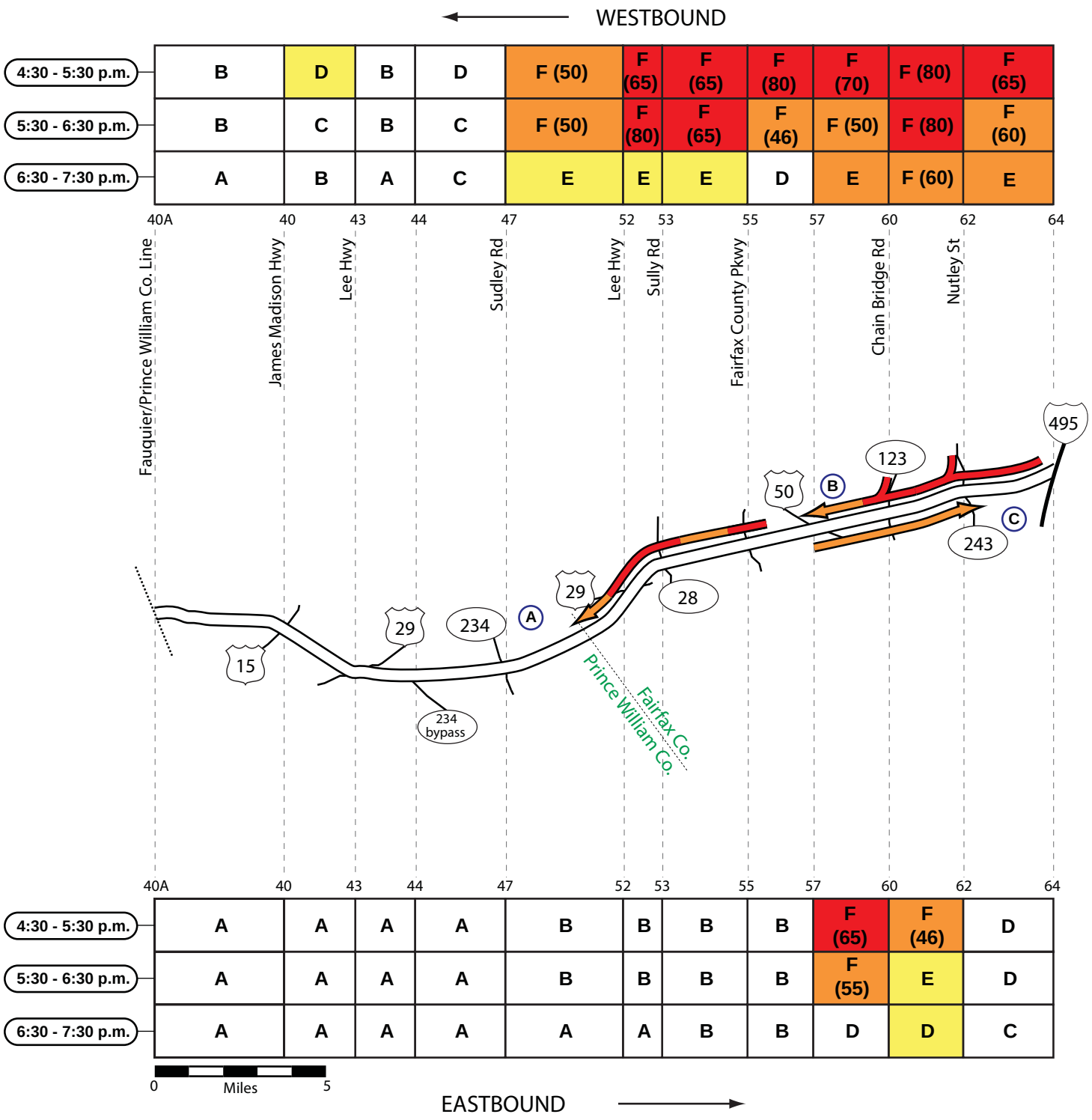
C
Congestion Type: Mainline Congestion
Frequency: Between 7:00 and 8:30 a.m.
Direction: Eastbound
Location: Approaching the I-495 Interchange
Queue Length: 0.5 miles
Estimated Speed: 30 to 40 mph
Note: The short zone of congestion approaching I-495 was primarily limited to the right lanes on I-66 (vehicles accessing the outer loop ramp). Vehicles continuing straight on I-66 or going north on the Beltway Inner loop appeared to experience little or no delay.

D
Congestion Type: Mainline Congestion
Frequency: Between 7:30 and 9:00 a.m.
Direction: Westbound
Location: Vicinity of Nutley St
Queue Length: 1 to 2 miles
Estimated Speed: 20 to 40 mph
Note: Westbound congestion found in the vicinity of Nutley St appeared to be caused by traffic entering the mainline from the divided roadway one-half mile west of the Nutley St overpass. Intermittent stop-and-go conditions were found within this congested zone.



Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

I-66 Outside Beltway (Virginia) - Evening



Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

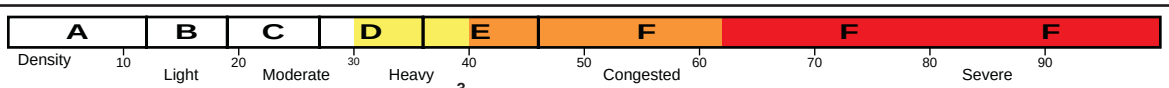
Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-66 Outside Beltway (Virginia) - Evening

A
Congestion Type: Mainline Congestion
Frequency: All observations before 6:30 p.m.
Direction: Westbound
Location: Between US 50 & Sudley Rd (SR 234)
Queue Length: 8 to 10 miles
Estimated Speed: 20 to 50 mph
Note: Severe westbound congestion was typically found in the vicinity of Fairfax County Parkway and Sully Rd where heavy traffic on the entrance ramps merged into the mainline.

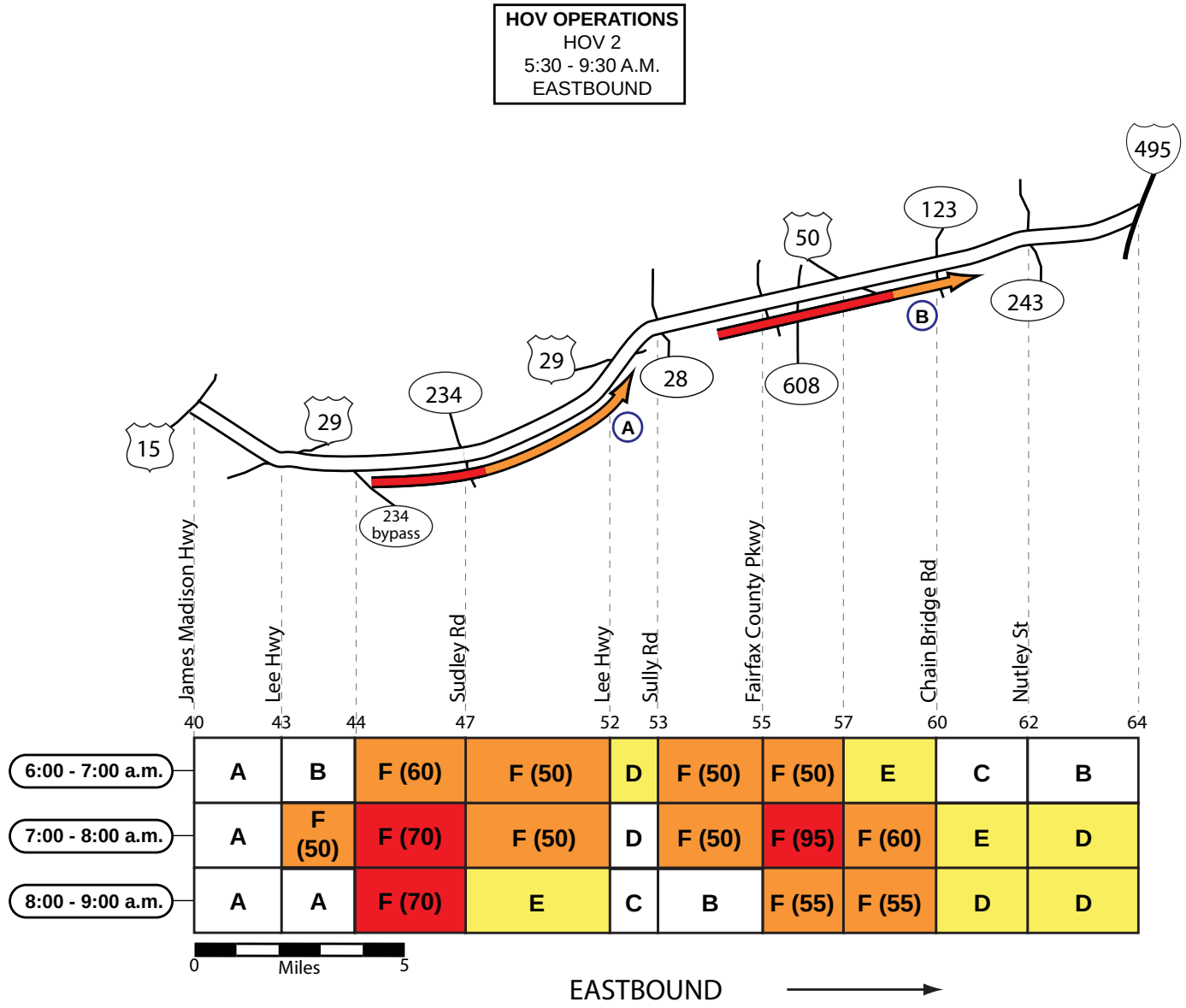
B
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Westbound
Location: Between I-495 & US 50
Queue Length: 4 to 6 miles
Estimated Speed: 20 to 50 mph
Note: The tail of the queue on westbound I-66 was typically found in the vicinity of the I-495 interchange (during several observations the queue extended back a short distance inside the beltway); congestion was particularly severe in the vicinity of the Nutley St and Chain Bridge Rd interchanges where traffic entered the mainline. Westbound travelers typically resumed free flow speeds for a short distance approaching the interchange at US 50; vehicles exiting into the auxiliary lane prior to US 50 may have contributed to the improved flow.

C
Congestion Type: Mainline Congestion
Frequency: Most observations between 4:30 and 6:30 p.m.
Direction: Eastbound
Location: Between US 50 and Nutley St
Queue Length: 1 to 3 miles
Estimated Speed: 30 to 50 mph
Note: Eastbound congestion along this section of I-66 appeared to be caused by traffic entering at the US 50 Interchange (2 lane entrance ramp) and the lane drop (4 lanes to 3) at the service road at the Vienna Metro.



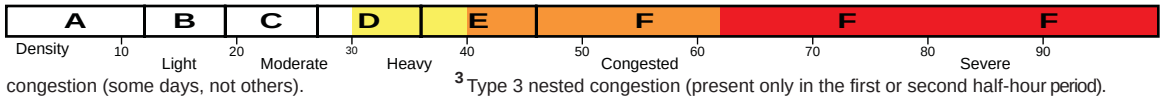
Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

I-66 (Outside Beltway) Left Lane / Concurrent Flow HOV - Morning



A
Congestion Type: HOV Congestion
Frequency: All observations before 8:30 a.m.
Direction: Eastbound
Location: Between VA 234 Bypass & US 29 (Lee Hwy)
Queue Length: 6 to 9 miles
Estimated Speed: 20 to 50 mph
Note: Congestion appeared to be exacerbated by weaving and friction between the HOV facility and the congested general-purpose lanes.

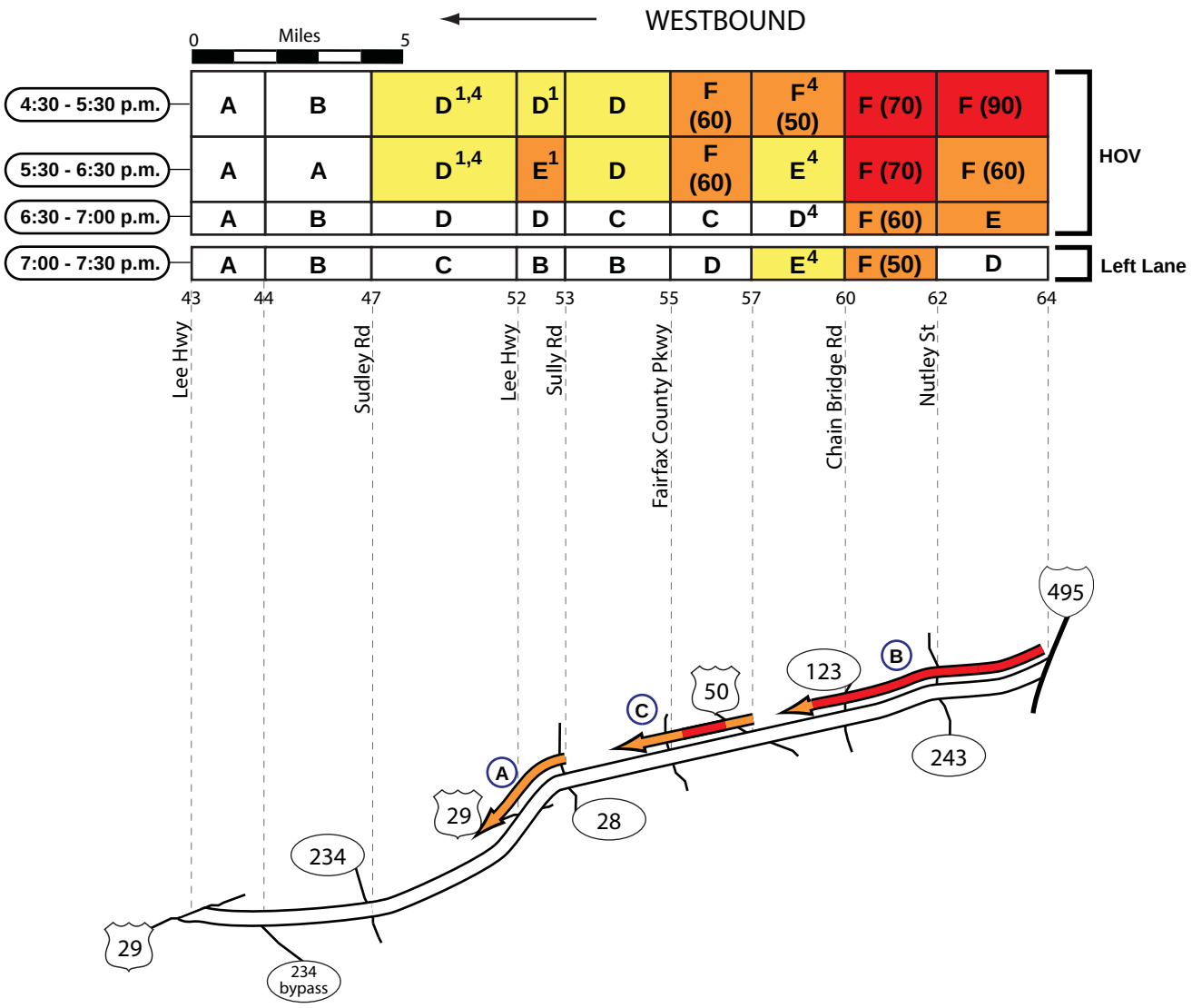
B
Congestion Type: HOV Congestion
Frequency: All observations between 6:30 and 8:30 a.m.
Direction: Eastbound
Location: Between VA 28 & VA 123
Queue Length: 4 to 6 miles
Estimated Speed: 15 to 50 mph
Note: Factors contributing to the congestion were: 1) traffic entering from the center of the roadway at VA 608; and 2) friction between the HOV roadway and the congested general-purpose lanes.



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-66 (Outside Beltway) Left Lane / Concurrent Flow HOV - Evening

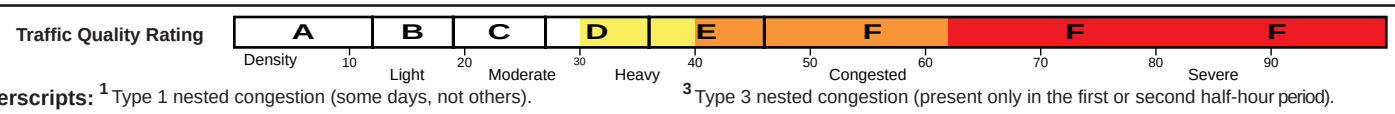
HOV OPERATIONS
HOV 2
3:00 - 7:00 P.M.
WESTBOUND



A
Congestion Type: HOV Congestion
Frequency: Intermittent
Direction: Westbound
Location: Between Sully Rd (SR 28) & Lee Hwy (US 29)
Queue Length: 1 to 2 miles
Estimated Speed: 40 to 55 mph

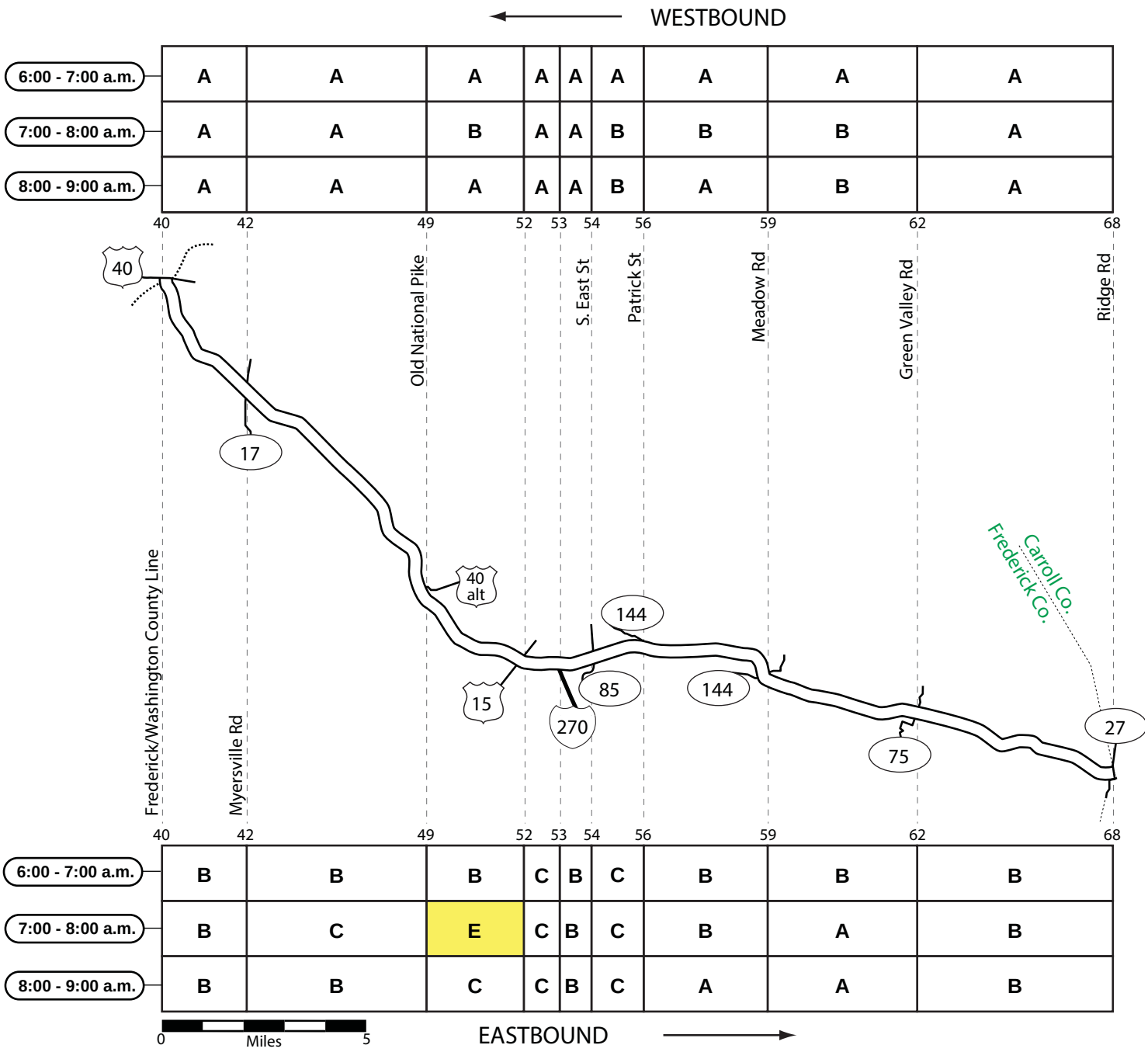
B
Congestion Type: HOV Congestion
Frequency: Most observations
Direction: Westbound
Location: Between I-495 & Chain Bridge Rd
Queue Length: 3 to 5 miles
Estimated Speed: 20 to 50 mph
Note: Westbound travelers in the HOV lane typically resumed free flow speeds somewhere between the Interchanges at Chain Bridge Rd and US 50; intermittently, congestion persisted through the US 50 Interchange.

C
Congestion Type: HOV Congestion
Frequency: Most observations
Direction: Westbound
Location: Between US 50 & Fairfax County Parkway
Queue Length: 2 to 3 miles
Estimated Speed: 35 to 50 mph



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-70 (Maryland) - Morning



Traffic Quality Rating

A	B	C	D	E	F	F	F

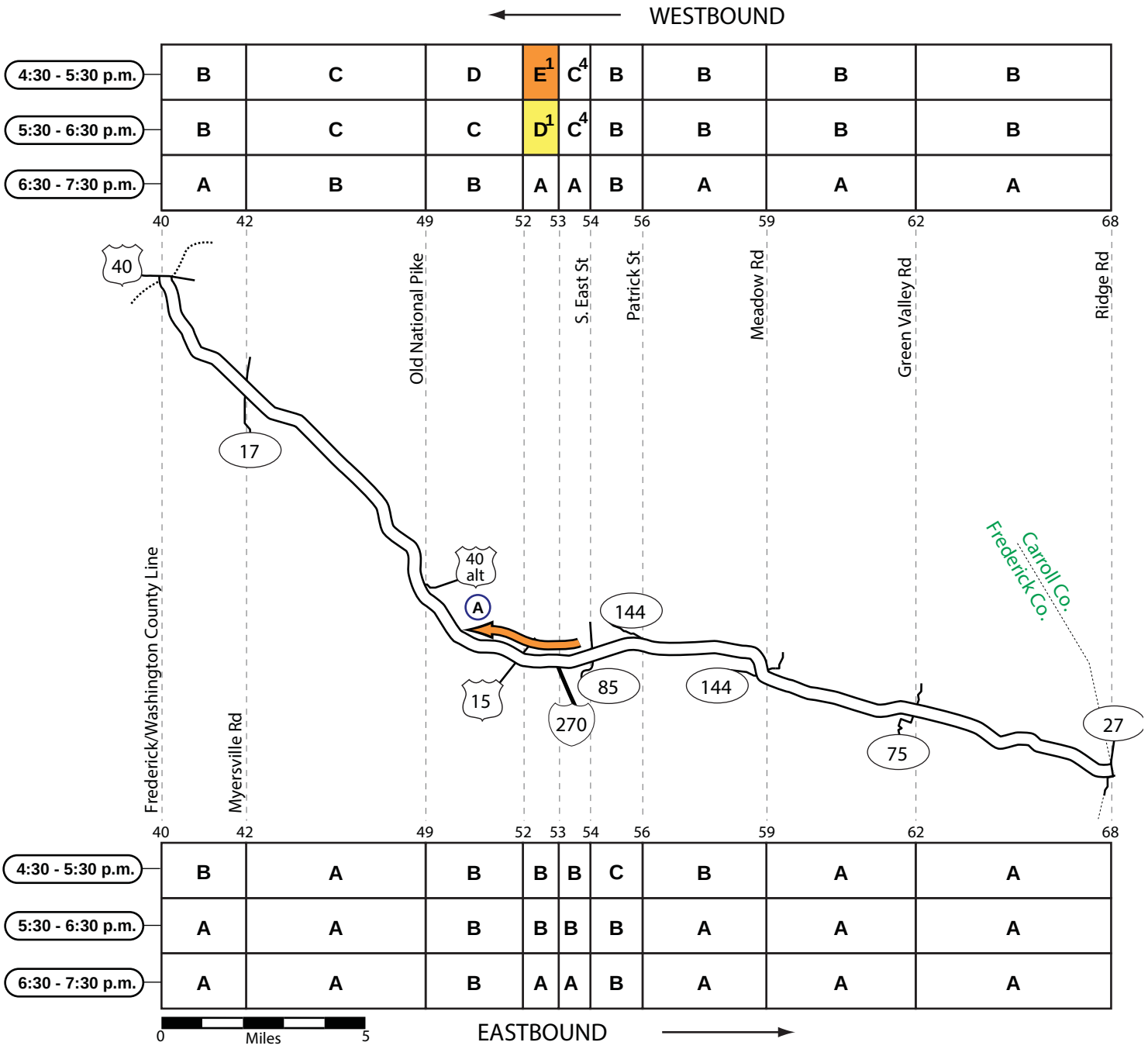
Density 10 20 30 40 50 60 70 80 90

Light Moderate Heavy Congested Severe

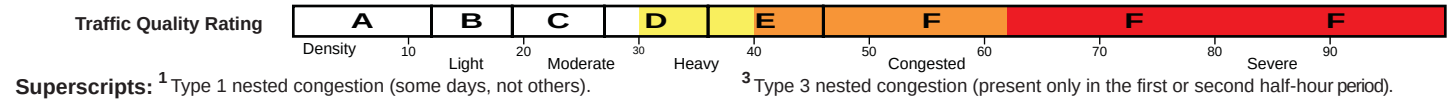
Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).

[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-70 (Maryland) - Evening

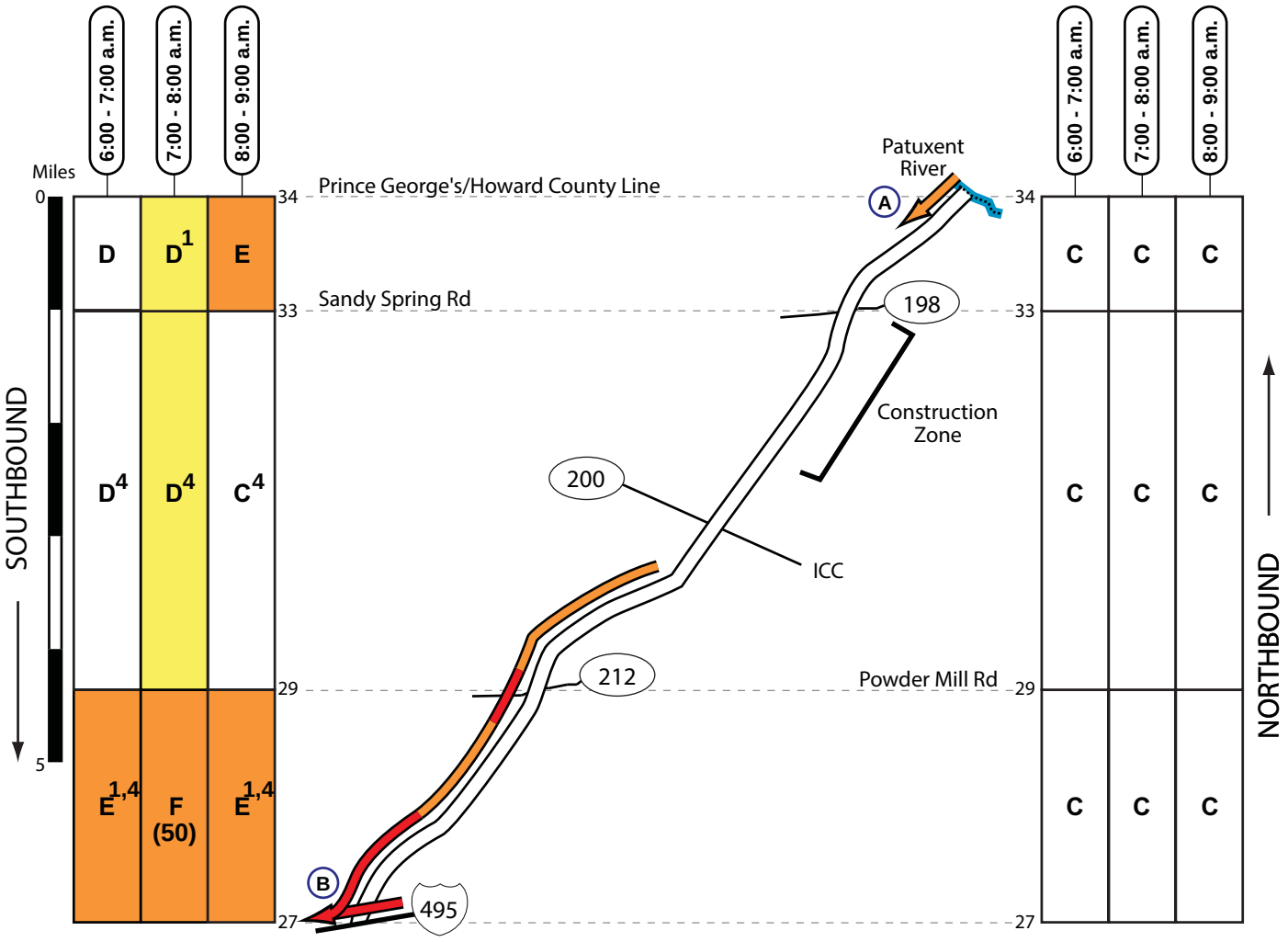


A
Congestion Type: Mainline Congestion
Frequency: Intermittent (one of 3 evenings)
Direction: Westbound
Location: Vicinity of I-270 and US 15 Interchanges
Queue Length: 1 to 2 miles
Estimated Speed: 20 to 50 mph
Note: Congestion appeared to be caused by merging and weaving at the I-70 and US 15 Interchanges.



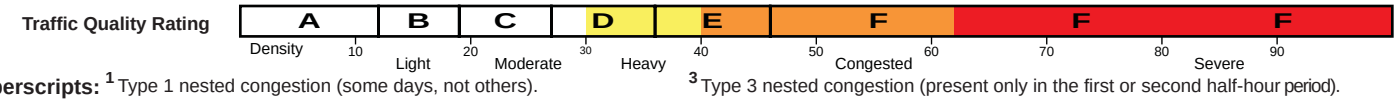
Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-95 (Maryland) - Morning



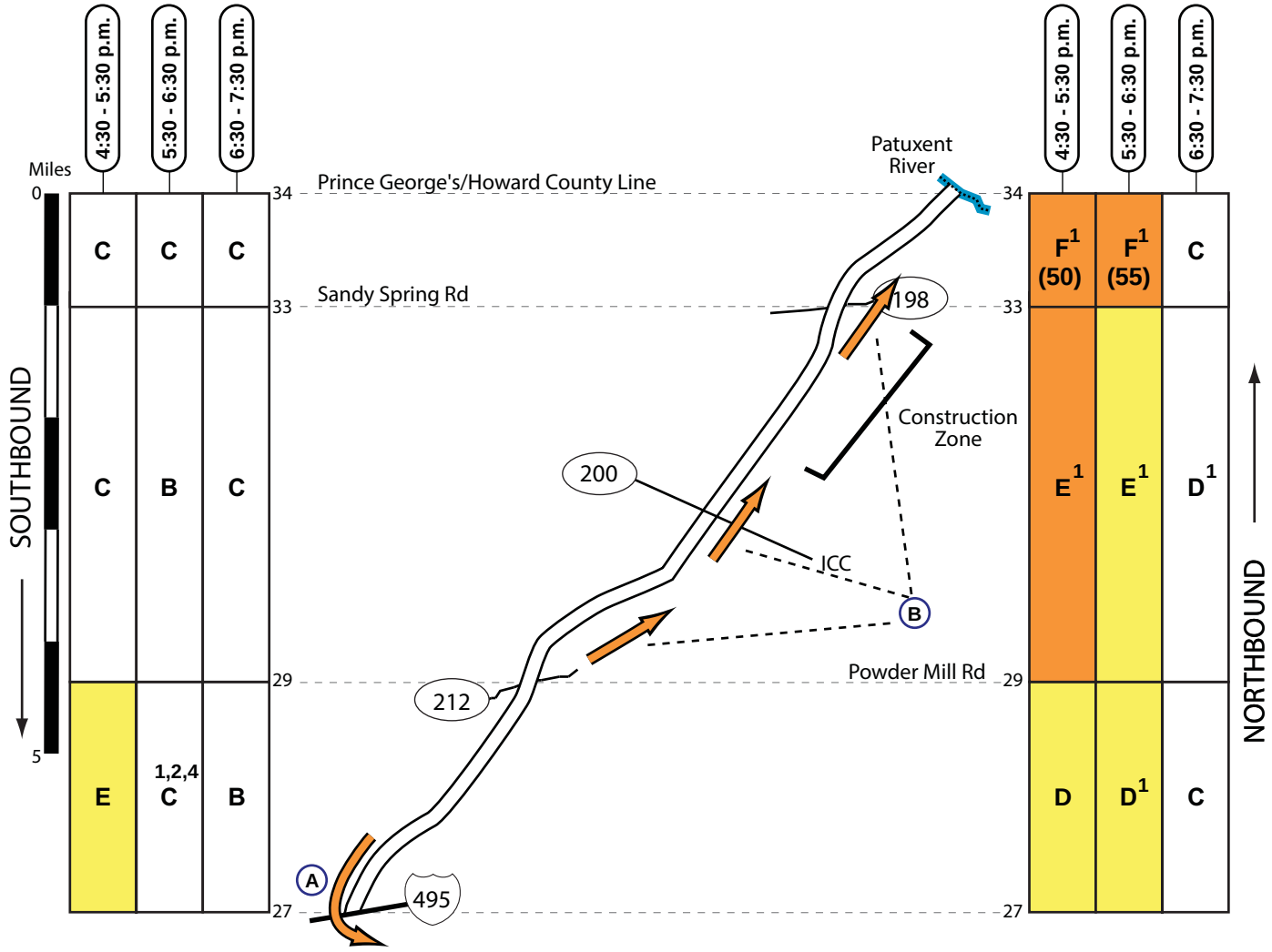
A
Congestion Type: Marginal mainline congestion
Frequency: Intermittent
Direction: Southbound
Location: Crossing the Patuxent River
Queue Length: 0.25 to 0.5 miles
Estimated Speed: 40 to 50 mph
Note: A short construction zone (Jersey Barriers blocking the left shoulder) may have contributed to the congestion found in the vicinity of the Patuxent River.

B
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Southbound
Location: Approaching I-495 (beltway)
Queue Length: 2 to 4 miles
Estimated Speed: 15 to 45 mph
Note: Factors contributing to the congestion were: 1) downstream congestion on I-495 extending back into the mainline on I-95; 2) weaving approaching the I-95/I-495 split. The severity and degree of congestion found on southbound I-95 was often directly related to the degree of congestion downstream on I-495 (Inner and Outer loops).



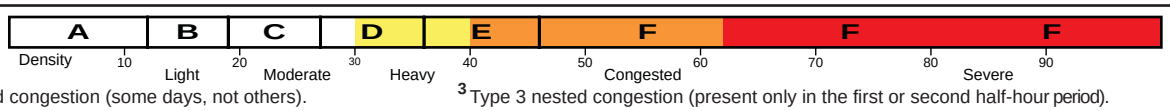
Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

I-95 (Maryland) - Evening



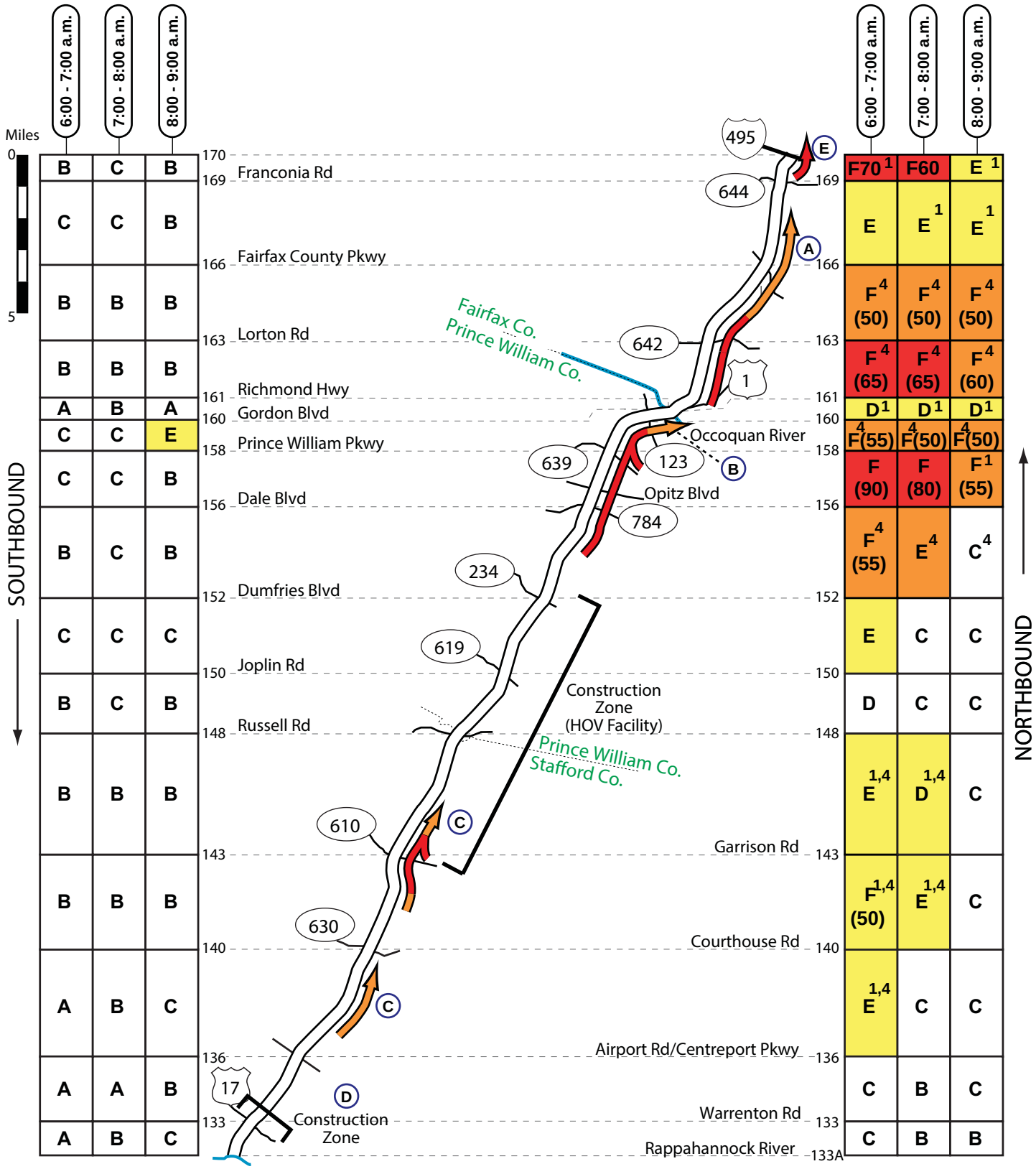
A
Congestion Type: Mainline / Ramp Congestion
Frequency: Intermittent
Direction: Southbound
Location: Approaching I-495 (Inner Loop)
Queue Length: .5 to 1.5 miles
Estimated Speed: 20 to 30 mph
Note: Congestion on the Inner Loop of the Beltway often extended back onto the I-95 ramp and into the 2 left lanes on I-95; however, congestion was typically limited to the ramp.

B
Congestion Type: Mainline Congestion
Frequency: Intermittent (before 7:00 p.m.)
Direction: Northbound
Location: Between I-495 and the Patuxent River (county line)
Queue Length: 3 to 5 miles
Estimated Speed: 30 to 50 mph
Note: Factors contributing to the congestion were: 1) traffic entering the mainline from MD 212, ICC and MD 198; 2) the grade and the presence of many tractor-trailers.



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-95 (Virginia) - Morning



Traffic Quality Rating

A	B	C	D	E	F	F	F

Density 10 20 30 40 50 60 70 80 90

Light Moderate Heavy Congested Severe

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).

[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-95 (Virginia) - Morning

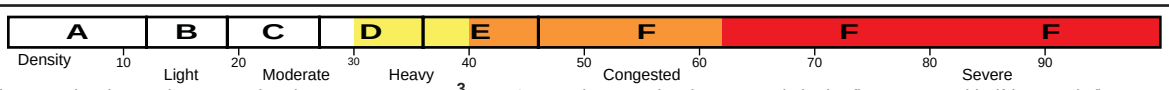
A
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Northbound
Location: Between the Occoquan River and Fairfax County Parkway
Queue Length: 4 to 6 miles
Estimated Speed: 30 to 50 mph
Note: Northbound travelers typically flowed freely across the Occoquan River before encountering congestion; traffic entering at US Route 1 appeared to be the primary bottleneck along this section of I-95.

B
Congestion Type: Mainline Congestion
Frequency: All observations
Direction: Northbound
Location: Between Dumfries Blvd & Gordon Blvd
Queue Length: 3 to 5 miles
Estimated Speed: 25 to 45 mph
Note: The primary bottlenecks were found where traffic merged into the mainline from the auxiliary lane at Dale Blvd and Opitz Blvd (2 lane ramp). After the merge at Gordon Blvd, traffic typically resumed free flow speeds crossing the Occoquan River.

C
Congestion Type: Mainline Congestion
Frequency: Most observations before 8:00 a.m.
Direction: Northbound
Location: Between Airport Rd and Garrison Rd
Estimated Speed: 30 to 50 mph
Note: The primary bottleneck was found where traffic entered the mainline at Garrison Rd; stop-and-go flow was typically found approaching the merge. Farther south, northbound congestion was found between Airport Rd and Courthouse Rd; it appeared that tractor-trailers in the traffic stream may have contributed to the congestion.

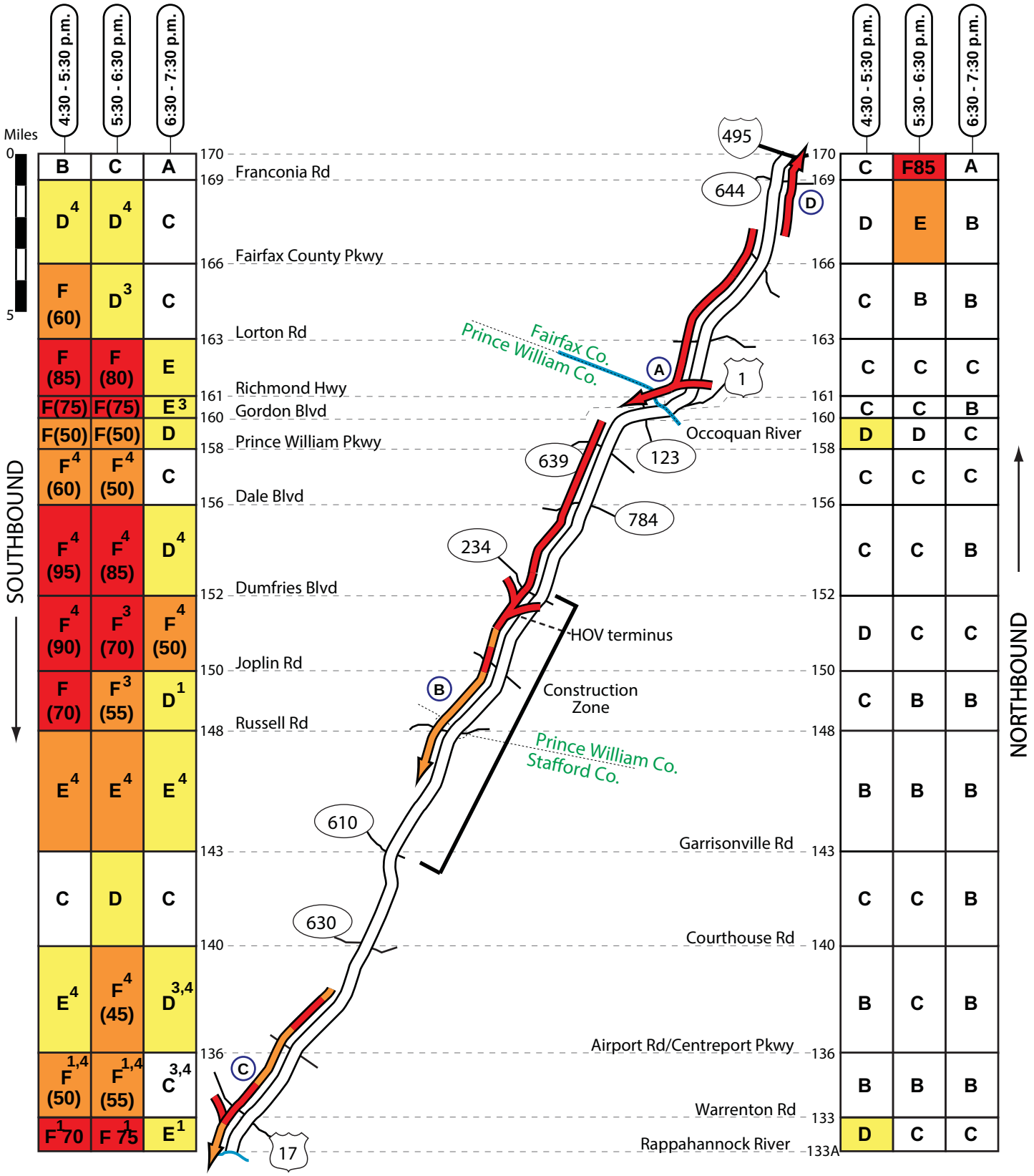
D
Congestion Type: Mainline Congestion (Construction-Related) - Not depicted
Frequency: Most observations after 7:30 a.m.
Direction: Northbound
Location: Between the Rappahannock River and US 17
Estimated Speed: 30 to 50 mph
Note: The closure of the left lane on US 17 (westbound) caused congestion on the exit ramp that extended back into the mainline on I-95.

E
Congestion Type: Mainline Congestion
Frequency: All observations before 8:30 a.m.
Direction: Northbound
Location: Between Franconia Rd and I-495
Queue Length: 0.5 to 1 mile
Estimated Speed: 20 to 30 mph
Note: Northbound congestion on I-95 approaching the I-495 Interchange was directly related to the degree of downstream congestion on I-395; the tail of the queue on I-95 was typically found somewhere between Franconia Rd and I-495.



Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

I-95 (Virginia) - Evening



Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

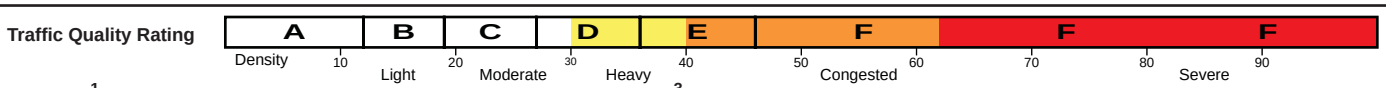
I-95 (Virginia) - Evening

A
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Southbound
Location: Between Fairfax County Parkway & Gordon Blvd
Queue Length: 4 to 7 miles
Estimated Speed: 20 to 40 mph
Note: The primary bottlenecks were found where traffic entered the mainline from the interchanges at US Route 1 and Gordon Blvd.

B
Congestion Type: Mainline Congestion
Frequency: All observations before 7:00 p.m.
Direction: Southbound
Location: Between Prince William Parkway & Russell Rd
Queue Length: 6 to 10 miles
Estimated Speed: 20 to 50 mph
Note: Factors that contributed to the congestion included: 1) traffic entering at the series of interchanges along this section of I-95; 2) the merge into the left lane at the terminus of the HOV facility; 3) jersey barriers along the construction zone where the HOV facility was being extended.

C
Congestion Type: Mainline Congestion
Frequency: Most observations before 7:00 p.m.
Direction: Southbound
Location: Between Courthouse Rd and the Rappahannock River
Queue Length: 4 to 7 miles
Estimated Speed: 25 to 50 mph
Note: The primary bottleneck along this section of I-95 was found where traffic entered the mainline at US 17.

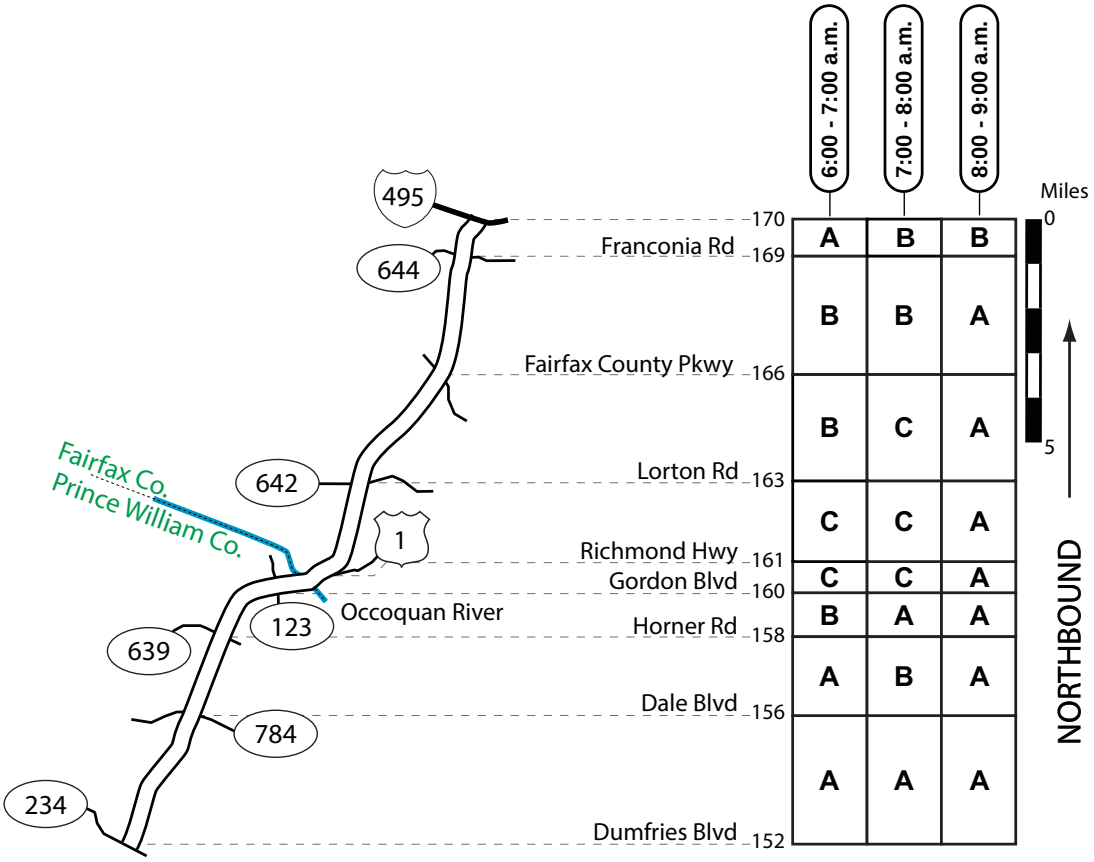
D
Congestion Type: Mainline Congestion
Frequency: Some days, not others
Direction: Northbound
Location: Between Fairfax County Parkway & I-495
Queue Length: 2 to 3 miles
Estimated Speed: 10 to 30 mph
Note: When congested, the head of this queue was found downstream on I-395. Construction on I-395 may have caused or exacerbated the congestion on I-95.



Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

I-95 Barrier Separated HOV (Virginia) - Morning

HOV OPERATIONS
HOV 3
6:00 - 9:00 A.M.
NORTHBOUND

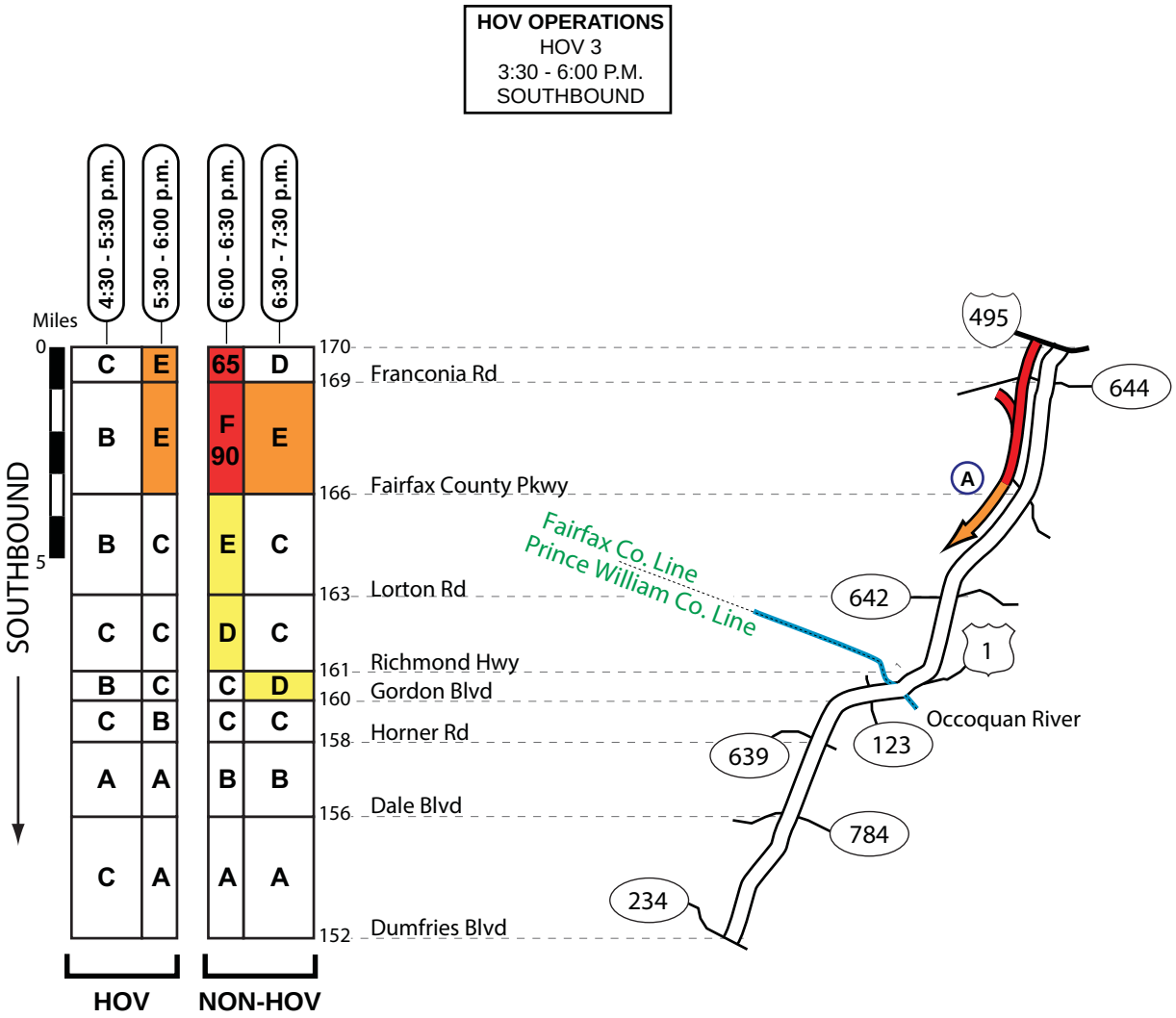


Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-95 Barrier Separated HOV (Virginia) - Evening



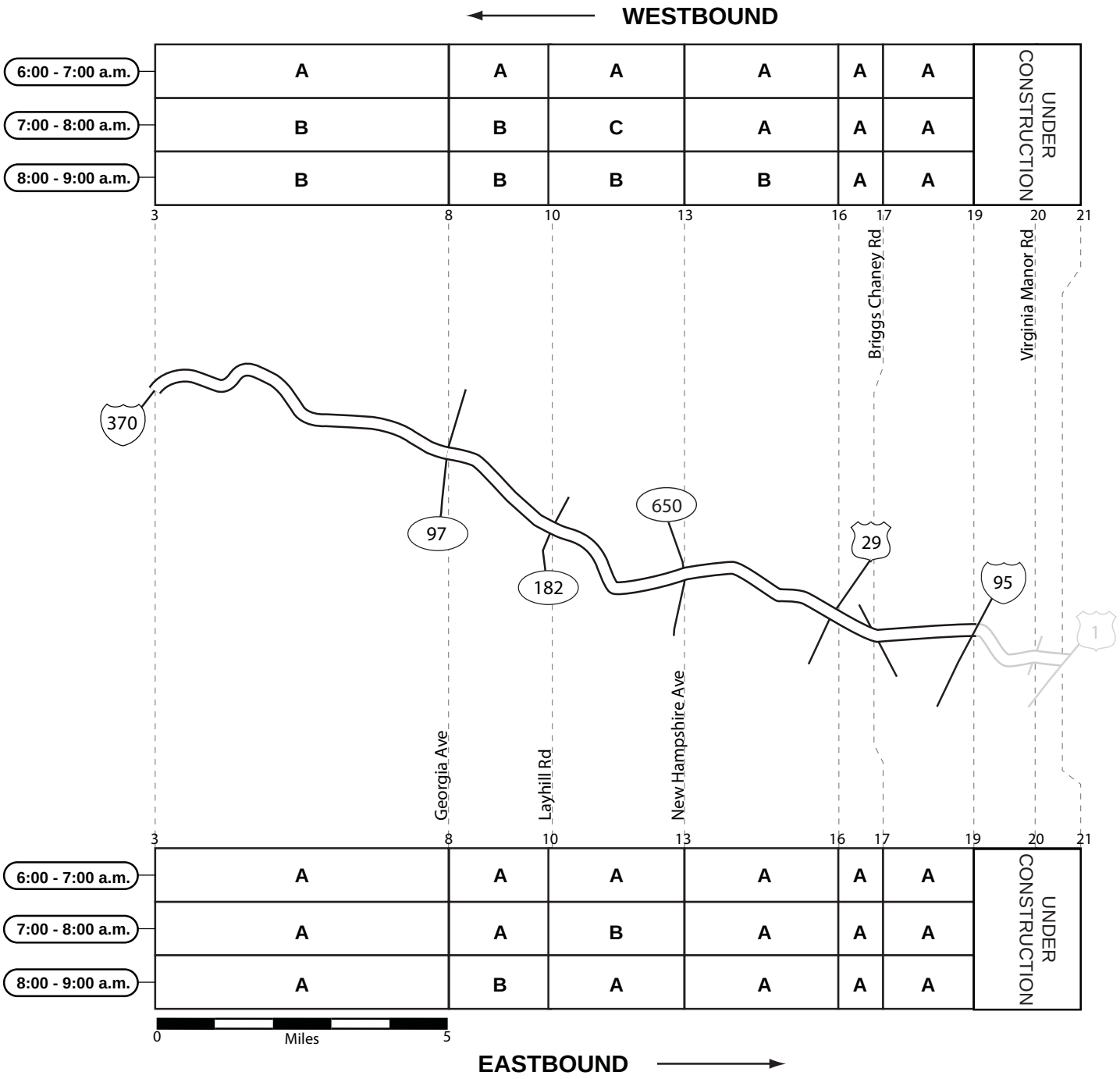
A
Congestion Type: Mainline Congestion
Frequency: Most observations after 6:00 p.m.
Direction: Southbound
Location: Between I-495 & Fairfax County Parkway
Queue Length: 1 to 3 miles
Estimated Speed: 20 to 50 mph
Note: The primary bottleneck was found where traffic entered the HOV facility on the ramp from Franconia Springfield Parkway

Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

MD 200 (Intercounty Connector) - Morning

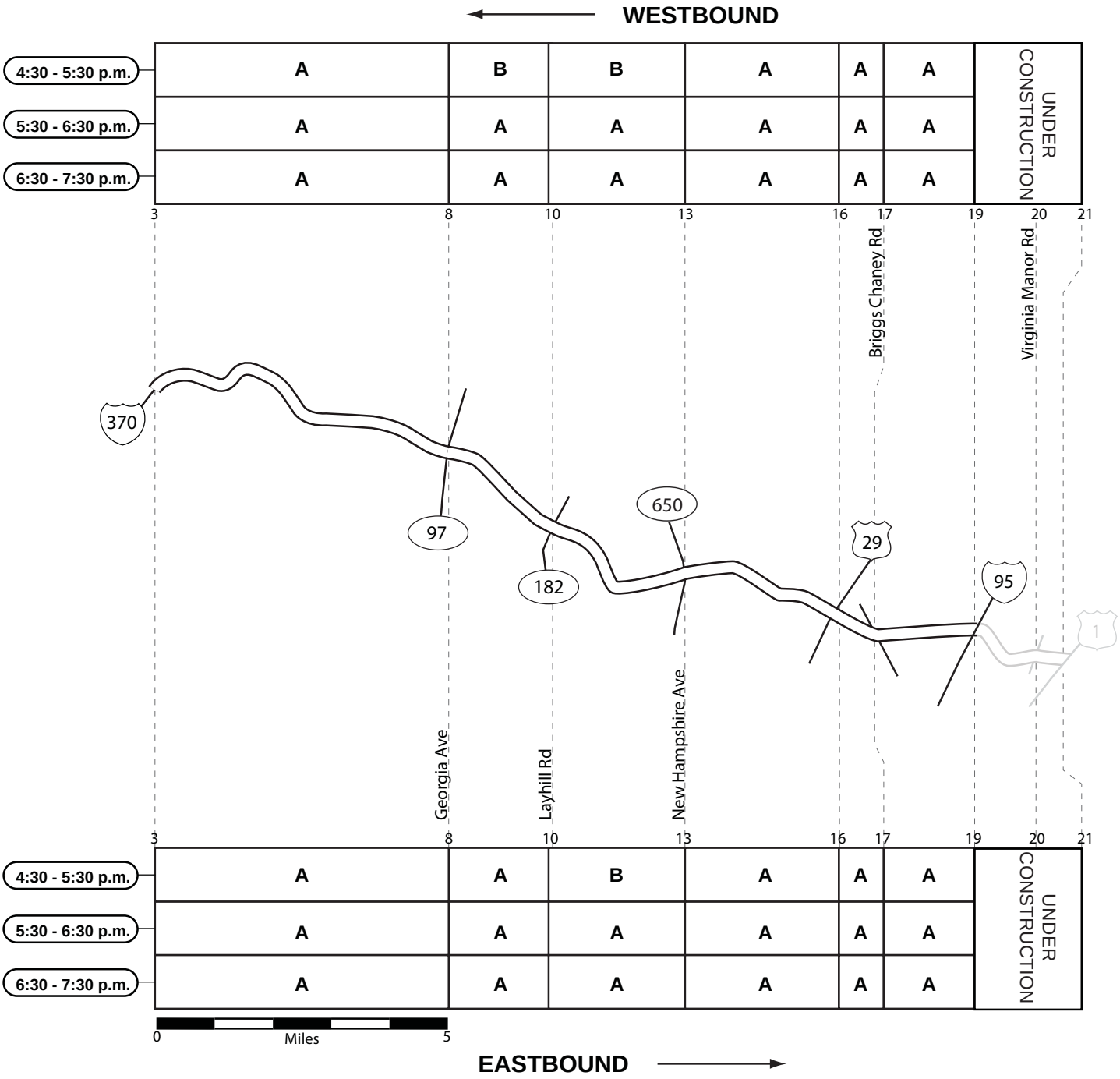


Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

MD 200 (Intercounty Connector) - Evening



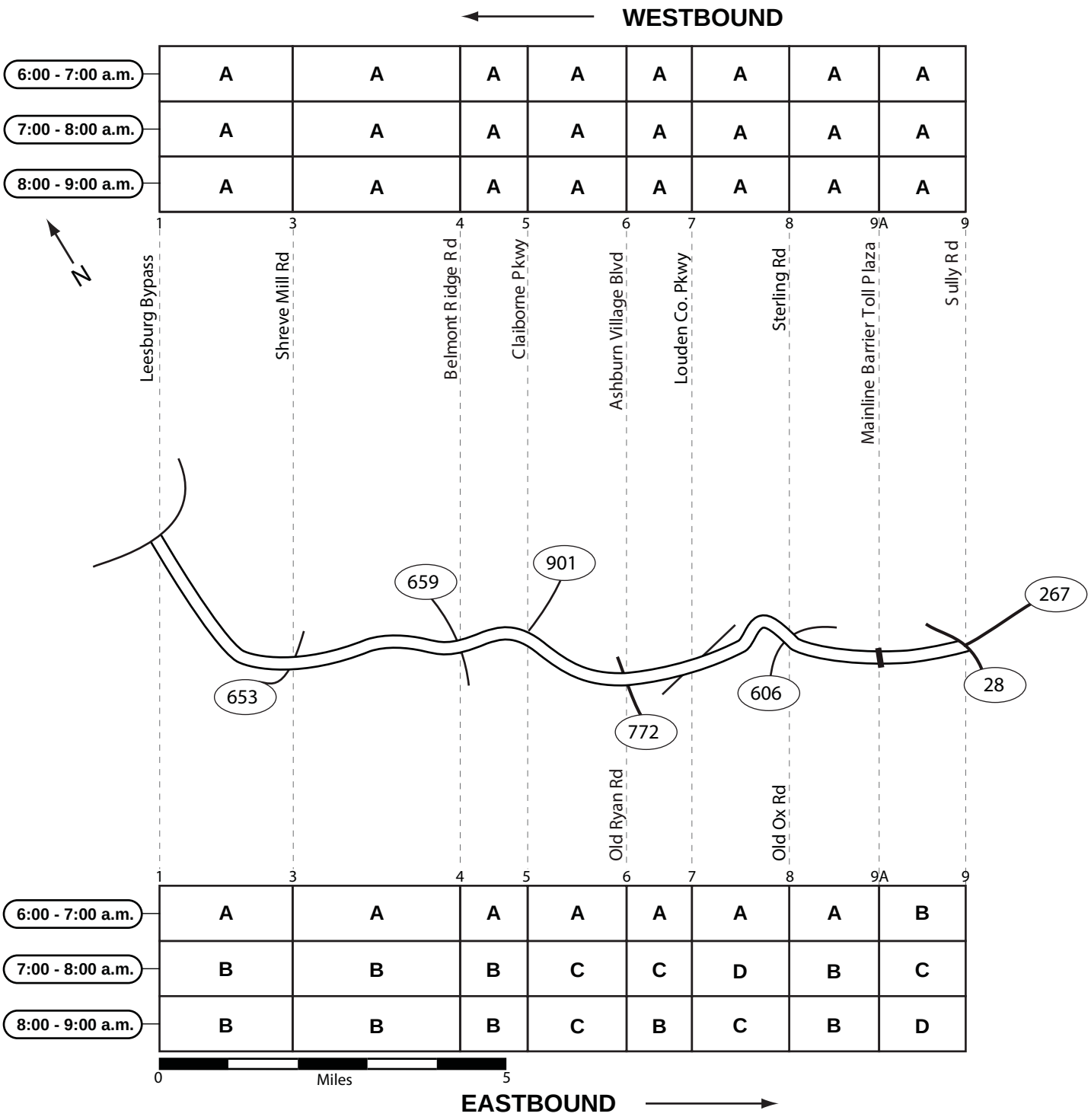
Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).

[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

VA 267 (Dulles Greenway) - Morning

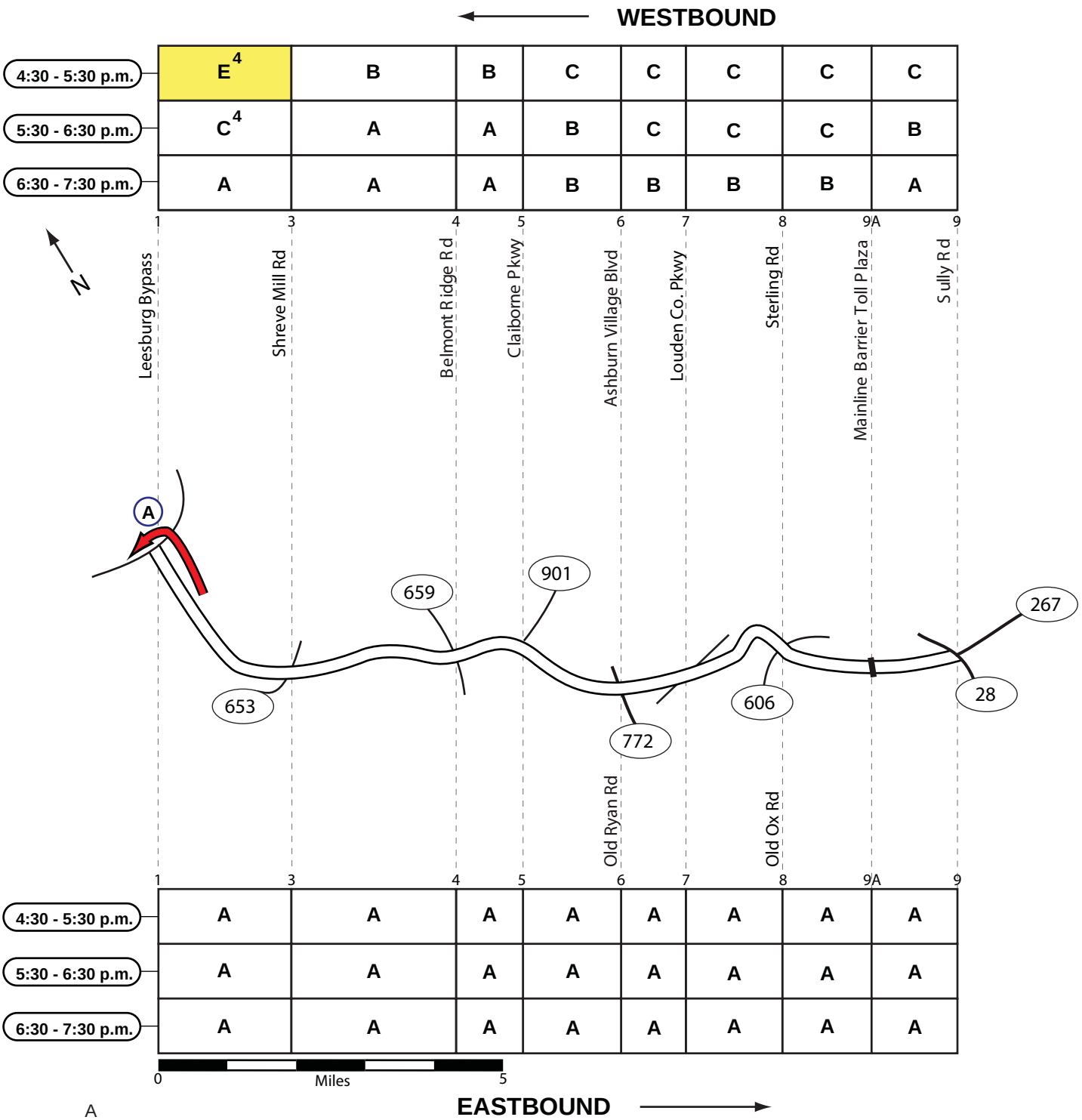


Traffic Quality Rating

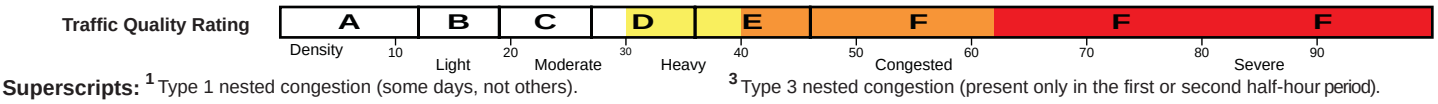
A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

VA 267 (Dulles Greenway) - Evening

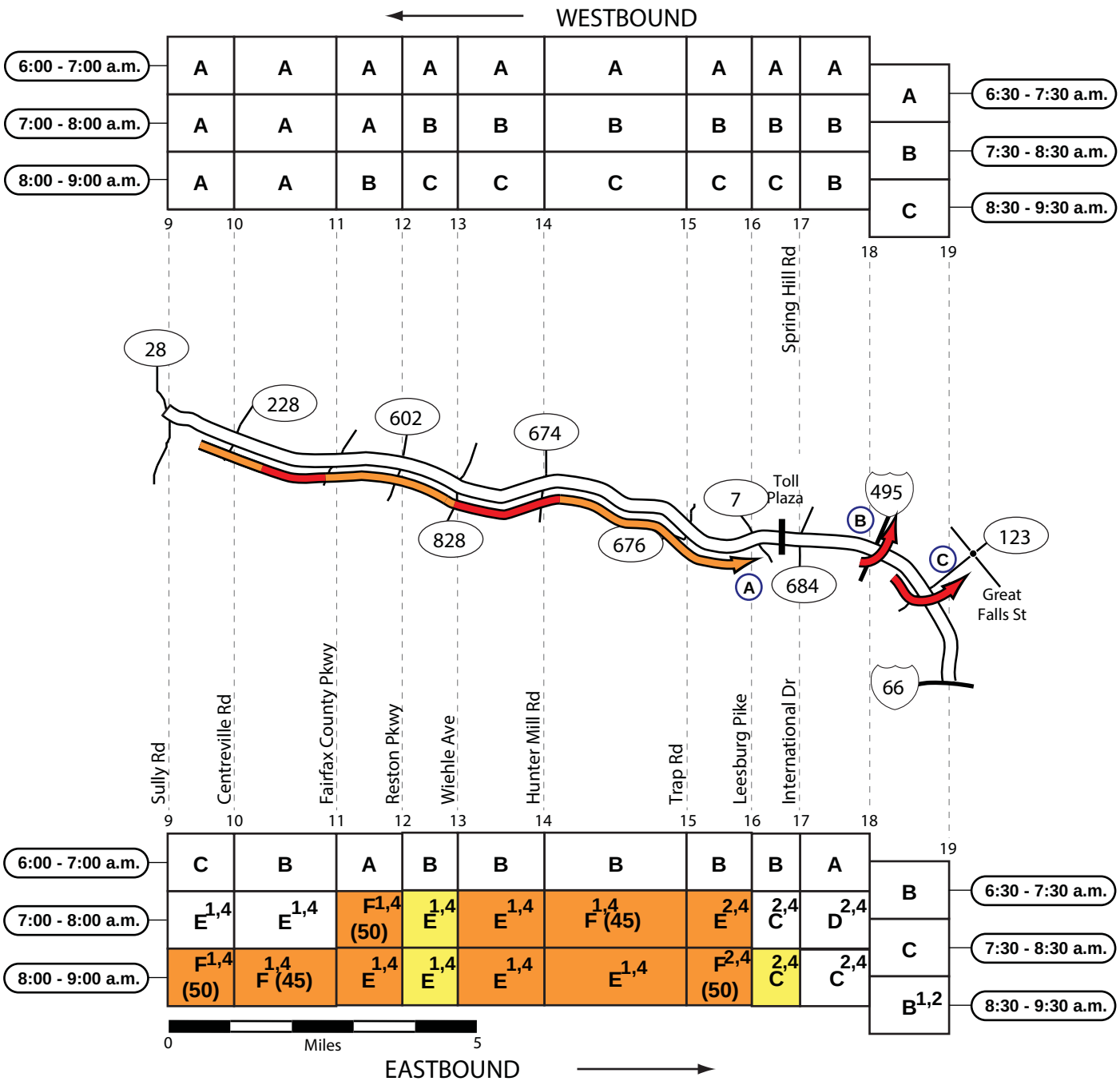


A
Congestion Type: Mainline Congestion
Frequency: Most observations between 4:30 and 6:30 p.m.
Direction: Northbound
Location: Northern Terminus
Queue Length: 0.5 to 1 mile
Estimated Speed: Stop-and-go
Note: Varying lengths of severe northbound congestion was found approaching Leesburg Pike (US 15); the head of the queue was found on the ramp to westbound US 15.



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

VA 267 (Toll Road) - Morning



Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

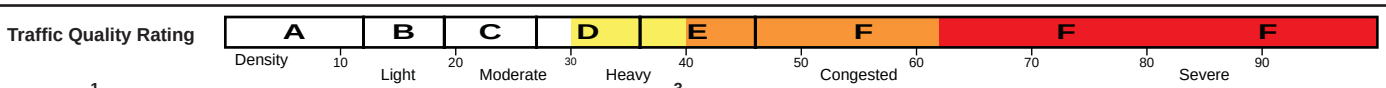
Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

VA 267 (Toll Road) - Morning

A
Congestion Type: Mainline Congestion
Frequency: Most observations after 7:00 a.m.
Direction: Eastbound
Location: Between VA 28 and VA 7
Queue Length: 6 to 8 miles
Estimated Speed: 20 to 50 mph
Note: The primary cause of congestion appeared to be traffic entering the mainline at the interchanges along this corridor. Congestion approaching VA 7 was more severe In the right-hand lanes; congestion at the ramp toll plaza sometimes extended back into the right lane on the Toll Road.

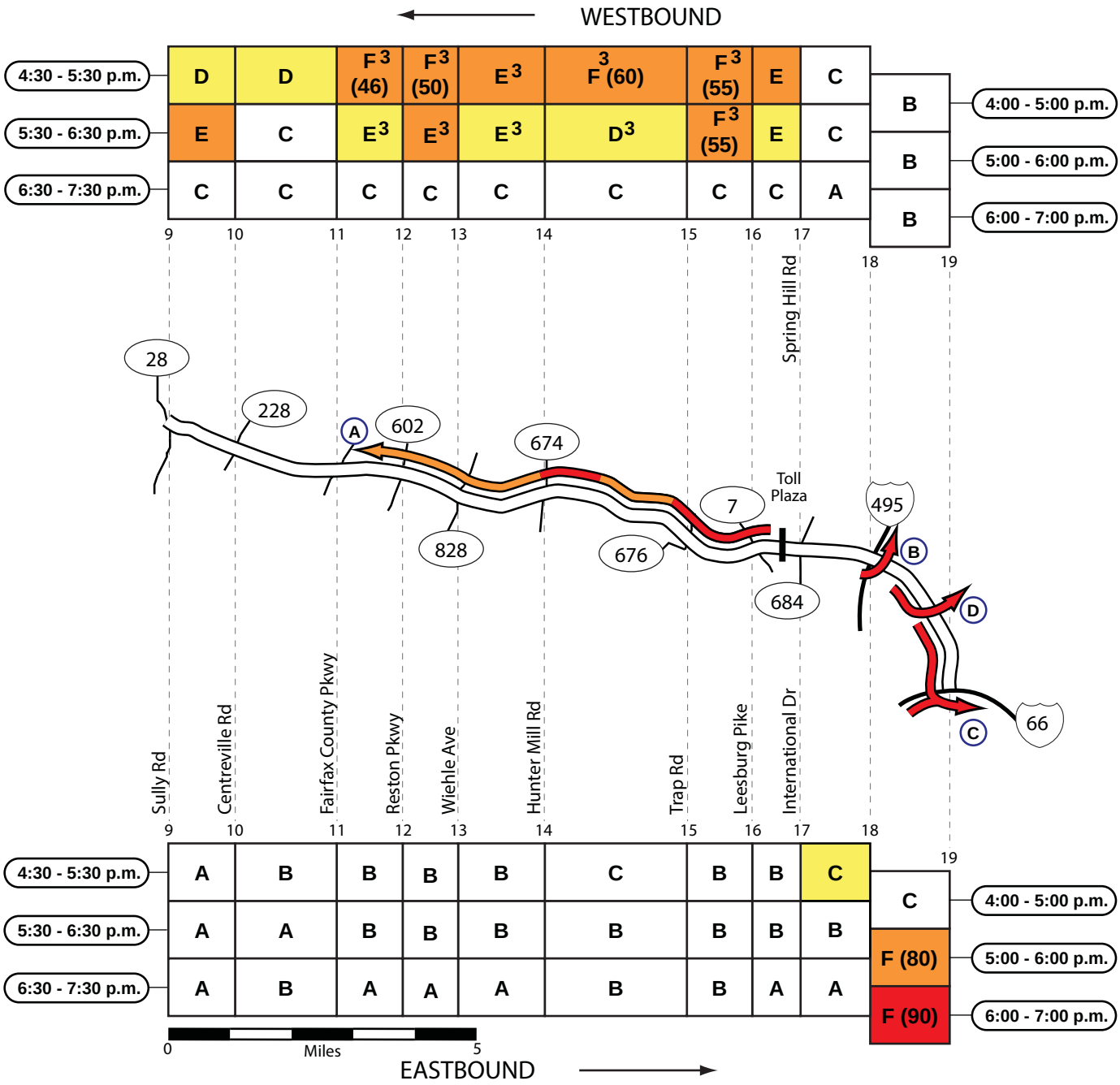
B
Congestion Type: Exit Ramp Queue
Frequency: Most observations
Direction: Eastbound
Location: I-495 Inner Loop Exit Ramp
Queue Length: 0.5 to 1 mile
Estimated Speed: Stop-and-go
Note: Severe congestion on the ramp to the Inner Loop typically extended back into the two right lanes on VA 267; vehicles continuing eastbound on VA 267 were able to bypass the queue without delay. Congestion on the ramp to the Outer Loop was limited to the ramp.

C
Congestion Type: Exit Ramp Queue
Frequency: Intermittently after 8:00 a.m.
Direction: Eastbound
Location: Approaching VA 123
Queue Length: 0.5 to 1 mile
Estimated Speed: Stop-and-go
Note: The head of the queue was found on northbound VA 123 approaching the signal at Great Falls St; the signal queue sometimes extended back onto the eastbound VA 267 exit ramp and back into the right lane on the Toll Road.



Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

VA 267 (Toll Road) - Evening



Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

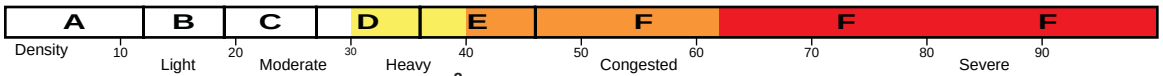
VA 267 (Toll Road) - Evening

A
Congestion Type: Mainline Congestion
Frequency: Between 5:00 and 6:30 p.m.
Direction: Westbound
Location: Between the Mainline Toll Plaza and Fairfax County Pkwy
Queue Length: 6 to 8 miles
Estimated Speed: 30 to 50 mph
Note: Westbound congestion appeared to be caused primarily by traffic entering the mainline at the Interchanges along this section of VA 267.

B
Congestion Type: Exit Ramp Queue
Frequency: On some days but not others
Direction: Eastbound
Location: I-495 Inner Loop Exit Ramp
Queue Length: 0.5 to 1 mile
Estimated Speed: Stop-and-go
Note: Severe congestion on the ramp to the Inner Loop Intermittently extended back into the two right lanes on VA 267; vehicles continuing eastbound on VA 267 were typically able to bypass the queue without delay. Congestion on the ramp to the Outer Loop was limited to the ramp.

C
Congestion Type: Mainline Congestion
Frequency: All observations after 5:00 p.m.
Direction: Eastbound
Location: Approaching I-66
Queue Length: 1 to 2 miles
Estimated Speed: 10 to 30 mph
Note: Severe stop-and-go congestion was found along this section of VA 267; the head of the queue was found at the merge into congested flow on I-66 (eastbound).

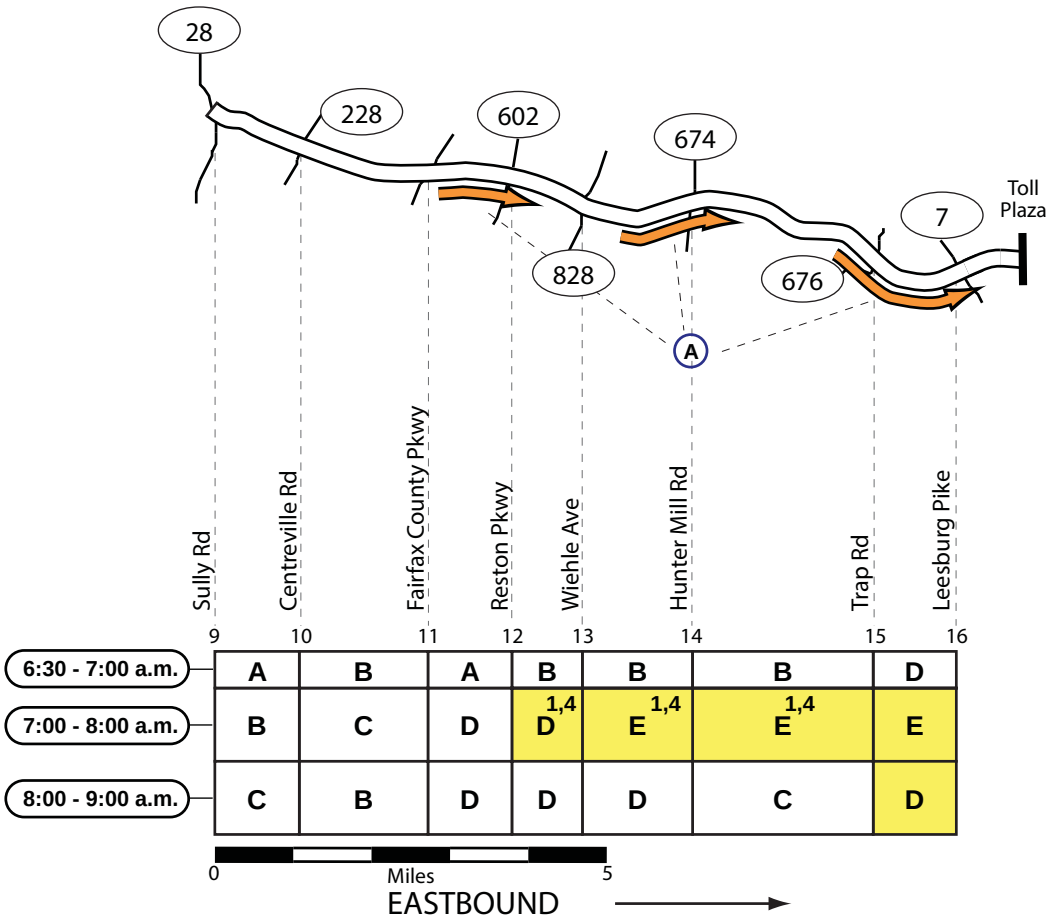
D
Congestion Type: Exit Ramp Queue
Frequency: Intermittently between 4:30 and 6:30 p.m.
Direction: Eastbound
Location: Approaching VA 123
Queue Length: 0.5 to 1 mile
Estimated Speed: Stop-and-go
Note: The head of the queue was found on northbound VA 123 approaching the signal at Great Falls St; the signal queue sometimes extended back onto the eastbound VA 267 exit ramp and back Into the right lane on the Toll Road.



Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

VA 267 (Dulles Toll Road) Left Lane Concurrent HOV - Morning

HOV OPERATIONS
HOV 2
6:30 - 9:00 A.M.
EASTBOUND



A
Congestion Type: Mainline Congestion
Frequency: Intermittently after 7:00 a.m.
Direction: Eastbound
Location: Between Fairfax County Parkway and VA 7
Queue Length: 1-2 miles
Estimated Speed: 40 to 50 mph
Note: For the most part it appeared users of the HOV facility experienced minor delays where only moderate congestion was found in the left lane.

Traffic Quality Rating

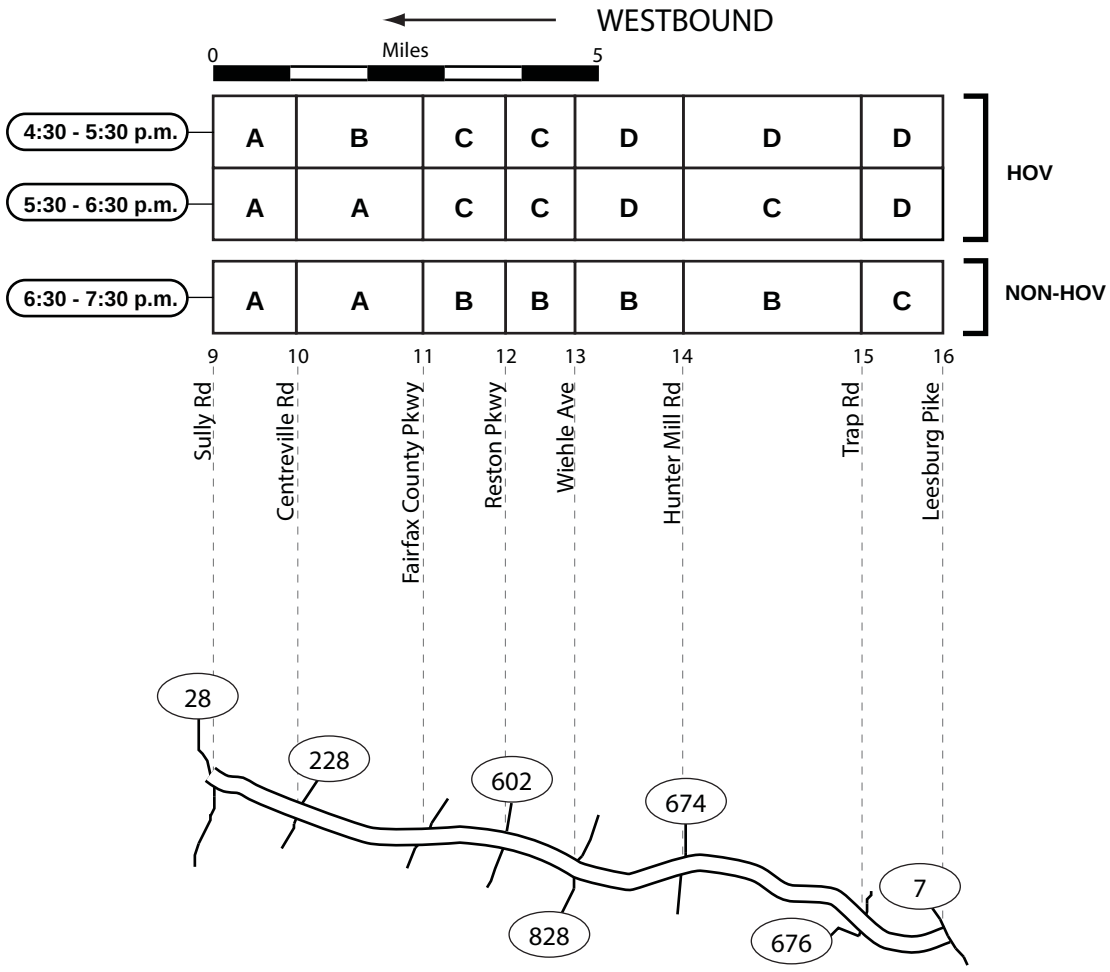
A	B	C	D	E	F	F	F

Density 10 20 30 40 50 60 70 80 90
Light Moderate Heavy Congested Severe

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

VA 267 (Dulles Toll Road) Left Lane Concurrent HOV - Evening

HOV OPERATIONS
HOV 2
4:00 - 6:30 P.M.
WESTBOUND

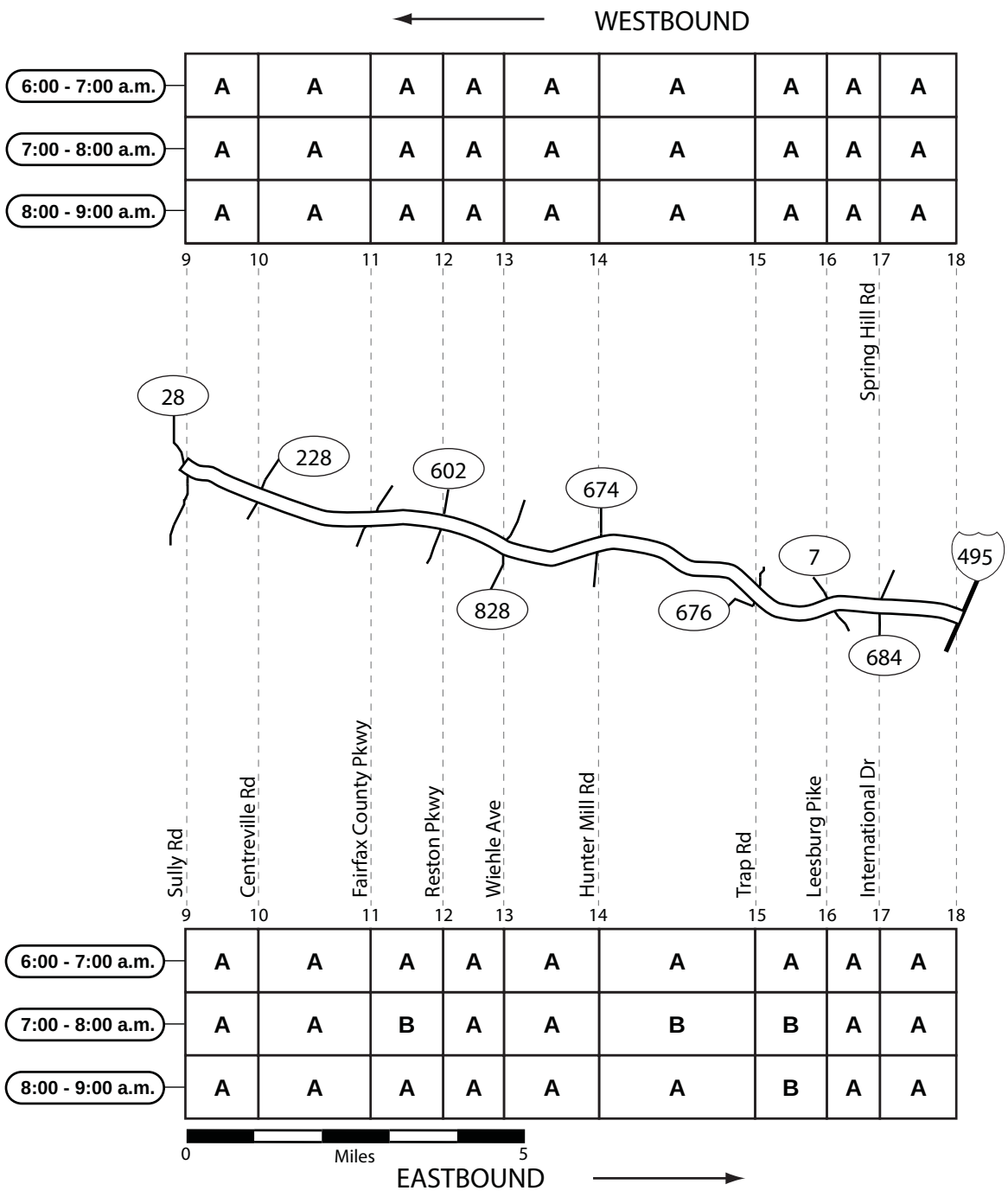


Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

VA 267 (Dulles Airport Access Road) - Morning

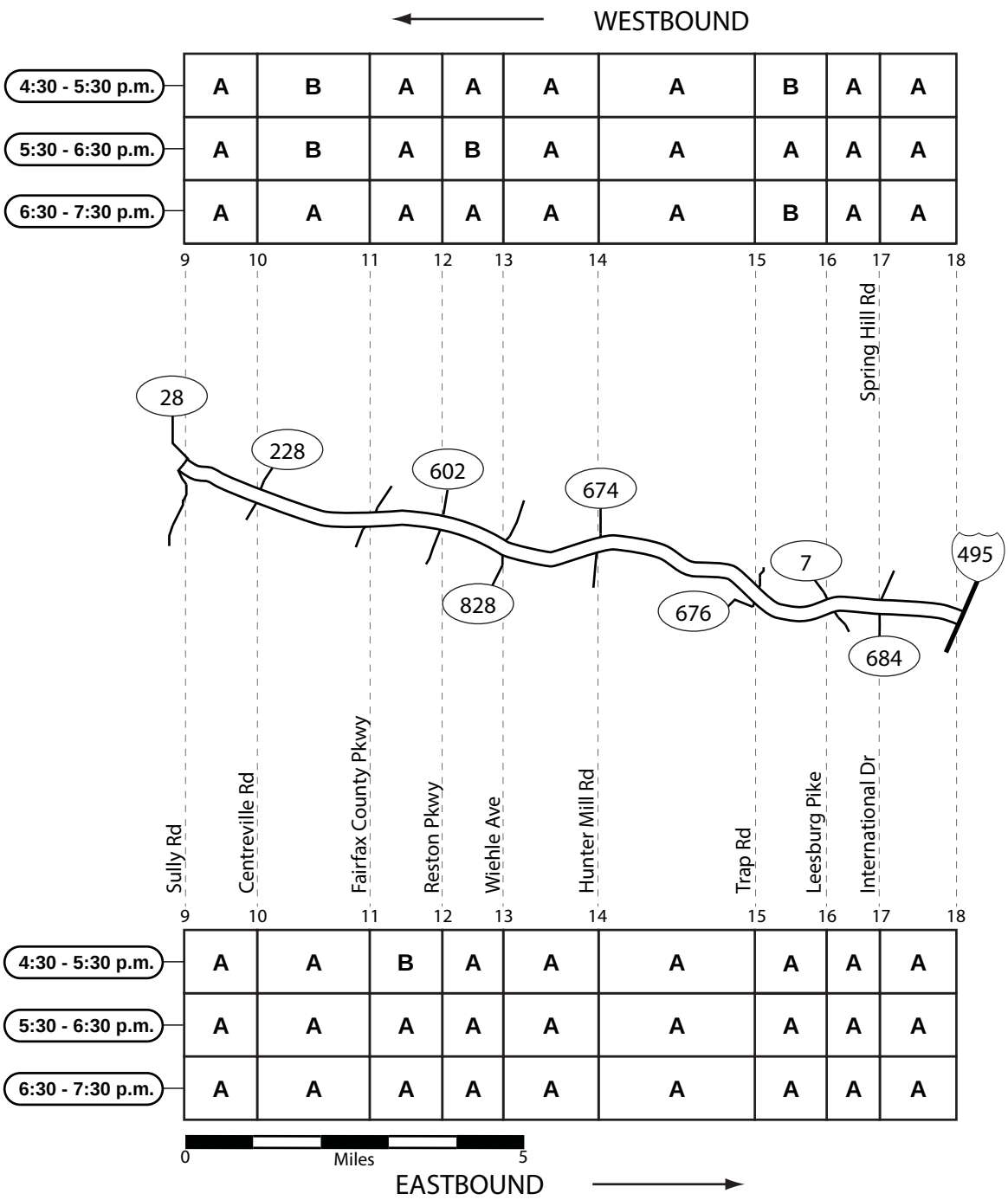


Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

VA 267 (Dulles Airport Access Road) - Evening



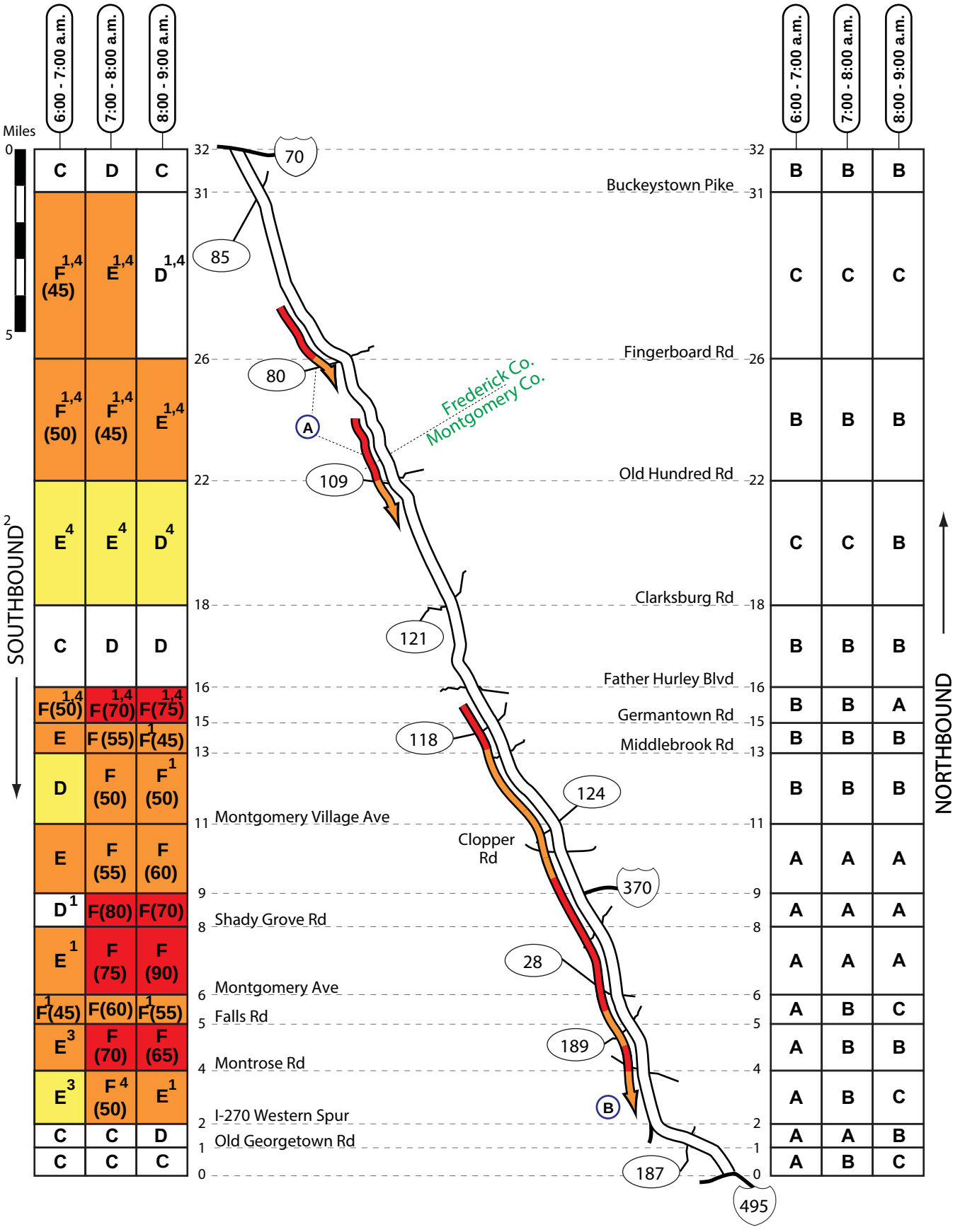
Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).

[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-270 (Maryland) - Morning



Traffic Quality Rating

A	B	C	D	E	F	F	F

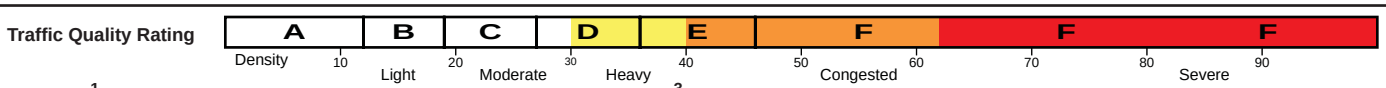
Density: 10 Light, 20 Moderate, 30 Heavy, 40, 50 Congested, 60, 70, 80 Severe, 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

I-270 (Maryland) - Morning

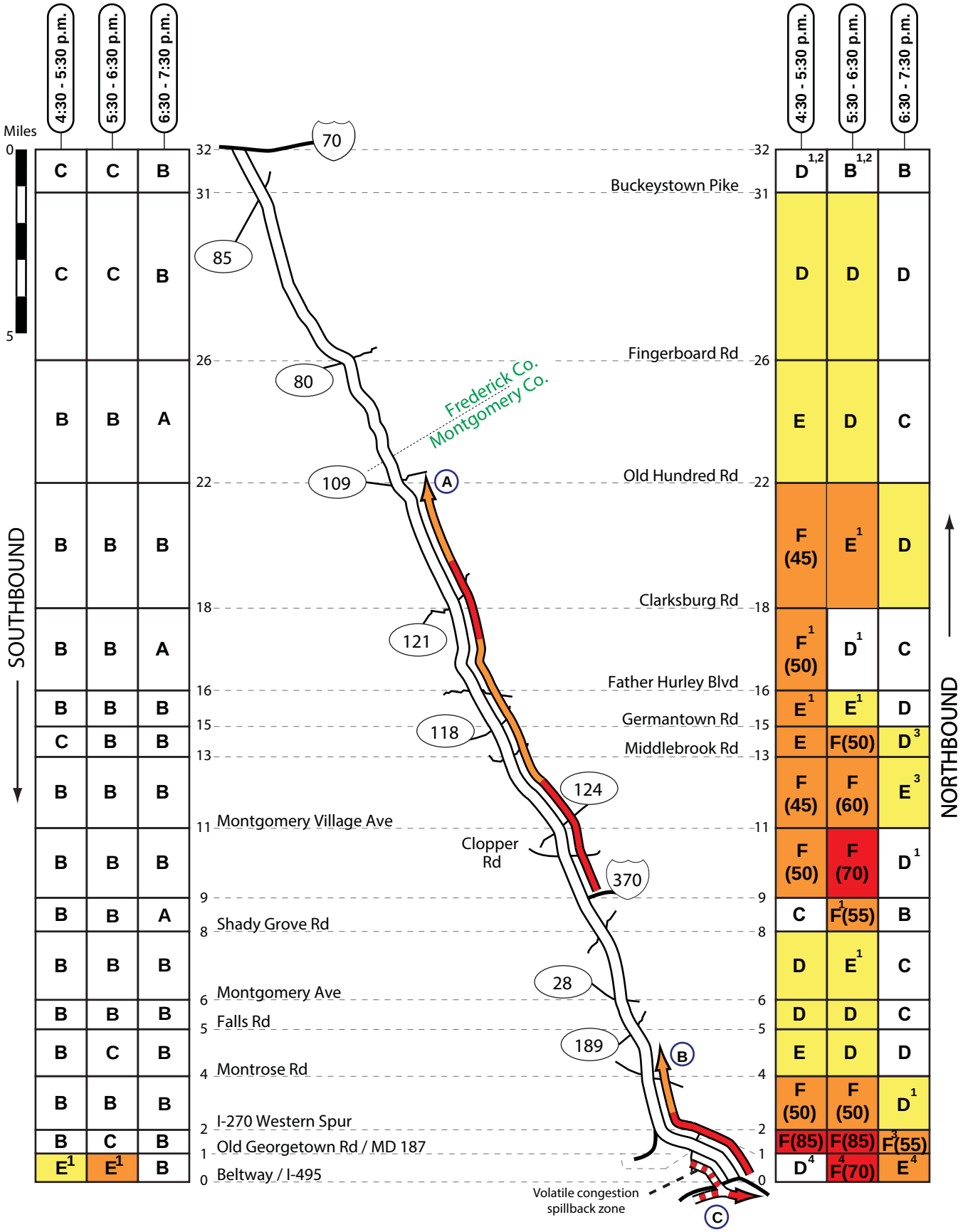
A
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Southbound
Location: Approaching the interchanges at MD 80 and MD 109
Queue Lengths: 2 to 3 miles
Estimated Speed: 30 to 50 mph
Note: The primary cause of congestion appeared to be traffic merging into the mainline at the interchanges at MD 80 and MD 109; south of the merge at MD 80 traffic typically resumed free flow speeds until encountering congestion approaching MD 109.

B
Congestion Type: Mainline Congestion
Frequency: All observations after 6:30 a.m.
Direction: Southbound
Location: Father Hurley Blvd to I-270 Western Spur
Queue Length: 10 to 13 miles
Estimated Speed: 20 to 50 mph
Note: Traffic entering the mainline at the series of interchanges along this section of I-270 appeared to exacerbate the congestion; stop-and-go flow was often found in the vicinity of the entrance ramps where vehicles merged into the right lane.



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-270 (Maryland) - Evening



Traffic Quality Rating

A	B	C	D	E	F	F	F

Density: 10 Light, 20 Moderate, 30 Heavy, 40, 50 Congested, 60, 70, 80 Severe, 90

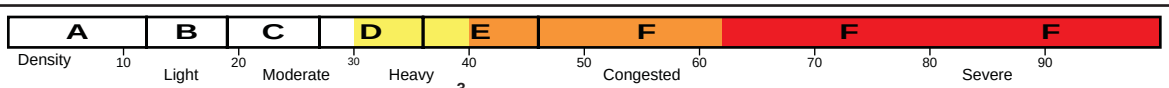
Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

I-270 (Maryland) - Evening

A
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Northbound
Location: Between I-370 and MD 109 (Old Hundred Rd)
Queue Length: 8 to 12 miles
Estimated Speed: 30 to 50 mph
Note: Early in the evening survey period (before 6:00 p.m.), significant northbound congestion was found between I-370 and Germantown Rd; the primary bottleneck here was found where vehicles entered the mainline at Montgomery Village Ave. For the most part, congestion north of Montgomery Village Ave was moderate; however, a short zone of stop-and-go flow was intermittently found where the HOV facility ends (just north of Clarksburg Rd).

B
Congestion Type: Mainline Congestion
Frequency: Most observations before 7:00 p.m.
Direction: Northbound
Location: From I-495 to Montrose Rd
Queue Length: 2 to 4 miles
Estimated Speed: 20 to 40 mph
Note: Severe northbound congestion was typically found in the two general-purpose lanes (non HOV) between the Beltway and the I-270 Western Spur. After the assimilation of traffic converging from I-270 and the Spur, moderate congestion persisted northbound on I-270 for several miles.

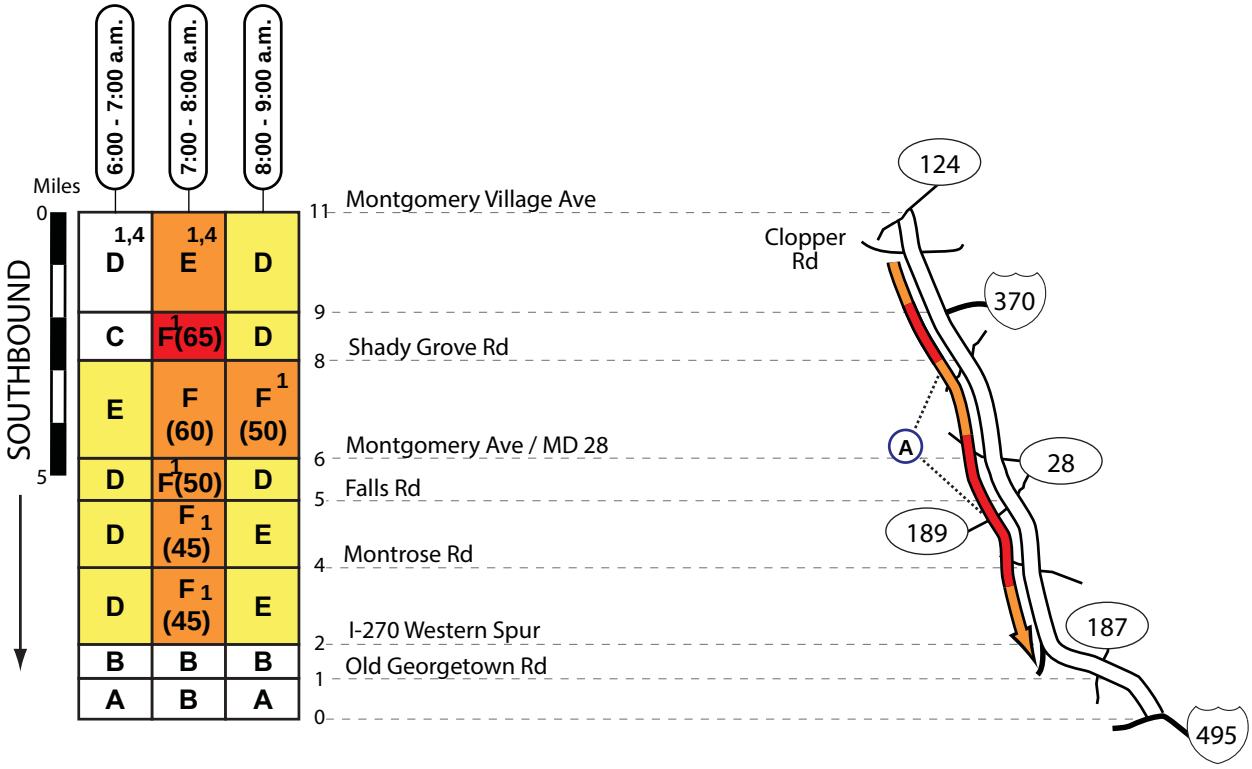
C
Congestion Type: Mainline Congestion
Frequency: Intermittently before 6:30 p.m.
Direction: Southbound
Location: I-270 approaching I-495 (Beltway)
Queue Length: 1 to 2 miles
Estimated Speed: 15 to 30 mph
Note: The last several segments of I-270 approaching the beltway appeared to serve as a “spillback zone” for congestion on the Beltway that occurred some evenings but not others; when congested, the tail of the queue was typically found somewhere between Old Georgetown Rd and the I-270 spur.



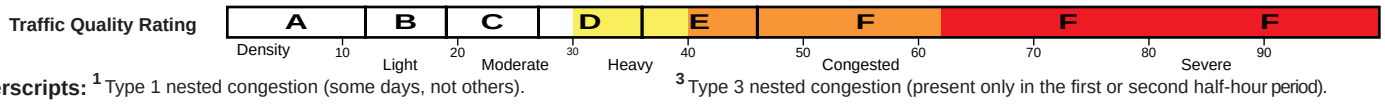
Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-270 (Maryland) Left Lane / Concurrent Flow HOV - Morning

HOV OPERATIONS
HOV 2
6:00 - 9:00 A.M.
SOUTHBOUND

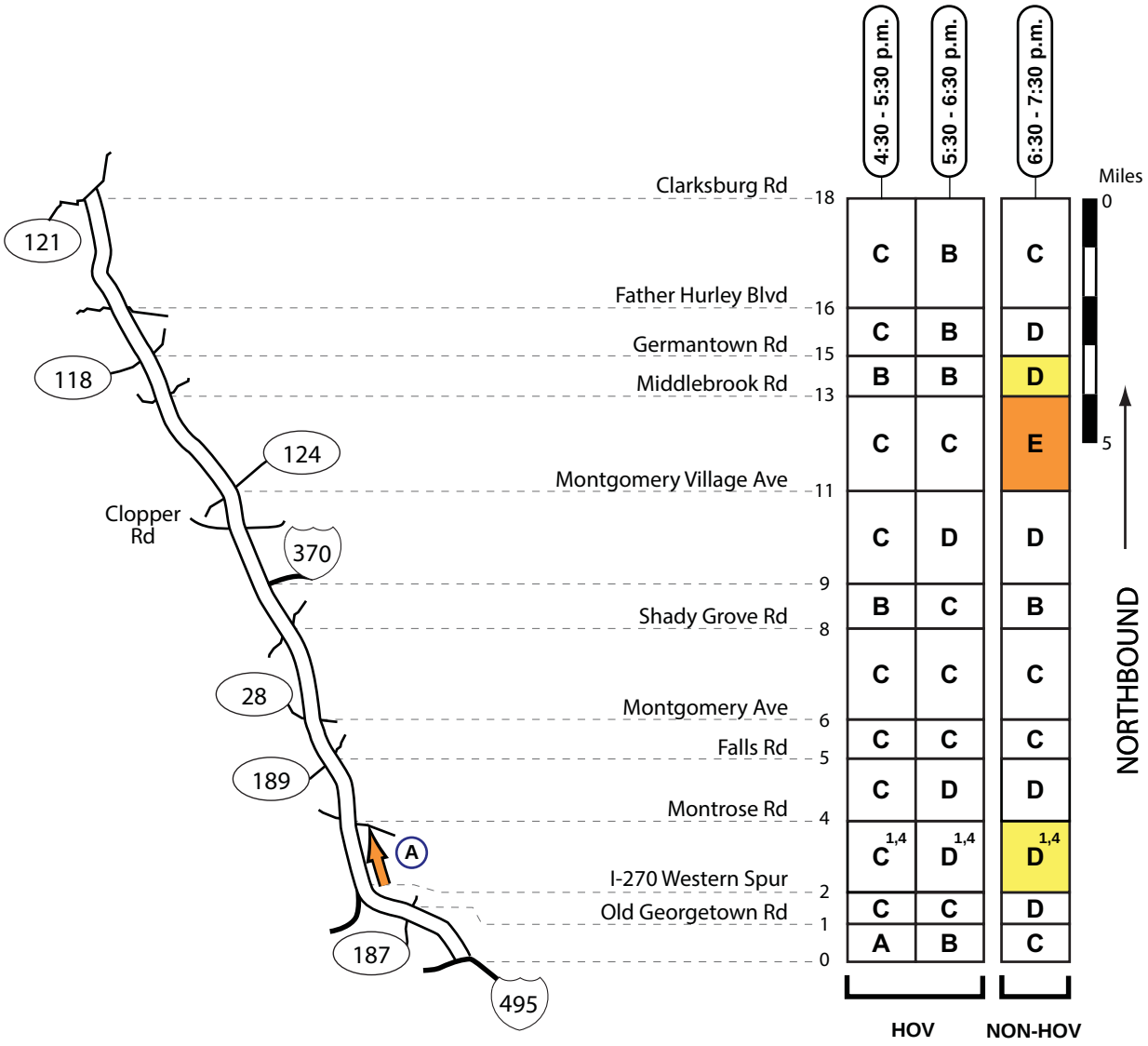


A
Congestion Type: Concurrent-flow HOV lane
Frequency: Most observations
Direction: Southbound
Location: MD 124 to I-270 Western Spur
Queue Length: 4 to 7 miles
Estimated Speed: 25 to 50 mph
Note: During the peak period, a mostly continuous zone of southbound congestion was found in the HOV lane between MD 124 and the I-270 Western Spur; intermittently, stop-and-go flow was found along this section of HOV facility.

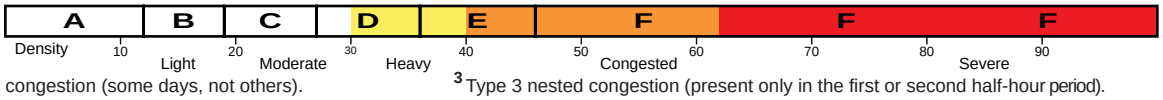


Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-270 (Maryland) Left Lane / Concurrent Flow HOV - Evening

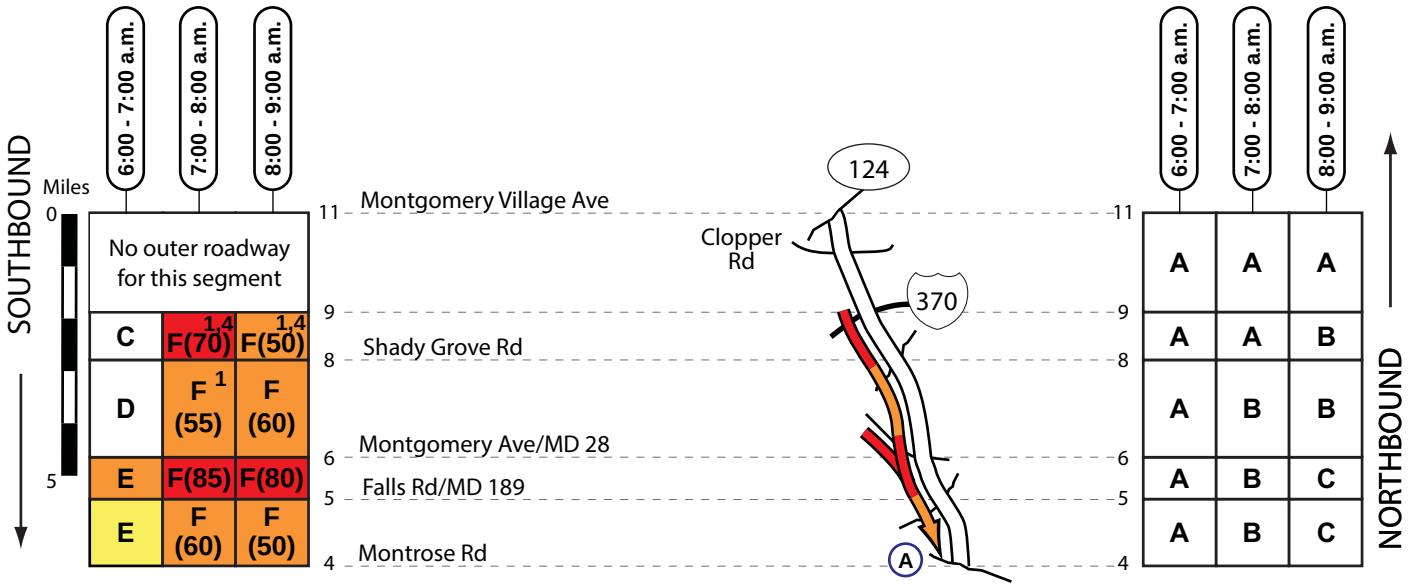


A
Congestion Type: Concurrent-flow HOV lane
Frequency: Intermittent
Direction: Northbound
Location: Vicinity of the I-270 Western Spur
Queue Length: 0.5 to 1 mile
Estimated Speed: 30 to 50 mph
Note: Intermittently, minor northbound congestion was found in the HOV facility (left lane) in the vicinity of the merge with traffic from I-270 and the I-270 Western Spur.



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-270 Local Lanes - Morning



A
Congestion Type: Mainline Congestion
Frequency: Most observations after 6:30 a.m.
Direction: Southbound
Location: Local lanes
Queue Length: 3 to 5 miles
Estimated Speed: 20 to 50 mph
Note: After 6:30 a.m., moderate to severe southbound congestion was typically found in the local lanes beginning at I-370 to the terminus just south of Montrose Rd. The primary bottlenecks were found at the following locations: 1) traffic entering at Shady Grove Rd and W. Montgomery Ave; 2) traffic merging from the express lanes into the Local Lanes.

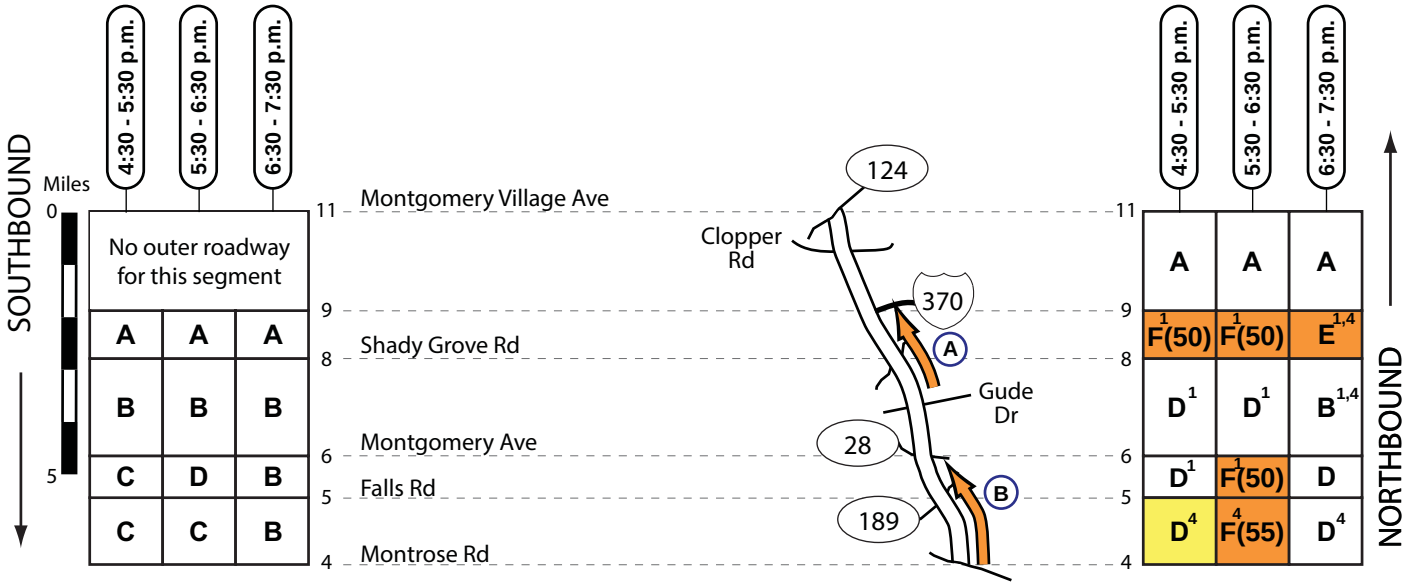
Traffic Quality Rating

A	B	C	D	E	F	F	F

Density 10 20 30 40 50 60 70 80 90
Light Moderate Heavy Congested Severe

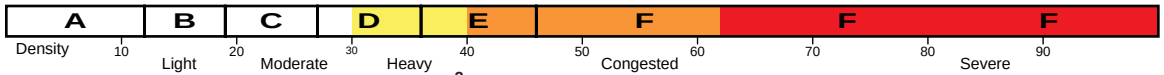
Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-270 Local Lanes - Evening



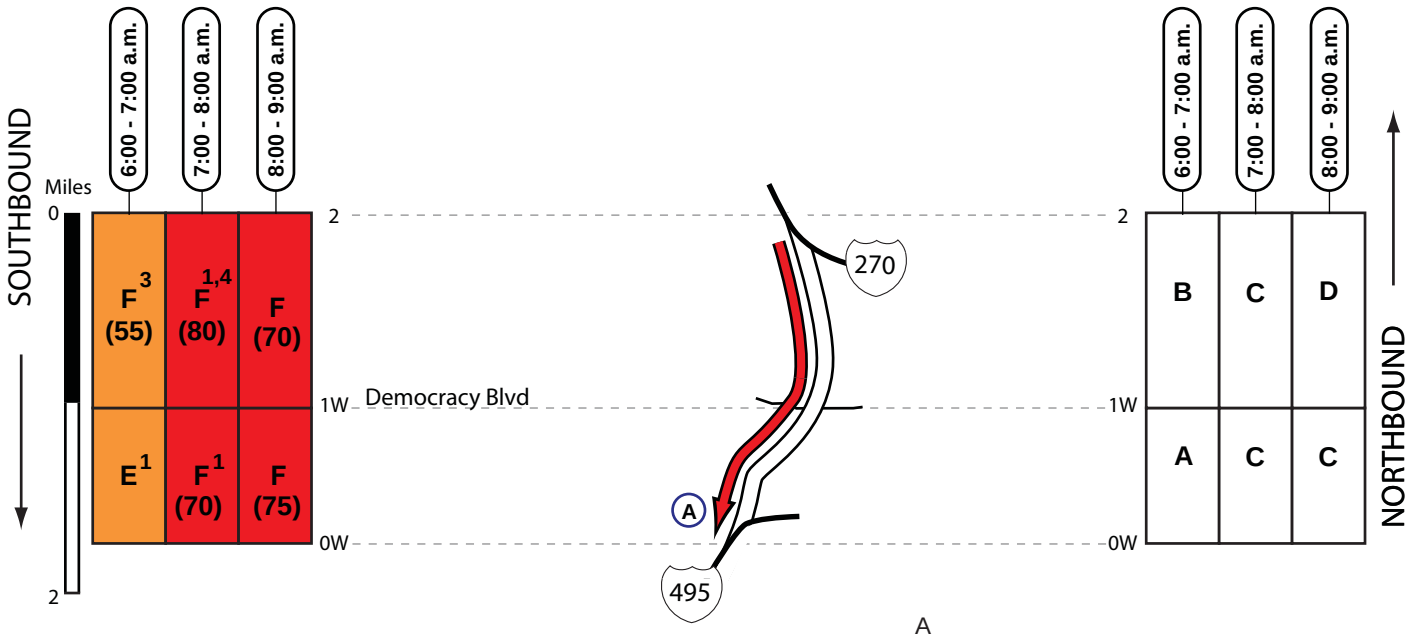
A
Congestion Type: Mainline Congestion
Frequency: All observations before 7:00 p.m.
Direction: Northbound
Location: Local lanes in the vicinity of Shady Grove Rd
Queue Length: 1 to 1.5 miles
Estimated Speed: 25 to 45 mph
Note: Northbound congestion in the vicinity of Shady Grove Rd was caused by the lane drop (2 lanes to 1), and weaving between the interchange ramps and the next crossover to the express lanes.

B
Congestion Type: Mainline Congestion
Frequency: Most observations between 5:00 and 6:30 p.m.
Direction: Northbound
Location: Local lanes between Montrose Rd and MD 28
Queue Length: 1 to 2 miles
Estimated Speed: 40 to 55 mph
Note: Northbound congestion in the local lanes was caused by traffic merging from the entrance ramps at Montrose Rd and Falls Rd.



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

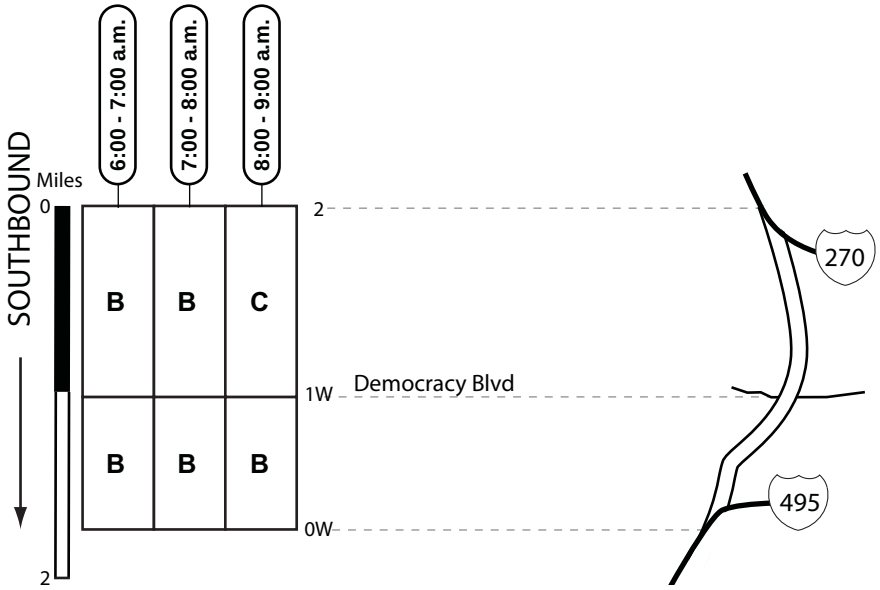
I-270 Western Spur (Maryland) - Morning

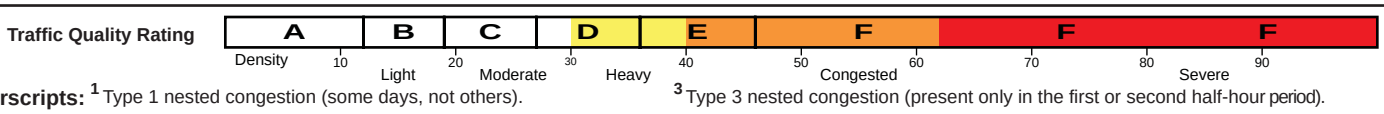


A
Congestion Type: Mainline Congestion
Frequency: All observations after 6:30 a.m.
Direction: Southbound
Location: Between I-270 and I-495
Queue Length: 1 to 2 miles
Estimated Speed: 25 to 40 mph
Note: Factors contributing to the congestion included: 1) the lane drop (3 lanes to 2) at Democracy Blvd; 2) traffic entering the mainline at Democracy Blvd; 3) the merge with I-495 traffic at the terminus of the Western Spur.

Left Lane / Concurrent Flow HOV - Morning

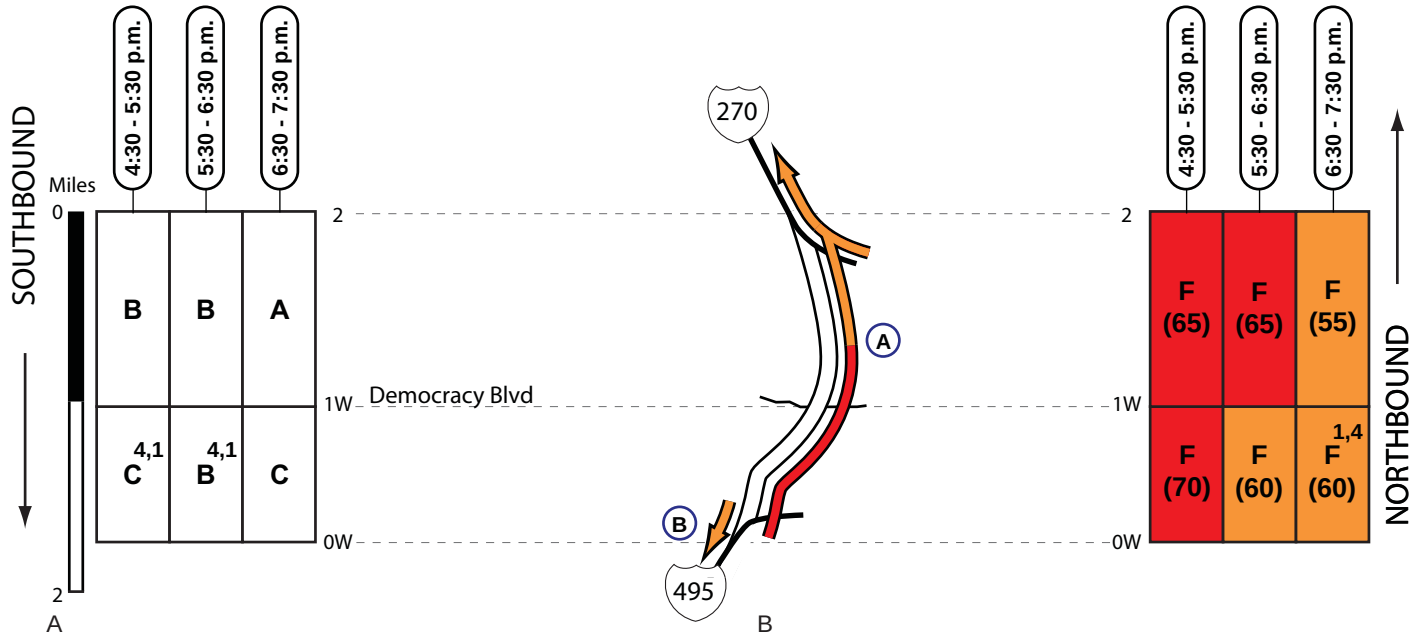
HOV OPERATIONS
HOV 2
6:00 - 9:00 A.M.
SOUTHBOUND





Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-270 Western Spur (Maryland) - Evening

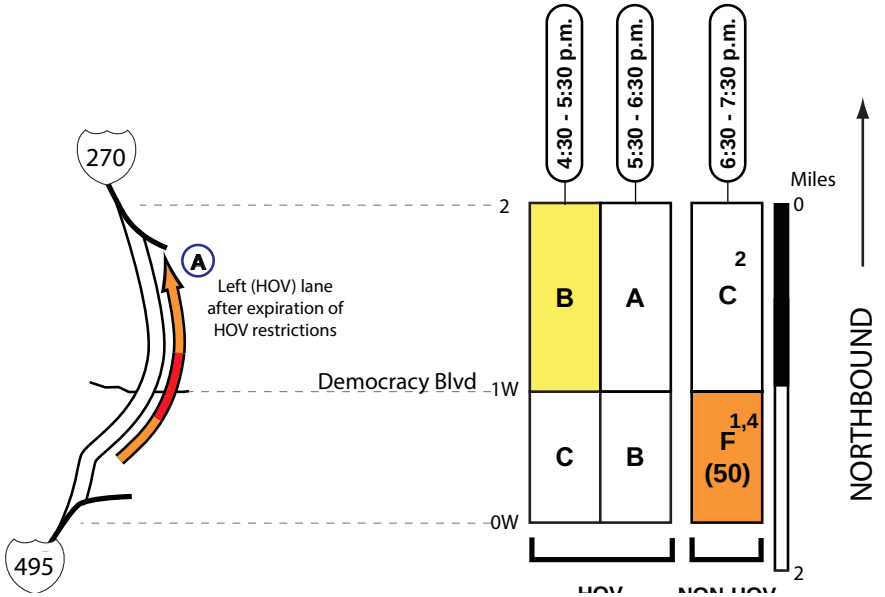


A
Congestion Type: Mainline Congestion
Frequency: Throughout the evening survey period
Direction: Northbound
Location: Between I-495 and I-270
Queue Length: 2 miles
Estimated Speed: 25 to 40 mph
Note: The primary bottlenecks were found where traffic entered the mainline at the Democracy Blvd entrance ramps.

B
Congestion Type: Mainline Congestion
Frequency: One Day Only
Direction: Southbound
Location: Western spur
Queue Length: 0.5 miles
Estimated Speed: 20 to 30 mph
Note: A short zone of severe southbound congestion was found at the terminus of the western spur where vehicles from the Spur merged into southbound congestion on the outer loop of the beltway.

Left Lane / Concurrent Flow HOV - Evening

HOV OPERATIONS
HOV 2
3:30 - 6:30 P.M.
NORTHBOUND



A
Congestion Type: Left Lane after HOV restrictions
Frequency: Both observations after 6:30 p.m.
Direction: Northbound
Location: Between I-495 and Democracy Blvd
Queue Length: 0.5 to 1 mile
Estimated Speed: 30 to 50 mph
Note: Northbound travelers in the left-concurrent flow HOV lane were not delayed until after restrictions were lifted after 6:30 p.m.

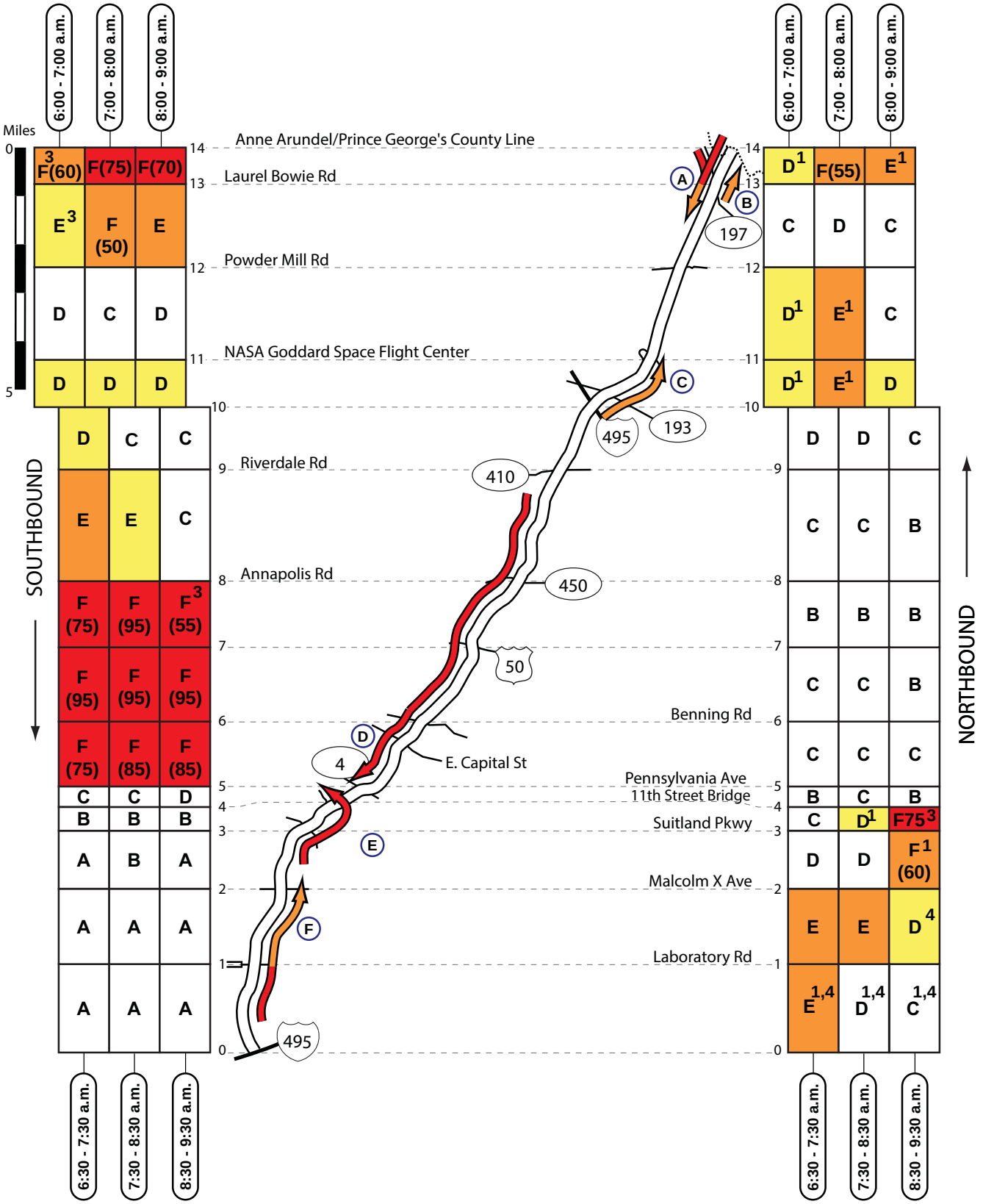
Traffic Quality Rating

A	B	C	D	E	F	F	F

Density 10 20 30 40 50 60 70 80 90
Light Moderate Heavy Congested Severe

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-295/D.C. 295/Kenilworth Ave/Baltimore-Washington Parkway - Morning



Traffic Quality Rating

A	B	C	D	E	F	F	F

Density: 10 Light, 20 Moderate, 30 Heavy, 40, 50 Congested, 60, 70, 80 Severe, 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).

[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-295/D.C. 295/Kenilworth Ave/Baltimore-Washington Parkway - Morning

A
Congestion Type: Mainline Congestion
Frequency: All observations between 6:30 and 9:00 a.m.
Direction: Southbound
Location: Between the Anne Arundel County Line and MD 197
Queue Length: 1 to 2 miles
Estimated Speed: 20 to 40 mph
Note: The primary bottleneck was found where traffic entered at MD 197; a short acceleration lane appeared to contribute to the congestion.

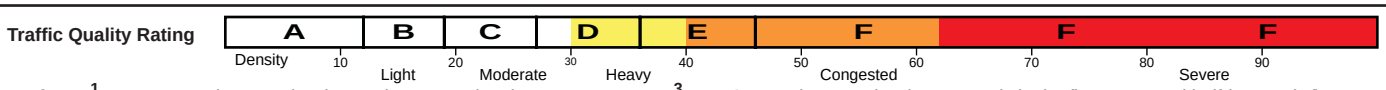
B
Congestion Type: Mainline Congestion
Frequency: Most observations after 7:00 a.m.
Direction: Northbound
Location: In the vicinity of MD 197
Queue Length: 0.5 to 1 mile
Estimated Speed: 35 to 50 mph
Note: Congestion appeared to be caused by traffic entering at MD 197; in some cases, stop and go flow was found approaching the merge at MD 197.

C
Congestion Type: Mainline Congestion
Frequency: Intermittent
Direction: Northbound
Location: Between I-495 and NASA Goddard Space Flight Center Interchange
Queue Length: 1 to 1.5 miles
Estimated Speed: 30 to 50 mph
Note: Congestion appeared to be caused by traffic entering at MD 193 (Greenbelt Rd).

D
Congestion Type: Mainline Congestion
Frequency: All observations during the morning survey period
Direction: Southbound
Location: Between MD 410 (Riverdale Rd) and MD 4 (Pennsylvania Ave)
Queue Length: 4 to 5 miles
Estimated Speed: 15 to 25 mph
Note: Factors contributing to the congestion were: 1) traffic entering and exiting at the series of interchanges along this section of MD/DC 295; and 2) congestion on the eastbound US 50 ramp backing into the mainline on MD 295. Southbound vehicles consistently resumed free flow speeds south of the MD 4 Interchange.

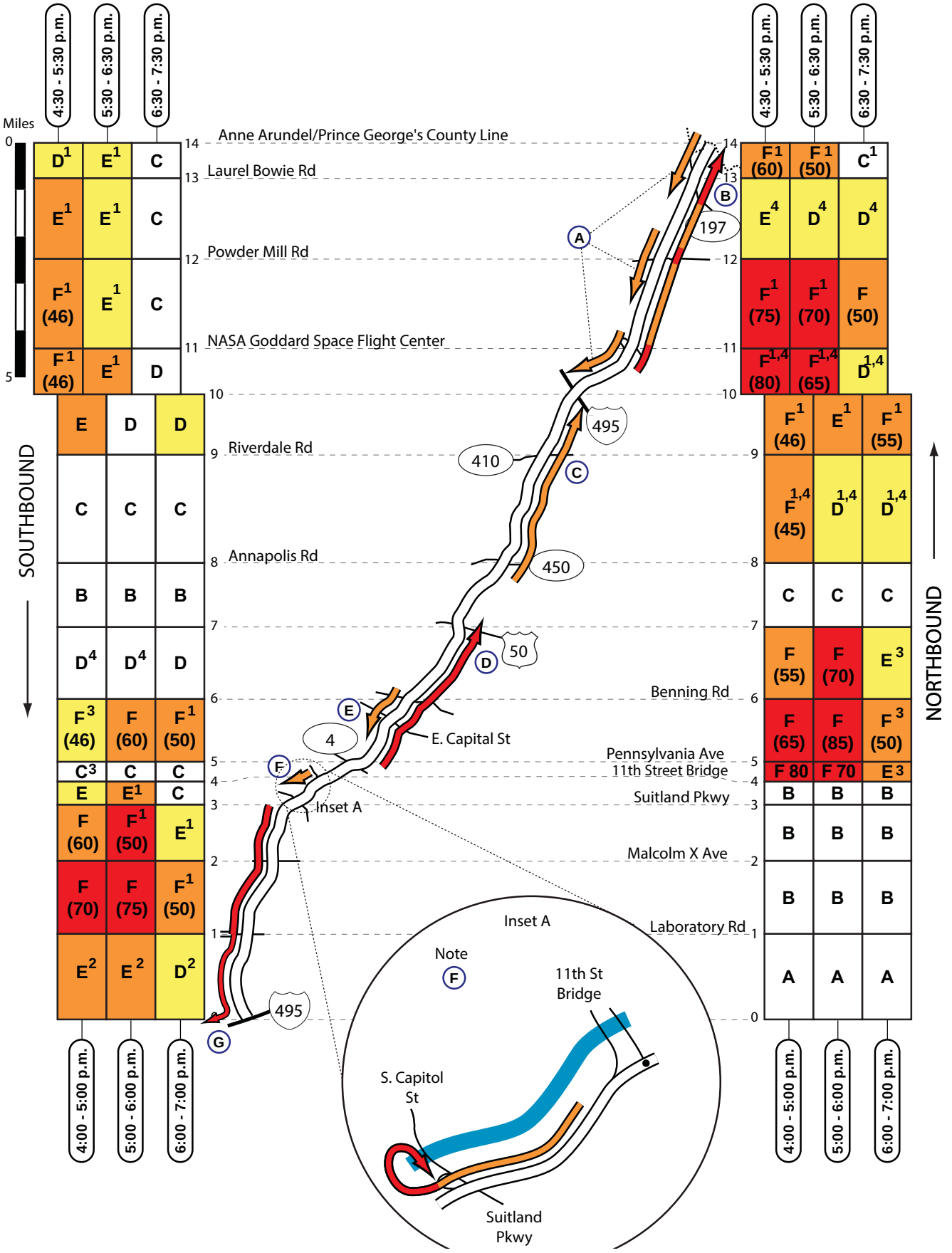
E
Congestion Type: Mainline Congestion
Frequency: Most observations after 8:00 a.m.
Direction: Northbound
Location: Between Malcolm X Blvd and the 11th Street Bridge
Queue Length: 1 to 3 miles
Estimated Speed: 10 to 50 mph
Note: The head of the queue was found on the 11th St Bridge where northbound and southbound traffic merged; vehicles on the 2 lane ramps from each direction assimilated on the bridge (3 lanes).

F
Congestion Type: Mainline Congestion
Frequency: Between 7:00 and 8:00 a.m.
Direction: Northbound
Location: Between I-495 and Malcolm X Ave
Queue Length: 2 to 3 miles
Estimated Speed: 30 to 50 mph
Note: The primary bottleneck was the series of lane drops (4 lanes to 3 and 3 lanes to 2) at the Laboratory Rd interchange.



Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

I-295/D.C. 295/Kenilworth Ave/Baltimore-Washington Parkway - Evening



Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	20	30	40	50	60	70	80	90
Light	Moderate	Heavy	Congested	Severe

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-295/D.C. 295/Kenilworth Ave/Baltimore-Washington Parkway - Evening

A
Congestion Type: Minor mainline congestion
Frequency: Most observations before 6:30 p.m.
Direction: Southbound
Location: Between Anne Arundel County Line and I-495
Queue Length: 1 to 3 miles (Intermittent)
Estimated Speed: 40 to 50 mph
Note: Southbound congestion along this corridor was found on some days and not others; when congested, traffic entering the mainline at the interchanges appeared to cause delays.

B
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Northbound
Location: Between I-495 and the Anne Arundel County Line
Queue Length: 3 to 6 miles
Estimated Speed: 20 to 45 mph
Note: The primary cause of congestion appeared to be traffic entering at NASA, Powder Mill Rd and MD 197; intermittently, stop-and-go flow was found in the vicinity of these interchanges

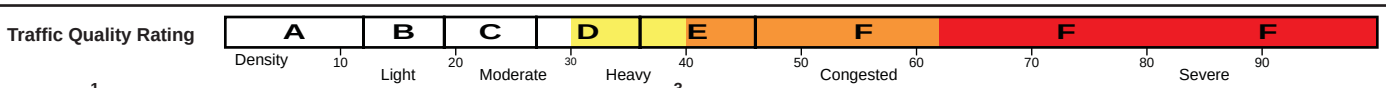
C
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Northbound
Location: Between MD 450 and I-495
Queue Length: 3 to 4 miles
Estimated Speed: 25 to 45 mph
Note: Merging and weaving at MD 450, Riverdale Rd and I-495 appeared to exacerbate the congestion.

D
Congestion Type: Mainline Congestion
Frequency: Throughout the evening survey period
Direction: Northbound
Location: Between 11th St Bridge and US 50
Queue Length: 3 to 4 miles
Estimated Speed: 15 to 35 mph
Note: The head of the queue was found on the ramp to US 50 (eastbound); congestion on the ramp extended back into the right lane, and eventually across all lanes. Congestion was also exacerbated by vehicles entering the mainline at the series of interchanges along this corridor.

E
Congestion Type: Mainline Congestion
Frequency: Most observations after 4:30 p.m.
Direction: Southbound
Location: Between Benning Rd and Pennsylvania Ave
Queue Length: 1 to 2 miles
Estimated Speed: 30 to 50 mph
Note: Traffic entering at Benning Rd, E. Capital St and Pennsylvania Ave appeared to exacerbate the congestion.

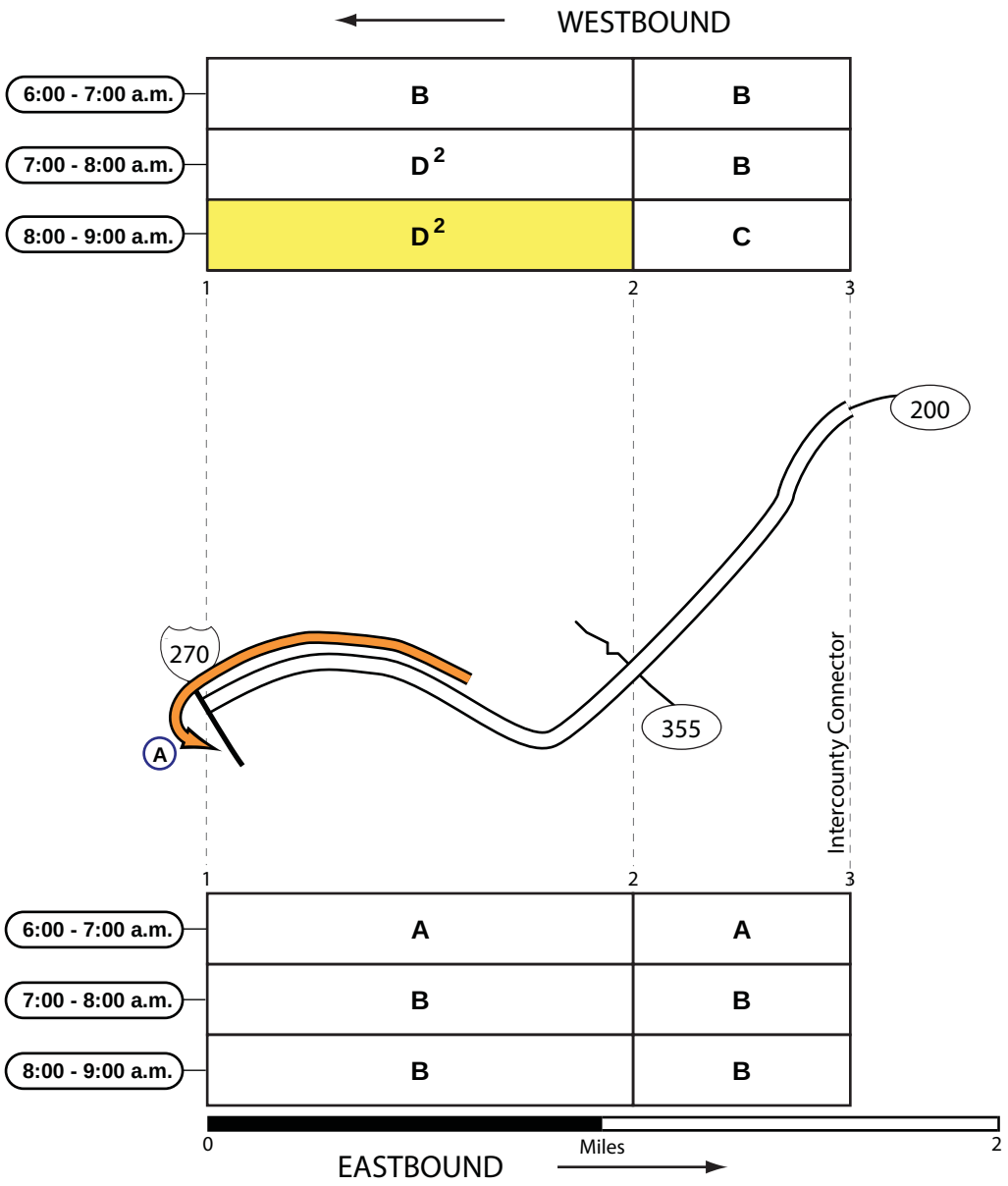
F
Congestion Type: Mainline congestion and exit ramp queue
Frequency: Intermittent
Direction: Southbound
Location: Approaching Suitland Parkway
Queue Length: 0.5 to 1 mile
Estimated Speed: 30 to 50 mph
Note: The ramp to Suitland Parkway was typically congested; however, ramp congestion extended back into the mainline during one observation only.

G
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Southbound
Location: Between the 11th St Bridge and I-495
Queue Length: 4 to 5 miles
Estimated Speed: 20 to 50 mph
Note: The head of the queue was found on the ramp to the Beltway (westbound); congestion on the ramp extended back into the right lane, and eventually across all lanes on I-295. Congestion was also exacerbated by traffic entering at Laboratory Rd. and S. Capital St.

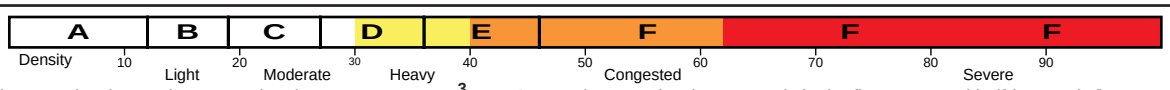


Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

I-370 - Morning

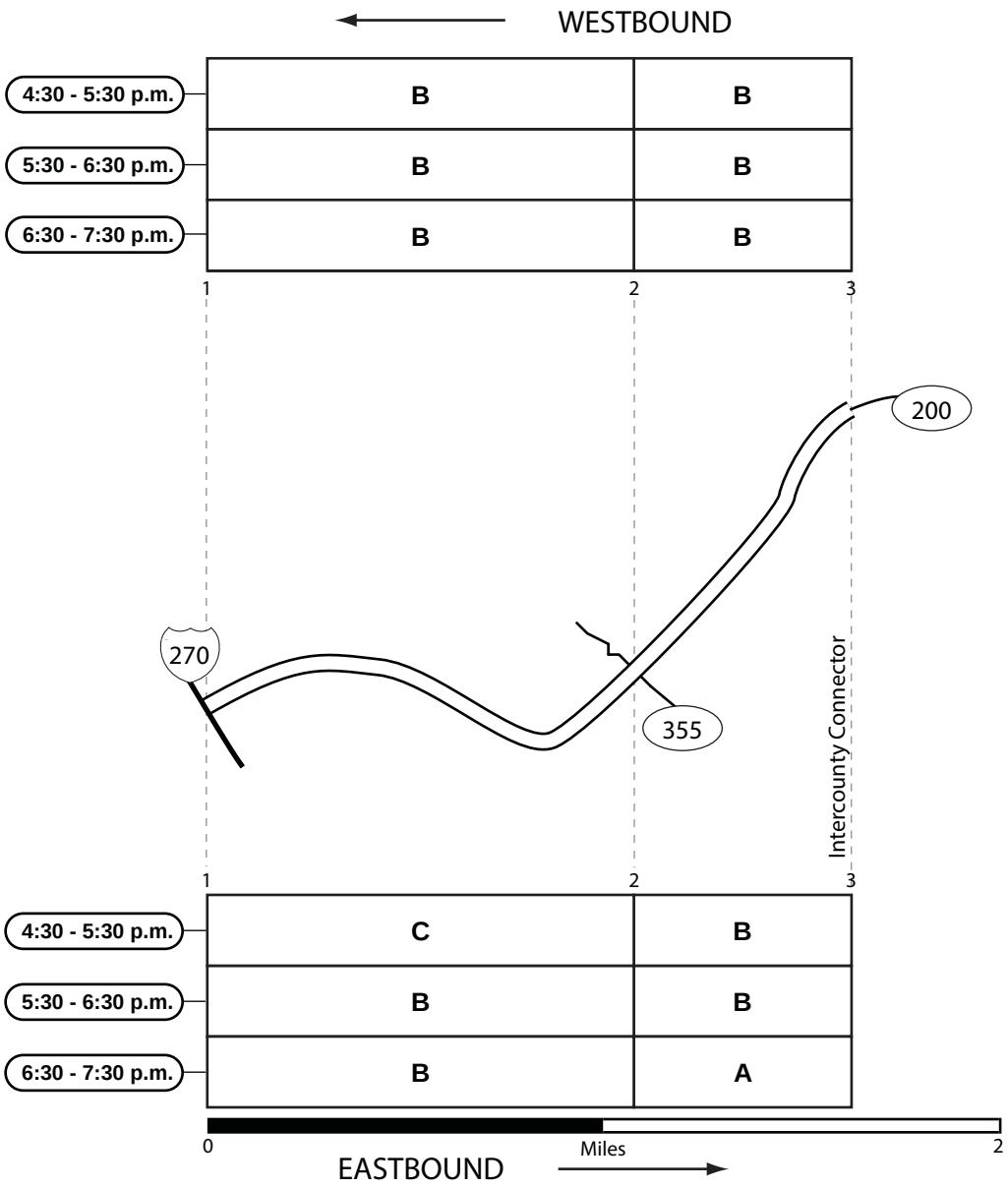


A
Congestion Type: Mainline Congestion (left lane)
Frequency: Intermittent
Direction: Westbound
Location: Between MD 355 and I-270
Queue Length: 0.5 to 1 mile
Estimated Speed: 15-30 mph
Note: During some observations, congestion on the ramp to southbound I-270 extended back Into the left lane on I-370.



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-370 - Evening



Traffic Quality Rating

A	B	C	D	E	F	F	F

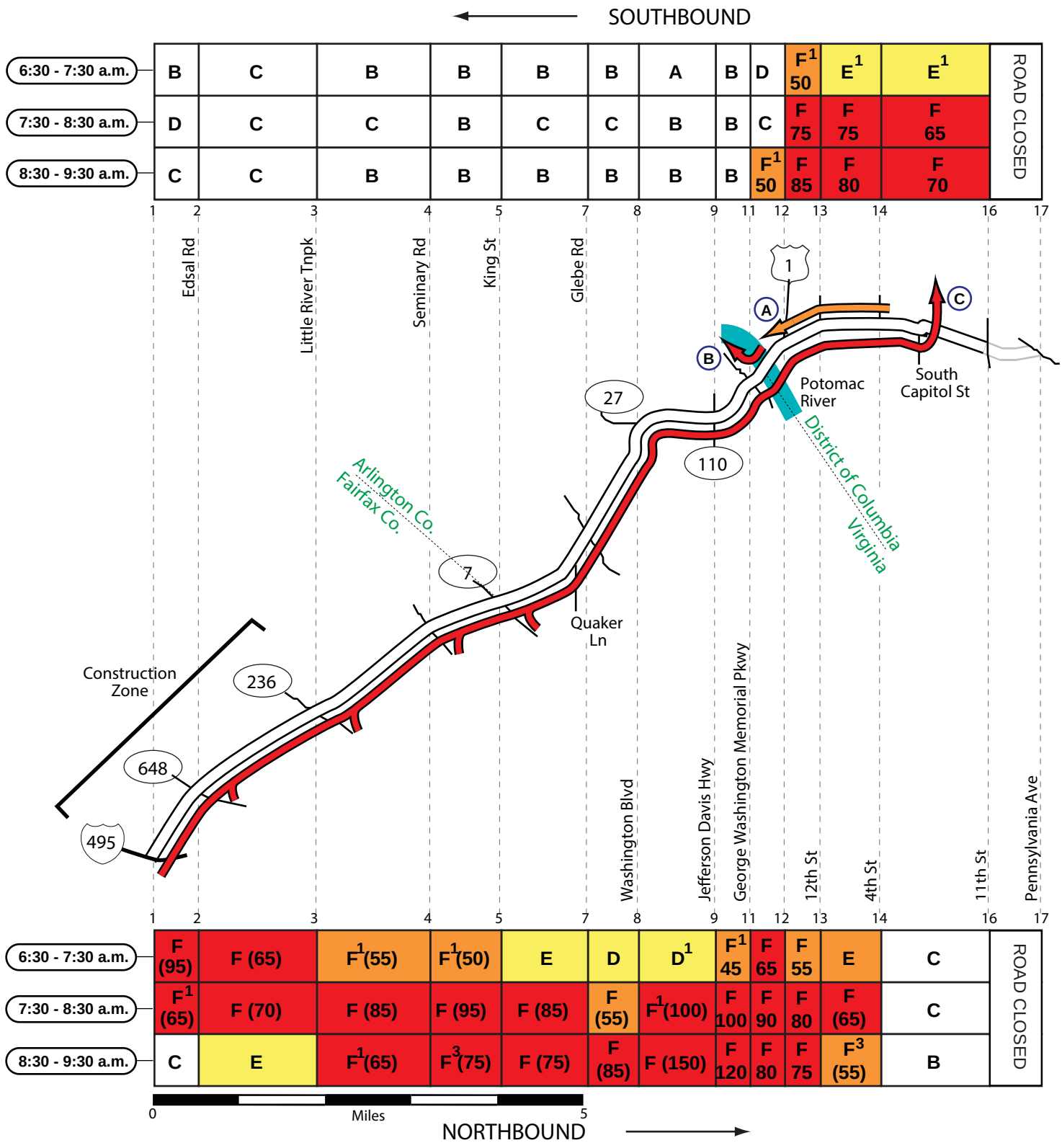
Density 10 20 30 40 50 60 70 80 90

Light Moderate Heavy Congested Severe

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).

[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-395/Southeast/Southwest Freeway (Virginia/District of Columbia) - Morning



	1	2	3	4	5	7	8	9	11	12	13	14	16	17
6:30 - 7:30 a.m.	B	C	B	B	B	B	A	B	D	F[1] 50	E[1]	E[1]	ROAD CLOSED	
7:30 - 8:30 a.m.	D	C	C	B	C	C	B	B	C	F 75	F 75	F 65		
8:30 - 9:30 a.m.	C	C	B	B	B	B	B	B	F[1] 50	F 85	F 80	F 70		

	1	2	3	4	5	7	8	9	11	12	13	14	16	17
6:30 - 7:30 a.m.	F (95)	F (65)	F[1](55)	F[1](50)	E	D	D[1]	F[1] 45	F 65	F 55	E	C	ROAD CLOSED	
7:30 - 8:30 a.m.	F[1] (65)	F (70)	F (85)	F (95)	F (85)	F (55)	F[1](100)	F 100	F 90	F 80	F (65)	C		
8:30 - 9:30 a.m.	C	E	F[1](65)	F[3](75)	F (75)	F (85)	F (150)	F 120	F 80	F 75	F[3] (55)	B		

Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

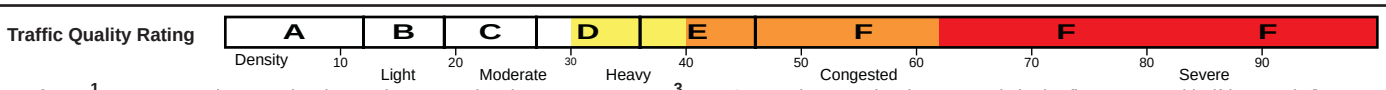
Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-395/Southeast/Southwest Freeway (Virginia/District of Columbia) - Morning

A
Congestion Type: Mainline Congestion
Frequency: All observations after 7:00 a.m.
Direction: Westbound
Location: Between South Capitol St & the 14th Street Bridge
Queue Length: 1.0 to 1.5 miles
Estimated Speed: 15 to 30 mph
Note: The primary bottlenecks were found at two separate lane drops: 1) 5 lanes to 3 just before the Case Bridge; 2) 3 lanes to 2 at the start of the HOV facility.

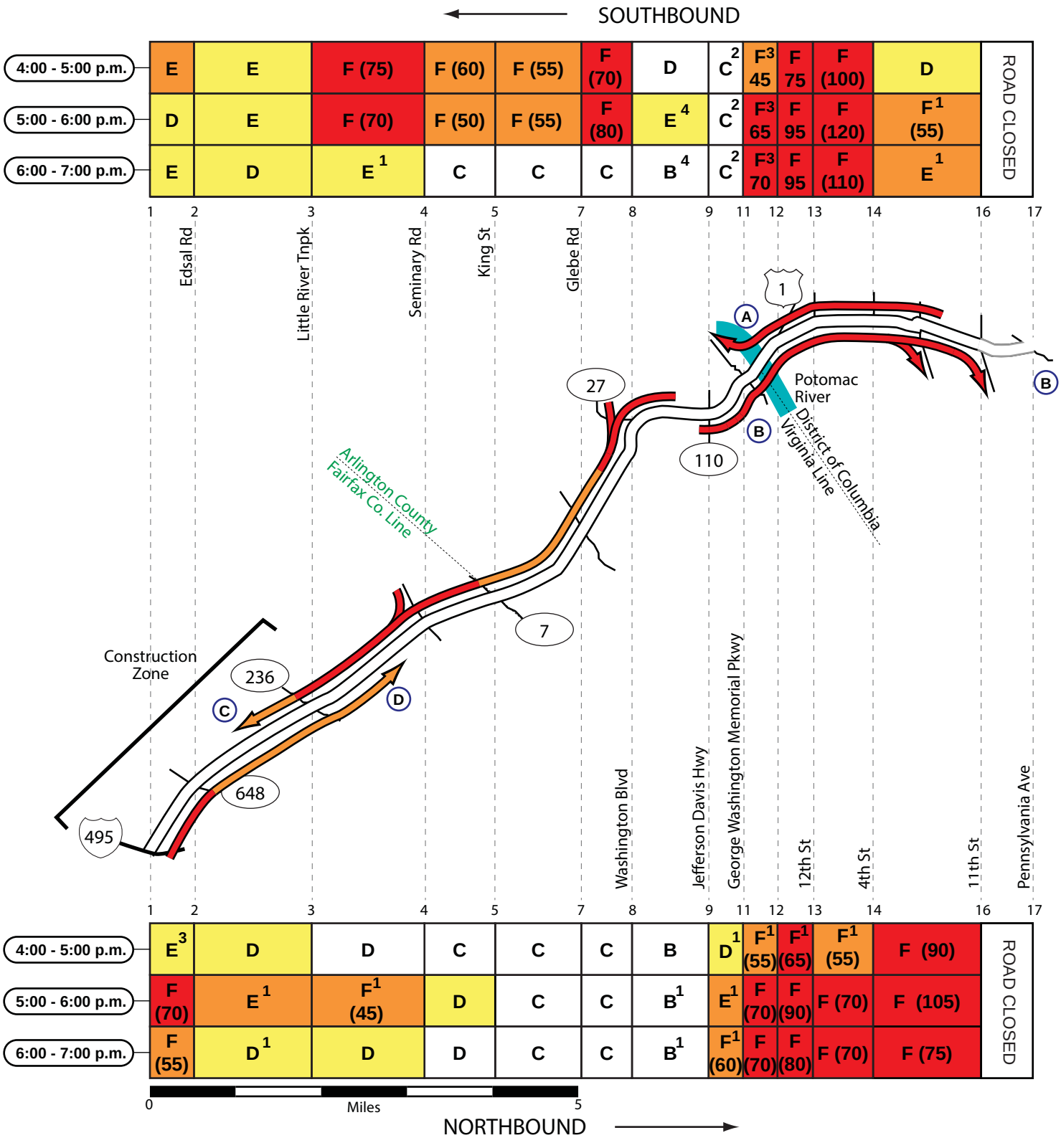
B
Congestion Type: Exit Ramp Queue
Frequency: Intermittent (8:30-9:30 a.m.)
Direction: Southbound
Location: George Washington Memorial Parkway
Queue Length: 0.5 miles
Note: On 2 of 3 mornings after 8:30 a.m., congestion on the GWP ramp extended back into the right lane on the 14th St Bridge; congestion was not found exiting at the GWP during any other observations.

C
Congestion Type: Mainline Congestion
Frequency: Throughout the morning survey period
Direction: Northbound
Location: Between I-495 & the 3rd St Tunnel in Washington D.C. (I-395 terminus)
Queue Length: 10 to 12 miles
Estimated Speed: 10 to 25 mph
Note: Before 7:30 a.m., there were typically two distinct queues on I-395. The first was between I-495 and vicinity of Seminary Rd, and the second between George Washington Memorial Pkwy (GWP) and the 3rd St Tunnel in Washington D.C. (I-395 terminus). During the peak period (7:30-8:30), a mostly continuous queue was found the entire length between I-495 and the 3rd St Tunnel; the most severe congestion along this corridor was approaching the GWP/14th Street Bridge. Later in the survey period, the tail of the queue shortened such that mostly free flow speeds were found north of I-495 Interchange to the vicinity of Little River Turnpike.



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-395/Southeast/Southwest Freeway (Virginia/District of Columbia) - Evening



Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

I-395/Southeast/Southwest Freeway (Virginia/District of Columbia) - Evening

A
Congestion Type: Mainline Congestion
Frequency: Throughout the evening survey period
Direction: Westbound / Southbound
Location: Between 11th St & the George Washington Memorial Pkwy
Queue Length: 2 to 3 miles
Estimated Speed: 15 to 40 mph
Note: Factors contributing to the congestion were: 1) the lane drop (5 lanes to 3) just before the Case Bridge; 2) the lane drop (3 lanes to 2) at the start of the HOV facility; 3) traffic entering at the series of on-ramps along the Southwest Freeway; 4) congestion on the George Washington Parkway ramps extending back into the mainline on the 14 Street Bridge.

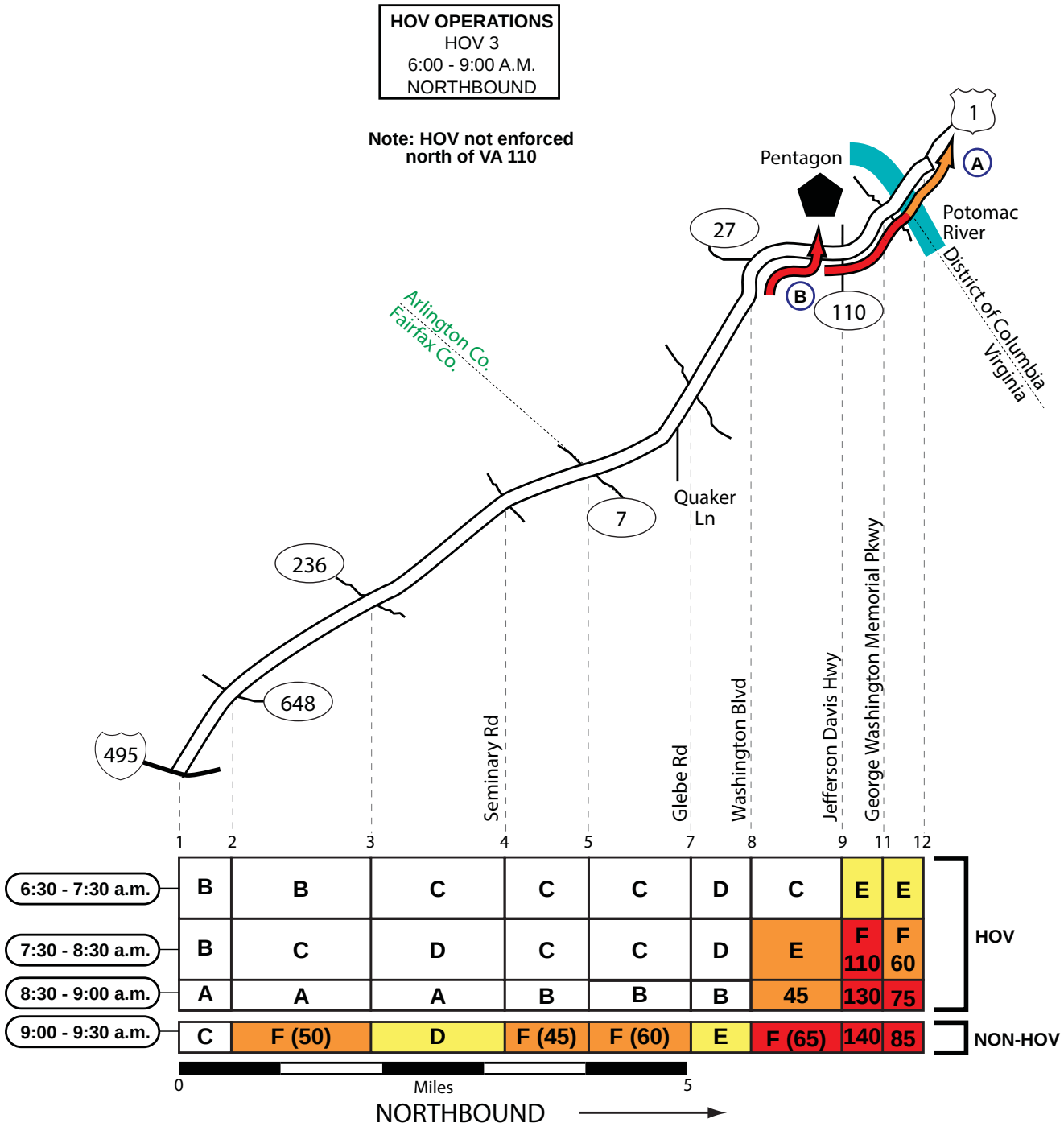
B
Congestion Type: Mainline Congestion
Frequency: Throughout the evening survey period
Direction: Northbound / Eastbound
Location: Between VA 110 (Jefferson Davis Hwy) and the 11th St Bridge
Queue Length: 3 to 4 miles
Estimated Speed: 15 to 40 mph
Note: Factors contributing to the congestion were: 1) traffic entering at George Washington Memorial Parkway; 2) HOV traffic entering the mainline at the Case Bridge (HOV terminus); 3) congestion on the ramp to South Capitol St that extended back into the mainline. Eastbound congestion on Southeast Expressway continued across the 11th Street Bridge and onto the ramp to northbound I-295.

C
Congestion Type: Mainline Congestion
Frequency: All observations before 6:00 p.m.
Direction: Southbound
Location: Between VA 110 (Jefferson Davis Hwy) & VA 236 (Little River Turnpike)
Queue Length: 5 to 6 miles
Estimated Speed: 20 to 45 mph
Note: Southbound congestion on I-395 was very similar to that found during the two previous surveys in 2008 and 2011. During the peak period, southbound travelers normally encountered congestion in the vicinity of Washington Blvd (VA 27); congestion typically persisted south for approximately seven miles to VA 236 (Little River Turnpike). The primary bottleneck was found at the lane drop (4 lanes to 3) at Little River Turnpike (VA 236); traffic entering the mainline at VA 110, VA 27 and Seminary Rd exacerbated the congestion.

D
Congestion Type: Mainline Congestion
Frequency: Most observations after 4:30 p.m.
Direction: Northbound
Location: Between I-495 and Seminary Rd
Queue Length: 2 to 4 miles
Estimated Speed: 25 to 45 mph
Note: Construction likely caused the congestion as free flow speeds have historically been documented along this section of I-395. Congestion was more severe approaching Edsall Rd where vehicles from the I-495 ramps and I-95 assimilated. North of Edsall Rd, congestion was found between 5:00 and 5:30 p.m. only.

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-395/SE Fwy (Virginia/District of Columbia) Barrier Separated HOV - Morning



Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

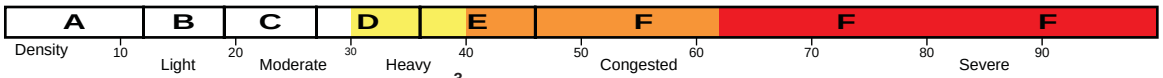
Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-395/SE Fwy (Virginia/District of Columbia) Barrier Separated HOV - Morning

A
Congestion Type: HOV Congestion
Frequency: Most observations
Direction: Northbound
Location: Approaching and across the 14th St Bridge
Queue Length: 0.5 to 1.5 miles
Estimated Speed: 10 to 40 mph
Note: The head of the queue was found on the ramp where HOV traffic merges with the general-purpose lanes at the Case Bridge (Note: HOV restrictions are not enforced north of VA 110). Congestion was particularly severe where traffic entered the HOV facility in the vicinity of VA 110.

B
Congestion Type: HOV Congestion
Frequency: Early in the survey period (before 8:00 a.m.)
Direction: Northbound
Location: Approaching the exit to the Pentagon (Eads St)
Queue Length: 0.5 miles
Note: The northbound exit ramp to the Pentagon at Eads Rd was intermittently congested; when congested, the ramp queue extended back into the right lane in the HOV facility (stop-and-go congestion).

Note: After HOV restrictions (9:00 a.m.), northbound congestion was found in the barrier separated facility between Seminary Rd and the termination at the Case Bridge in Washington, D.C. Congestion approaching the 14th Street Bridge was similar to that found in the general-purpose lanes (severe).

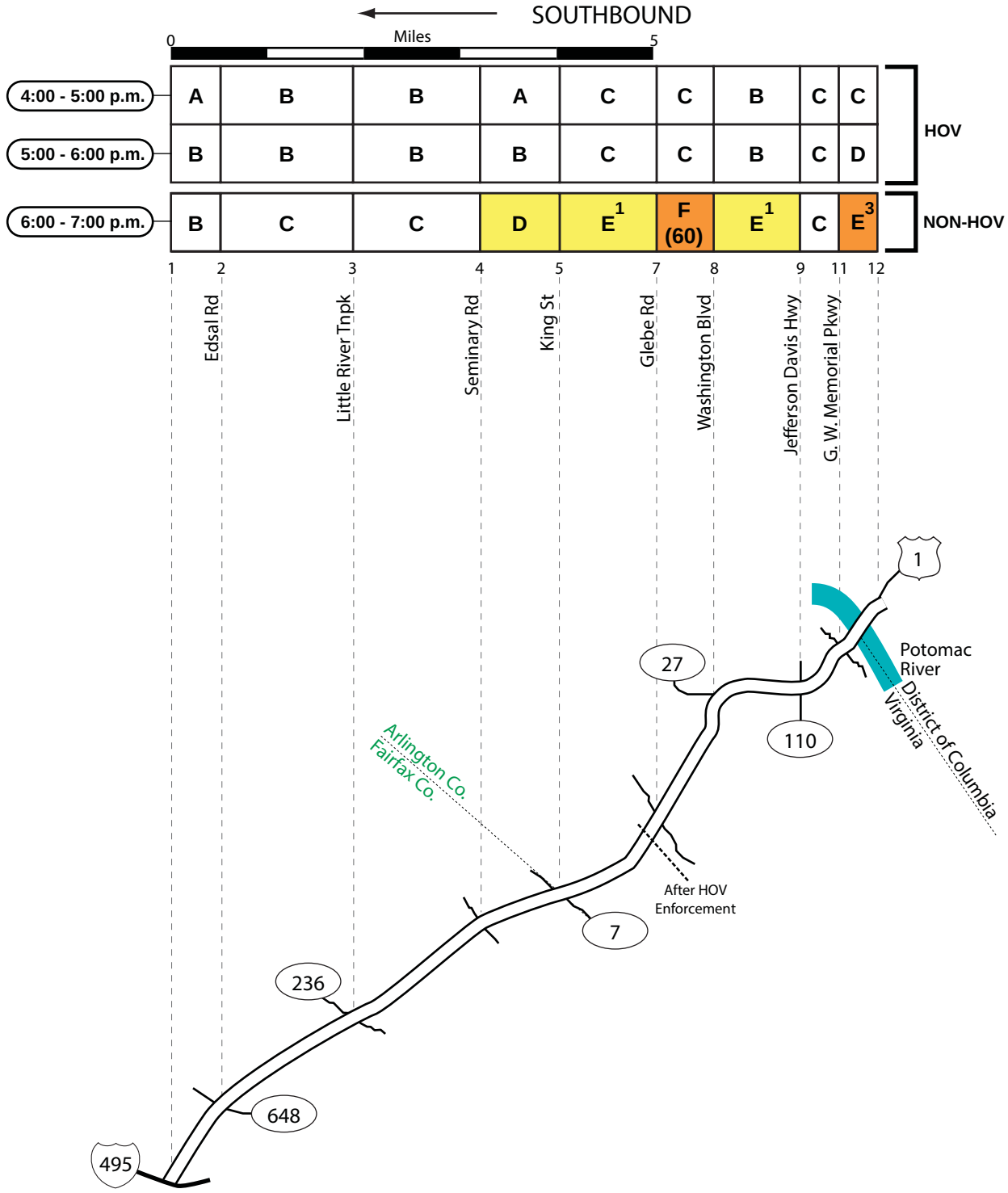


Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-395/SE Fwy (Virginia/Distict of Columbia) Barrier Separated HOV - Evening

HOV OPERATIONS
HOV 3
3:30 - 6:00 P.M.
SOUTHBOUND

Note: HOV not enforced north of VA 110



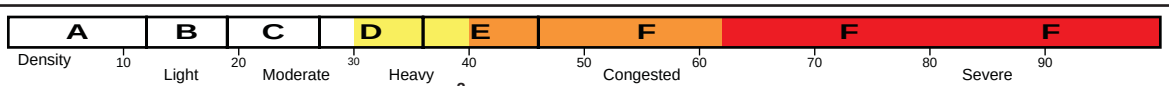
Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

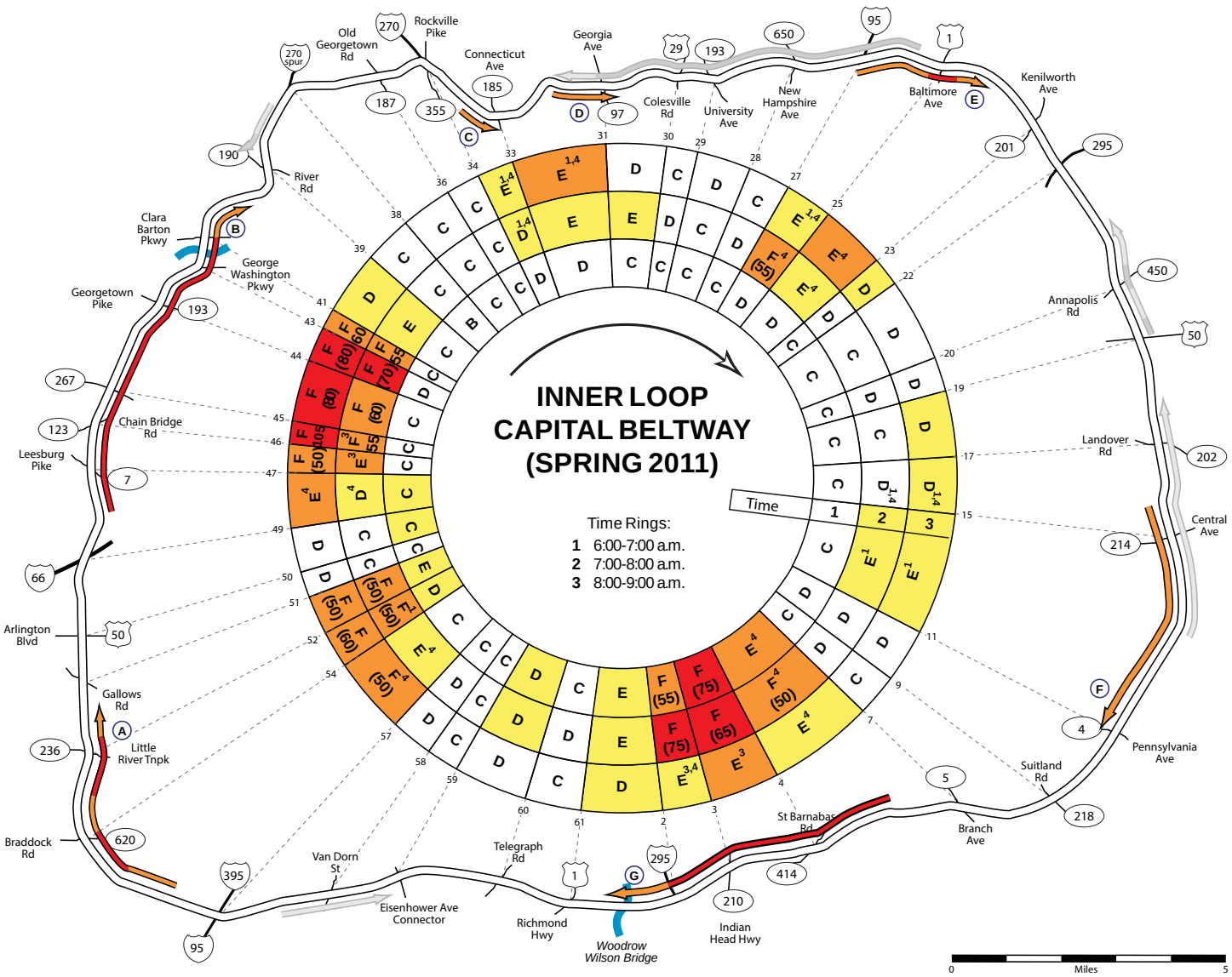
I-395/SE Fwy (Virginia/Distict of Columbia) Barrier Separated HOV - Evening

Note: During HOV enforcement (4:00-6:00 p.m.), southbound vehicles in the HOV facility typically traveled at free flow speeds; after 6:00 p.m., moderate southbound congestion was found crossing the 14th Street Bridge, and again farther south between VA 110 and Glebe Rd.



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-495/95 Capital Beltway (Inner Loop) - Morning



*note: Gray arrows represent Outer Loop Congestion (see pages 66-67)

Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10		20	30	40	50	60	70	80	90
Light		Moderate		Heavy		Congested			Severe

Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

I-495/95 Capital Beltway (Inner Loop) - Morning

A
Congestion Type: Mainline Congestion
Frequency: Most observations after 7:00 a.m.
Direction: Northbound / Inner Loop
Location: Between I-95/395 & VA 236 (Little River Turnpike)
Queue Length: 3 to 5 miles
Estimated Speed: 25 to 50 mph
Note: Traffic entering the mainline at I-395/95, Braddock Rd and Little River Turnpike appeared to exacerbate the congestion; north of Little River Turnpike, vehicles on the Inner Loop typically resumed free flow speeds until the vicinity of the I-66 Interchange.

B
Congestion Type: Mainline Congestion
Frequency: All observations after 7:00 a.m.
Direction: Northbound / Inner Loop
Location: Between I-66 & The American Legion Bridge
Queue Length: 3 to 6 miles
Estimated Speed: 20 to 40 mph
Note: The primary bottlenecks along this section of the Inner loop were found where traffic entered the mainline at the VA 267 ramps and just downstream of VA 267 where the HOV facility terminates (HOV vehicles merge into the left lane on the Inner Loop). Inner loop congestion found later in the morning survey period was exacerbated by sun glare; after crossing from Virginia into Maryland on the American Legion Bridge, the roadway bends sharply to the right into the direction of the sun (eastbound).

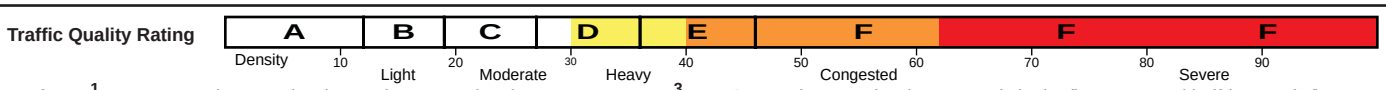
C
Congestion Type: Minor mainline congestion
Frequency: Intermittent
Direction: Eastbound / Inner Loop
Location: Between I-270 and Connecticut Ave (MD 185)
Queue Length: 0.5 to 1.5 miles
Estimated Speed: 40 to 50 mph
Note: Factors contributing to the mainline congestion included: 1) traffic merging from the left (vehicles from I-270 southbound); 2) highway curves; 3) weaving associated with the Connecticut Ave interchange.

D
Congestion Type: Minor mainline congestion
Frequency: Intermittent
Direction: Eastbound / Inner Loop
Location: Approaching MD 97
Queue Length: 0.5 to 1.5 miles
Estimated Speed: 40 to 55 mph
Note: Heavy eastbound flow at slightly reduced speeds was intermittently found approaching the interchange at MD 97 (Georgia Ave).

E
Congestion Type: Mainline Congestion
Frequency: Most observations after 7:00 a.m.
Direction: Eastbound
Location: Between I-95 and Greenbelt Metro Station
Queue Length: 1 to 2 miles
Estimated Speed: 35 to 50 mph
Note: Factors contributing to the congestion included: 1) two lanes of traffic merging from the left (vehicles from southbound I-95); 2) traffic entering from the auxiliary lane at US Route 1.

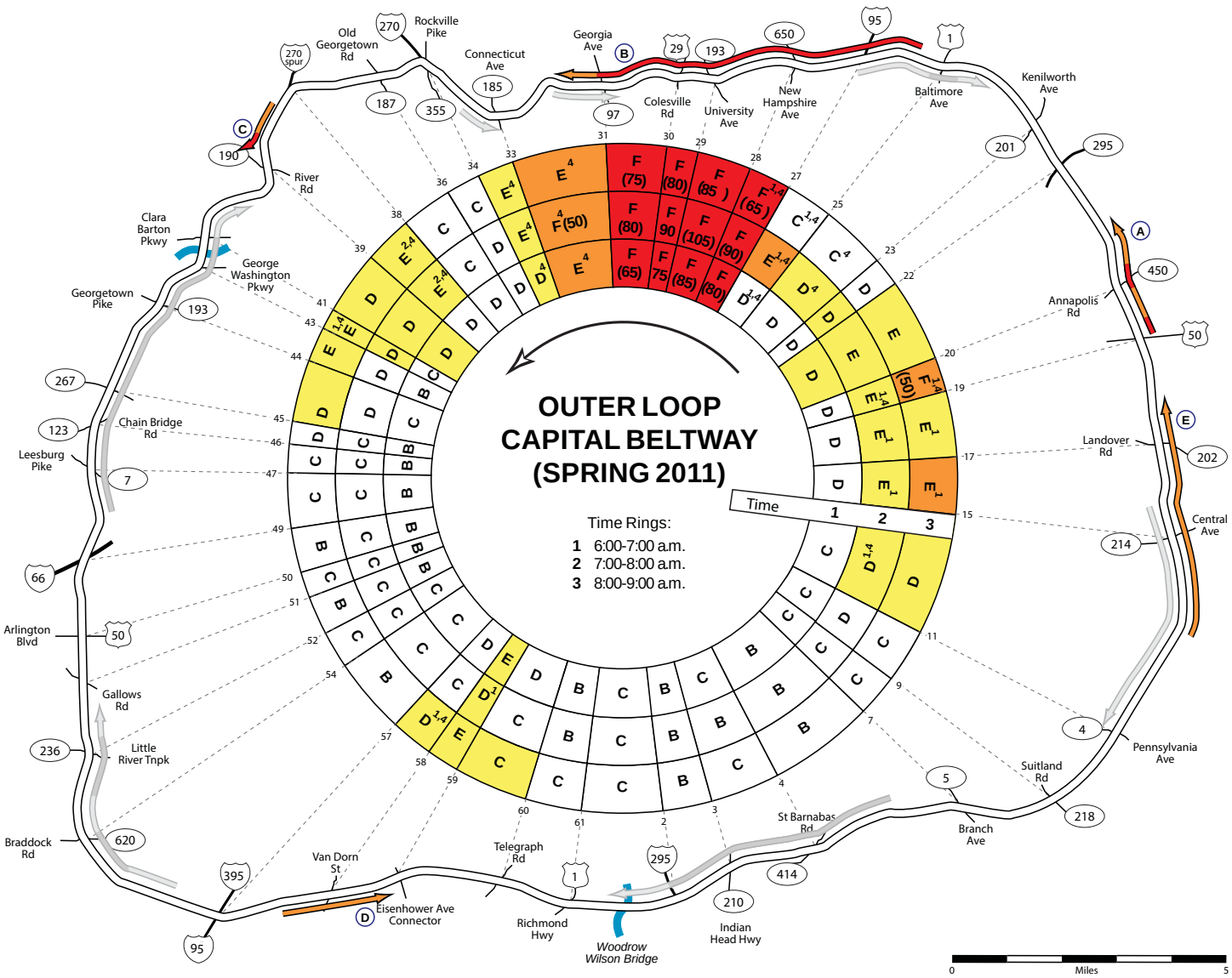
F
Congestion Type: Mainline Congestion
Frequency: Intermittent
Direction: Southbound / Inner Loop
Location: Between MD 202 and MD 4
Queue Length: 2 to 4 miles
Note: Factors that appeared to contribute to the congestion included: 1) traffic exiting at MD 4 (Pennsylvania Ave) backing into the right lane on the Inner loop and ultimately across all lanes; 2) traffic merging into the mainline at Arena Dr and MD 202.

G
Congestion Type: Mainline Congestion
Frequency: All observations between 6:30 & 8:30 a.m.
Direction: Westbound / Inner Loop
Location: Between MD 5 and Woodrow Wilson Bridge
Queue Length: 3 to 5 miles
Note: Factors that appeared to contribute to the congestion included: 1) traffic entering the mainline from St Barnabas Rd 2) traffic entering the mainline from Indian Head Hwy (separate entrance ramps at the inner and outer roadway); 3) weaving on the approach to the divided roadway located between St Barnabas Rd & Indian Head Hwy. Traffic flow consistently improved beyond the I-295 Interchange and across the Woodrow Wilson Bridge.



Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

I-495/95 Capital Beltway (Outer Loop) - Morning



*note: Gray arrows represent Inner Loop Congestion (see pages 64-65)

Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10		20	30	40	50	60	70	80	90
	Light	Moderate	Heavy		Congested			Severe	

Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

I-495/95 Capital Beltway (Outer Loop) - Morning

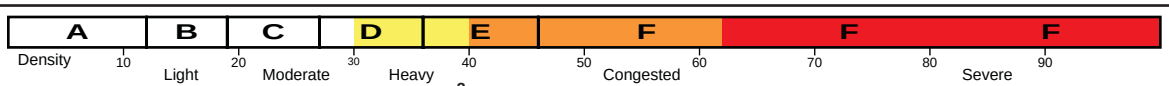
A
Frequency: Intermittent
Direction: Northbound / Outer Loop
Location: Between US 50 & MD 450 (Annapolis Rd)
Queue Length: 1 to 2 miles
Estimated Speed: 35 to 50 mph
Note: Congestion appeared to be caused by traffic entering the mainline at US 50 and MD 450.

B
Congestion Type: Exit Queue
Frequency: Most observations after 7:30 a.m.
Direction: Southbound / Outer Loop
Location: River Rd (MD 190)
Note: Southbound congestion was typically found in the exit lane at River Rd; during some observations, congestion extended back into the right lane on the outer loop, and eventually across all lanes on the outer loop. The head of the exit queue was found on eastbound River Rd at the signal at Burdette Rd.

C
Congestion Type: Mainline Congestion
Frequency: All observations
Direction: Westbound / Outer Loop
Location: Outer loop between I-95 and Georgia Ave
Queue Length: 4 to 6 miles
Estimated Speed: 10 to 25 mph
Note: Historical westbound congestion (severe) between I-95 and MD 97 (Georgia Ave) was again found during the 2014 survey flights; weaving/merging at the interchanges along this section of the Beltway exacerbated the congestion. West of the I-97 Interchange traffic flow consistently improved.

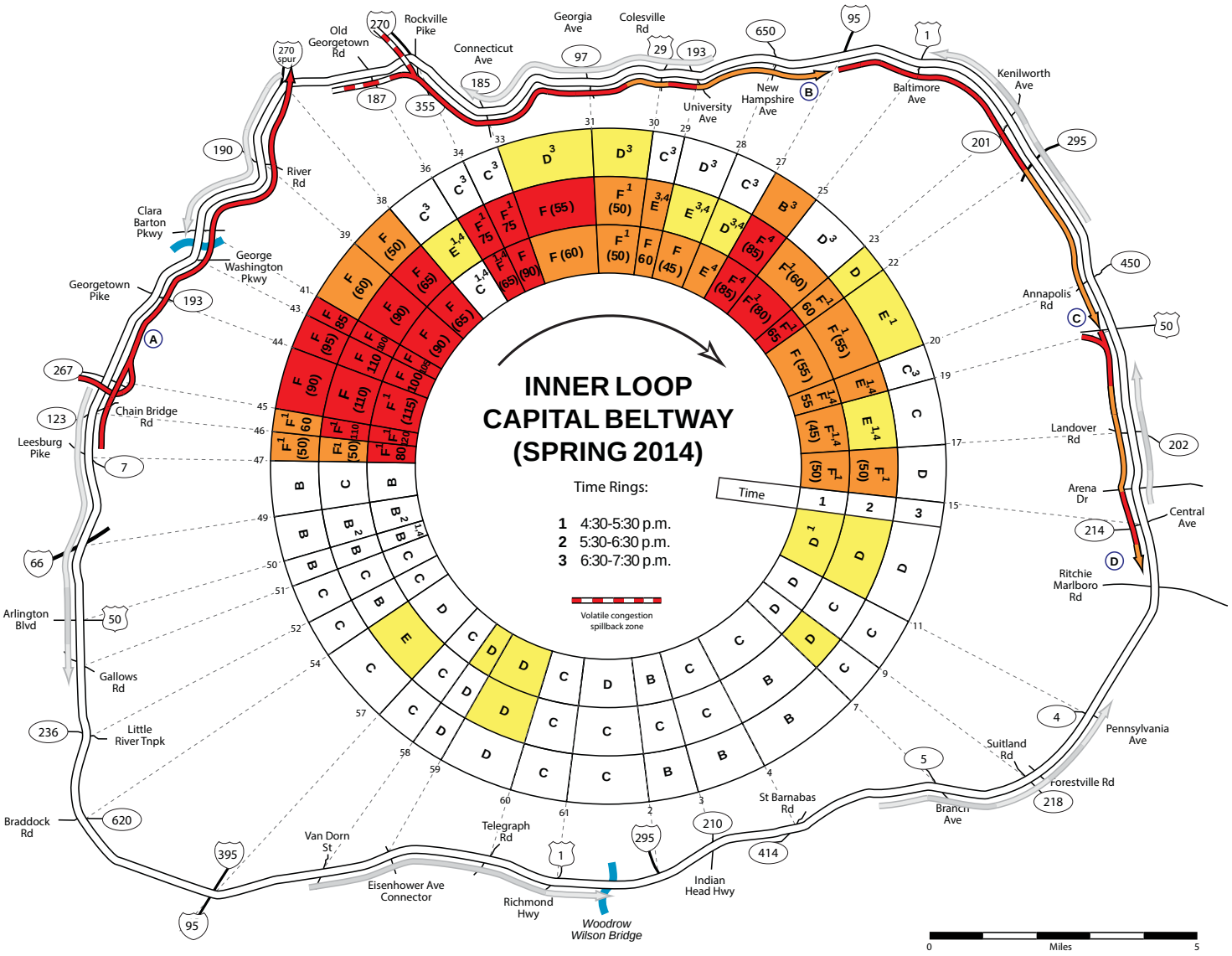
D
Congestion Type: Mainline Congestion
Frequency: Intermittent
Direction: Northbound Outer Loop
Location: Between MD MD 4 (Pennsylvania Ave) & US 50
Queue Length: 3 to 5 miles
Estimated Speed: 40 to 55 mph
Note: Factors that appeared to contribute to the congestion included: 1) traffic entering the mainline at Ritchie Marlboro Rd, MD 214 and Arena Dr; 2) merging and weaving associated with the auxiliary lane located between MD 202 and US 50.

E
Congestion Type: Mainline Congestion
Frequency: Intermittent
Direction: Eastbound
Location: Outer Loop between I-95 & Eisenhower Connector
Queue Length: 1 to 2 miles
Estimated Speed: 40 to 50 mph
Note: When congested, it appeared the lane drop (5 lanes to 4) at Eisenhower Connector caused upstream congestion.



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-495/95 Capital Beltway (Inner Loop) -Evening



*note: Gray arrows represent Outer Loop Congestion (see pages 70-71)

Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10		20	30	40	50	60	70	80	90
	Light	Moderate	Heavy		Congested			Severe	

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

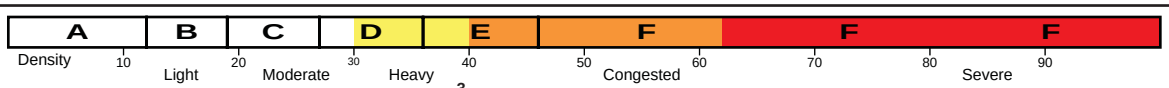
I-495/95 Capital Beltway (Inner Loop) -Evening

A
Congestion Type: Mainline Congestion
Frequency: All observations
Direction: Northbound
Location: Between VA 7 & the I-270 Spur
Queue Length: 5 to 8 miles
Estimated Speed: 10 to 30 mph
Note: Traffic entering the mainline at the series of interchanges along this corridor exacerbated the congestion. Weaving on the approach to the split at the 270 Spur also appeared to contribute to the congestion.

B
Congestion Type: Mainline Congestion
Frequency: Most observations before 6:30 p.m.
Direction: Eastbound Inner Loop
Location: Between I-270 spur and I-95
Queue Length: 8 to 11 miles
Estimated Speed: 20 to 55 mph
Note: Congestion was typically more severe between the 270 Spur and Georgia Ave; east of Georgia Ave, traffic flow normally improved on the approach to the I-95 Interchange. After 6:30 p.m., traffic flowed at mostly free flow speeds along the length of this section of the Inner Loop.

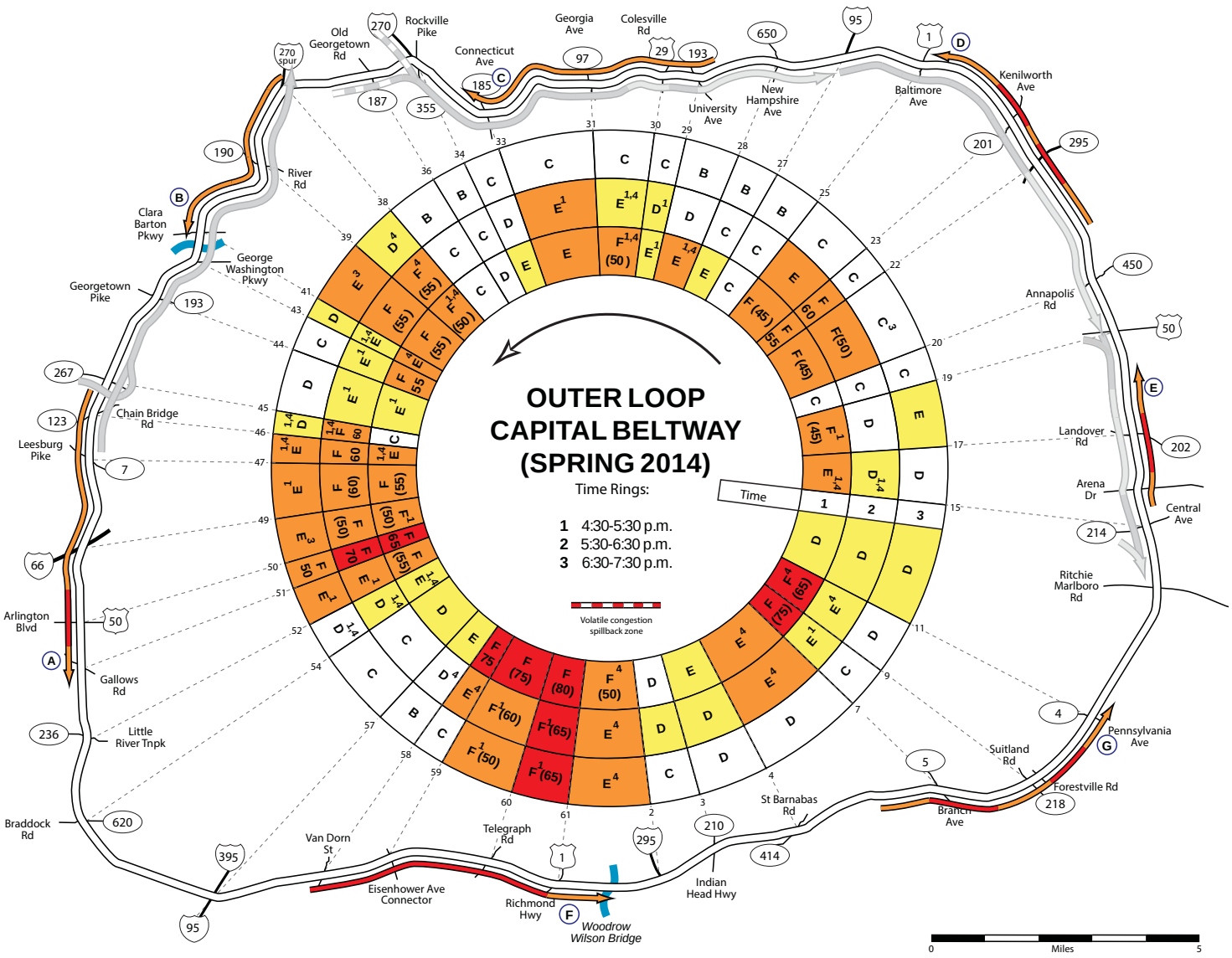
C
Congestion Type: Mainline Congestion
Frequency: Most observations before 6:30 p.m.
Direction: Eastbound / Southbound Inner Loop
Location: Between I-95 (MD) and US 50
Queue Length: 4 to 8 miles
Estimated Speed: 30 to 55 mph
Note: Traffic entering the mainline at I-95, US Route 1 and MD 295 caused severe congestion on the approaches to these interchanges. While flow typically improved on the southbound approach to US 50, downstream congestion intermittently backed through that interchange.

D
Congestion Type: Mainline Congestion
Frequency: Most observations before 6:30 p.m.
Direction: Southbound
Location: Between US 50 & MD 214
Queue Length: 2 to 4 miles
Estimated Speed: 35 to 50 mph
Note: Factors contributing to the congestion included: 1) the merge at US 50 where two lanes of traffic enter the mainline; 2) weaving at the lane drop (4 lanes to 3) where the roadway divides on the approach to the SR 202 interchange; 3) traffic entering the mainline from the ramp at SR 214.



Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

I-495/95 Capital Beltway (Outer Loop) -Evening



*note: Gray arrows represent Inner Loop Congestion (see pages 68-69)

Traffic Quality Rating

A	B	C	D	E	F	F	F

Density 10 20 30 40 50 60 70 80 90

Light Moderate Heavy Congested Severe

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).

[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-495/95 Capital Beltway (Outer Loop) -Evening

A
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Southbound
Location: Between VA 267 and VA 236 (Little River Turnpike)
Queue Length: 6 to 7 miles
Estimated Speed: 20 to 40 mph
Note: The primary bottlenecks along this section of the Outer Loop were found where vehicles merged into the mainline at VA 123, VA 7, I-66 and US 50. Stop-and-go flow was often found in the vicinity of these interchanges. South of VA 236 (Little River Turnpike), traffic flow consistently improved approaching the I-95/395 Interchange.

B
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Southbound
Location: Between I-270 spur and VA 193 (Georgetown Pike)
Queue Length: 4 to 5 miles
Estimated Speed: 30 to 50 mph
Note: The primary bottleneck along this section of the Outer Loop was found at the lane drop (5 lanes to 4) approaching the River Rd Interchange. Traffic entering the mainline at River Rd, Clara Barton Parkway and Georgetown Pike also appeared to contribute to the congestion.

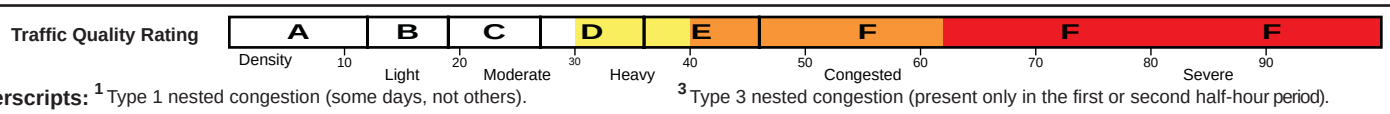
C
Congestion Type: Mainline Congestion
Frequency: Most observations before 6:00 p.m.
Direction: Westbound
Location: Between New Hampshire Ave and Connecticut Ave
Queue Length: 3 to 5 miles
Estimated Speed: 30 to 50 mph
Note: Roadway geometrics and weaving/merging at interchanges along this section of the Outer Loop appeared to exacerbate the congestion. Traffic flow consistently improved west of Connecticut Ave where free flow speeds were found approaching the I-270 Interchange.

D
Congestion Type: Mainline Congestion
Frequency: All observations before 6:30 p.m.
Direction: Northbound Outer Loop
Location: Between MD 450 (Annapolis Rd) and US Route1
Queue Length: 3 to 5 miles
Estimated Speed: 30 to 50 mph
Note: Northbound congestion along this section of the outer loop of the beltway appeared to be caused or exacerbated by merging and weaving at MD 295, MD 201.

E
Congestion Type: Mainline Congestion
Frequency: Intermittent
Direction: Northbound
Location: Between MD 214 & US 50
Queue Length: 2 to 4 miles
Estimated Speed: 30 to 50 mph
Note: Congestion appeared to be exacerbated by merging and weaving along the divided highway section of I-495 (vicinity of Arena Dr and SR 202).

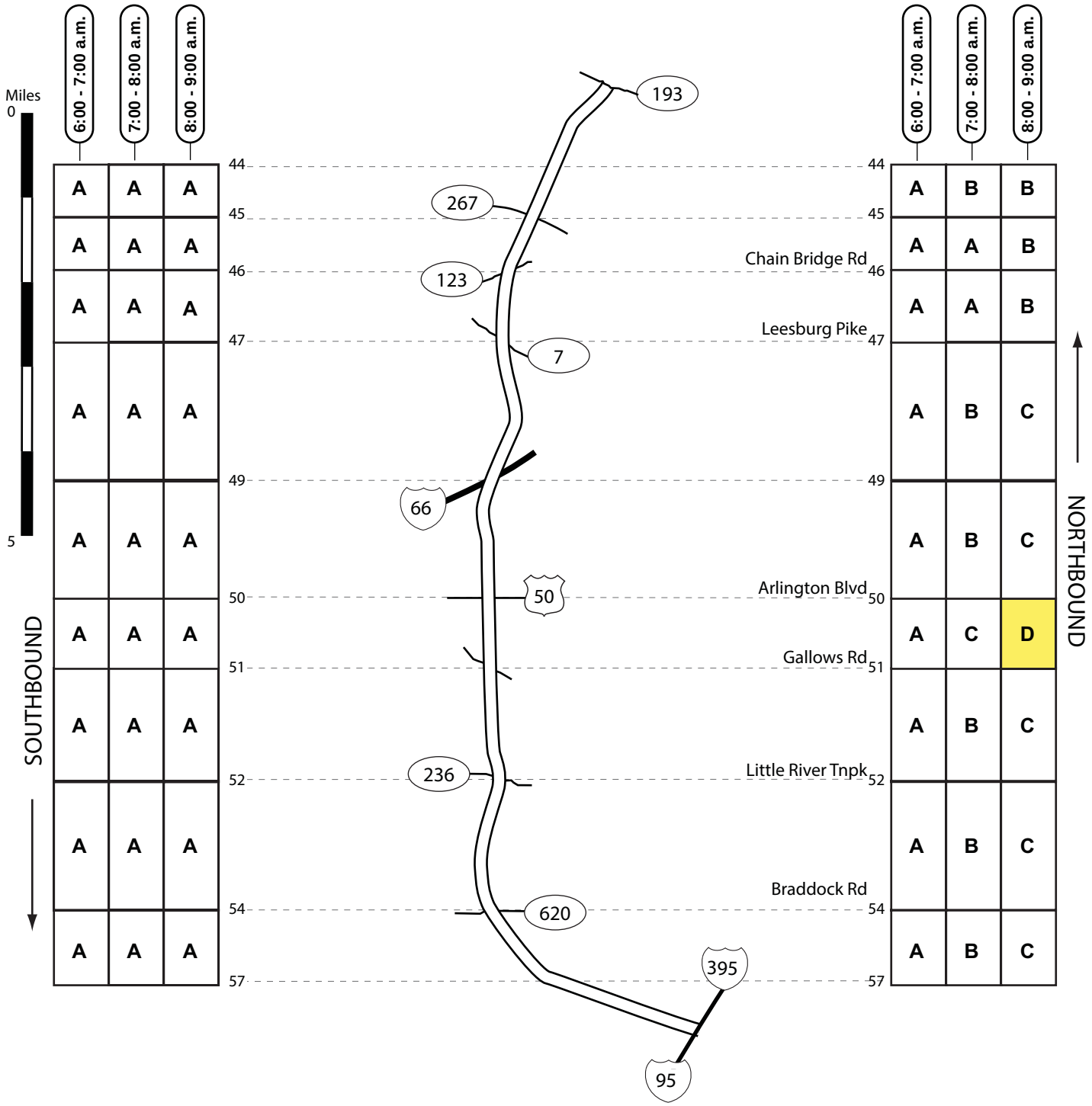
F
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Eastbound
Location: Between I-95/39 and the Woodrow Wilson Bridge
Queue Length: 4 to 6 miles
Estimated Speed: 25 to 40 mph
Note: Traffic entering the mainline at the series of interchanges along this corridor appeared to exacerbate the congestion. Weaving on the approach to where the roadway divides in the vicinity of Eisenhower Connector may also have contributed to the congestion.

G
Congestion Type: Mainline Congestion
Frequency: Most observations before 6:00 p.m.
Direction: Eastbound / Northbound Outer Loop
Location: Between St Barnabas Rd (MD 414) and Pennsylvania Ave (MD 4)
Queue Length: 3 to 5 miles
Estimated Speed: 35 to 50 mph
Note: Traffic entering the mainline at MD 5 and Forrestville Rd appeared to exacerbate the congestion. Tractor-trailers in the traffic stream also appeared to contribute to the congestion.



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-495 Capital Beltway (HOV/HOT) -Morning

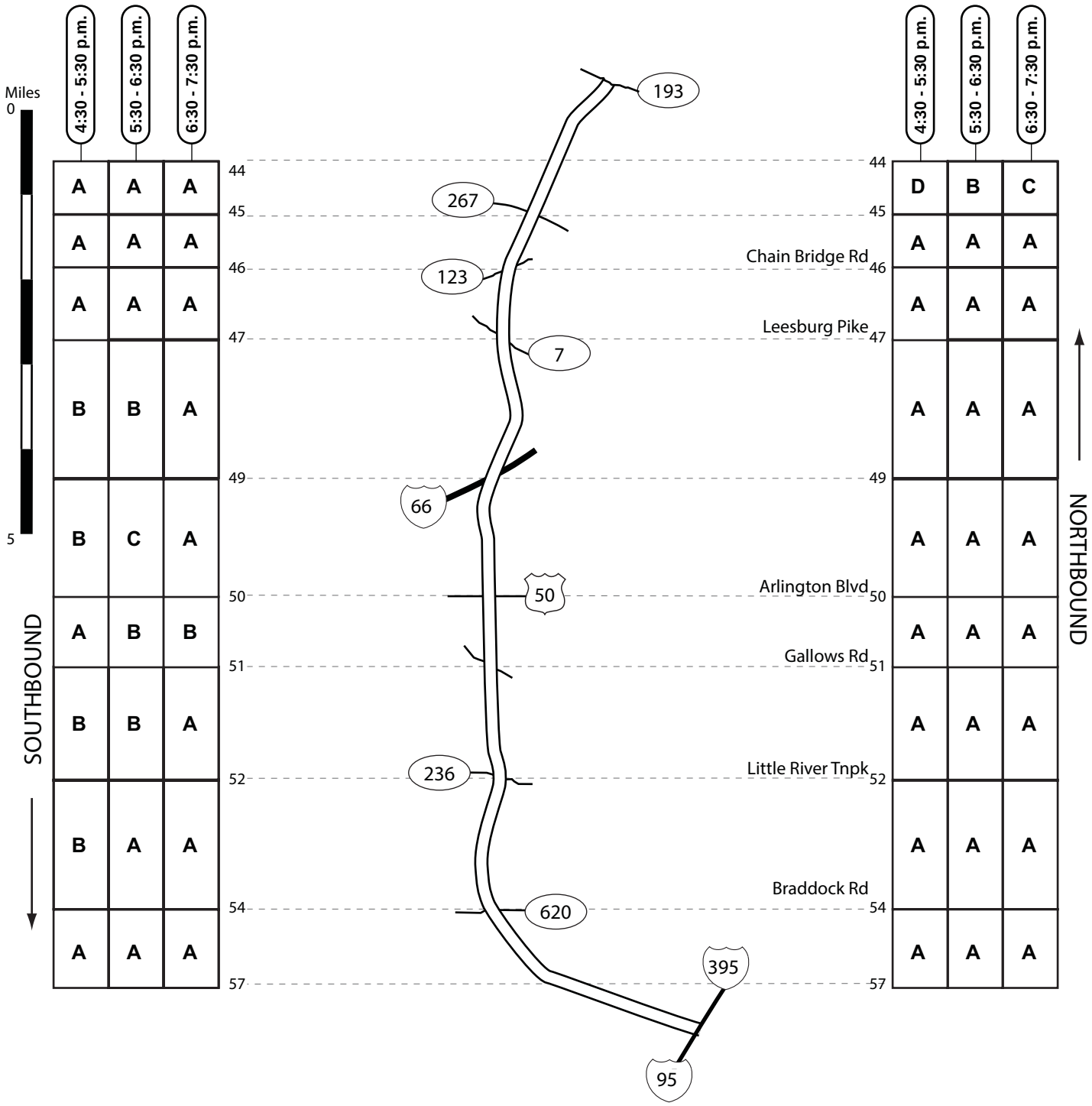


Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

I-495 Capital Beltway (HOV/HOT) -Evening



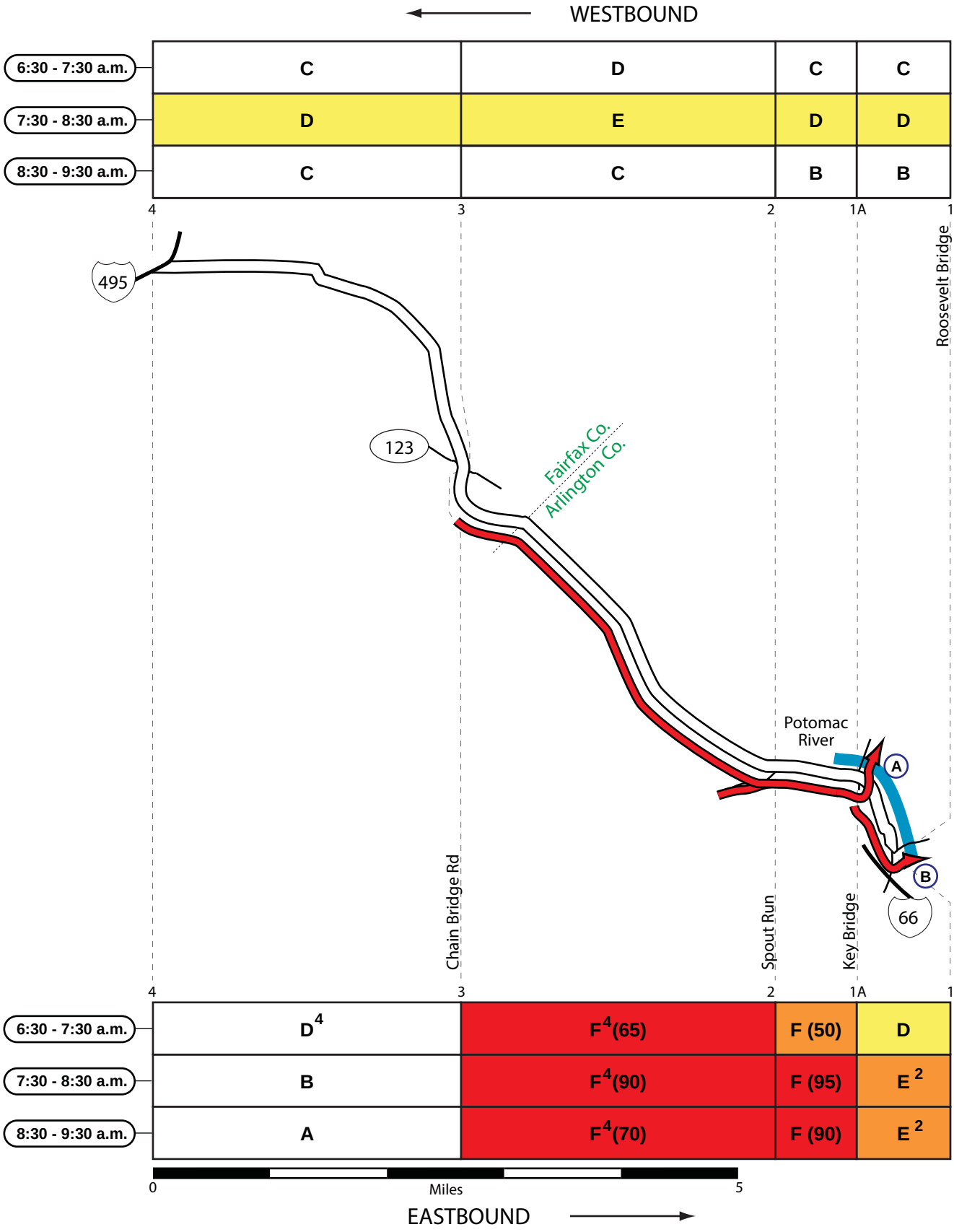
Traffic Quality Rating

A	B	C	D	E	F	F	F

Density 10 20 30 40 50 60 70 80 90
Light Moderate Heavy Congested Severe

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

George Washington Memorial Parkway (Virginia) - Morning



Traffic Quality Rating

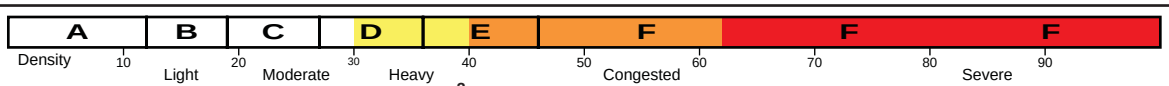
A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

George Washington Memorial Parkway (Virginia) - Morning

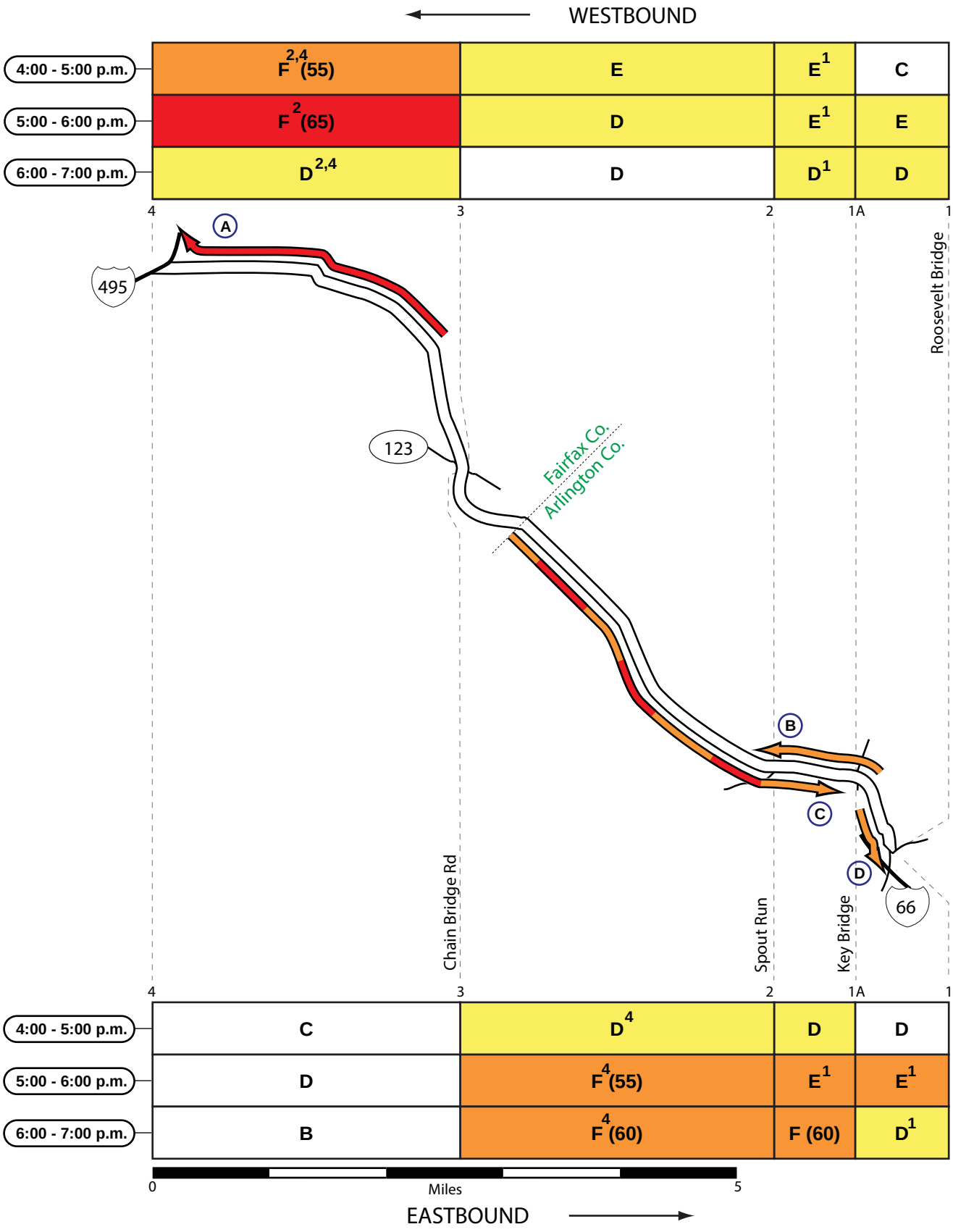
A
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Eastbound
Location: Between Chain Bridge Rd & I-66
Queue Length: 3 to 5 miles
Estimated Speed: 10 to 40 mph
Note: The primary bottleneck was found where traffic merged into the mainline at Spout Run; congestion persisted south to the Key Bridge where the ramp queue typically extended back into the mainline (after 8:00 a.m.).

B
Congestion Type: Right lane exit queue
Frequency: Most observations after 8:00 a.m.
Direction: Eastbound
Location: Roosevelt Bridge
Queue Length: 0.5 to1 mile
Estimated Speed: Stop-and-go
Note: After 8:00 a.m., severe congestion was found on the ramp from the GWP to the Roosevelt Bridge; the ramp queue typically extended back into the right lane on the GWP to the vicinity of the Key Bridge.



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

George Washington Memorial Parkway (Virginia) - Evening



Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

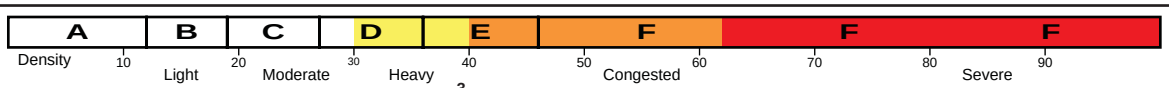
George Washington Memorial Parkway (Virginia) - Evening

A
Congestion Type: Mainline Congestion
Frequency: Most observations before 6:00 p.m.
Direction: Westbound
Location: Between Chain Bridge Rd and I-495 (Beltway)
Queue Length: 2 to 3 miles
Estimated Speed: 20 to 40 mph
Note: The head of the queue was found on the ramp to the inner loop of the Beltway; congestion here extended back into the right lane, and eventually across all lanes of the GWP. Congestion was particularly severe in the right lane on the approach to the Beltway.

B
Congestion Type: Mainline Congestion
Frequency: Intermittent
Direction: Westbound
Location: Between the Key Bridge & Spout Run
Queue Length: 0.5 to 1 mile
Estimated Speed: 30 to 50 mph
Note: Congestion appeared to be exacerbated by merging and weaving associated with the Key Bridge and Spout Run interchanges.

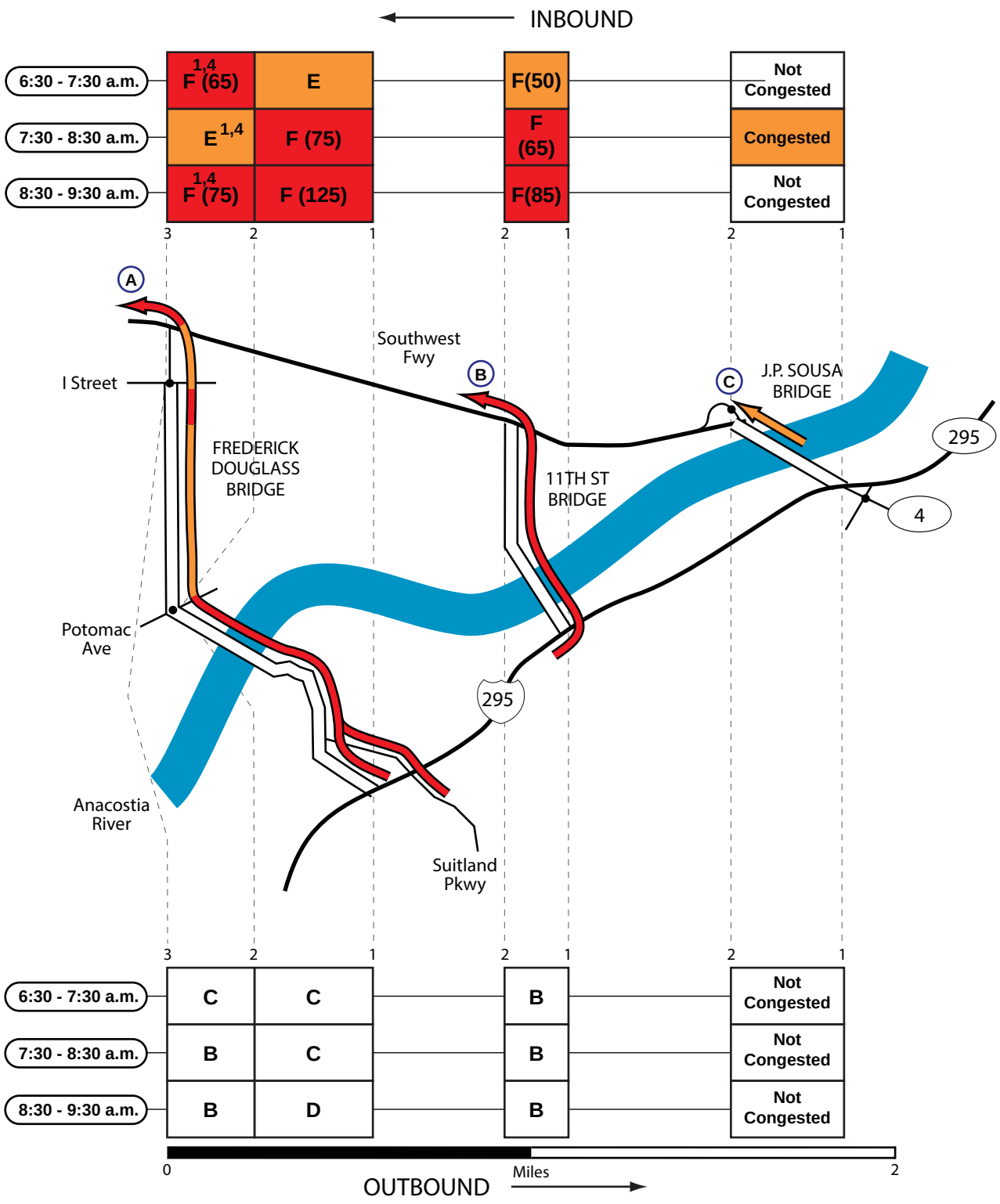
C
Congestion Type: Mainline Congestion
Frequency: Most observations after 5:00 p.m.
Direction: Eastbound
Location: Between Chain Bridge Rd and the Key Bridge
Queue Length: 3 to 5 miles
Estimated Speed: 25 to 50 mph
Note: Congestion found at the south end was exacerbated by merging at Spout Run and weaving at the ramp to the Key Bridge. Between Chain Bridge Rd and Spout Run, shock waves were found with intermittent stop-and-go flow.

D
Congestion Type: Mainline Congestion
Frequency: Intermittent
Direction: Eastbound
Location: Between the Key Bridge and the Roosevelt Bridge
Queue Length: 0.5 miles
Estimated Speed: 30 to 50 mph
Note: Downstream congestion on the GWP intermittenly backed into this segment of the GWP.



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

Anacostia River Bridges - Morning



Traffic Quality Rating

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

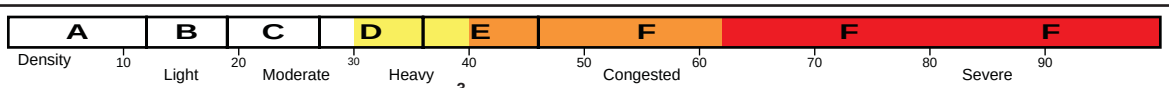
Superscripts: [1] Type 1 nested congestion (some days, not others). [2] Type 2 nested congestion (more severe in left or right-hand lanes). [3] Type 3 nested congestion (present only in the first or second half-hour period). [4] Type 4 nested congestion (partial length of segment).

Anacostia River Bridges - Morning

A
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Inbound
Location: Between I-295 & Southeast Freeway
Queue Length: 1 to 2 miles
Estimated Speed: 10 to 40 mph
Note: The primary bottleneck was found at the signal at Potomac Ave; north of the signal, traffic flow typically improved. Intermittently, minor queuing was found approaching the signal at I St.

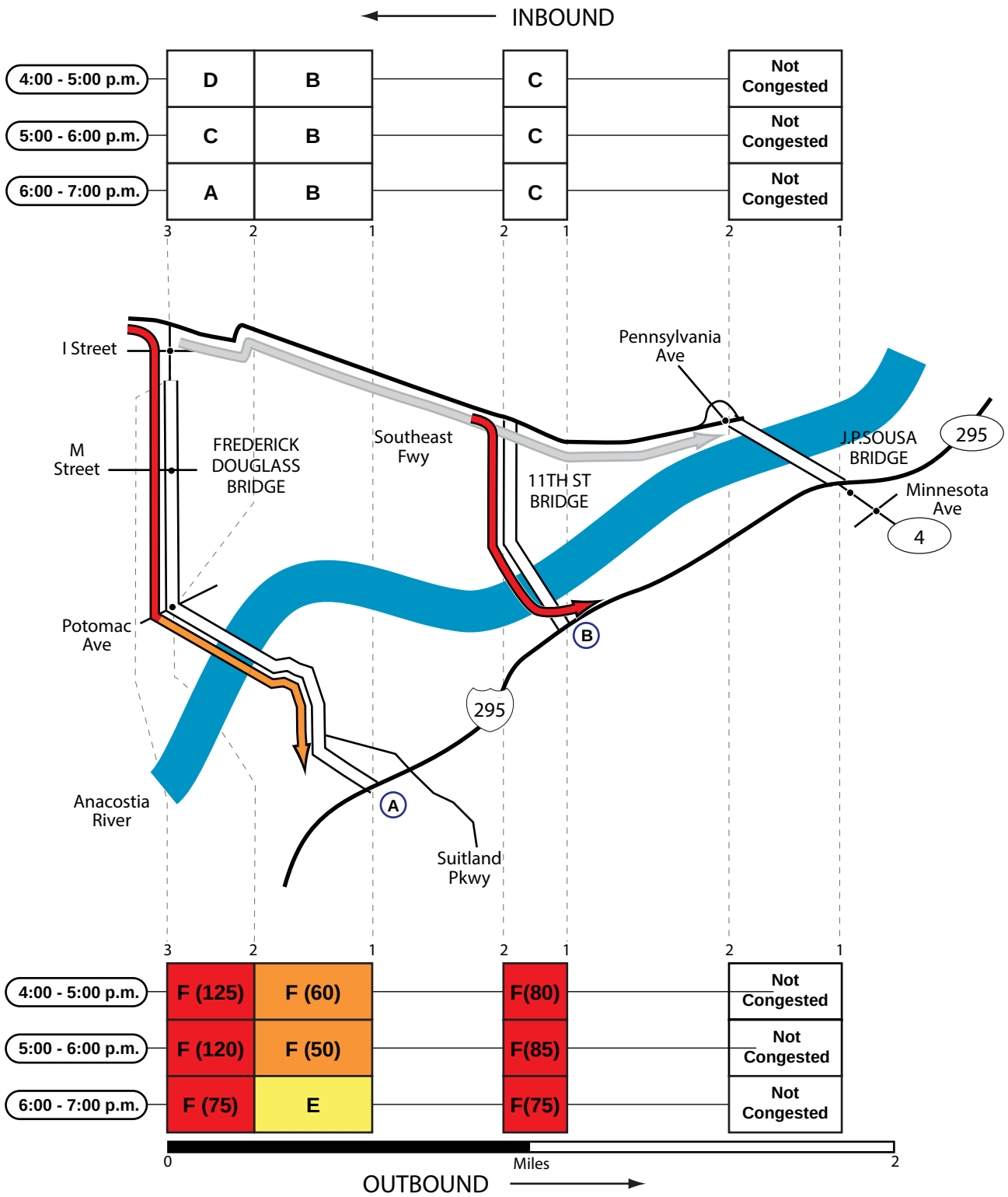
B
Congestion Type: Mainline Congestion
Frequency: Throughout the morning survey period
Direction: Inbound
Location: 11th St Bridge
Queue Length: 0.5 to 1 miles
Estimated Speed: 10 to 30 mph
Note: The head of the queue was found on the ramp to the Southeast Freeway; congestion at this river crossing may have been exacerbated by ongoing construction on the bridge.

C
Congestion Type: Mainline Congestion
Frequency: Intermittent
Direction: Inbound
Location: John Phillip Sousa Bridge
Queue Length: 0.25 miles
Note: When congested vehicles were queued at the signal at Barney Circle SE; queue populations ranged from approximately 20-40 vehicles per lane. The ramp to the Southeast Freeway was closed (construction).

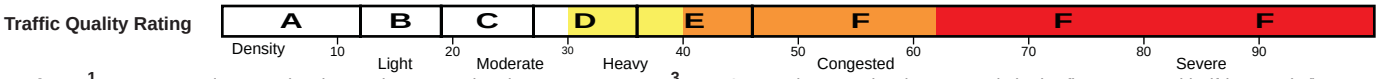


Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

Anacostia River Bridges - Evening



*note: Gray arrow represents I-395 Congestion (see pages 58-59)

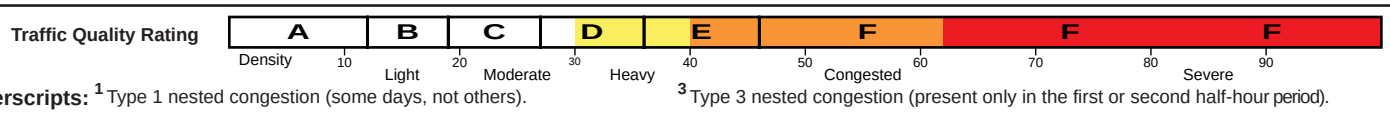


Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

Anacostia River Bridges - Evening

A
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Outbound
Location: Between Southeast Freeway and I-295
Queue Length: 1 to 2 miles
Estimated Speed: 5 to 40 mph
Note: Stop-and-go congestion was caused by the signals at I St, M St, and Potomac Ave; south of Potomac Ave, traffic flow typically improved.

B
Congestion Type: Mainline Congestion
Frequency: Most observations
Direction: Outbound
Location: 11th St Bridge
Queue Length: 0.5 to 1 mile
Estimated Speed: 5 to 25 mph
Note: Factors contributing to the congestion were: 1) weaving approaching the 13th St/I-295 split; 2) the lane drop (2 lanes to 1) on the ramp to I-295 (southbound) and; 3) construction on the bridge (left lane closed).



Superscripts: [1] Type 1 nested congestion (some days, not others). [3] Type 3 nested congestion (present only in the first or second half-hour period).
[2] Type 2 nested congestion (more severe in left or right-hand lanes). [4] Type 4 nested congestion (partial length of segment).

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Chapter IV

Summary of Congested Locations and Corridors

This chapter provides a summary of the 2014 “Top Ten Congested Locations” by ranking the densities of all segments and picking the top ten irrespective of whether they are congested during the AM or PM peak period. The 2011 Top Ten Congested locations are included for reference in Appendix C.

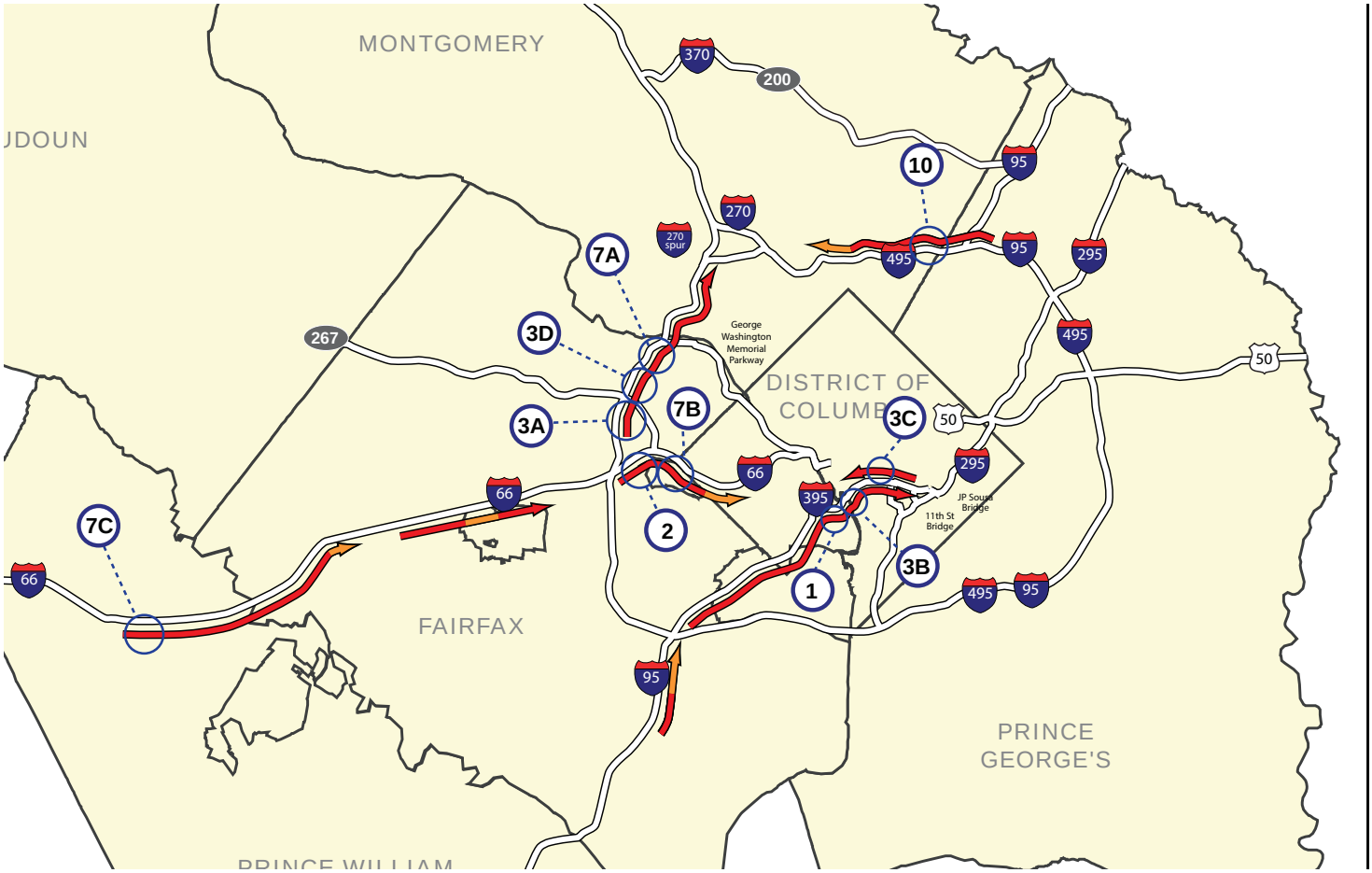
Corridors with the longest delay are also presented in this chapter. The purpose of this metric is to identify corridors which may not have bottlenecks in the Top Ten Congested Locations but are long congested corridors. Delay is calculated by estimating the additional travel time during congested conditions over the free flow travel time. Free flow speed is assumed to be 60 mph. This chapter lists the “Top Five Congested Corridors” in the AM and PM peak period. The 2011 Top Five Congested Corridors are presented in Appendix C for reference.

A comparison of lane mile hours at level-of-service F by facility (2014 vs. 2011) are also presented in this chapter.

Top Ten Congested Locations (2014) (AM and PM)

Criteria for the top ten congested locations are as follows:

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



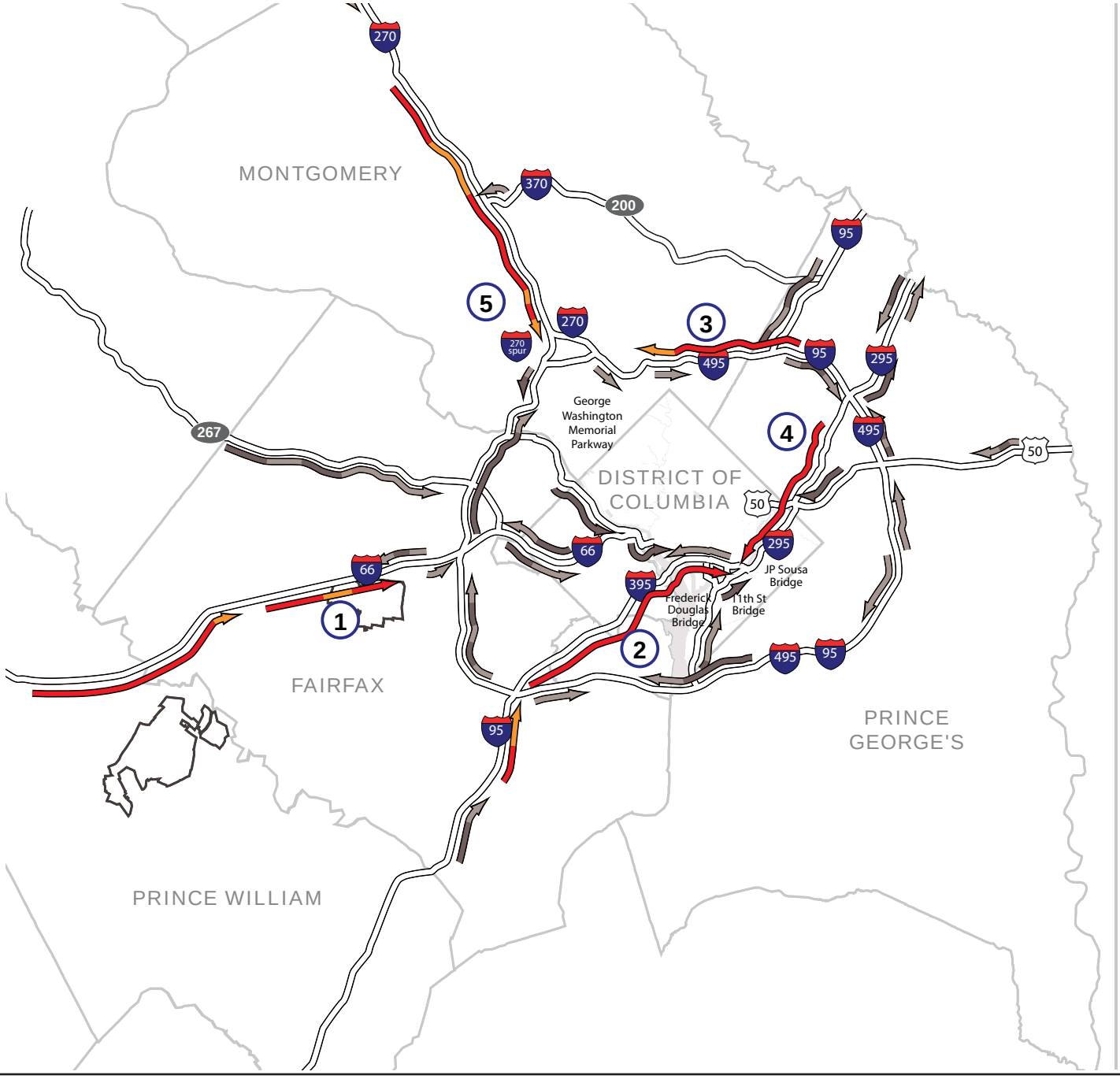
Top Ten Congested Segments on the Freeway System (2014)

Rank	Route	From	To	Density	Speed Range
1	NB I-395 (8:30-9:30 AM)	VA 27 (Washinton Blvd)	VA 110 (Jefferson Davis Hwy)	150	5 MPH
2	EB I-66 (6:00-7:00 PM)	VA 7 (Leesburgh Pike)	VA 267	140	5 MPH
3A	Inner Loop I-495 (4:30-5:30 PM)	VA 123 (Chain Bridge Rd)	VA 267	120	5-10 MPH
3B	NB I-395 (8:30-9:30 AM)	VA 110 (Jefferson Davis Hwy)	George Washington Memorial Pkwy	120	5-10 MPH
3C	SB I-395 (5:00-6:00 PM)	4th St	12th St	120	5-10 MPH
3D	Inner Loop I-495 (4:30-5:30 PM)	VA 267	VA 193 (Georgetown Pike)	120	5-10 MPH
7A	Inner Loop I-495 (5:30-6:30 PM)	VA 193 (Georgetown Pike)	George Washington Memorial Pkwy	110	10-15 MPH
7B	EB I-66 (6:00-7:00 PM)	VA 267	Westmoreland St	110	10-15 MPH
7C	EB I-66 (6:00-7:00 AM)	VA 234 Bypass	VA 234 (Sudley Rd)	110	10-15 MPH
10	Outer Loop I-495 (7:00-8:00 AM)	MD 650 (New Hampshire Ave)	MD 193 (University Ave)	105	10-15 MPH

Note: Due to construction at the terminus of the Southeast Freeway, eastbound densities along this corridor were not included in the Top Ten list above.

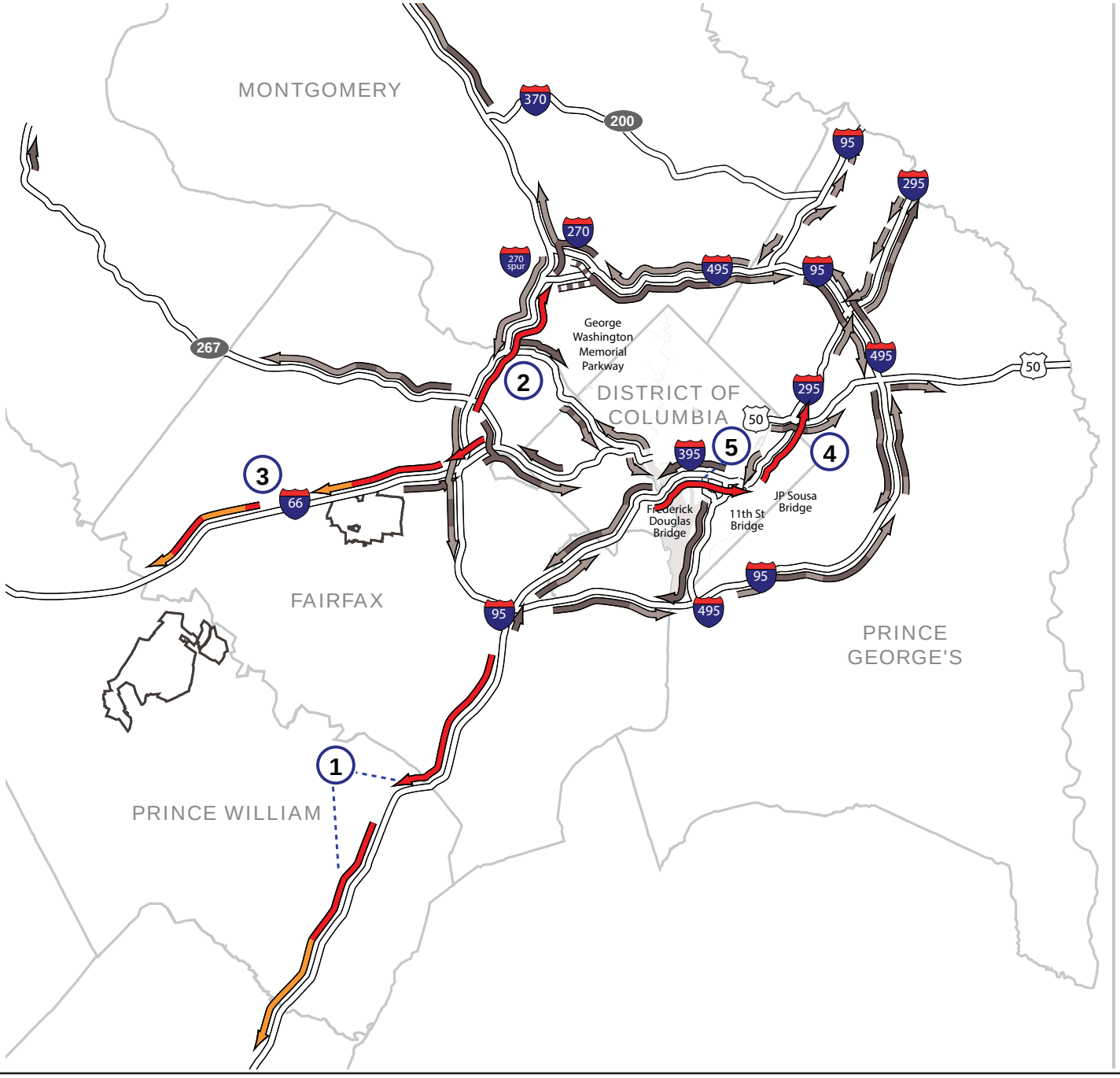
Longest Delay Corridors- Morning Peak Period (2014)

Site Name	Road Name	Time	Direction	From	To	Queue Length (miles)	Estimated Travel Time (minutes)	Estimated Speed (mph)	Estimated Delay (minutes)
Site #1	I-66	7:30 – 8:30	Eastbound	US 29 (Lee Highway)	VA 243 (Nutley St)	18.8	43.3	26	24.5
Site #2	I-95 / I-395	7:00 – 8:00	Northbound	US 1 (Richmond Highway)	George Washington Parkway	18.0	38.2	28	20.2
Site #3	I-495	7:00 – 8:00	Outerloop	I-95	MD 185 (Connectiucut Ave)	7.0	21.7	19	14.7
Site #4	DC 295	8:00 – 9:00	Southbound	MD 450 (Annapolis Rd)	MD 4 (Pennsylvania Ave)	5.7	19.9	17	14.2
Site #5	I-270	7:30 – 8:30	Southbound	Father Hurley Blvd	I-270 Western Spur	13.1	24.6	32	11.5

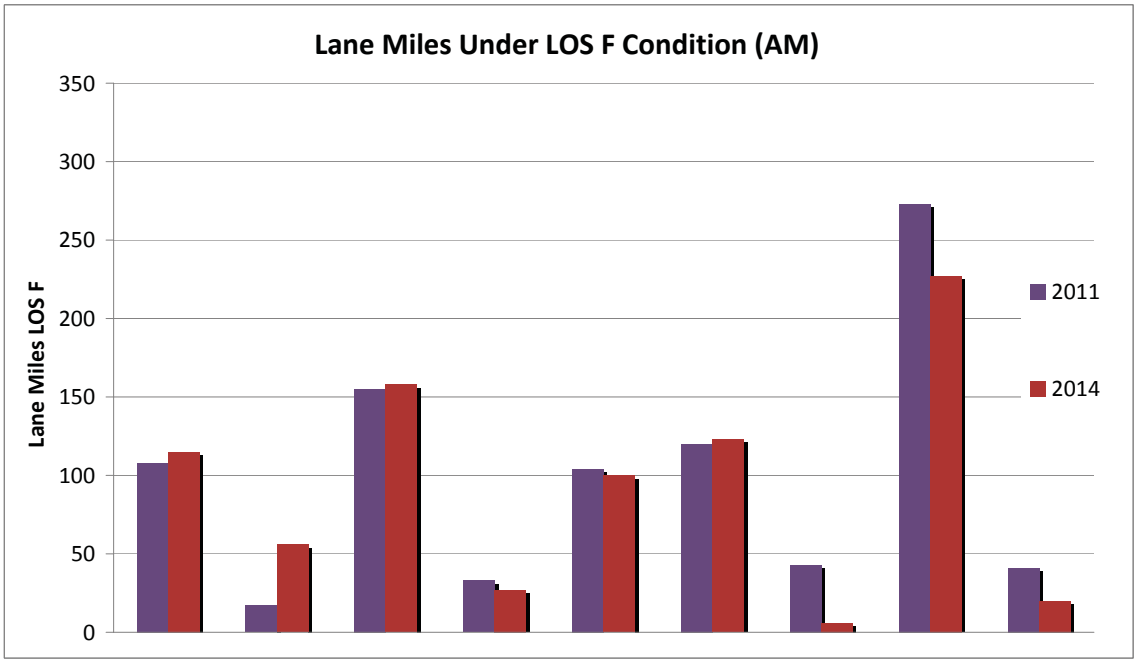


Longest Delay Corridors- Evening Peak Period (2014)

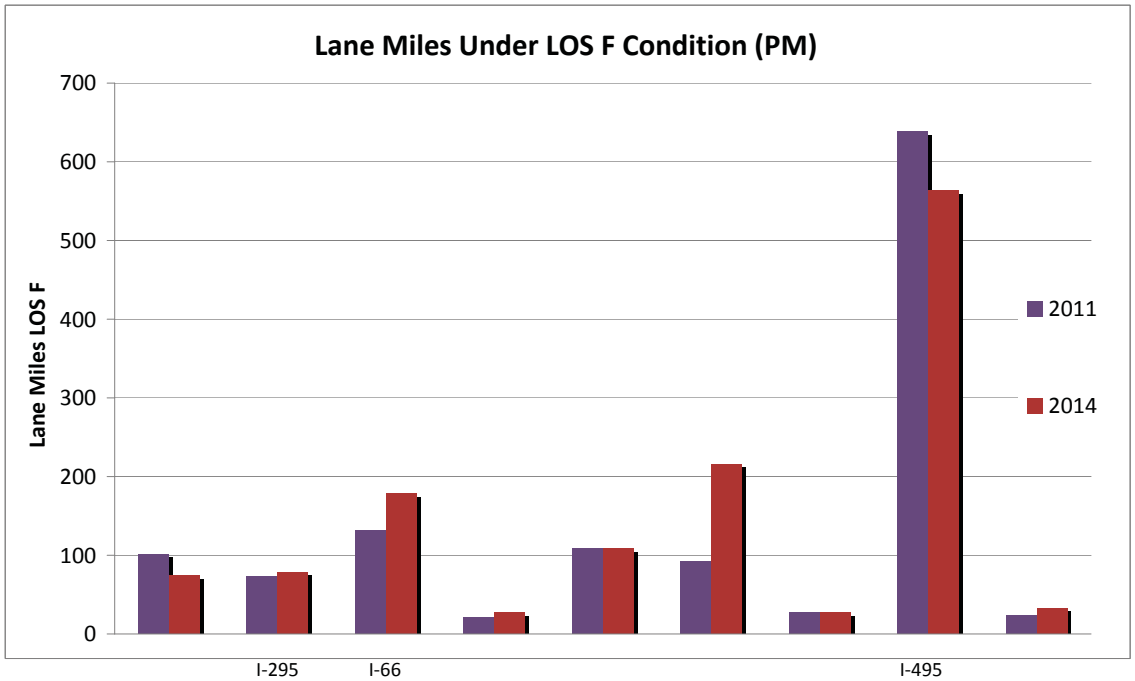
Site Name	Road Name	Time	Direction	From	To	Queue Length (miles)	Estimated Travel Time (minutes)	Estimated Speed (mph)	Estimated Delay (minutes)
Site #1	I-95	4:30 – 5:30	Southbound	Fairfax County Parkway	Garrisonvile Rd	23.0	51.5	27	28.5
Site #2	I-495	4:30 – 5:30	Innerloop	VA 7(Leesburg Pike)	I-270 Western Spur	8.4	35.1	14	26.7
Site #3	I-66	4:30 – 5:30	Westbound	VA 7 (Leesburg Pike)	VA 234 (Sudley Rd)	18.3	36.6	30	18.3
Site #4	DC 295	4:30 – 5:30	Northbound	11th Street Bridge	US 50	5.0	19.3	16	14.3
Site #5	I-395	5:00 – 6:00	Northbound	VA 110 (Jeff. Davis Hwy)	11th Street Bridge	3.7	17.5	13	13.8



Lane Miles of Congestion AM and PM Peak Period (2014)



	I-270	I-295 (Inside Beltway)	I-66 (Outside Beltway)	I-66 (Inside Beltway)	I-395	I-95 VA	I-95 MD	I-495 (Capital Beltway)	GW Parkway
2011 (6-9 AM)	108	17	155	33	104	120	43	273	41
2014 (6-9 AM)	115	56	158	27	100	123	6	227	20



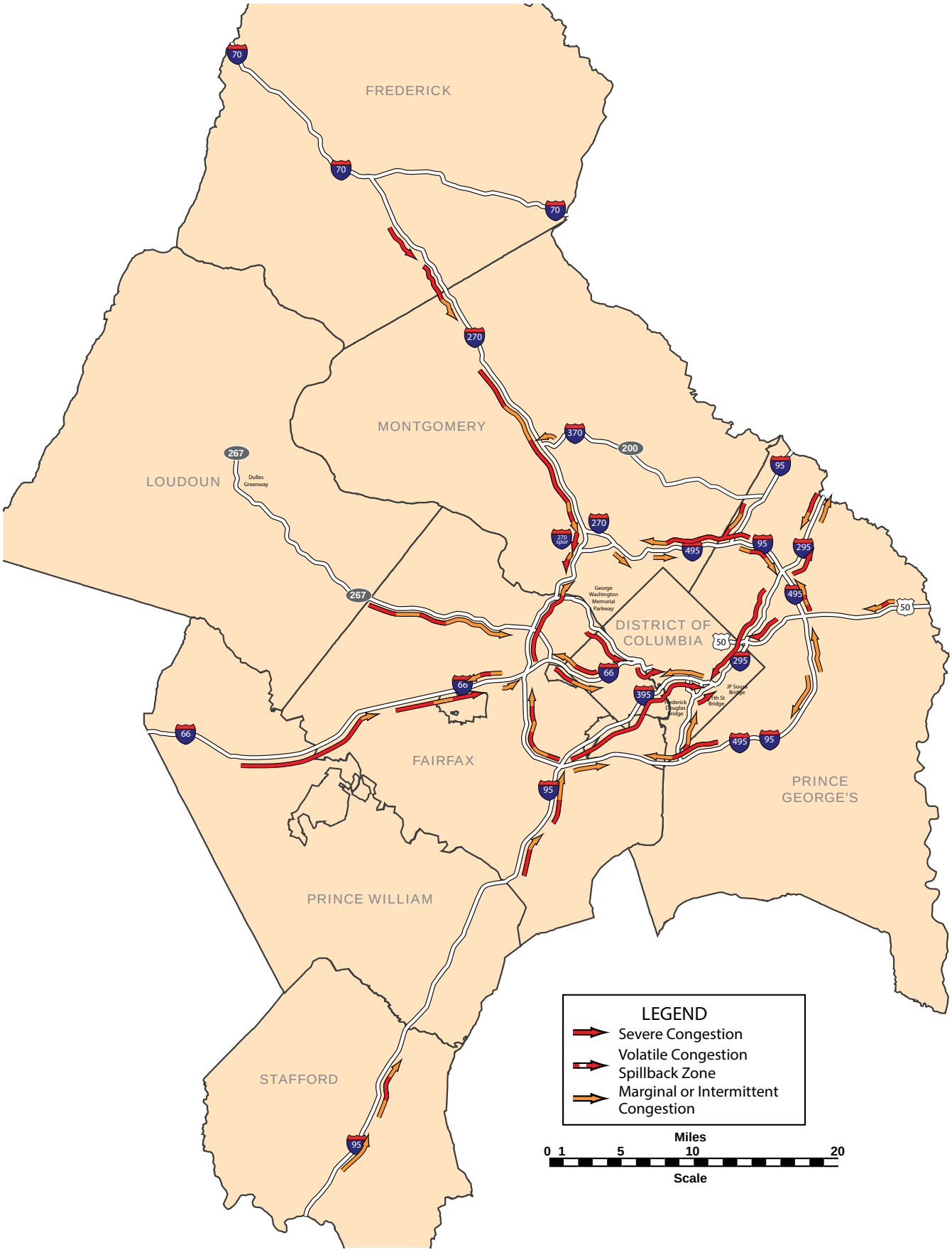
	I-270	I-295 (Inside Beltway)	I-66 (Outside Beltway)	I-66 (Inside Beltway)	I-395	I-95 VA	I-95 MD	I-495 (Capital Beltway)	GW Parkway
2011 (4-7 PM)	101	73	131	21	108	92	27	638	23
2014 (4-7 PM)	74	78	178	27	108	216	27	563	33

Chapter V

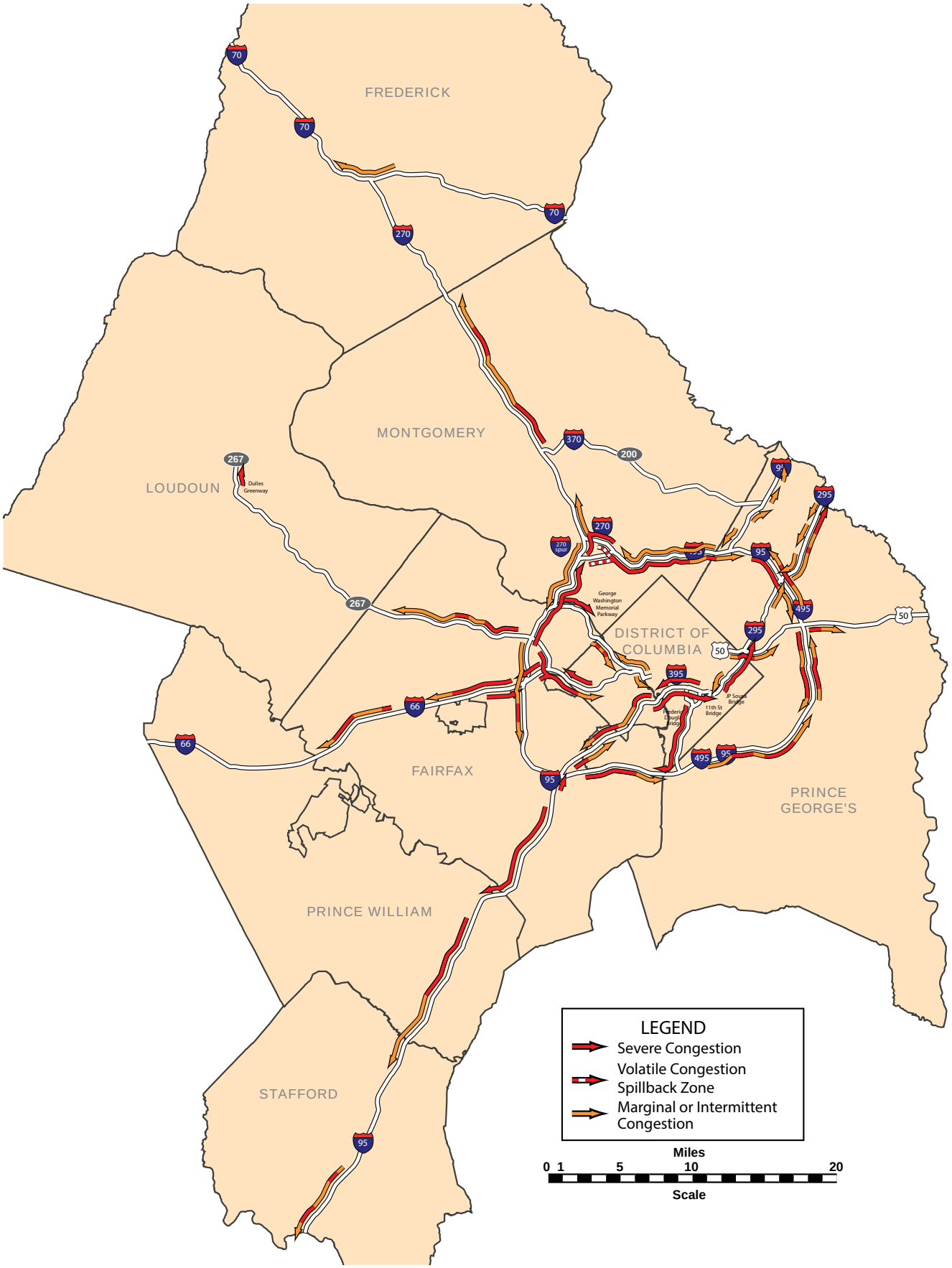
Regional Congestion Summary

This chapter shows summary maps of congestion in the region. The first set of maps summarizes all congestion that occurs within the three hour AM and PM peak period windows. If a segment is congested in two or three hours, the peak hour will be used. The second set of maps (six) illustrates congestion by the first hour, second hour and third hour during the AM and PM peak period; note that times vary for facilities located within the Beltway and outside the Beltway.

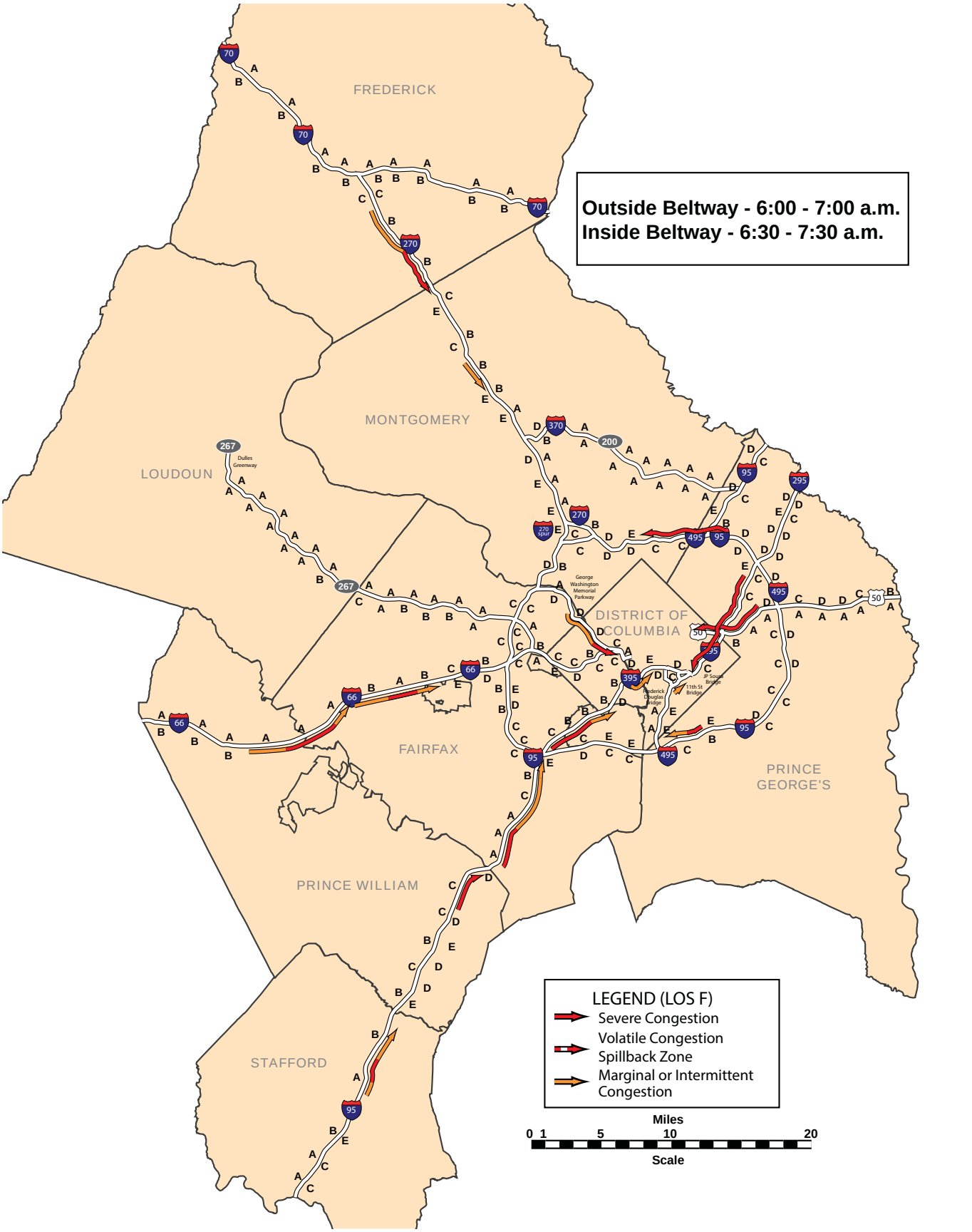
Morning Regional Congestion (Peak Period)-Spring 2014



Evening Regional Congestion (Peak Period)-Spring 2014



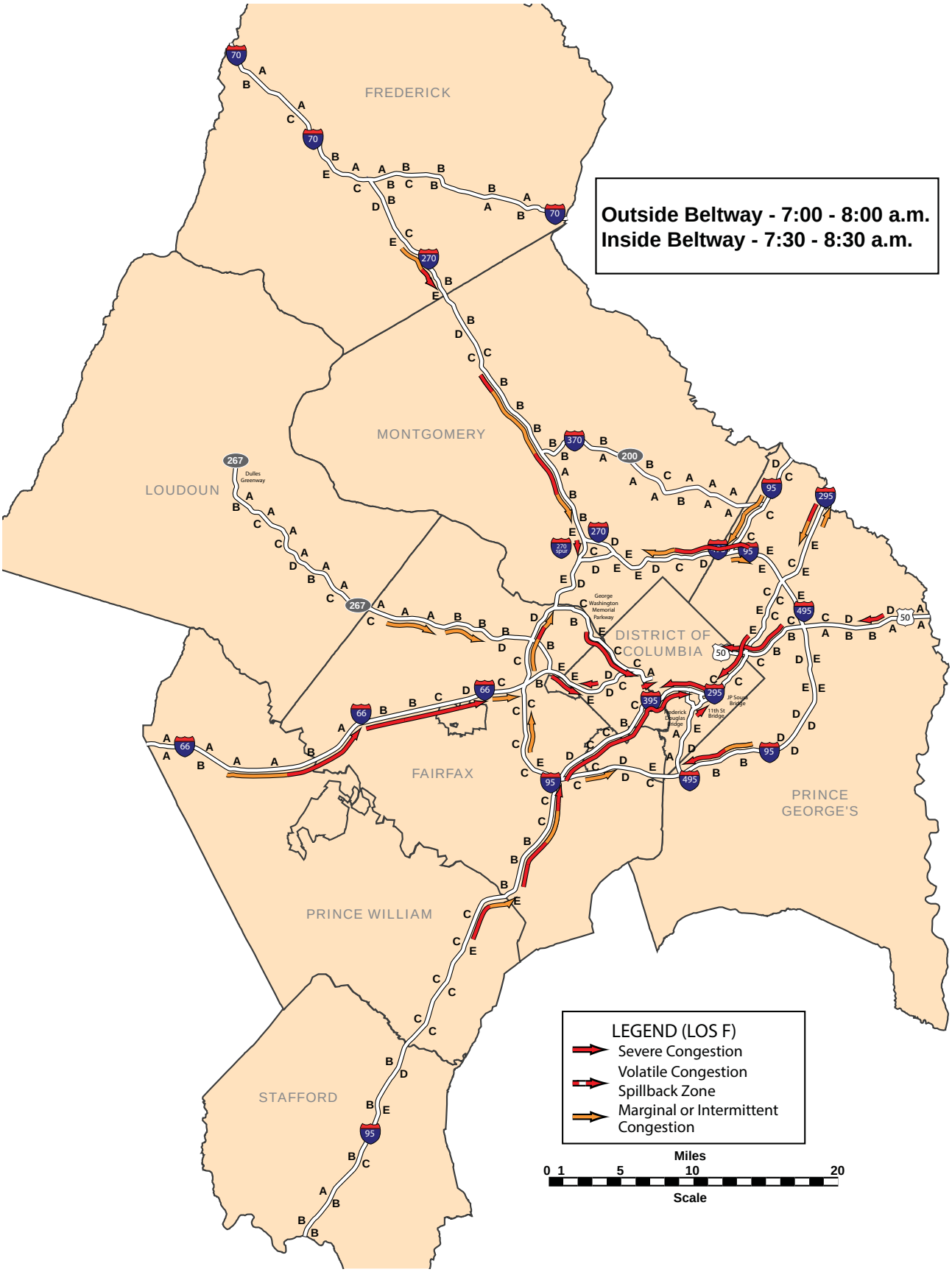
Morning - First Time Period



Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40		50 Congested 60	70	80 Severe 90

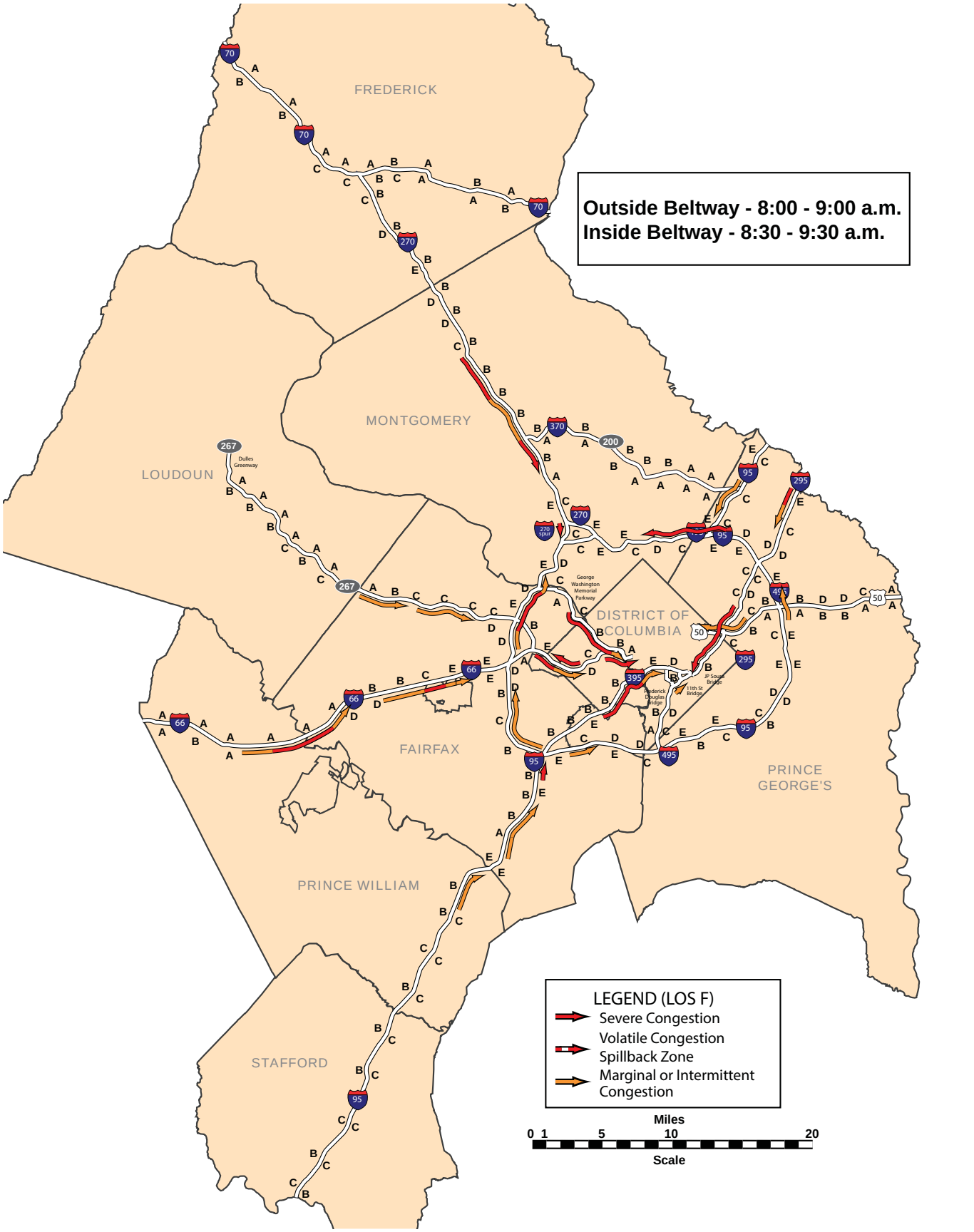
Morning - Second Time Period



Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

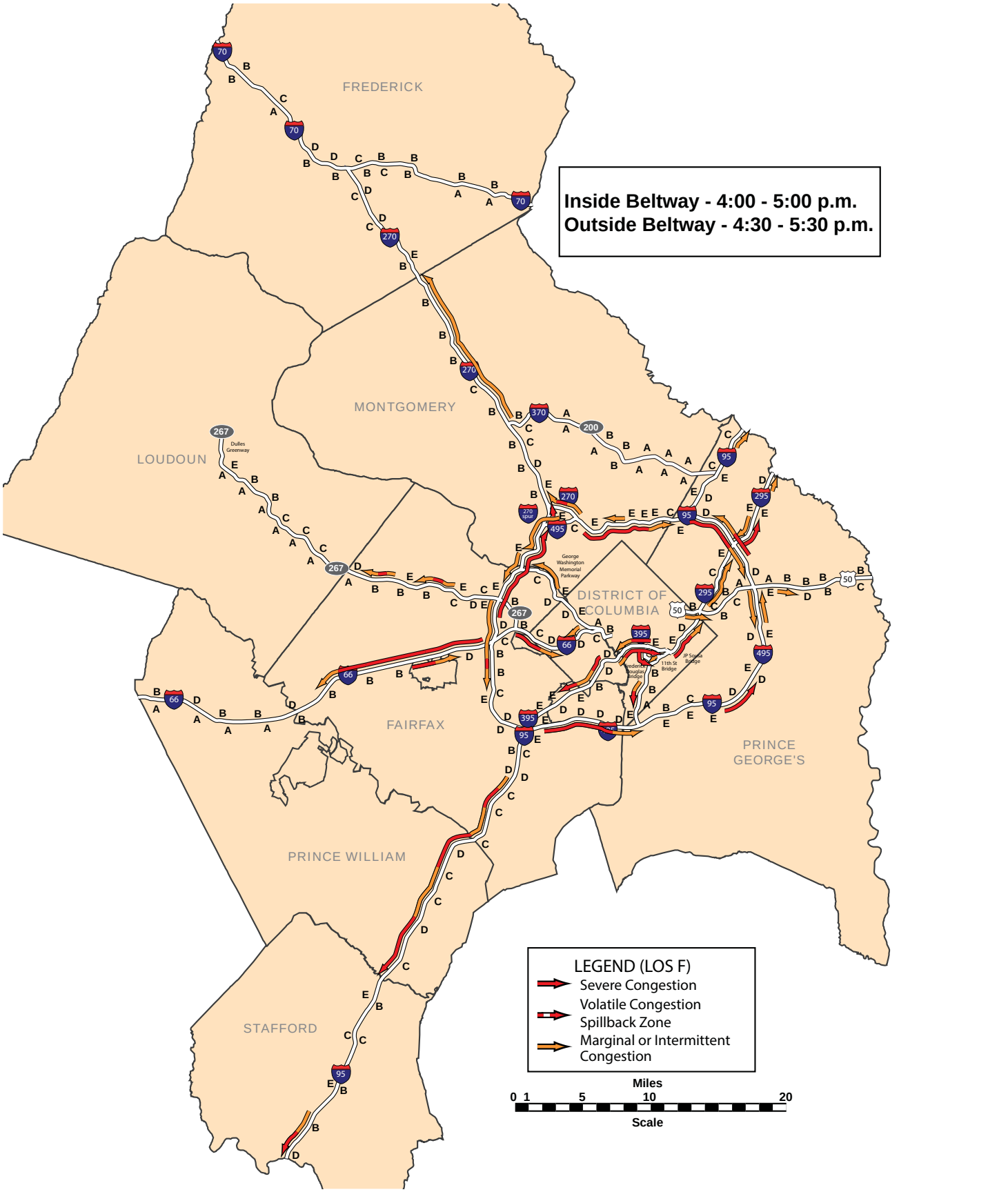
Morning - Third Time Period



Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40		50 Congested 60	70	80 Severe 90

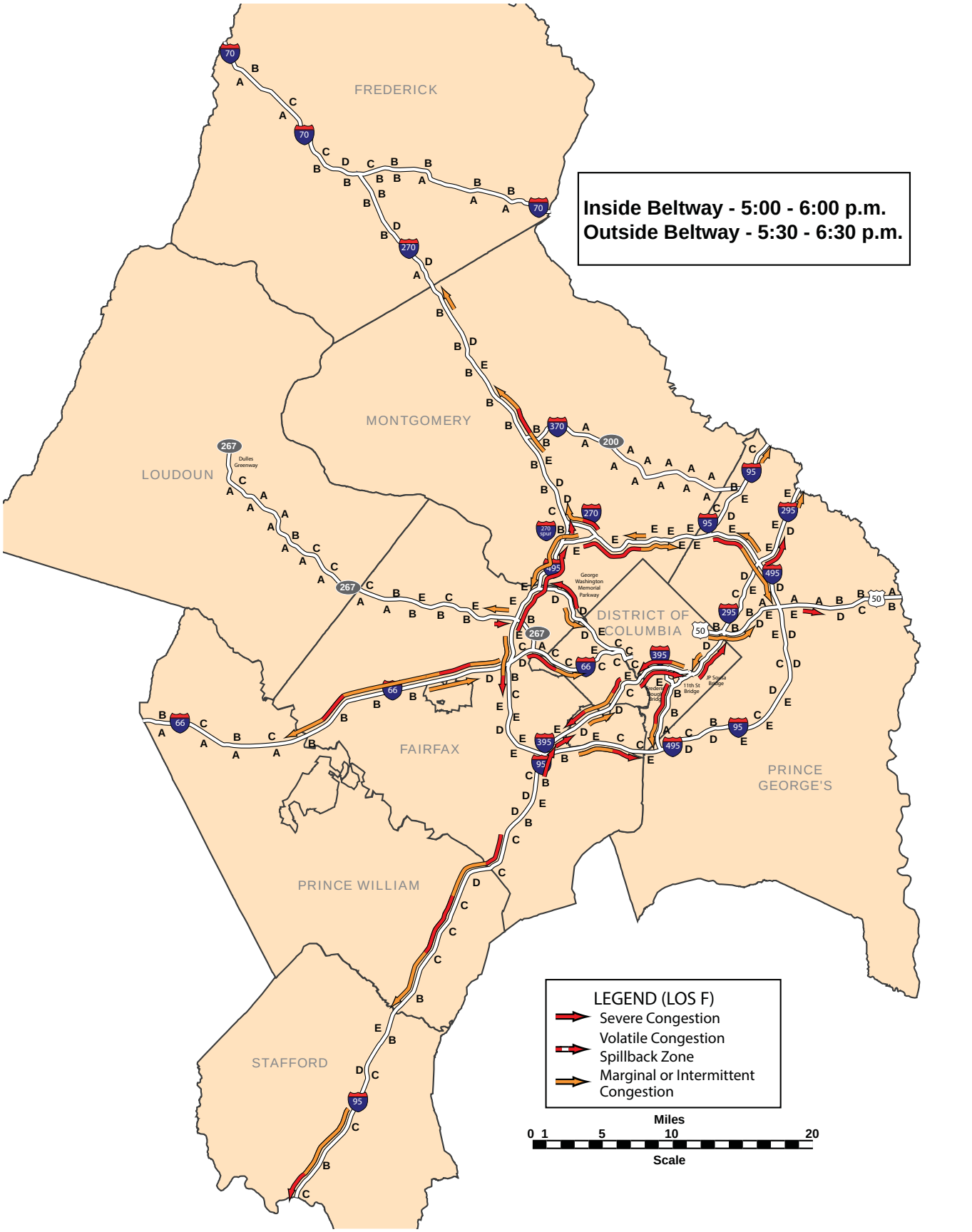
Evening - First Time Period



Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	20		30	40	50	60	70	80	90
Light	Moderate		Heavy		Congested		Severe

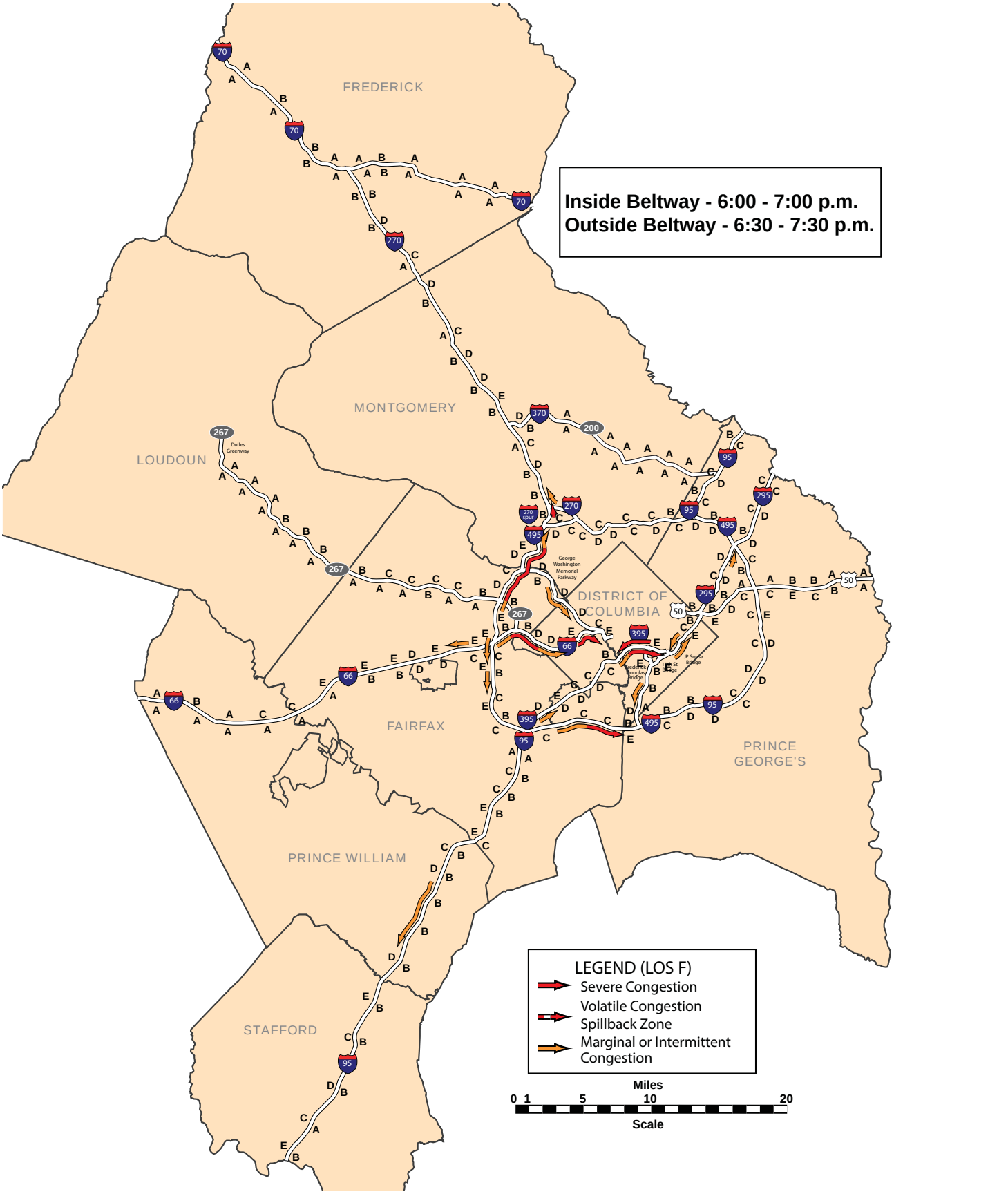
Evening - Second Time Period



Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40		50 Congested 60	70	80 Severe 90

Evening - Third Time Period



Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40		50 Congested	60 70 80	Severe 90

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Chapter VI

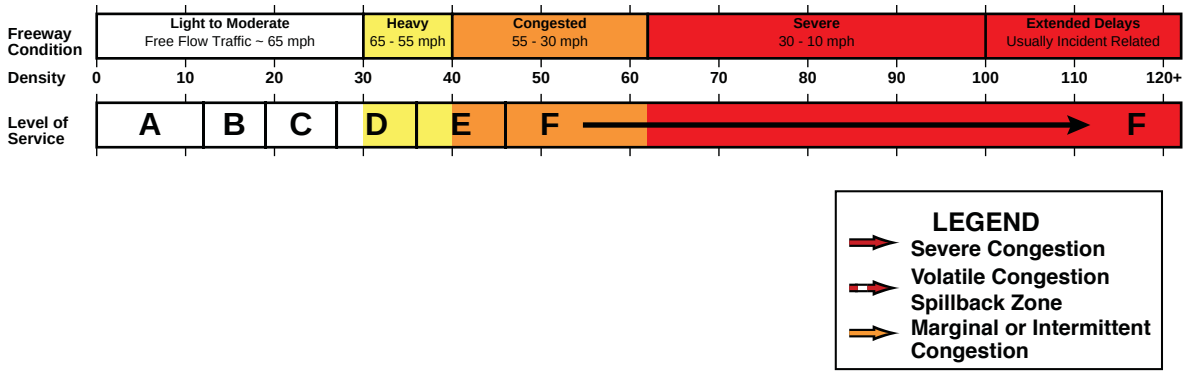
Major Trends and Changes in Traffic Conditions Between 1993 and 2014

This section of the report identifies locations on the highway system where major trends or changes in traffic conditions were found since the first aerial survey in 1993. On some highways, the absence or presence of construction contributed to the changed conditions. On other highways, added capacity contributed to improved flow; in some cases, no apparent cause could be attributed to the improvement or degradation of traffic flow.

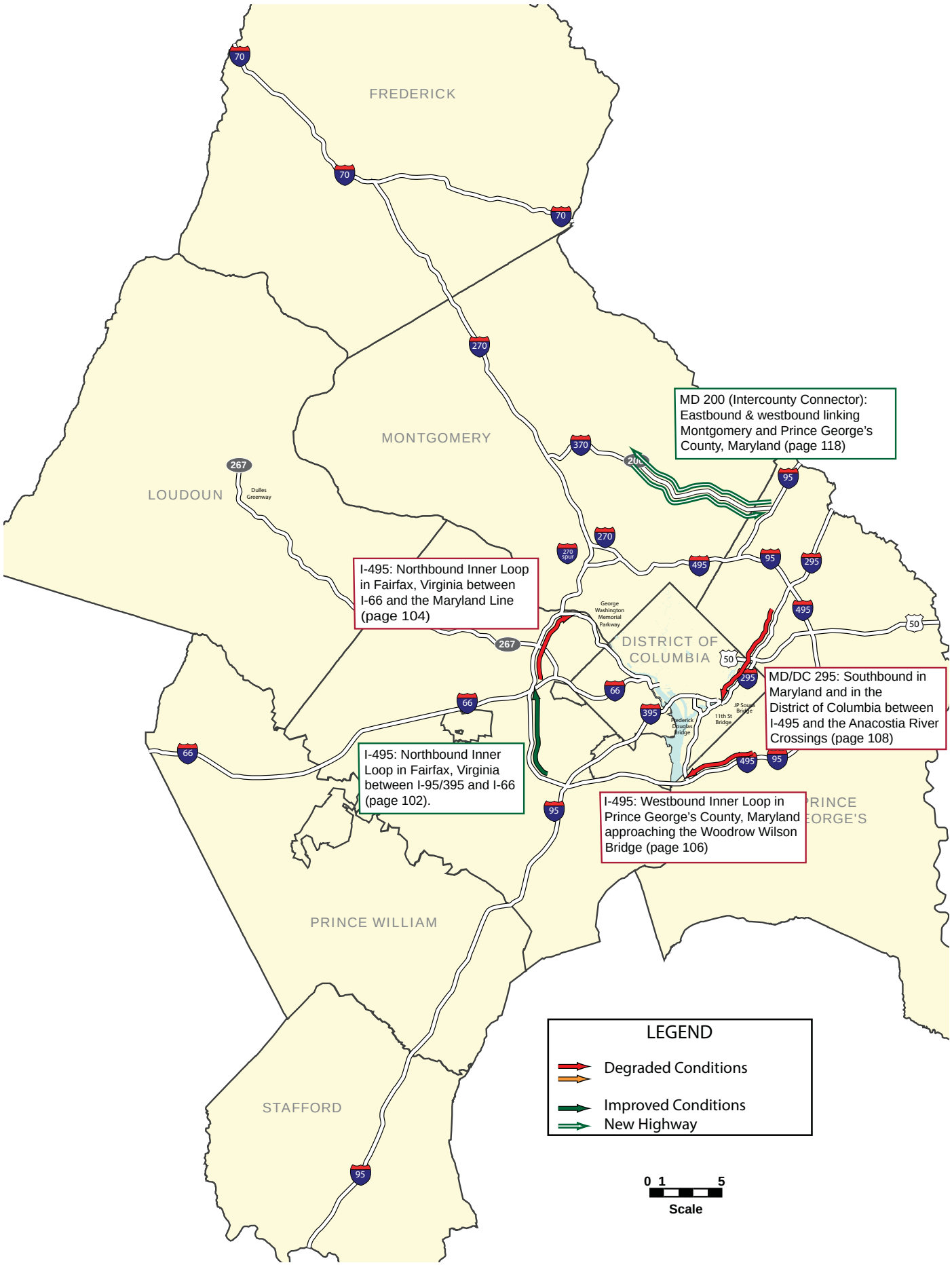
Excerpts from the level-of-service (LOS) tables contained in Chapter III have been used in this section of the report to depict the changes in traffic conditions.

A summary of traffic conditions for each level-of-service is provided below.

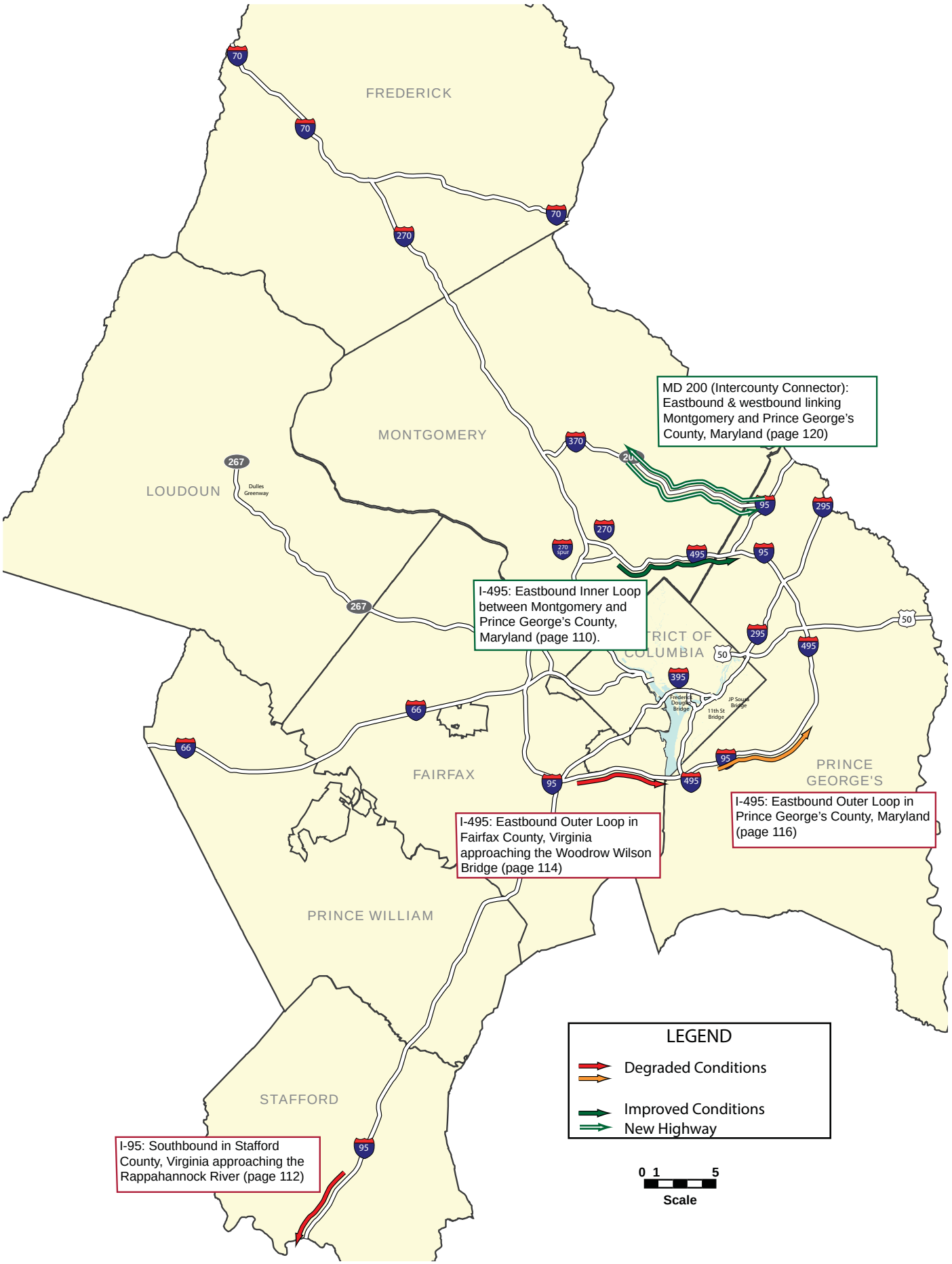
Traffic Quality Ratings:



Significant Changes (2008 - 2014) - Morning Peak Period



Significant Changes (2008 - 2014) - Evening Peak Period



I-495 VIRGINIA (FAIRFAX COUNTY) - MORNING

Location: I-495 Inner Loop in Virginia between I-95/395 and I-66

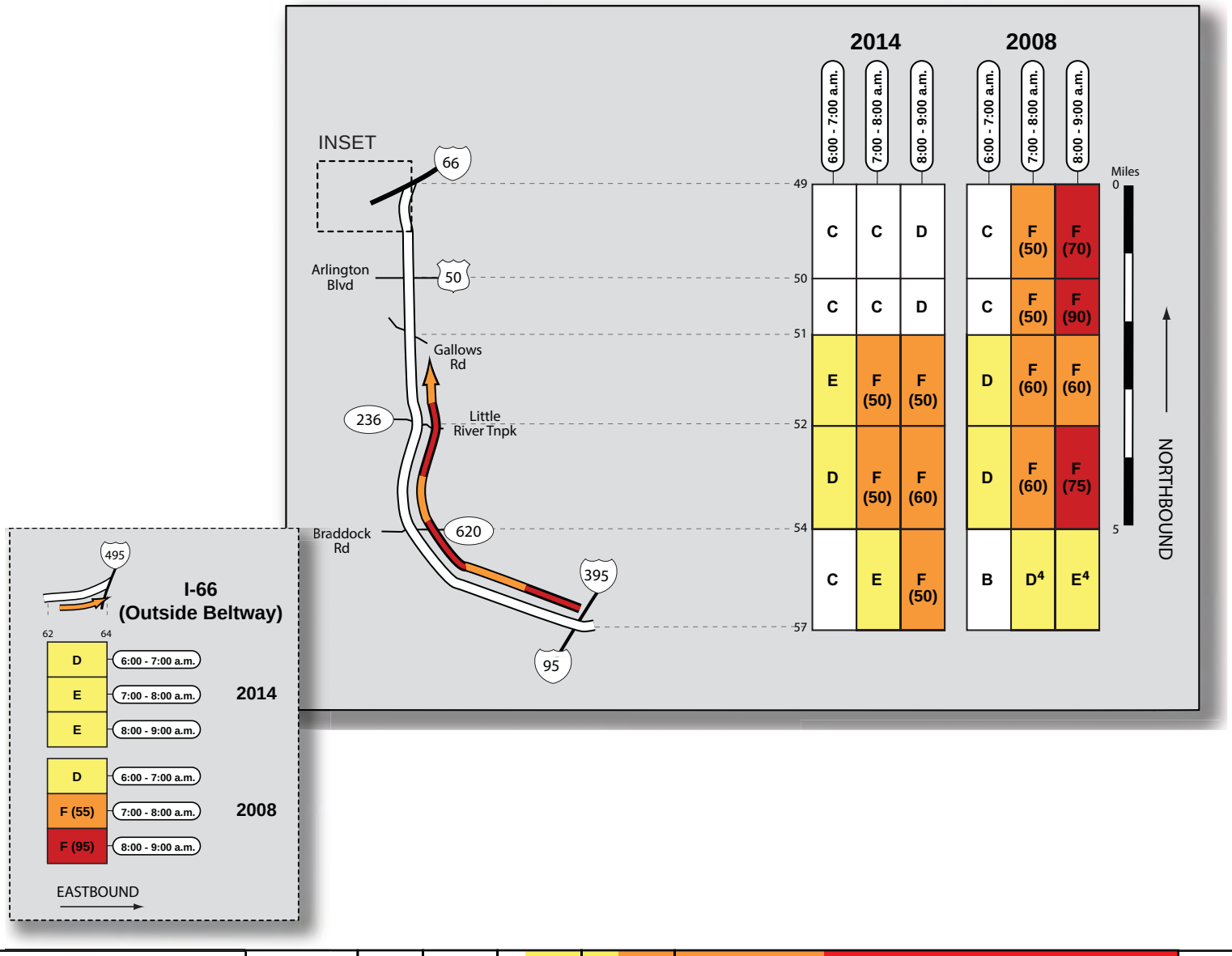
Time Period: Morning (7:00-9:00 a.m.)

Type of Change: **Improved**

Potential Cause: New HOV/HOT Facility

On I-495, a new HOV/HOT facility in Virginia between the I-95/395 and VA 267 Interchanges was completed between the 2011 and 2014 surveys. For the most part, 2 lanes are available in each direction (Inner and Outer Loop). Level-of-service A and B were documented on this facility throughout the 2014 morning and evening surveys.

For morning commuters in the 4 general-purpose lanes along this corridor (Inner Loop – Northbound), a noticeable improvement was evident. The graphic below (pre vs. post construction) shows less severe congestion between I-95/395 and VA 236 (Gallows Rd), and a dramatic improvement on the approach to the I-66 Interchange where free-flow speeds were consistently found in 2014. Additionally, historical eastbound congestion on I-66 approaching I-495 was not found during the 2014 survey (see I-66 level-of-service data in the graphic below). The increased capacity of I-495 and Interchange reconstruction likely contributed to the improved conditions.



Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	20	30	40	50	60	70	80	90
Light	Moderate	Heavy	Congested	Severe

I-495 VIRGINIA (FAIRFAX COUNTY) - MORNING

2011

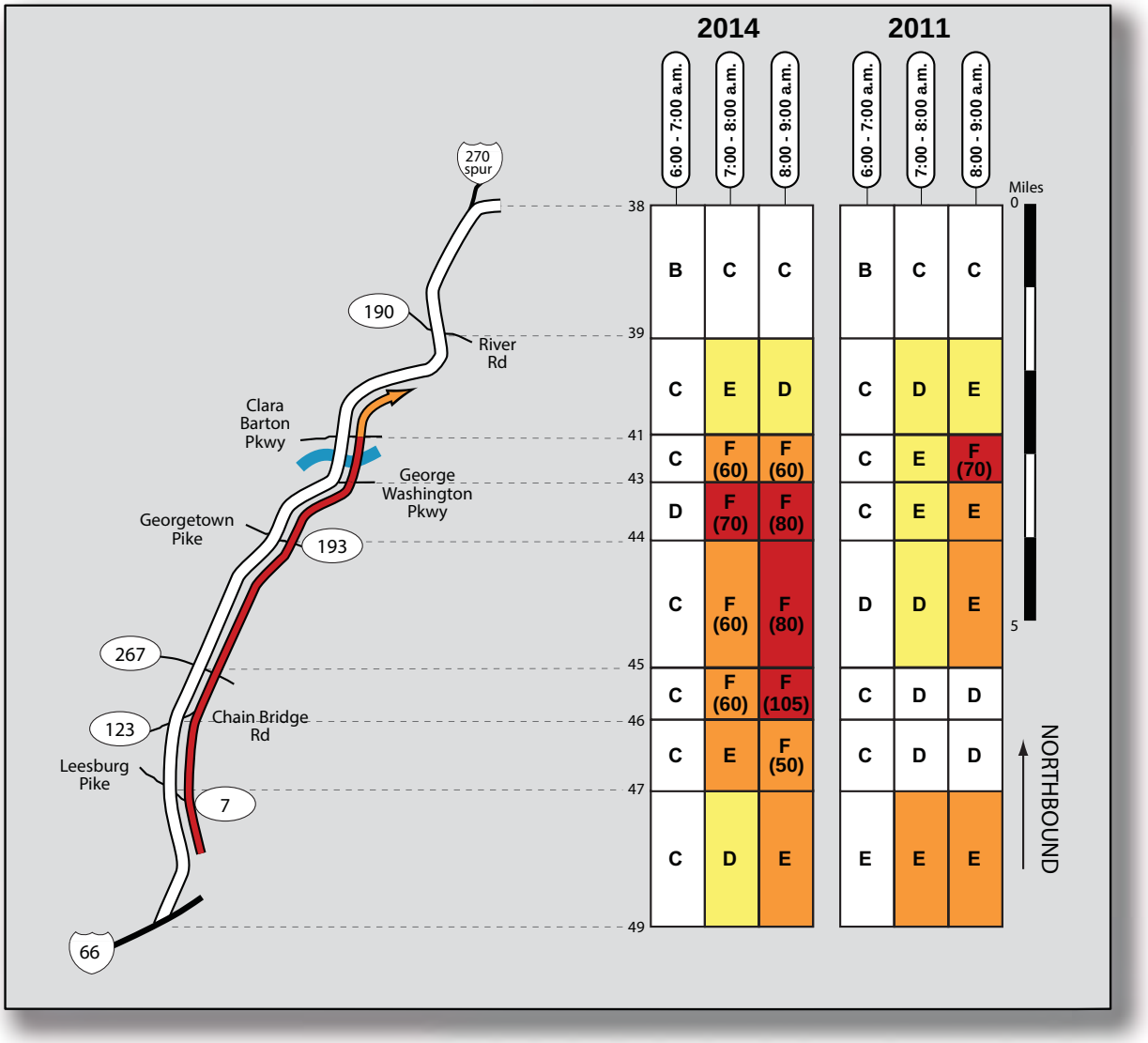
2014

Photographs:
The photo at the top shows typical/historical northbound congestion on the inner loop of the Beltway passing through the US 50 Interchange. The bottom photos shows free-flow conditions consistently found here during the morning surveys in 2014. Note the new HOV/HOT facility in the center of the highway (both directions).

I-495 VIRGINIA (FAIRFAX COUNTY) - MORNING

Location:	I-495 Inner Loop in Virginia between I-66 and the Maryland Line (American Legion Bridge)
Time Period:	Morning (7:00-9:00 a.m.)
Type of Change:	**Degraded**
Potential Cause:	Unknown

Traffic congestion on the northwest west side of I-495 (Inner Loop) in Virginia worsened since the 2011 reporting period. One factor contributing to the degradation was the left-side merge associated with the termination of the Beltway's HOV/HOT facility downstream of VA 267. Additionally, a historical primary bottleneck at the I-66 Interchange may have metered northbound traffic in the past; the elimination of this bottleneck in 2014 may have increased flow and thus degraded conditions downstream on the Inner Loop.



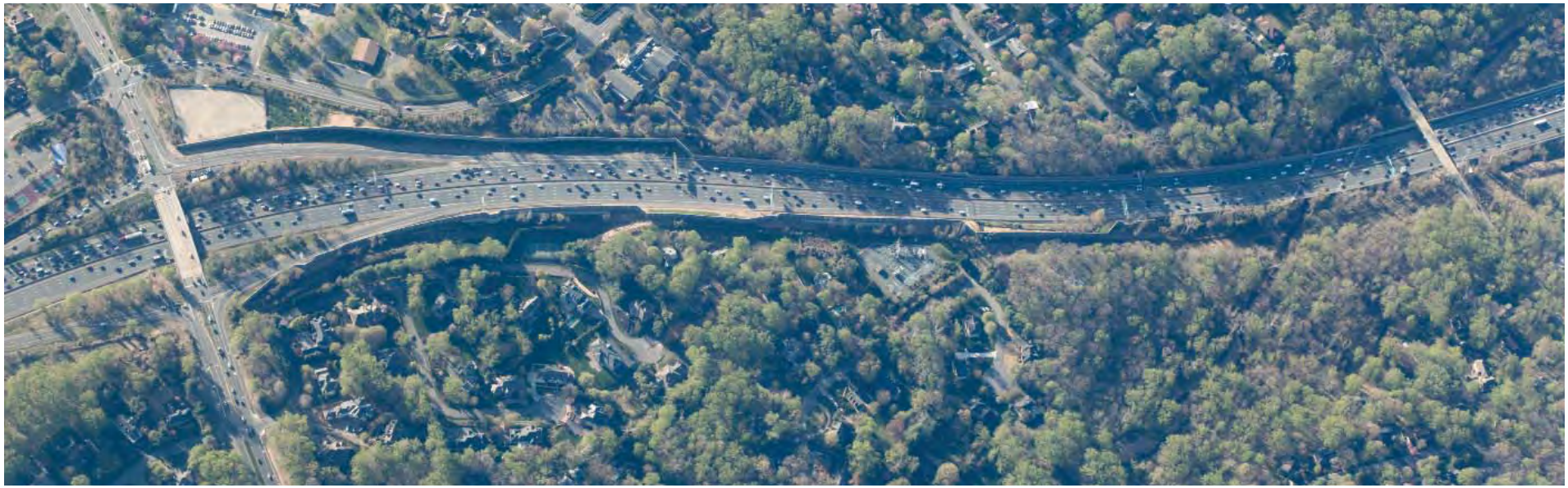
Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	20	30		40	50	60	70 80 90
Light	Moderate		Heavy		Congested		Severe

I-495 VIRGINIA (FAIRFAX COUNTY) - MORNING

2011

2014



Photographs:
The photo at the top shows typical/historical free-flow conditions on the inner loop of the Beltway approaching the VA 193 Interchange. The bottom photos shows typical congestion found here during the morning surveys in 2014.

I-495 MARYLAND (PRINCE GEORGE'S COUNTY) - MORNING

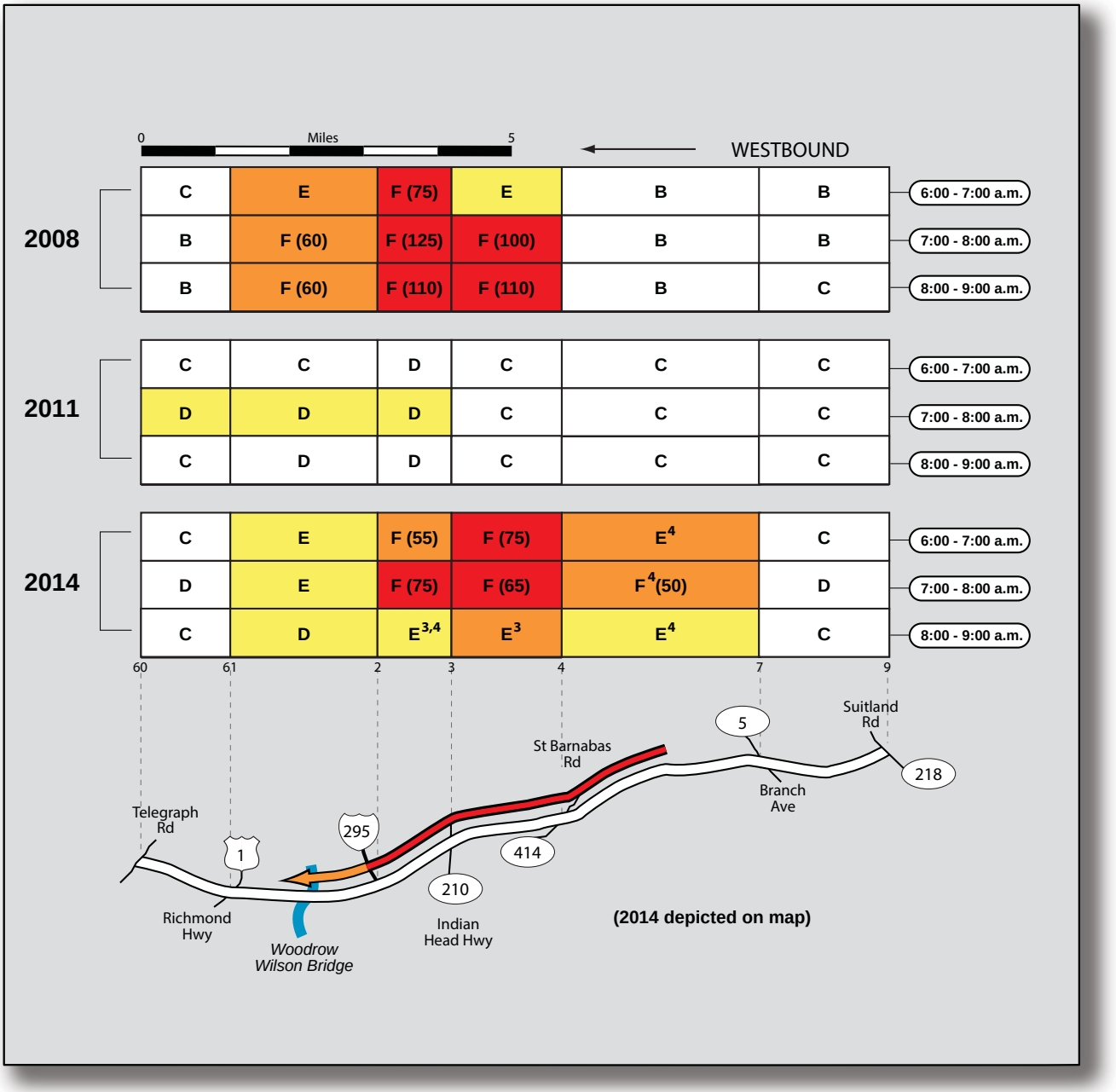
Location: I-495 Inner Loop in Maryland, MD 5 (Branch Avenue) to Woodrow Wilson Bridge

Time Period: Morning (6:00-9:00 a.m.)

Type of Change: **Degraded**

Potential Cause: Additional traffic attracted to completed Woodrow Wilson Bridge

Renewed congestion over the three to five-mile approach to the rebuilt Woodrow Wilson Bridge may be a result of added volume distributed to the higher-capacity crossing of the Potomac River. Traffic flows reasonably well prior to Branch Avenue, but degrades abruptly near the St. Barnabas Road Interchange and continues performing poorly downstream to the I-295 interchange. Rolling backups along the final three-mile approach to the bridge may be due to merging and repositioning associated with the multiple ramps concentrated around St. Barnabas Road, Indian Head Highway, and to a lesser degree, the I-295 interchange.



Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	20	30	40	50	60	70	80	90
Light	Moderate	Heavy	Congested	Severe

I-495 MARYLAND (PRINCE GEORGE'S COUNTY) - MORNING

2011

2014

Photographs:
The interchange at MD 5 is shown in both photographs. The top photograph shows typical free-flow conditions found here during the 2011 survey. The 2014 photograph shows the tail of the queue during the peak period; this congestion persisted downstream to the Woodrow Wilson Bridge.

MD/DC 295 (DISTRICT OF COLUMBIA) - MORNING

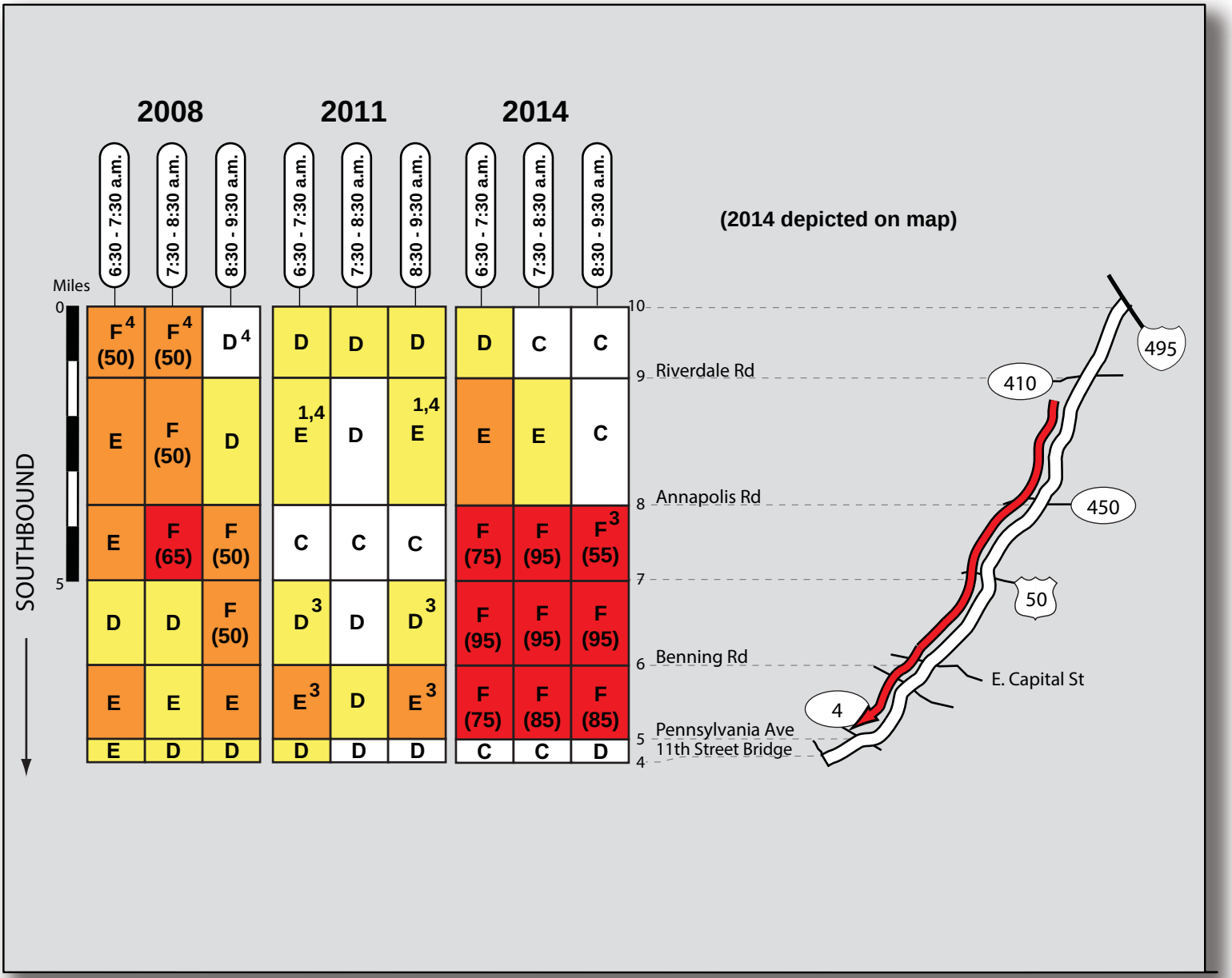
Location: MD/DC 295 (MD 450 to MD 4)

Time Period: Morning (6:30-9:30 a.m.)

Type of Change: **Degraded**

Potential Cause: Unknown

Adequate flow conditions were observed for the southbound morning commute approaching and through the Interchange at I-495; however, levels of service dropped considerably approaching MD 450 (Annapolis Road) and continued to worsen through the Benning Road, East Capital St and Pennsylvania Ave Interchanges. The 2014 graphic below clearly shows the head of the queue at the Pennsylvania Ave Interchange. Improved flow along this section of DC 295 was documented in the 2011 report (attributed to completed construction improvement projects); the graphic below depicts the return of level-of-service F conditions.



Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	20	30		40	50	60	70 80 90
Light	Moderate	Heavy			Congested		Severe

MD/DC 295 (DISTRICT OF COLUMBIA) - MORNING

2011

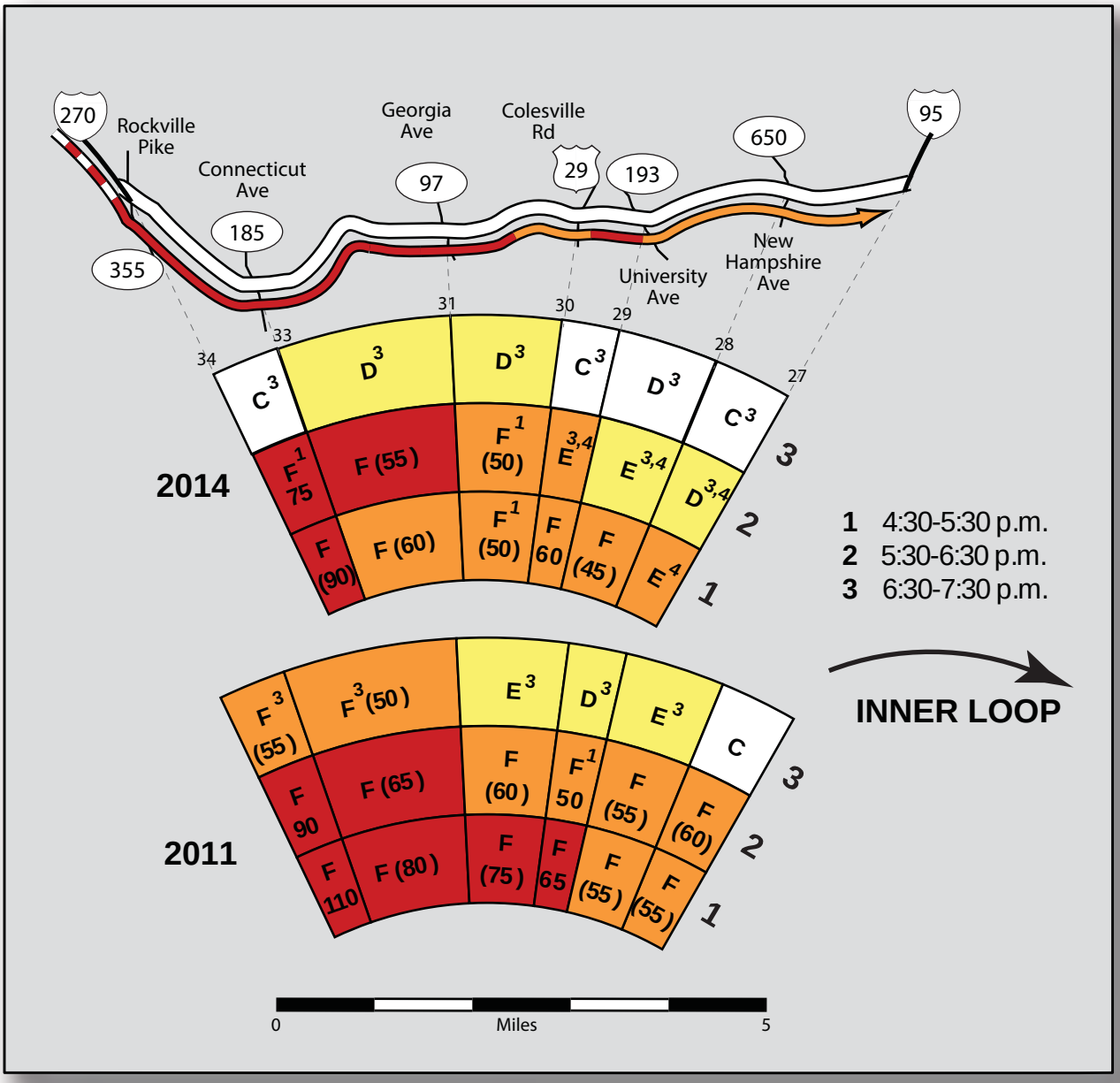
2014

Photographs:
These two photographs highlight the disparity in the conditions found along DC 295 between I-495 and the Anacostia River Crossings. The US 50 Interchange is at the right side of the photographs.

I-495 MARYLAND (MONTGOMERY COUNTY) – EVENING

Location:	I-495 Inner Loop in Maryland (I-270 to I-95)
Time Period:	Evening (4:30-7:30 p.m.)
Type of Change:	**Improved**
Potential Cause:	The opening of the Intercounty Connector (ICC), linking Montgomery and Prince George's Counties

Although significant eastbound congestion remains, observed levels of service in 2014 indicate an easing in some of the heavier congested zones along on the top of the Capital Beltway in Maryland. Although other transportation trends may have played a role as well, the opening of the ICC since the 2011 reporting period may have provided enough added capacity in the region to provide a measurable amount of eastbound relief in the corridor during the evening commute.



Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	20	30	40	50	60	70	80	90
Light	Moderate	Heavy	Congested	Severe

I-495 MARYLAND (MONTGOMERY COUNTY) – EVENING

2011

2014

Photographs:
Because "south" is oriented up, both photographs show eastbound inner loop flow (towards left edge of photo) on top of westbound flow. In both photos, MD 193 is at the left, US 29 on the right. The 2011 photo shows typical westbound congestion approaching MD 193; the 2014 photo shows slightly improved flow during the peak period.

I-95 VIRGINIA (STAFFORD COUNTY) - EVENING

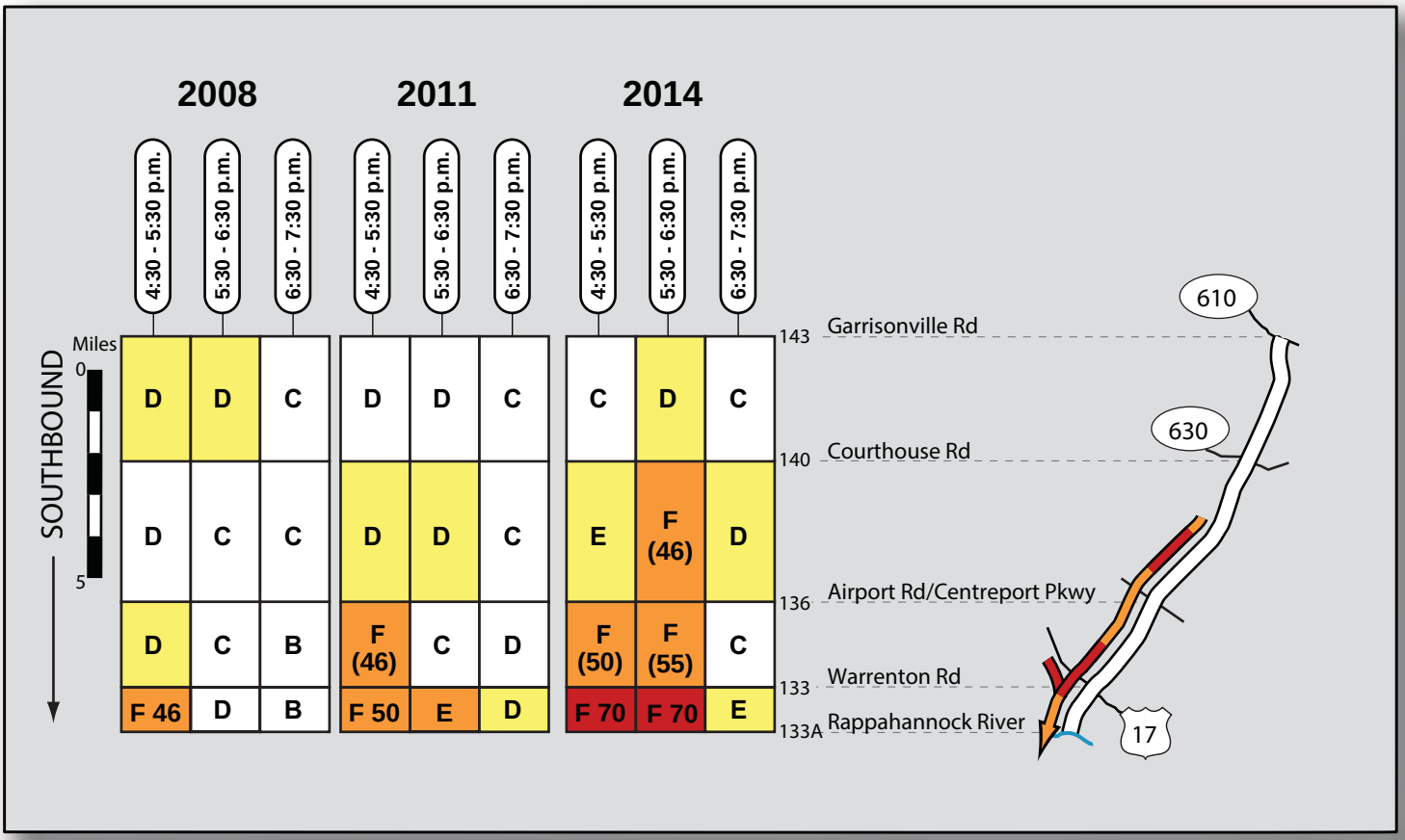
Location: I-95 in Stafford County, Virginia

Time Period: Evening (4:30-6:30 p.m.)

Type of Change: **Degraded**

Potential Cause: Increased Demand

The graphic below shows the continued degradation of level-of-service on I-95 in Stafford County. It is likely demand has increased due to commuters traveling greater distances. The continued highway improvements (added capacity) on the I-95 corridor between Stafford County and Washington D.C. may be attributable to the extended commutes. During the 2014 survey, a new section of the I-95 HOV facility was under construction between Dumfries Rd and Garrisonville Rd (a distance of approximately 10 miles).

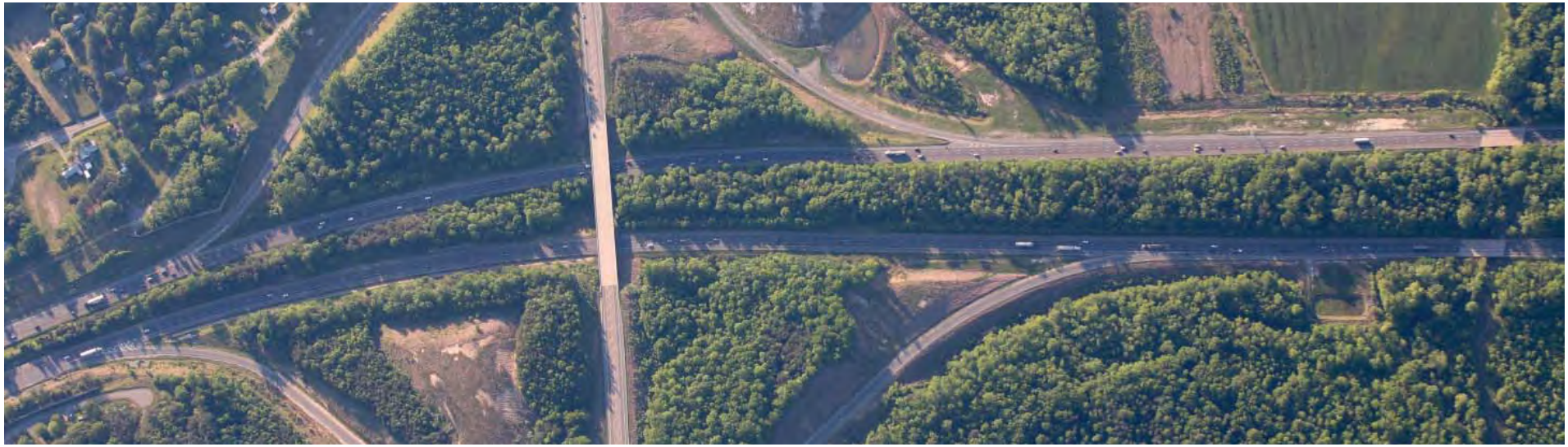


Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

I-95 VIRGINIA (STAFFORD COUNTY) - EVENING

2011



2014

Photographs:
The 2011 photo at the top shows typical/historical free-flow conditions at the Centreport Parkway Interchange. The bottom photo shows typical congestion found here during the evening peak period in 2014.

I-495 VIRGINIA (FAIRFAX COUNTY) - EVENING

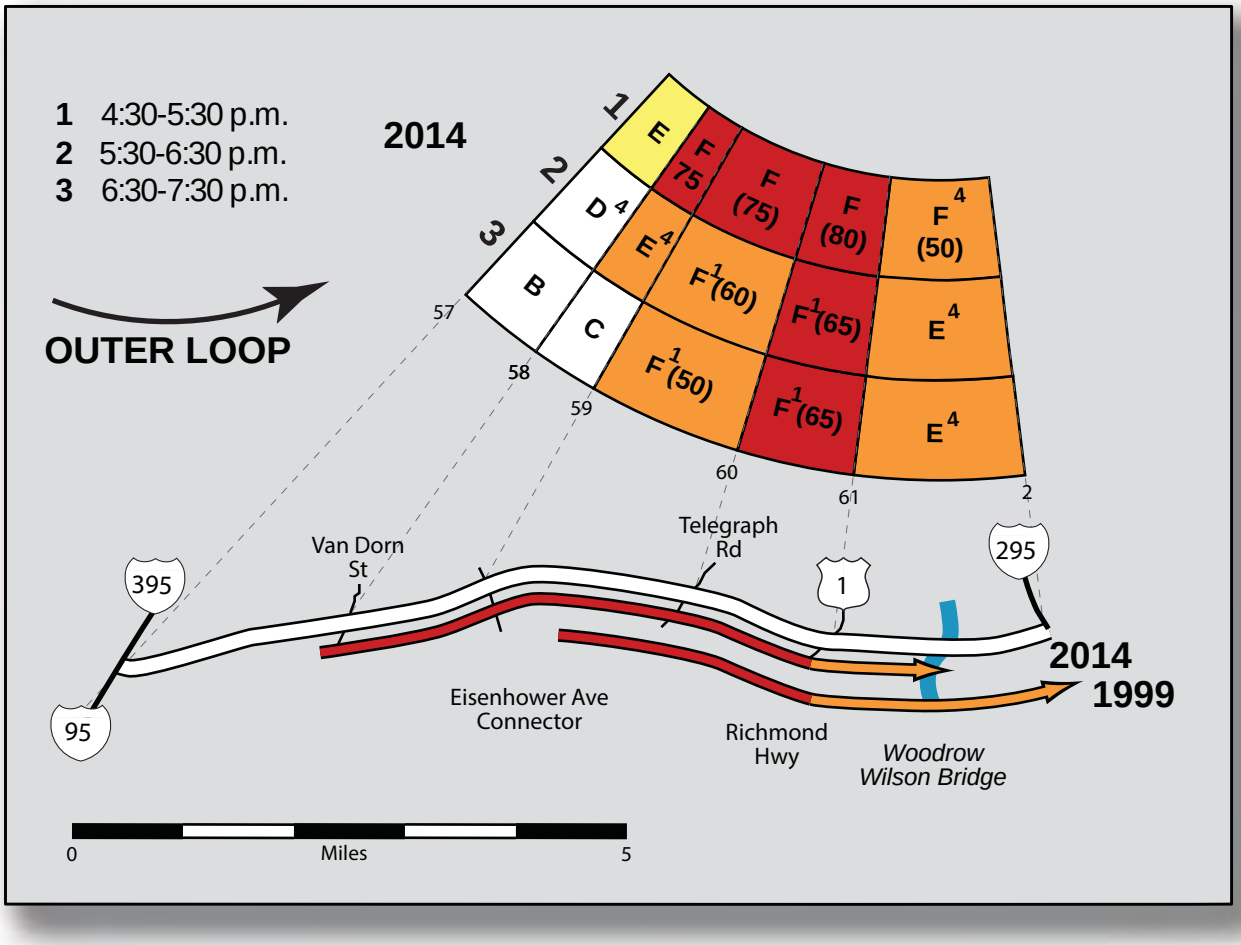
Location: I-495 Outer Loop in Virginia (I-95/395 to Woodrow Wilson Bridge)

Time Period: Evening (4:00-7:00 p.m.)

Type of Change: **Degraded**

Potential Cause: Unknown

Historically, before construction began between the Springfield Interchange and the Woodrow Wilson Bridge (pre-construction during the 1999 aerial survey), eastbound commuters on the outer loop of the Beltway incurred delays traveling from Virginia into Maryland at the Woodrow Wilson Bridge. Eastbound congestion on the outer loop was typically encountered somewhere between the Eisenhower Ave Connector and Telegraph Rd Interchanges. In the succeeding survey years, various configurations of construction zones caused atypical congestion along this corridor. With construction completed in 2014, eastbound congestion is now typically encountered somewhere between the I-95/395 Interchange and Van Dorn St; moderate to severe congestion persists downstream in both the inner outer divided roadways on the approach to the Woodrow Wilson Bridge. Once on the bridge span, traffic flow improves considerably.



Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

I-495 VIRGINIA (FAIRFAX COUNTY) - EVENING

2014

Photographs:
The 2014 photo above shows eastbound congestion on the outer loop of the Beltway at the Van Dorn St Interchange. During the 1999 survey (pre-construction), free-flow conditions were typically found here.

I-495 MARYLAND (PRINCE GEORGE'S COUNTY) - EVENING

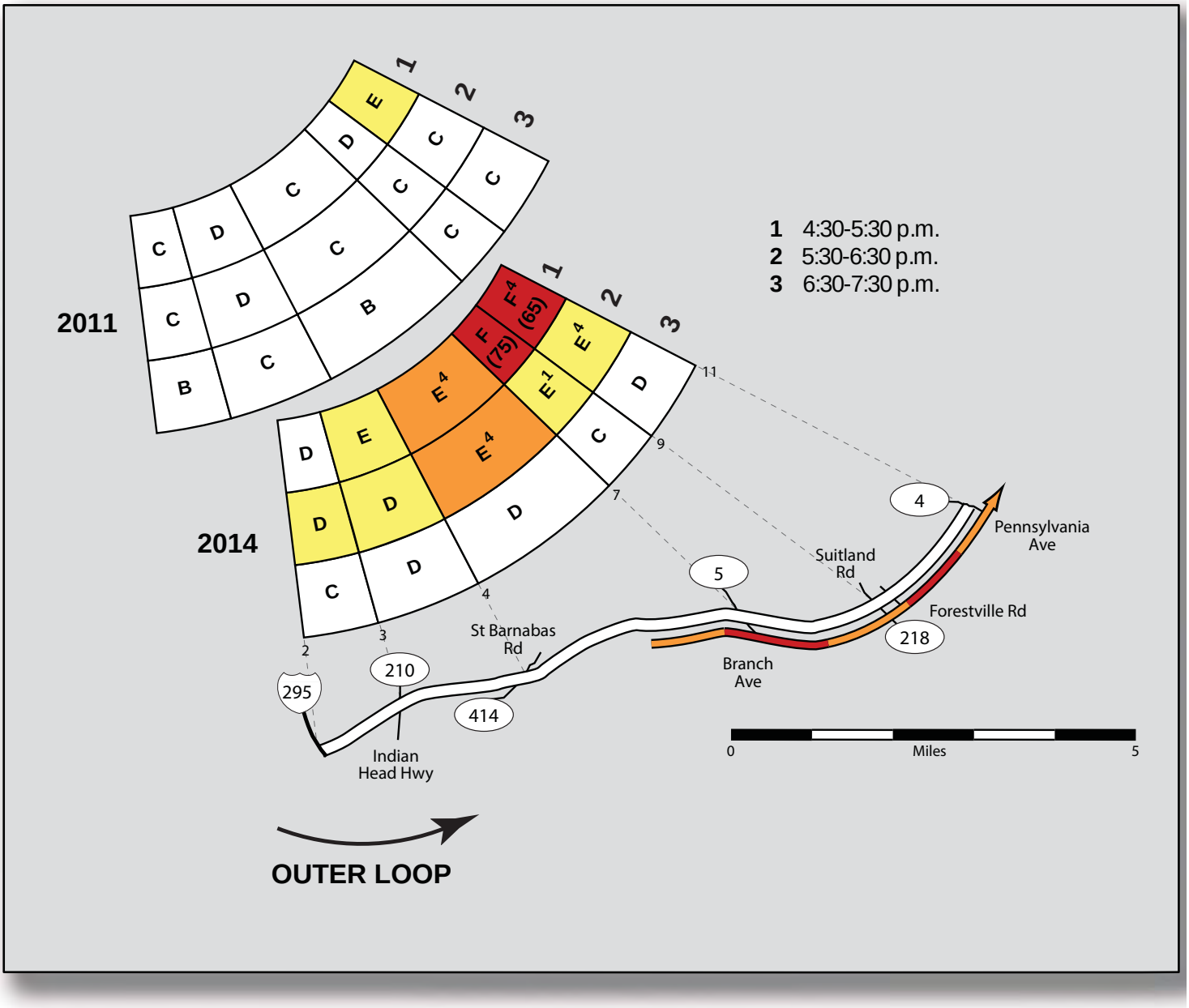
Location: I-495 Outer Loop in Prince George's County, Maryland (MD 210 to MD 4)

Time Period: Evening (4:00-6:30 p.m.)

Type of Change: **Degraded**

Potential Cause: Unknown

A new extended zone of congestion was found on the Outer Loop of the Beltway in 2014. Historically, mostly free flow conditions were found on the Outer Loop in Maryland traveling from the Woodrow Wilson Bridge up to the vicinity of MD 214 (Central Ave). The level-of-service table below shows that congestion is now typically encountered in the vicinity of Indian Head Highway and St Barnabas Rd Interchanges and persists downstream to MD 4 (Pennsylvania Ave).



Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

I-495 MARYLAND (PRINCE GEORGE'S COUNTY) - EVENING

2011

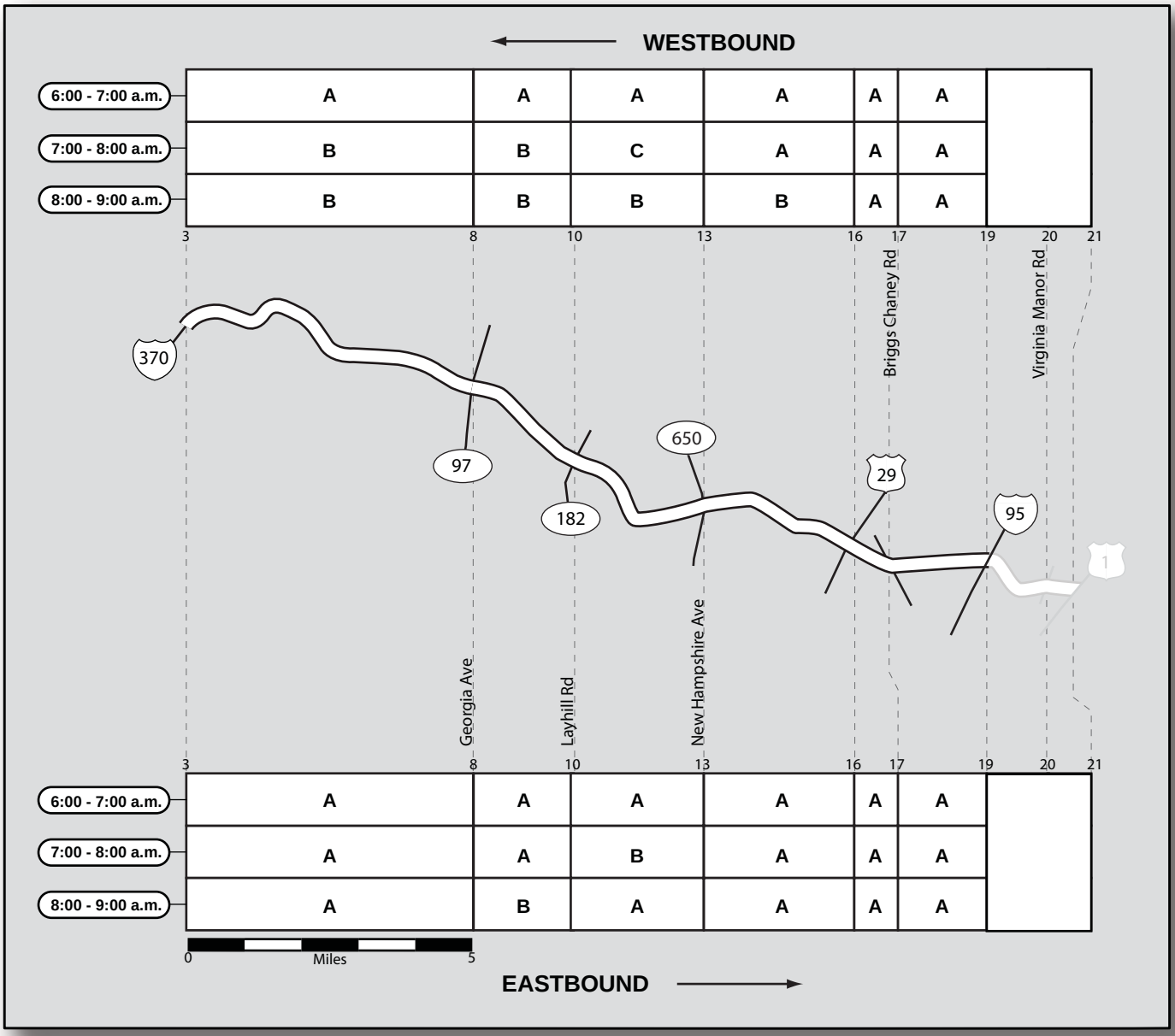
2014

Photographs:
The 2011 photo at the top shows historical/typical free flow conditions on the outer loop of the Beltway at the Suitland Rd and Forestville Rd Interchanges. The photo at the bottom shows typical congestion found during the peak period in 2014.

MD 200 INTERCOUNTY CONNECTOR, MARYLAND (PRINCE GEORGE'S & MONTGOMERY COUNTIES) - MORNING

Location:	MD 200 (Intercounty Connector)
Time Period:	Morning (6:30-9:30 a.m.)
Type of Change:	**Improved**
Cause:	Added Capacity: Completion of the Intercounty Connector (ICC) between MD 97 in Montgomery County and I-95 in Prince George's County

During the 2014 survey, levels-of-service A and B were found on the ICC throughout the morning survey period. The new corridor provided an alternate route for commuters traveling between Montgomery County and Prince George's County.



Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	20	30	40	50	60	70	80 90
Light	Moderate	Heavy		Congested		Severe	

MD 200 INTERCOUNTY CONNECTOR, MARYLAND (PRINCE GEORGE'S & MONTGOMERY COUNTIES) - MORNING

2014

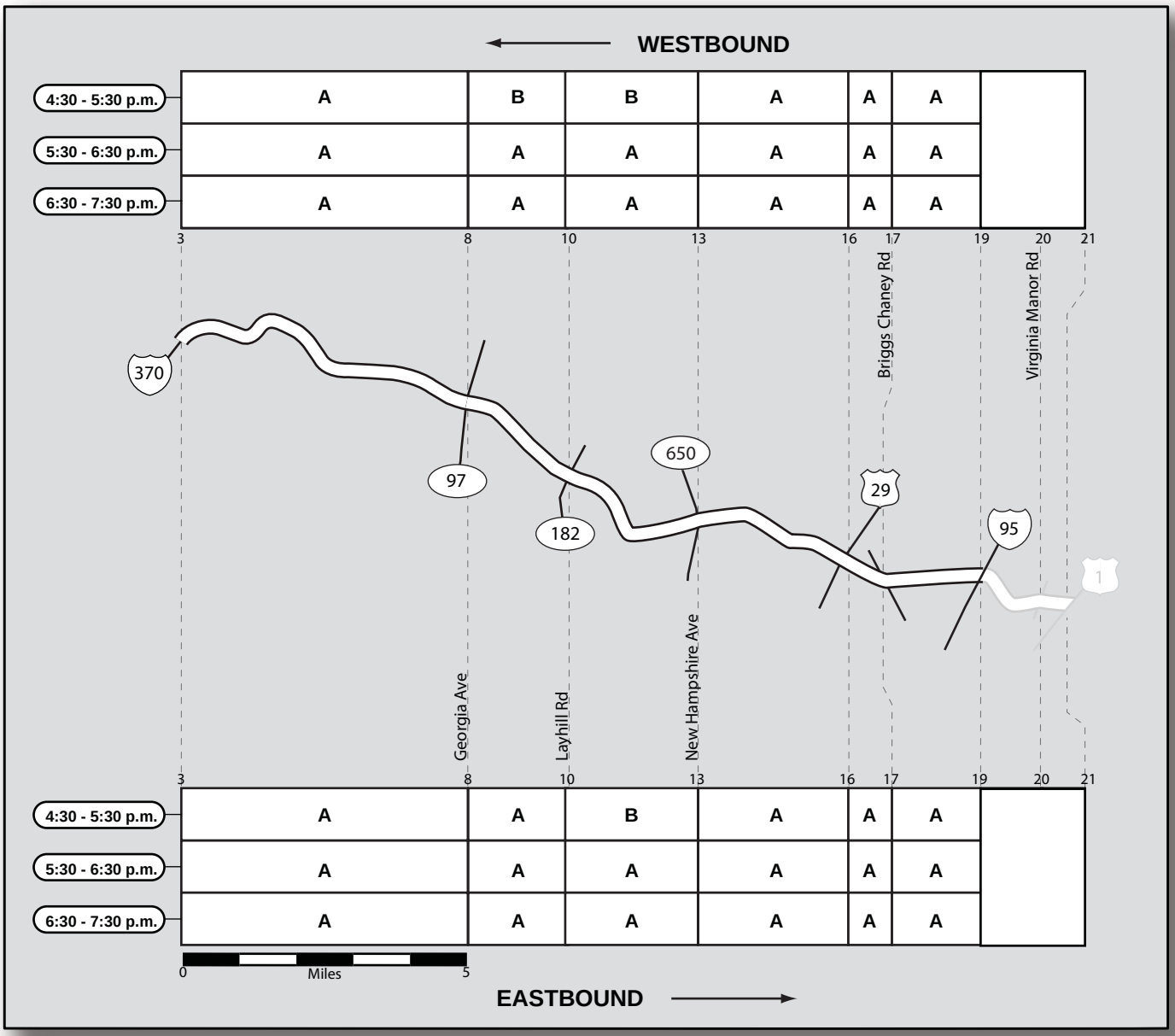
2014

Photographs:
Both photographs displayed here were taken during the 2014 survey. The ICC at US 29 is shown at the top while the New Hampshire Ave Interchange is shown below. The ICC was not open at these locations during the 2011 survey (not photographed).

MD 200 INTERCOUNTY CONNECTOR, MARYLAND (PRINCE GEORGE'S & MONTGOMERY COUNTIES) - EVENING

Location:	MD 200 (Intercounty Connector)
Time Period:	Evening (4:30-7:30 p.m.)
Type of Change:	**Improved**
Cause:	Added Capacity: Completion of the Intercounty Connector (ICC) between MD 97 in Montgomery County and I-95 in Prince George's County

During the 2014 survey, levels-of-service A and B were found on the ICC throughout the evening survey period. The new corridor provided an alternate route for commuters traveling between Montgomery County and Prince George's County.



Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	20	30		40	50	60	70 80 90
Light	Moderate	Heavy			Congested		Severe

MD 200 INTERCOUNTY CONNECTOR, MARYLAND (PRINCE GEORGE'S & MONTGOMERY COUNTIES) - EVENING

2011

2014

Photographs:
The MD 97 Interchange on the ICC is at the center of the top and bottom photos. The photograph at the top was taken in 2011 when the ICC was open only between I-370 and MD 97. During the 2014 survey, the ICC was completed and open between I-370 in Montgomery County and I-95 in Prince George's County; the last section between I-95 and US Route 1 in Laurel was still under construction.

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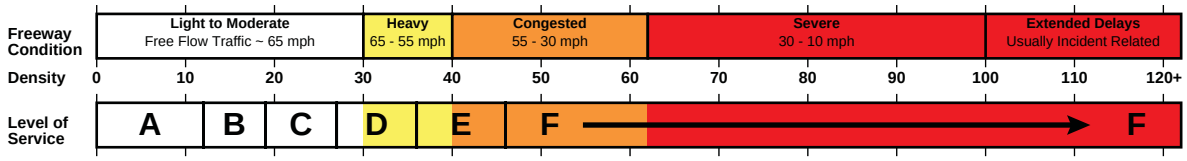
Chapter VII

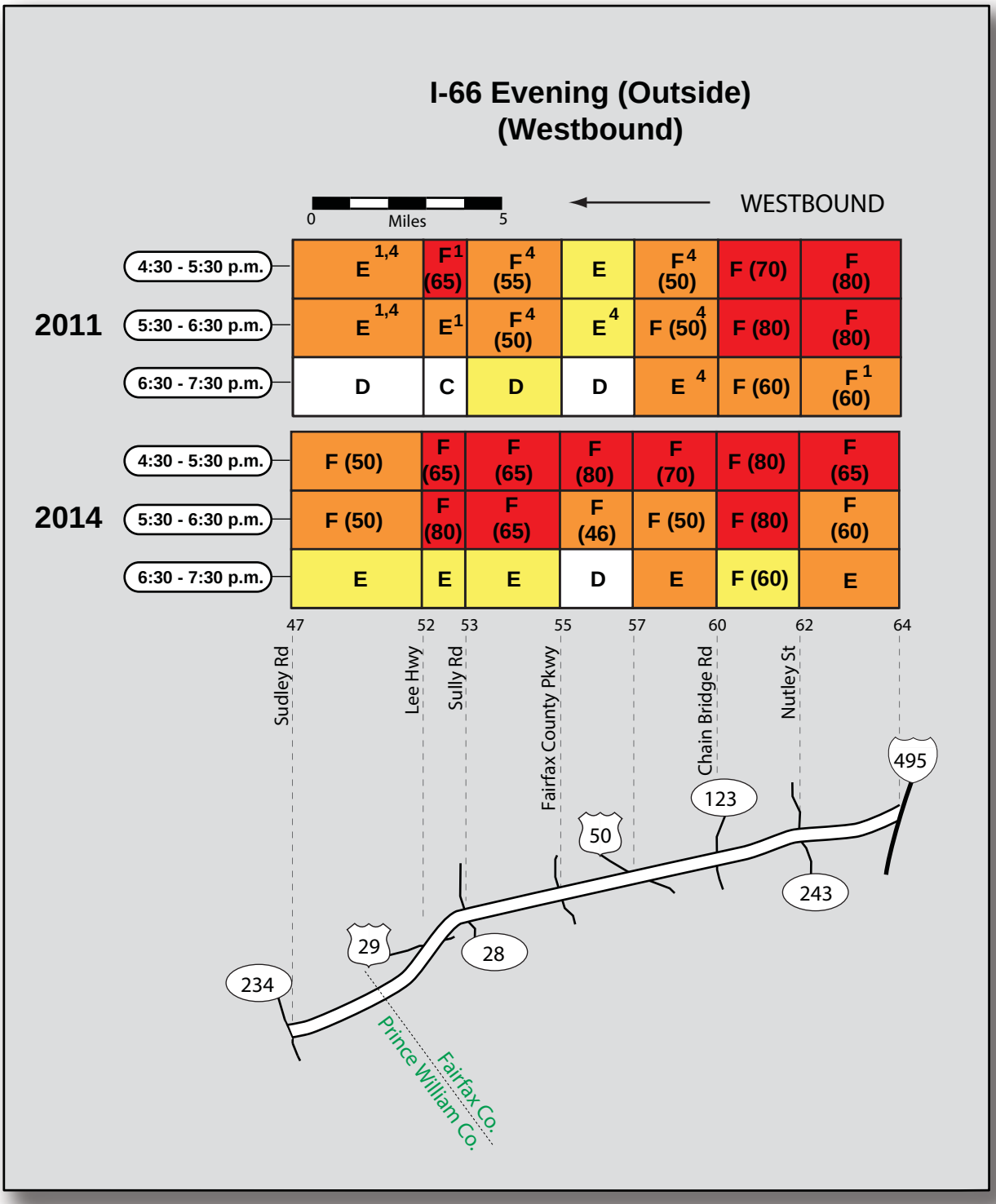
Minor Changes in Traffic Conditions Between 2008, 2011, and 2014

This section of the report identifies locations on the highway system where minor changes in traffic conditions were found between the aerial surveys in 2008 and 2014. Locations where traffic conditions changed as a result of construction are not included. For some highway segments, the severity of congestion was different, while other segments experienced differences in the duration of congestion. At each of these locations, level-of-service are depicted from the 2014 and/or 2008/2011 surveys. Atypical volatility may have accounted for the differences, as other reasons could not be identified.

Traffic Quality Ratings:



Minor Changes in Traffic Conditions
2014 vs. 2011



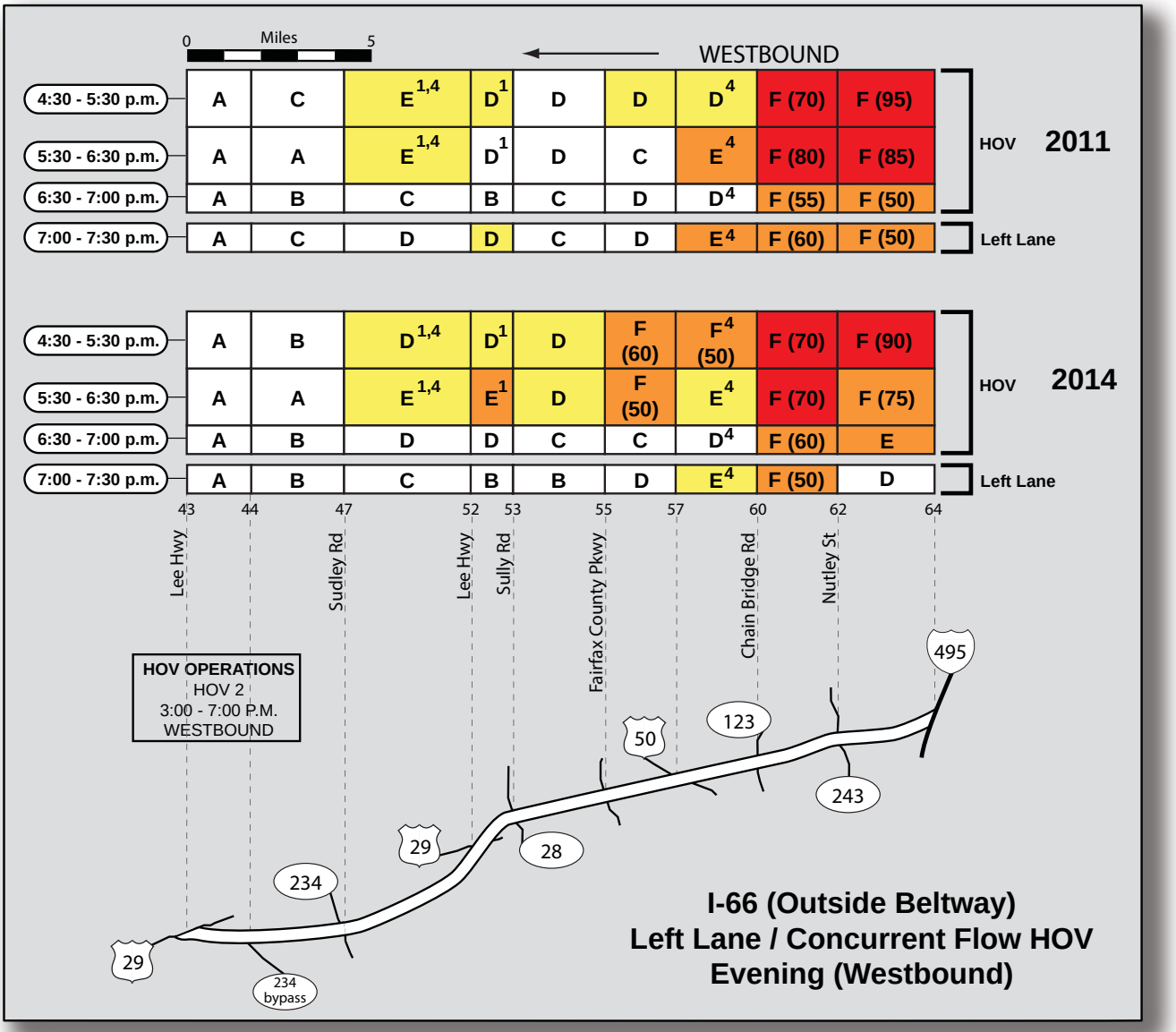
Freeway LOS Legend

A	B	C	D	E	F	F	F

Density 10 20 30 40 50 60 70 80 90

Light Moderate Heavy Congested Severe

Minor Changes in Traffic Conditions
2014 vs. 2011



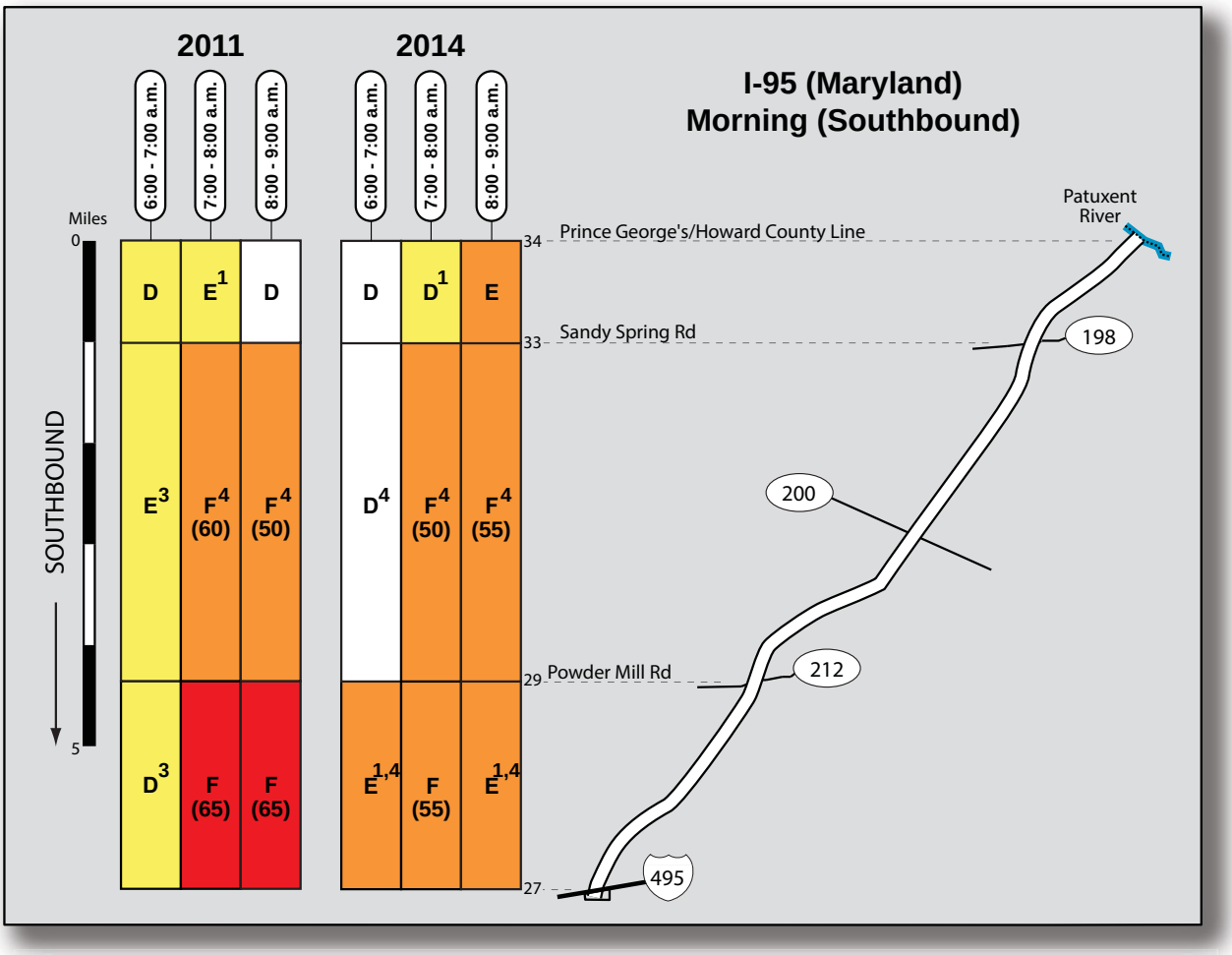
Freeway LOS Legend

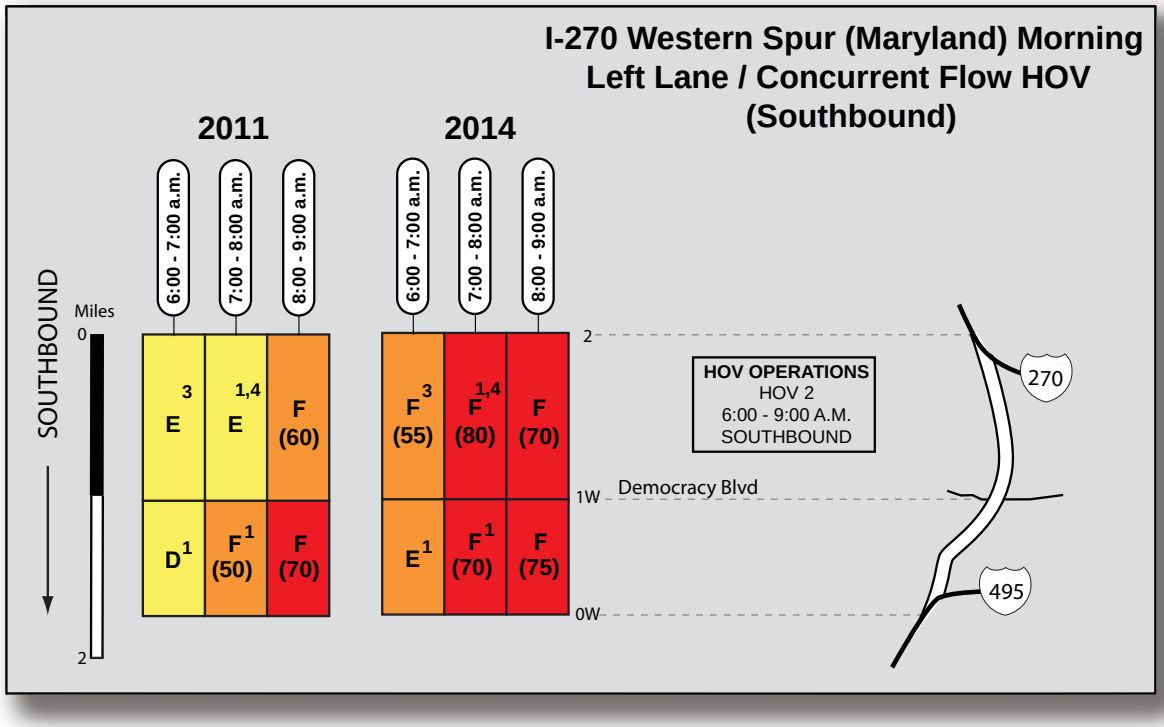
A	B	C	D	E	F	F	F

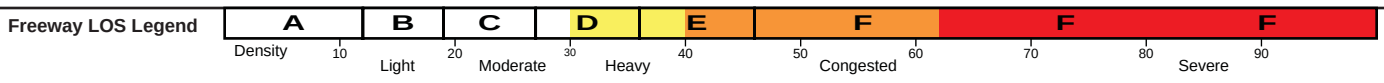
Density 10 20 30 40 50 60 70 80 90

Light Moderate Heavy Congested Severe

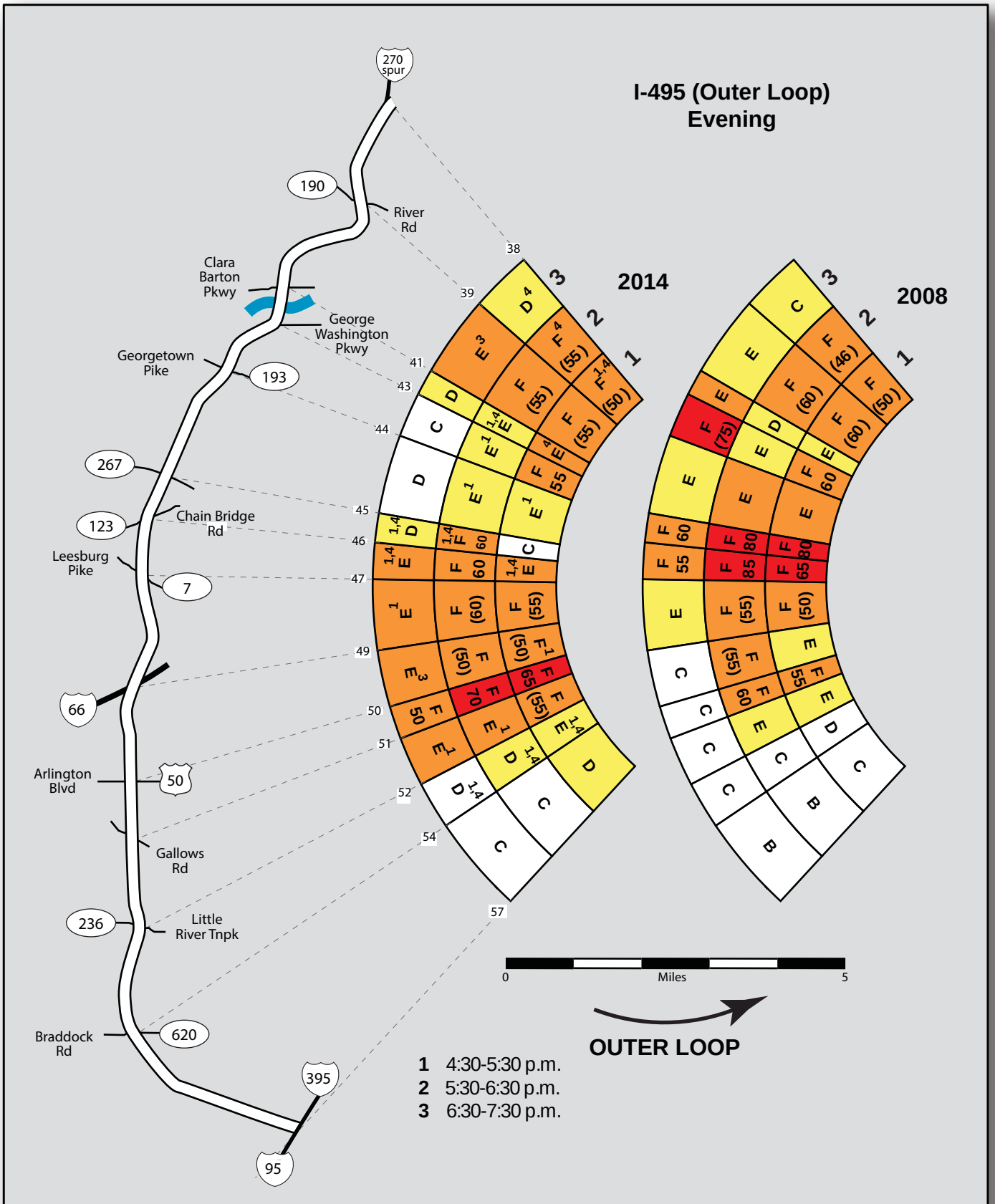
Minor Changes in Traffic Conditions
2014 vs. 2011







Minor Changes in Traffic Conditions
2014 vs. 2008



Freeway LOS Legend

A	B	C	D	E	F	F	F
Density 10	Light 20	Moderate 30	Heavy 40	50	Congested 60	70	80 Severe 90

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APPENDIX A

PROCEDURE FOR DETERMINING FREEWAY LEVEL-OF-SERVICE

Introduction

Overlapping aerial photography can document many useful characteristics of traffic flow on highway networks. The photographs can be invaluable for screening problem sites, winning support for ideas, and explaining decisions to others. If formal rules and procedures are applied to the analysis of aerial photographs, the photography can provide a cost-effective basis for periodically rating the performance of large highway systems on a link-by-link basis.

Background

For highways, traffic flow is normally measured in terms of three basic parameters: *volume*, *speed*, and *density*. These parameters are related mathematically such that, if only two are known, the third can be calculated (volume equals speed times density). Other useful flow parameters related to speed are *travel time* and *delay* between specific points on a system.

The *Highway Capacity Manual (HCM),* updated in 2000 by the Transportation Research Board of the National Research Council, is an authoritative resource that has established a simplified concept by which the performance of all types of transportation facilities can be described and compared. This concept is called *level of service,* or *LOS*. For each type of facility, a single traffic flow parameter – the one deemed most appropriate by the committee that publishes the manual – is chosen to be the basis for defining six rating categories. These categories are represented by the letters “A” through “F”, ranging from the most favorable rating of LOS A (indicating high service quality associated with lightly-used facilities) to the poorest rating of LOS F (indicating a facility burdened by congestion or other undesirable performance characteristics). This LOS system, introduced in 1965 version of the HCM and revised periodically since, has been widely adopted for evaluating existing highway systems and planning future improvements. Because six LOS classes are easier to understand than tables of numbers, LOS has been widely used in the political process. In some jurisdictions, LOS standards are even found in legislation attempting to guide facility planning or control real estate development.

Uninterrupted-flow highways (grade-separated highways without signals)

Summary

The defining parameter for HCM LOS on freeways and other uninterrupted-flow highways is the *density* of traffic flow (in units of passenger cars per lane per mile). Density was chosen as the basis for HCM LOS because, when traffic flows without interruption, traffic density relates mathematically to both speed and volume. This means that a single LOS measure based on density provides not only general speed information, but also provides an approximation of how heavily the facility is utilized. It also indicates where demand has exceeded capacity, resulting in congestion and delays. (Speed is less desirable as a defining basis for LOS because uninterrupted-flow highways can process high volumes of traffic at high speeds; ratings based on speed alone might not differentiate clearly between facilities that were heavily or lightly utilized.) The most common way to determine LOS on an existing freeway is to measure the speed and volume of the traffic, and then calculate the density. Another method is to determine density directly from aerial photographs, which allows for cost effective data collection across very large highway networks. (This also affords the other benefits of aerial photography, which often shows the underlying causes of congestion as well as conditions on interchange ramps, merges and crossroads.) Accordingly, when Skycomp evaluates the performance

of uninterrupted-flow highway facilities, Skycomp derives traffic densities from aerial photographs and then determines density-based HCM LOS ratings.

As discussed above, the LOS rating system uses the letters “A” through “F” to describe traffic conditions: LOS “A” represents superior traffic conditions (very light traffic), while LOS “F” represents poor traffic conditions (congested flow involving various degrees of delay). These letters are assigned based on how densely cars are traveling on the road. Research has shown that for all densities below 40 pcplpm, vehicles generally move at or close to normal highway speed; LOS “A” through “E” represent these densities according to the following table (pcplpm):

LOS “A”: densities from **zero to 11** (very light traffic);
LOS “B”: densities from **12 to 18** (light to moderate traffic);
LOS “C”: densities from **19 to 26** (moderate traffic);
LOS “D”: densities from **27 to 35** (moderate to heavy traffic);
LOS “E”: densities from **36 to approx. 45** (heavy traffic, but still at speeds close to free-flow)

At densities greater than **40**, speeds typically decrease and traveler delays are incurred. Because flow at all densities greater than **46** (approximately) are regarded as LOS “F”, this report attaches actual densities to all LOS “F” ratings. Accordingly:

LOS “F”:
- Densities from **46 to 60** indicate delay involving minor degrees of slowing; average speeds usually range between 50 and 30 mph;
- Densities from **60 to 80** indicate traffic flow at average speeds usually ranging between 40 and 15 mph;
- Densities from **80 to 100** indicate congested traffic flow, with some stopping possible; average speeds usually range between 10 and 25 mph;
- Densities above **100** indicate severe congestion, with considerable stop-and-go flow likely. For reference, densities above 120 almost always indicate the presence of unusual events (accidents, roadwork, etc.). The practical maximum value for density measurements is **180**; the theoretical maximum value is **264** (at 20 feet per vehicle).

Data Reduction Procedures

From overlapping time-stamped photographs, densities by highway segment were determined by manual counts taken along the entire segment length. Vehicles were classified as cars, trucks, buses, or tractor-trailers when counted; later, passenger-car equivalents (pce’s) were derived according to the following table:

Vehicle type:	PCE’s:
cars	1
buses	1.5
trucks	1.5
tractor-trailers	2.0

Data that were atypical due to roadwork or to known or suspected incidents were coded for exclusion

from the averaging process. All data were then entered into a microcomputer database program, which performed the following tasks: 1) samples were grouped by time slice; 2) average densities were calculated; and 3) densities were converted into service levels “A” through “F”. The computer then prepared matrices showing each averaged service level rating plotted by time and highway segment. These data matrices were then copied into the traffic quality tables, which are provided in this report.

In the tables, all LOS F conditions (congested traffic flow) have darkly shaded; this permits quick identification of locations experiencing demand at levels exceeding capacity. Because LOS “F” encompasses a wide range of densities, the actual density values are entered next to the “F”; using the travel characteristics in the density ranges provided above, the nature of the flow in LOS F segments can be determined.

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APPENDIX B

METHODOLOGY DESCRIPTION

Procedures for obtaining speed/density samples for calibration of
the Van Aerde Speed / Density Model

BACKGROUND

In the spring of 1995, Skycomp collected data to compare the speed of vehicles through congested freeway zones with corresponding densities obtained from aerial photographs. The purpose was to explore the relationship between the two, and, given a reasonable correlation, to prepare a model by which vehicle speeds could be estimated from aerial density photographs.

The program was conceived and executed by the Metropolitan Washington (D.C.) Council of Governments (MWCOG). Aerial data were collected by Skycomp; analysis of the data and calibration of the Van Aerde speed/density model were conducted by MWCOG.

A secondary objective was to evaluate the accuracy of aerial speed and density measurements by comparing them to data collected by traditional methods (floating cars and loop detectors embedded in the pavement).

Accordingly, segments of freeway were chosen to be surveyed that: 1) were expected to generate congested traffic flow; and 2) either contained a loop detector station or would accommodate quick turnarounds for multiple floating car runs. Thus, while data were being collected in the air (290 speed samples were obtained from the air, along with corresponding densities), loop detector or floating car data were collected concurrently on the ground.

The outcome of this study was a finding that travel speeds across congested freeway segments could be determined with reasonable accuracy using only aerial density photographs. It was also found that speeds and densities obtained through aerial techniques closely matched data obtained using the traditional ground methods.

PROCEDURES TO OBTAIN SPEED / DENSITY SAMPLES:

The observer/photographer followed the following procedure to obtain all speed/density samples: he first flew along the selected survey segment while taking time-stamped overlapping density photographs of the entire segment; next, at the upstream end, he selected a target "floating" car for tracking; he photographed the target as it entered and departed the segment, while simultaneously timing its run to the nearest second. He then took an "after" density photo set; and then recorded the following information on a clipboard: the time of the sample, the target vehicle description, lane(s) traveled, elapsed time, and any special notes. This procedure was repeated for each speed/density data point.

In the actual course of sampling, this procedure was modified in several ways. First, where cars were moving at high (free-flow) speeds, the density did not change significantly between samples; thus sometimes three or more floating cars were timed between density runs.

Another modification done in-flight is as follows: the observer noted in several cases that the density set taken before the target vehicle went through better reflected the conditions the car encountered than the density set taken after the vehicle went through (or vice versa). This was usually due to a delay in changing film, extra maneuvering the airplane, or any other event which delayed the "after" density sample for several minutes after the completion of the run. While normally the density associated with each speed sample was an average of the "before" and "after" density sets, in these cases only the "before" or "after" density set would be used (as directed by the observer).

With regard to selection of target vehicles, the plan was to select cars that reflected the average speed of traffic, just as floating car drivers are instructed to approximate the speed of traffic flow. Fortunately, vehicles have little freedom to choose their speeds in the congested density ranges (above 40 pcplpm). So, for example, almost any vehicle in a congested traffic stream in the middle lane of three will give a suitable floating car measurement. Even tractor-trailers (unless heavily loaded and traveling uphill) moved at the same speed as passenger cars. Thus the criteria the observer used in selecting each target vehicle was 1) is it in the correct lane; and 2) does the vehicle stand out so that it is easy to keep track of?

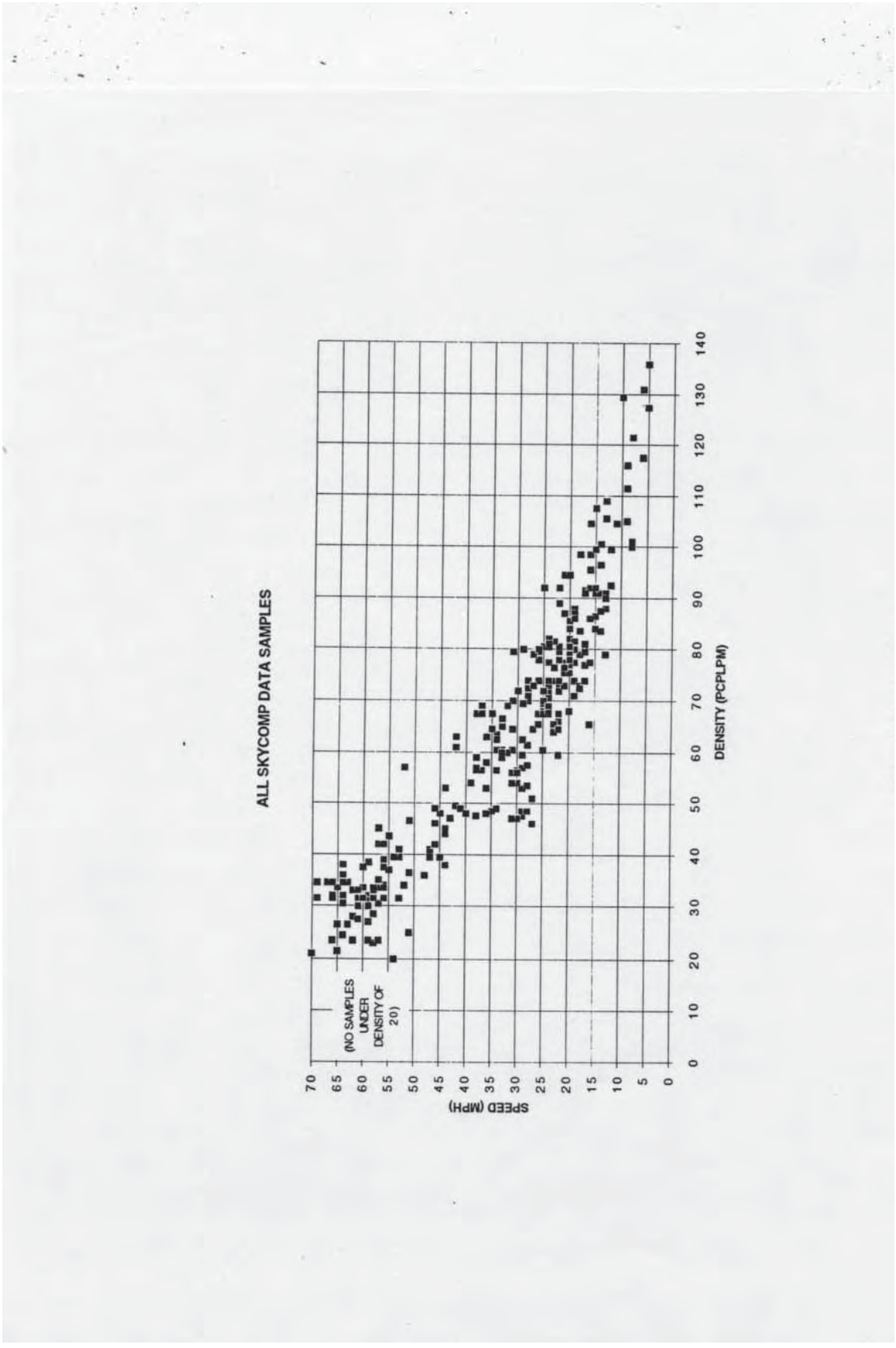
Also, in the event that the highway had four travel lanes in one direction, alternating samples were taken from both middle lanes.

In the event that a driver switched lanes while being tracked, the observer noted the lane change and also noted which lane the car spent the majority of time in (this is the lane for which a density count would be made later). In several cases (infrequently), the observer

abandoned tracking certain vehicles when: 1) the driver made multiple lane changes, trying to beat the average speed of traffic; 2) the driver switched lanes and changed speeds obviously and significantly; 3) the vehicle turned out to be a heavily loaded truck which delayed the traffic stream; or 4) the observer "lost" the vehicle being tracked. Also, for the samples made with traffic traveling at free-flow speeds, vehicles were abandoned which proved to be traveling significantly faster or slower than the average speed of traffic.

In the event that the target vehicle moved to the right lane in apparent preparation to exit, the observer often was able to switch tracking to another vehicle that had been just behind or ahead of the original vehicle in the same lane (and used the newly adopted vehicle to complete the sample). This was necessary because in some cases six or seven minutes had been invested in the tracking of a specific vehicle, and it was important to avoid wasting that time where possible.

It should also be pointed out that speeds were not tracked for very slow moving queues (densities over 120 / MWCOG samples only). Instead, density runs were made at 5 or 10 minute intervals, such that later on the ground the same vehicles could be found in succeeding sets of density photos; this allowed computation of speeds and associated densities.


ALL SKYCOMP DATA SAMPLES
SPEED (MPH)
DENSITY (PCPLPM)
(NO SAMPLES UNDER DENSITY OF 20)
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140

DATA PROCESSING

After each flight, a topographic map was prepared for each zone which showed the starting and stopping points for each tracked car. Measurements were then made of the segment length (distance traveled). Then each tracked vehicle was entered into the computer database, including:

1. vehicle description
2. time-of-day
3. initial lane and subsequent lane changes
4. precise travel time (from stopwatch or time-lapse photographs)
5. density-photo preference, if any (default was to average the before- and after- density samples)
6. any special notes pertaining to that vehicle.

After the photos had been processed, each set of overlapping "density" photographs was taped together into a "mosaic" that showed each entire segment. Then vehicles in the required lane(s) were counted, listed by "car", "truck", "tractor-trailer" and "bus". These totals were translated into passenger-car equivalents (PCE's) using the following values:

Vehicle type:	PCE's:
cars	1
trucks	1.5
tractor-trailers	2.0
buses	1.5

(It should be noted that the distinction between "cars" and "trucks" could not be cleanly made, since there are many varieties of light and heavy pick-ups (both covered and uncovered). In general, a pick-up or van had to be at least twice the size of an average-sized car to be considered a "truck".)

PCE's were then divided by segment length to calculate densities. These density samples were then matched to corresponding speed samples; each speed/density data pair was then plotted on the chart.

CALIBRATION OF THE VAN AERDE MODEL

Van Aerde Model

The main advantages to a single-regime model are that boundaries between regimes do not have to be defined; and curves from adjacent regimes do not have to be spliced at the boundaries. A single-regime model allows for a more subjective and repeatable calibration process. This will be is especially true if more data from the high-speed end of the curve is ever incorporated into this process.

The disadvantages to this particular model are that it expresses this project's independent variable as a function of the dependent variable; and that it is a non-linear function. These disadvantages make performing the initial calibration more difficult. However, once SAS programs for the task are written, they can be used again usually with a minimum of effort.

The procedure for calibration was as follows: 1) The model's equation was coded into a spreadsheet so that the shape could be defined by recognizable parameters: two points that the curve passes through, the free-flow speed, and the speed at capacity. By overlaying this curve with the scatter plot of the observations, initial estimates of the parameters were made. 2) The initial parameter estimates, the equation, and the observations were used in a SAS PROC NLIN job to machine-calibrate the parameter estimates. 3) A second SAS program translated the calibrated equation into a look-up table that expresses speed as a function of density. 4) The results of the SAS work were imported into a spreadsheet for plotting and for calculation of prediction intervals.

Two outstanding technical issues related to this procedure are determination of the free-flow speed, and calculation of prediction intervals.

The free-flow speed for best fit can be determined by the PROC NLIN program, as are all other parameters. Due to the lack of data at the low-density region of the model, PROC NLIN returns a very high free-flow speed. Additional data from MD SHA was used to calculate a free-flow speed for general application on the Beltway. The calibration of the model presented here resulted from forcing the free-flow speed to match the SHA data analysis.

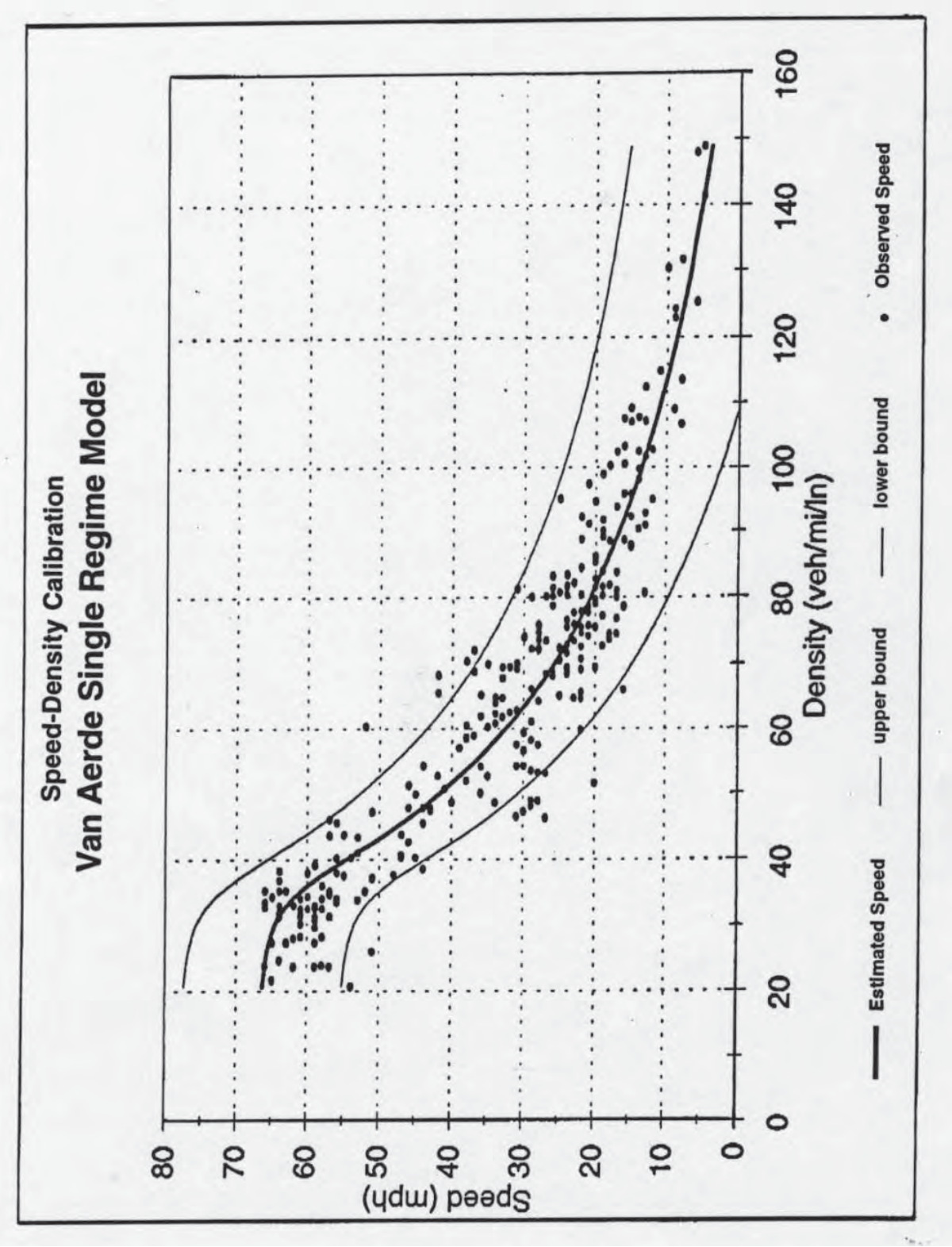
The prediction intervals shown in the current plot were calculated after the model was translated. This may have not been appropriate. PROC NLIN calculates prediction intervals directly as it calibrates the model. Those prediction intervals express density as a function of speed, however. Work is in progress to translate them, and to otherwise arrive at the most appropriate method of determining prediction intervals.
Since a single-regime model is more suitable in a computerized process, and for lack of significant difference in performance, the Van Aerde model is preferred over earlier approaches examined by MWCOG staff and presented before subcommittees.

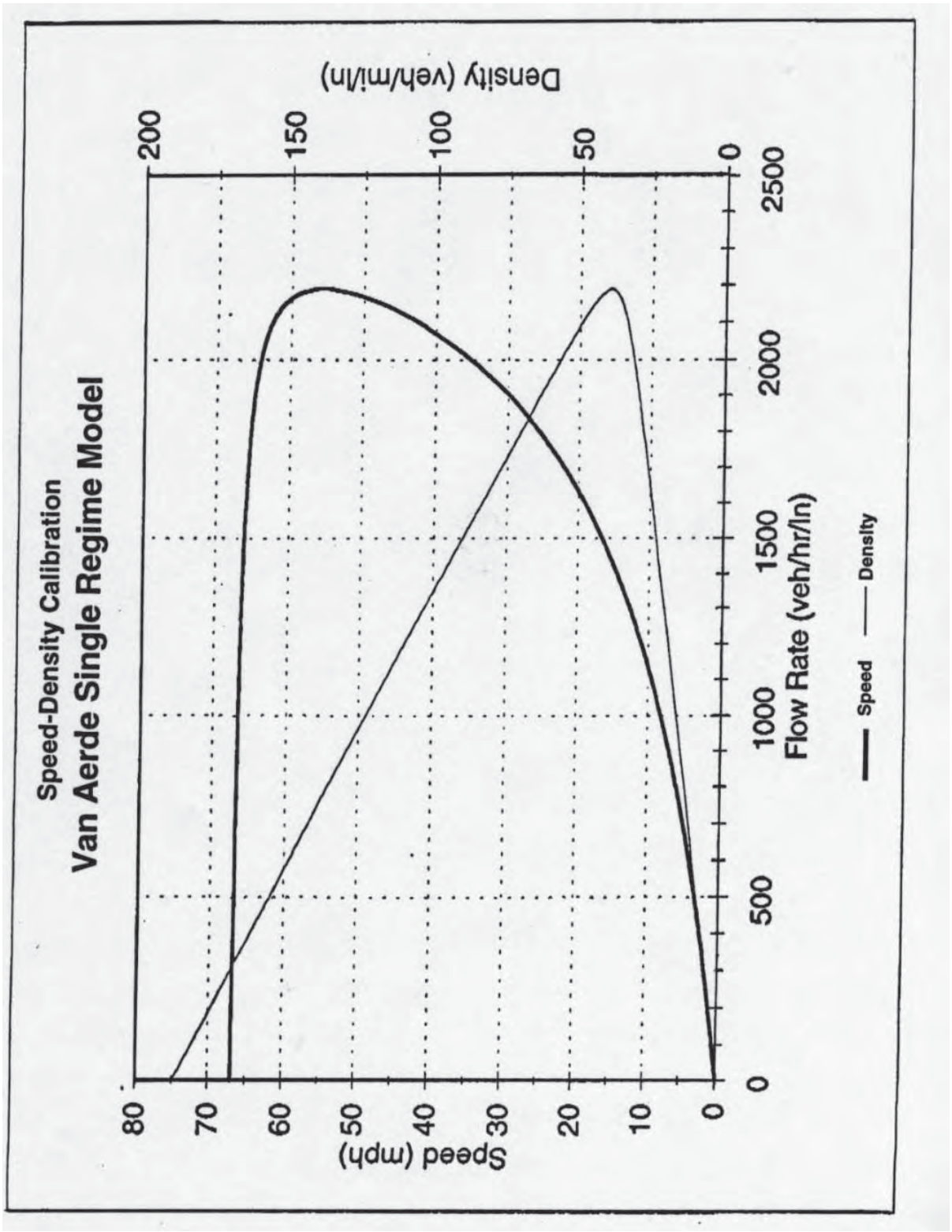
Speed-Density Calibration
Van Aerde Single Regime Model

free-flow spd = 67 mph / c1 = 0.00512 / c2 = 0.0114 / c3 = 0.000342

	DENSITY (veh/ln/mi)	SPEED (mph)	VOLUME (veh/ln/hr)
free-flow	0	67.0	0
	20	66.4	1,328
	25	65.8	1,661
	30	64.6	1,946
	35	61.3	2,144
capacity	39	55.8	2,190
	40	54.7	2,189
	45	47.8	2,153
	50	41.9	2,094
	55	36.8	2,025
	60	32.6	1,954
	65	28.9	1,880
	70	25.8	1,806
	75	23.1	1,731

DENSITY (veh/ln/mi)	SPEED (mph)	VOLUME (veh/ln/hr)	
80	20.7	1655	
85	18.6	1580	
90	16.7	1503	
95	15.0	1425	
100	13.5	1350	
105	12.1	1271	
110	10.9	1197	
115	9.7	1117	
120	8.7	1043	
125	7.7	963	
130	6.8	885	
135	6.0	810	
140	5.2	729	
187	0	0	jam


Speed-Density Calibration
Van Aerde Single Regime Model
Speed (mph)
0
10
20
30
40
50
60
70
80
Density (veh/mi/ln)
0
20
40
60
80
100
120
140
160
Estimated Speed
upper bound
lower bound
Observed Speed


Speed-Density Calibration
Van Aerde Single Regime Model
Speed (mph)
0
10
20
30
40
50
60
70
80
Density (veh/mi/ln)
0
50
100
150
200
Flow Rate (veh/hr/ln)
0
500
1000
1500
2000
2500
Speed
Density

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APPENDIX C

2011 Congestion Summaries (Locations and Corridors)

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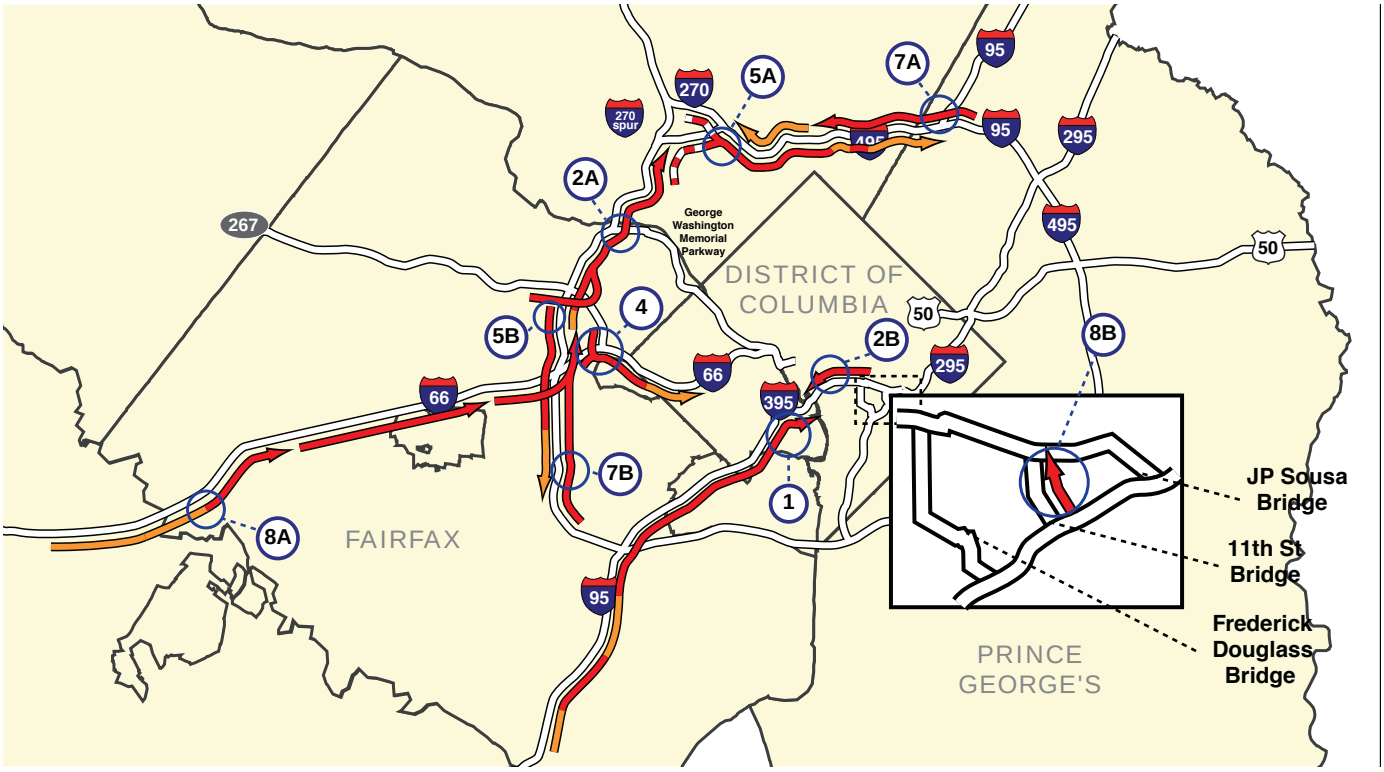
Top Ten Congested Locations 2011



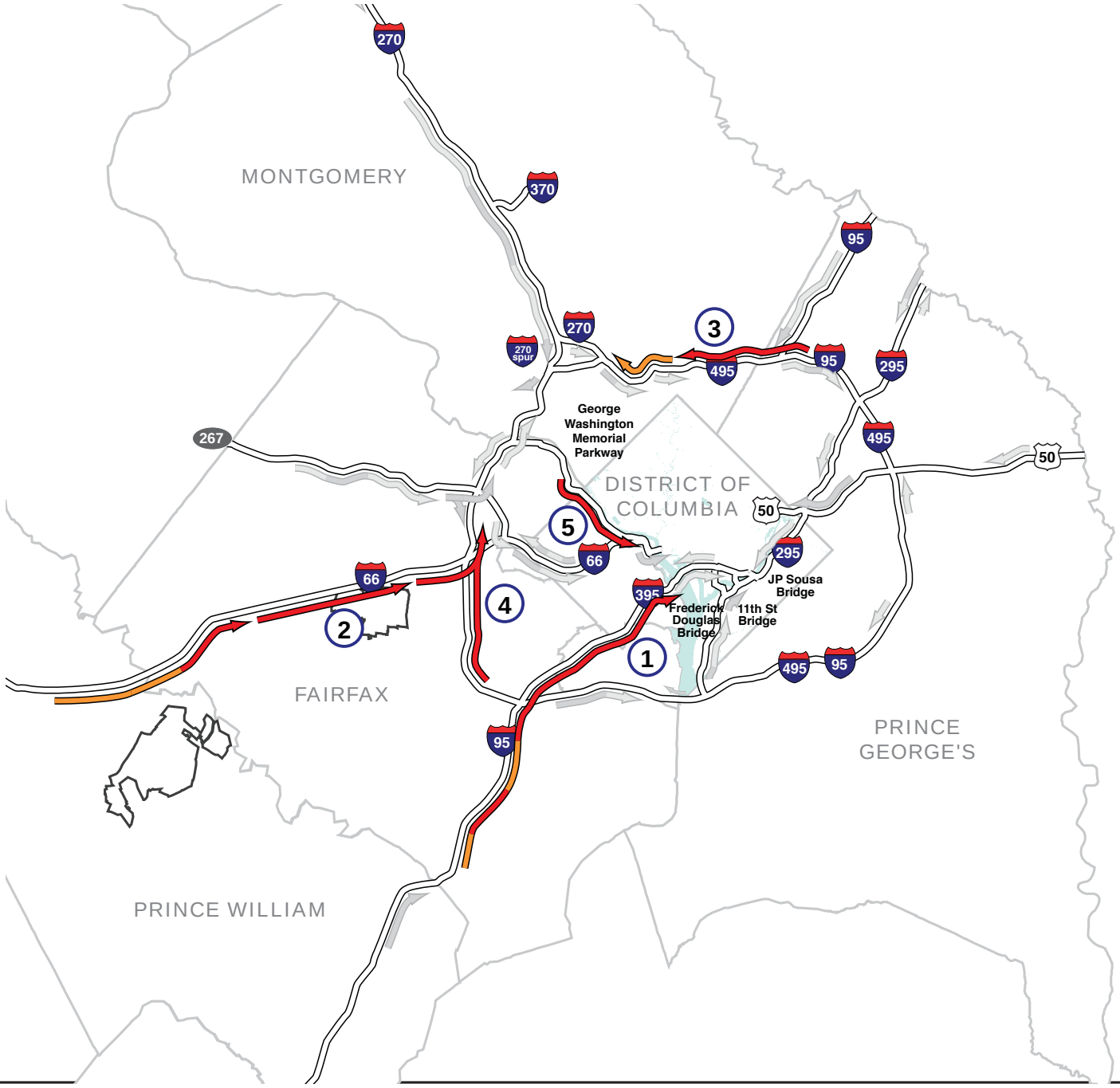
Top Ten Congested Segments on the Freeway System (2011)

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

* While impacted by construction, these links are historically congested

Longest Delay Corridors- Morning Peak Period (2011)

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



Longest Delay Corridors- Evening Peak Period (2011)

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