CONGESTION REPORT
2nd Quarter 2016

A quarterly update of the National Capital Region’s traffic congestion, travel time reliability, top-10 bottlenecks and featured spotlight

September 8, 2016

National Capital Region
Transportation Planning Board

ABOUT TPB

Transportation planning at the regional level is coordinated in the Washington area by the National Capital Region Transportation Planning Board (TPB). Members of the TPB include representatives of the transportation agencies of the states of Maryland and Virginia, and the District of Columbia, local governments, the Washington Metropolitan Area Transit Authority, the Maryland and Virginia General Assemblies, and nonvoting members from the Metropolitan Washington Airports Authority and federal agencies. The TPB is staffed by the Department of Transportation Planning of the Metropolitan Washington Council of Governments.

CREDITS

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ACCOMMODATIONS

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CONGESTION REPORT

2ndQuarter 2016

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CONGESTION – TRAVEL TIME INDEX (TTI)

Interstate System

TTI 2nd Quarter 2016:	1.40	↑3.1% or 0.04[1]
TTI Trailing 4 Quarters:	1.34	↑1.6% or 0.02[2]

Non-Interstate NHS[3]

TTI 2nd Quarter 2016:	1.20	↓1.4% or 0.02
TTI Trailing 4 Quarters:	1.21	↑0.2% or 0.003

Transit-Significant[4]

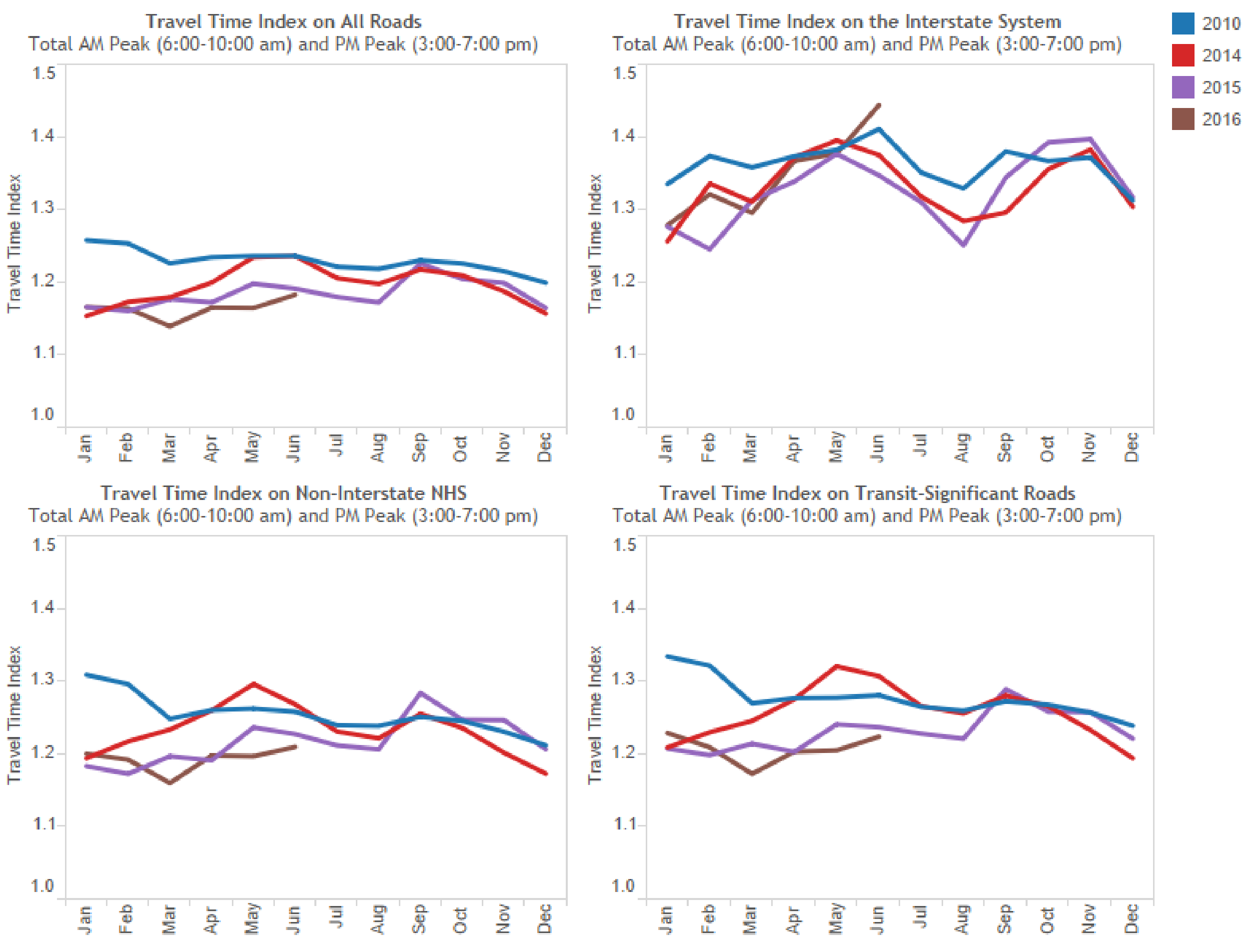
TTI 2nd Quarter 2016:	1.21	↓1.3% or 0.02
TTI Trailing 4 Quarters:	1.23	↓0.5% or 0.01

All Roads

TTI 2nd Quarter 2016:	1.17	↓1.4% or 0.02
TTI Trailing 4 Quarters:	1.18	↓0.8% or 0.01

[1] Compared to 2nd Quarter 2015; [2]Compared to one year earlier;[3] NHS: National Highway System; [4] See "Background" section.

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



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

UNRELIABILITY – PLANNING TIME INDEX (PTI)

Interstate System
PTI 2nd Quarter 2016: 1.98 ↑5.5% or 0.10[1]
PTI Trailing 4 Quarters: 1.89 ↑2.4% or 0.04[2]

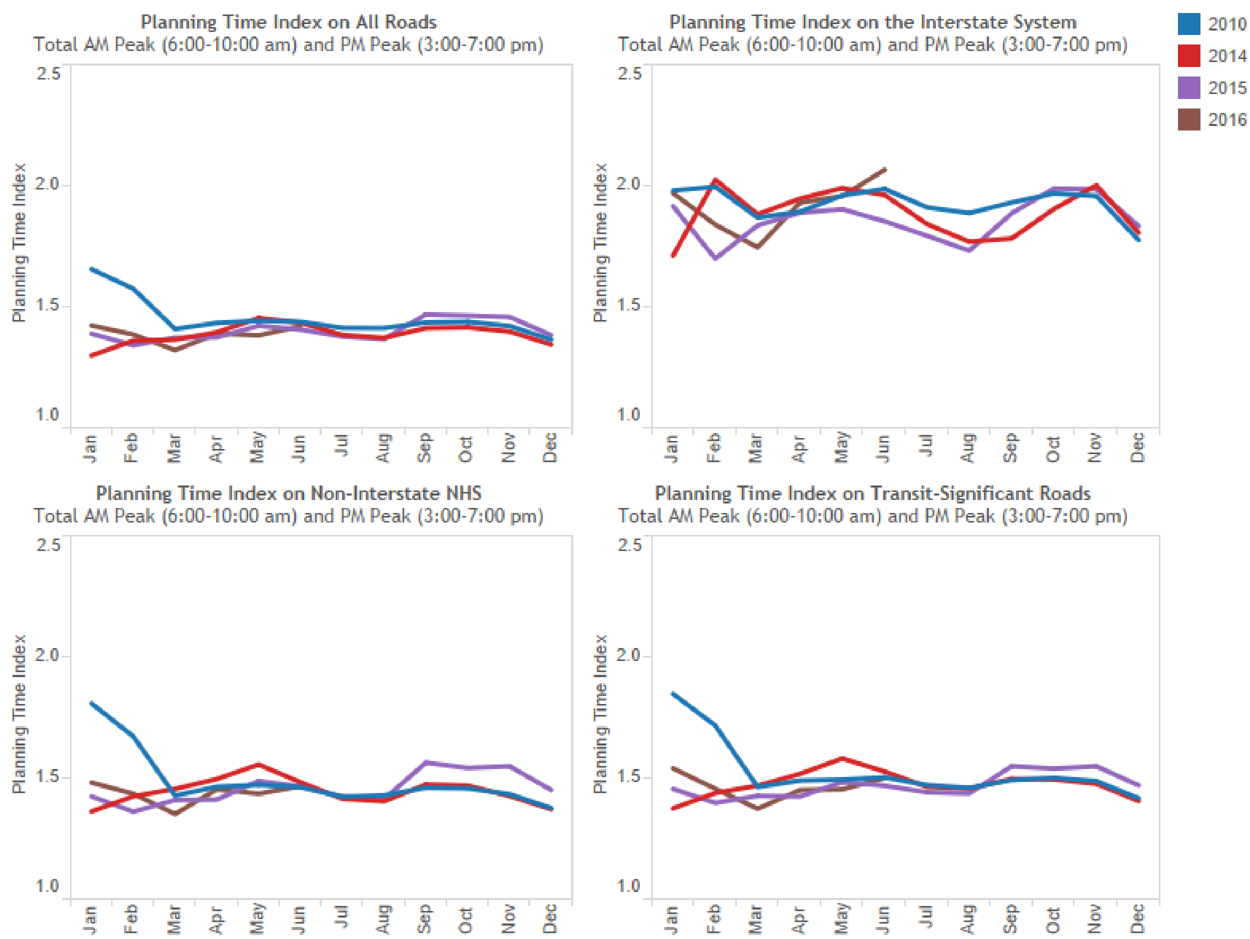
Non-Interstate NHS[3]
PTI 2nd Quarter 2016: 1.45 ↓0.2% or 0.003
PTI Trailing 4 Quarters: 1.46 ↑2.6% or 0.04

Transit-Significant[4]
PTI 2nd Quarter 2016: 1.47 ↑0.6% or 0.01
PTI Trailing 4 Quarters: 1.48 ↑1.8% or 0.03

All Roads
PTI 2nd Quarter 2016: 1.40 ↓0.3% or 0.004
PTI Trailing 4 Quarters: 1.40 ↑1.3% or 0.02

[1] Compared to 2nd Quarter 2015;[2]Compared to one year earlier; [3] NHS: National Highway System; [4] See "Background" section.

Figure 2. Monthly Planning Time Index for Total AM peak (6:00-10:00 am) and PM peak (3:00-7:00 pm)

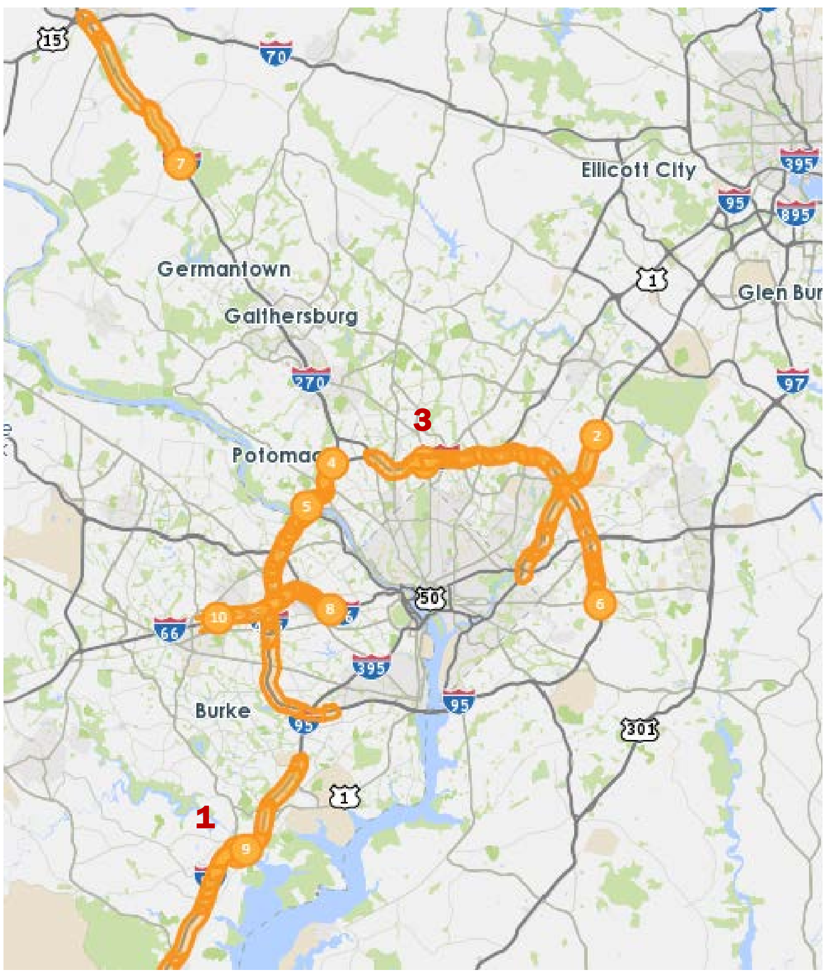


Planning Time Index (PTI), defined as the ratio of 95th percentile travel time to free flow travel time, measures travel time reliability. The higher the index, the less reliable traffic conditions it represents, e.g., PTI = 1.30 means a traveler has to budget 30% longer than the uncongested travel time to arrive on time 95% of the times (i.e., 19 out of 20 trips).

TOP 10 BOTTLENECKS

Rank (Last Quarter Rank)	Location	Average duration	Average max length (miles)	Total duration	Impact factor
1 (1)*	I-95 S @ VA-123/EXIT 160	5 h 34 m	3.24	21 d 02 h 55 m	91,210.07
2 (2)	MD-295 N @ POWDER MILL RD	7 h 19 m	2.88	27 d 19 h 04 m	89,587.23
3 (5)	I-495 CCW @ MD-97/GEORGIA AVE/EXIT 31	4 h 38 m	2.8	17 d 14 h 38 m	71,644.33
4 (4)	I-495 CW @ I-270 SPUR	2 h 31 m	4.3	9 d 13 h 41 m	60,004.27
5 (18)	I-495 CW @ CLARA BARTON PKWY/EXIT 41	5 h 10 m	2.36	19 d 14 h 30 m	57,706.90
6 (19)	I-495 CW @ MD-214/CENTRAL AVE/EXIT 15	3 h 08 m	3.04	11 d 22 h 00 m	52,884.38
7 (11)	I-270 S @ MD-109/EXIT 22	2 h 36 m	3.97	9 d 21 h 48 m	48,498.27
8 (3)	I-66 E @ SYCAMORE ST/EXIT 69	5 h 29 m	1.97	20 d 19 h 56 m	47,500.36
9 (9)	I-95 N @ VA-123/EXIT 160	3 h 05 m	3.29	11 d 16 h 46 m	46,672.69
10 (6)	I-66 W @ VADEN DR/EXIT 62	3 h 34 m	1.55	13 d 13 h 11 m	42,217.10

** See “Bottlenecks” section in the “Background” chapter for ranking variability from quarter to quarter.*



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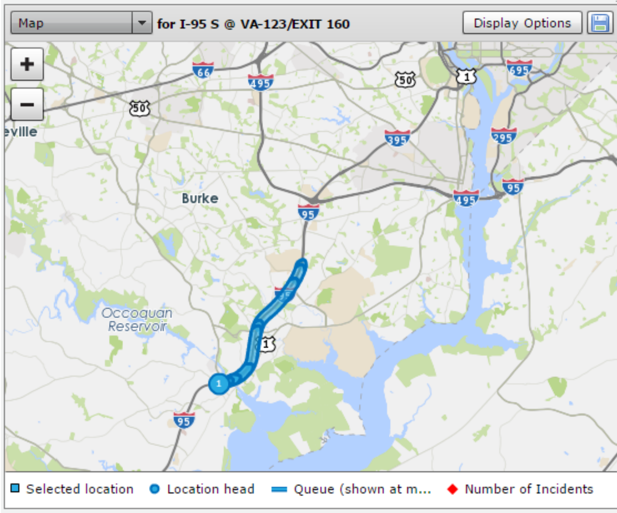

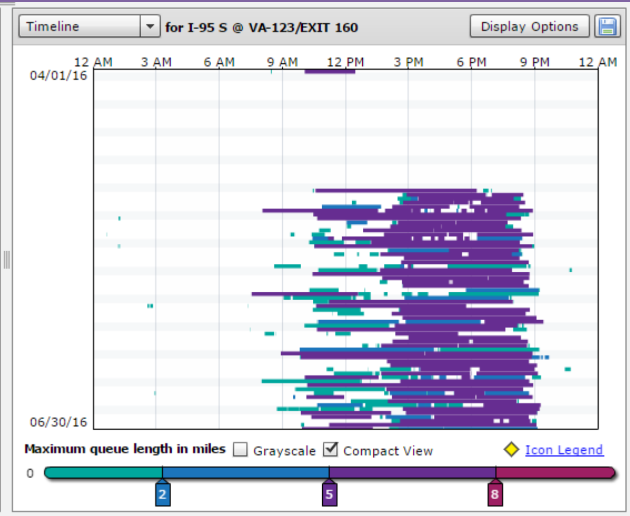

* *The Impact Factor of a bottleneck is simply the product of the Average Duration (minutes), Average Max Length (miles) and the number of occurrences.*

Rank	Location	Average duration	Average max length (miles)	Total duration	Impact factor
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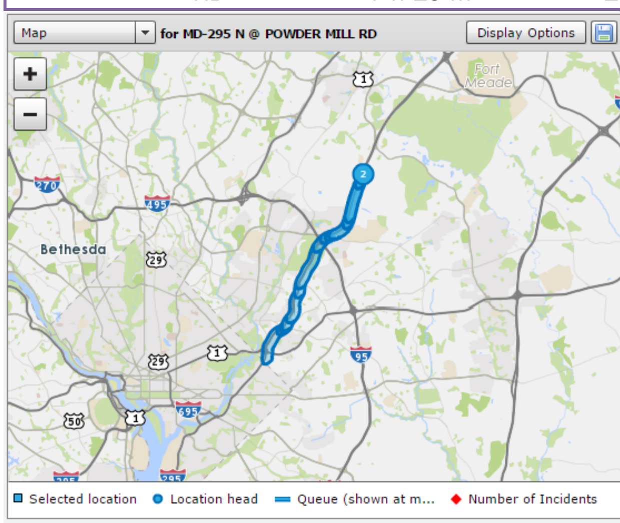

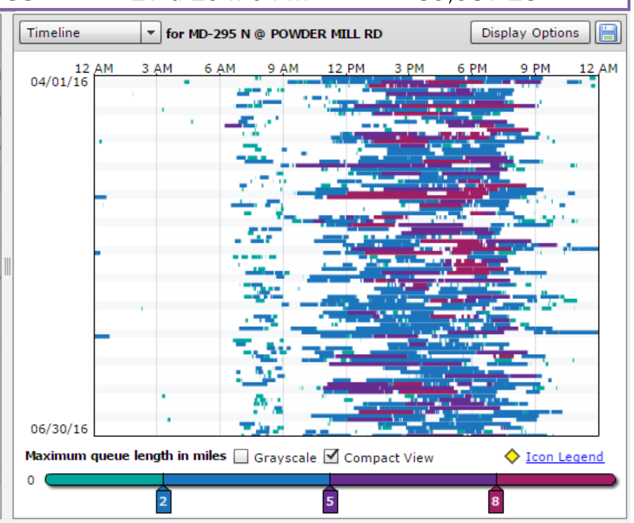

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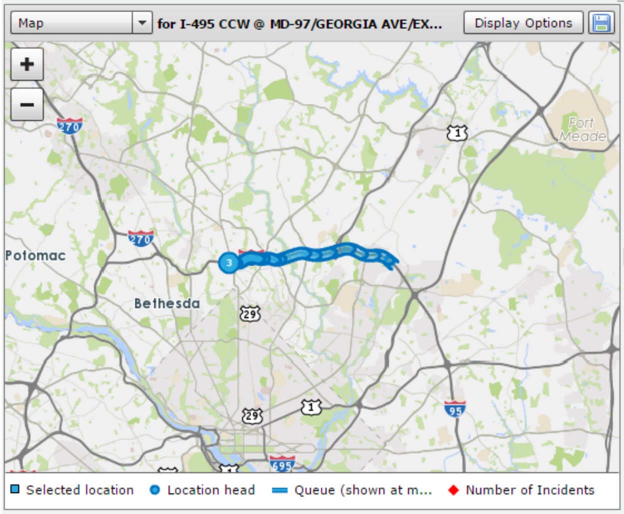

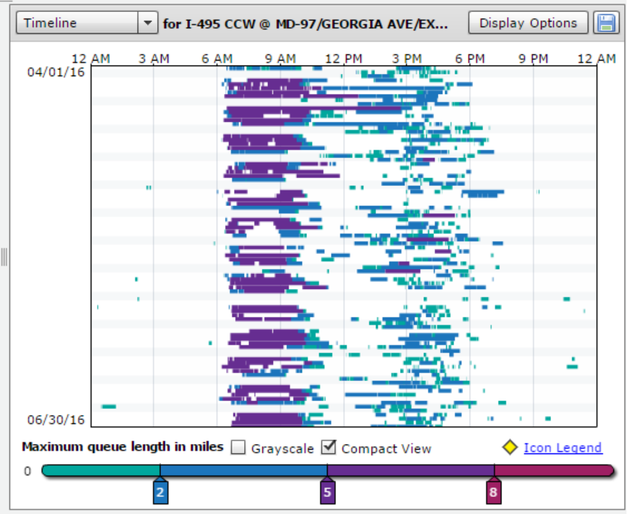

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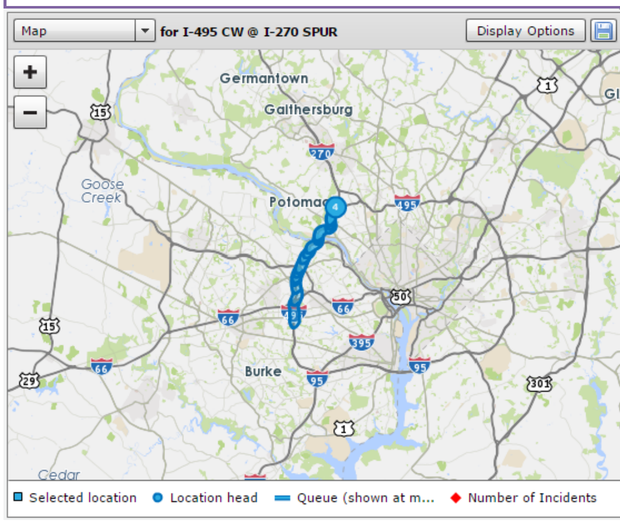

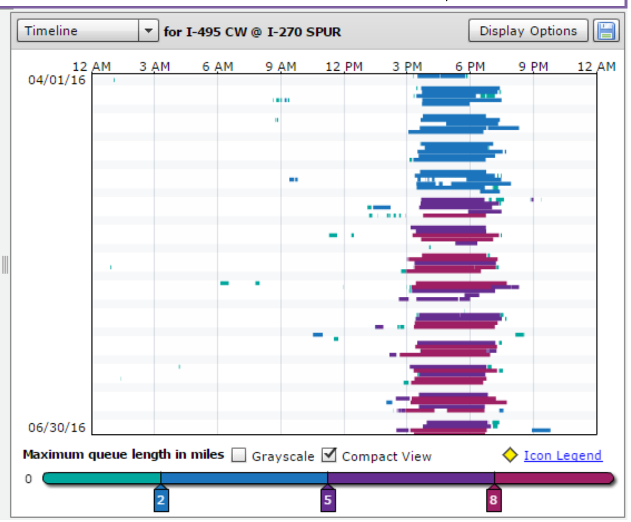

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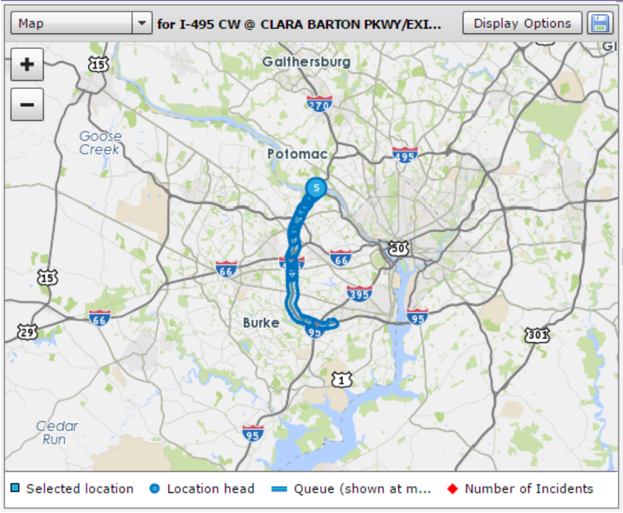

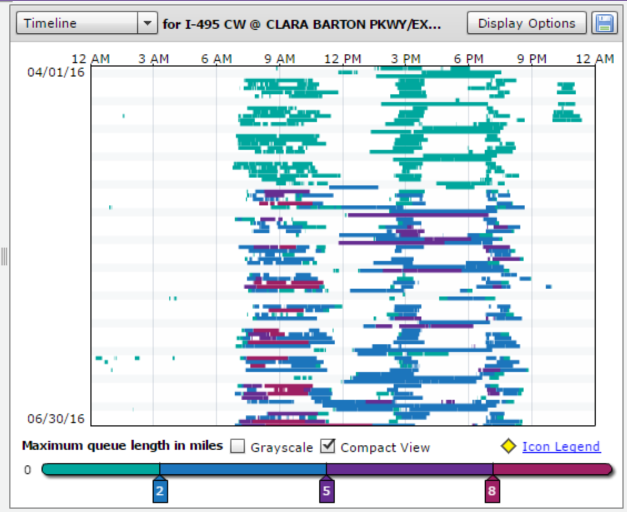

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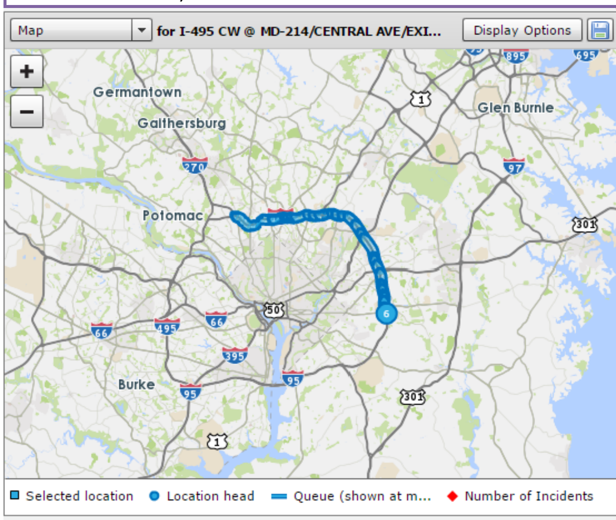

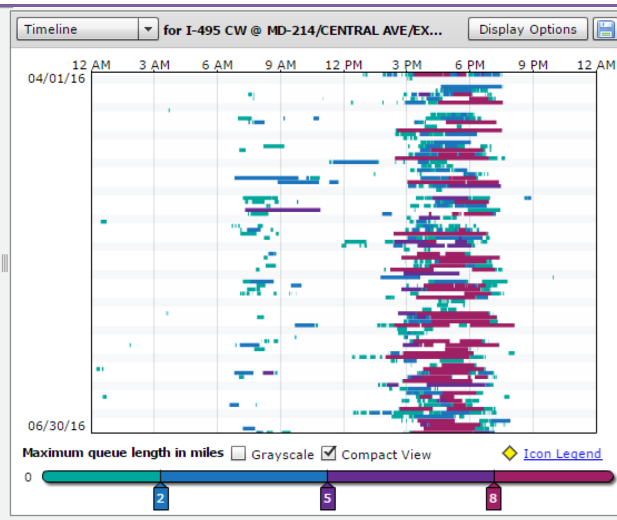

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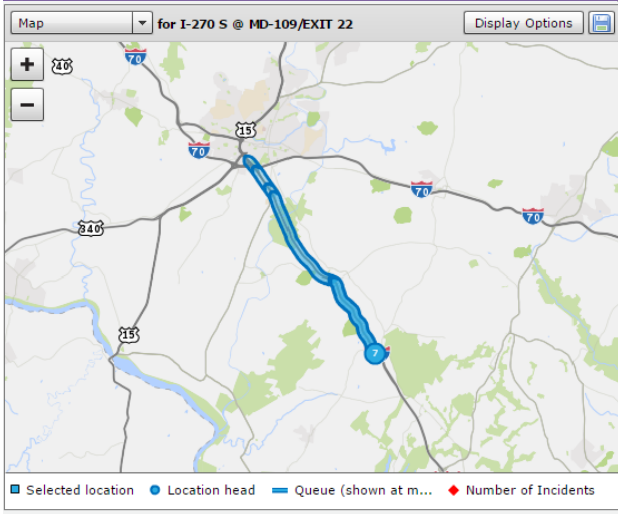

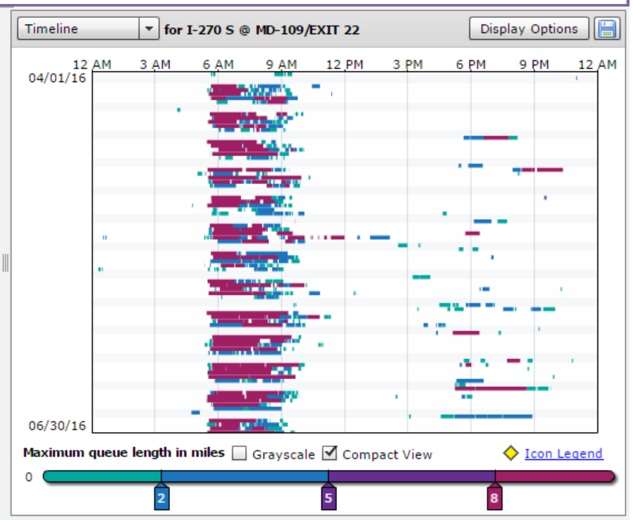

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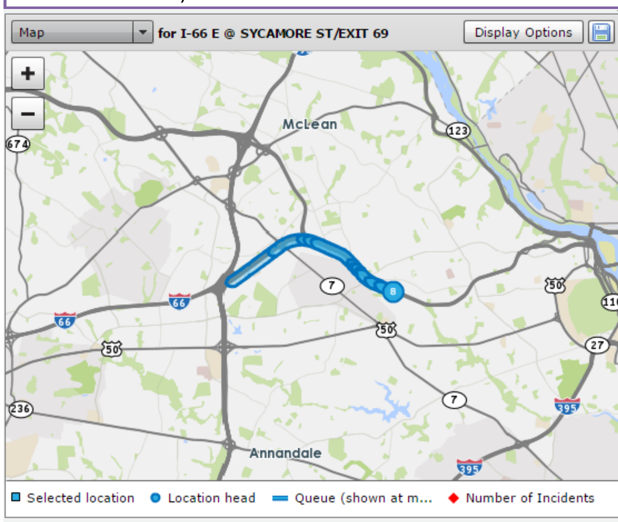

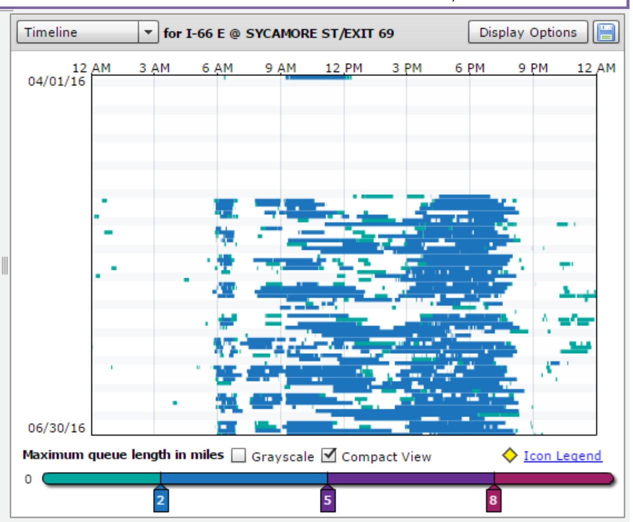

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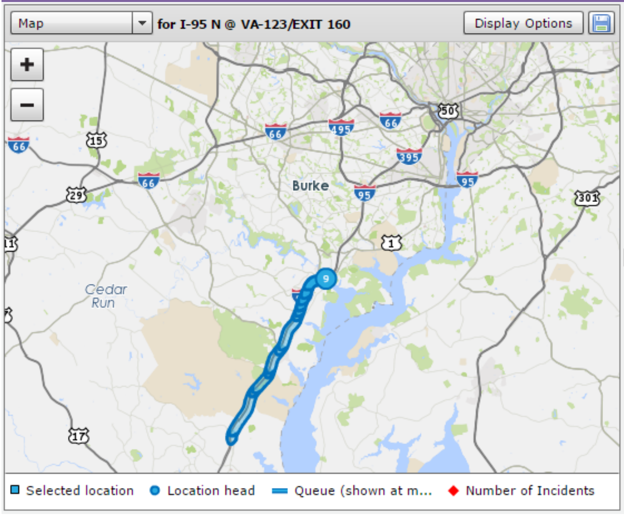

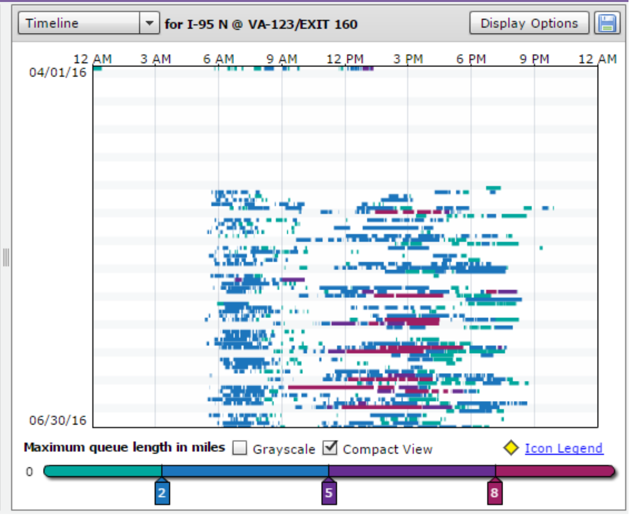

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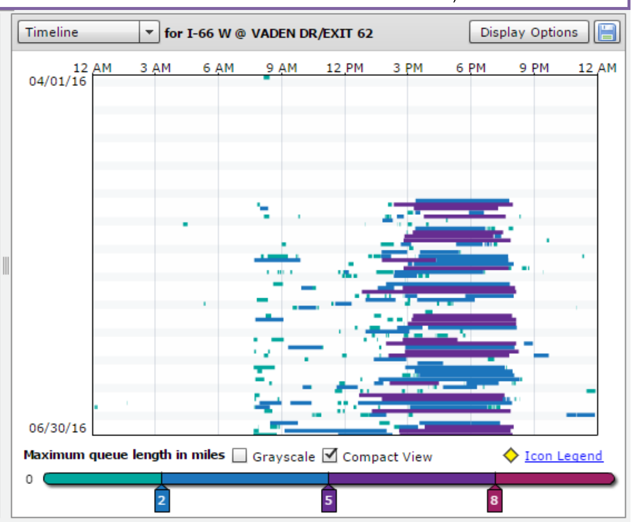


CONGESTION MAPS

Figure 3. Travel Time Index during weekday 8:00-9:00 A.M. in 2nd Quarter 2016

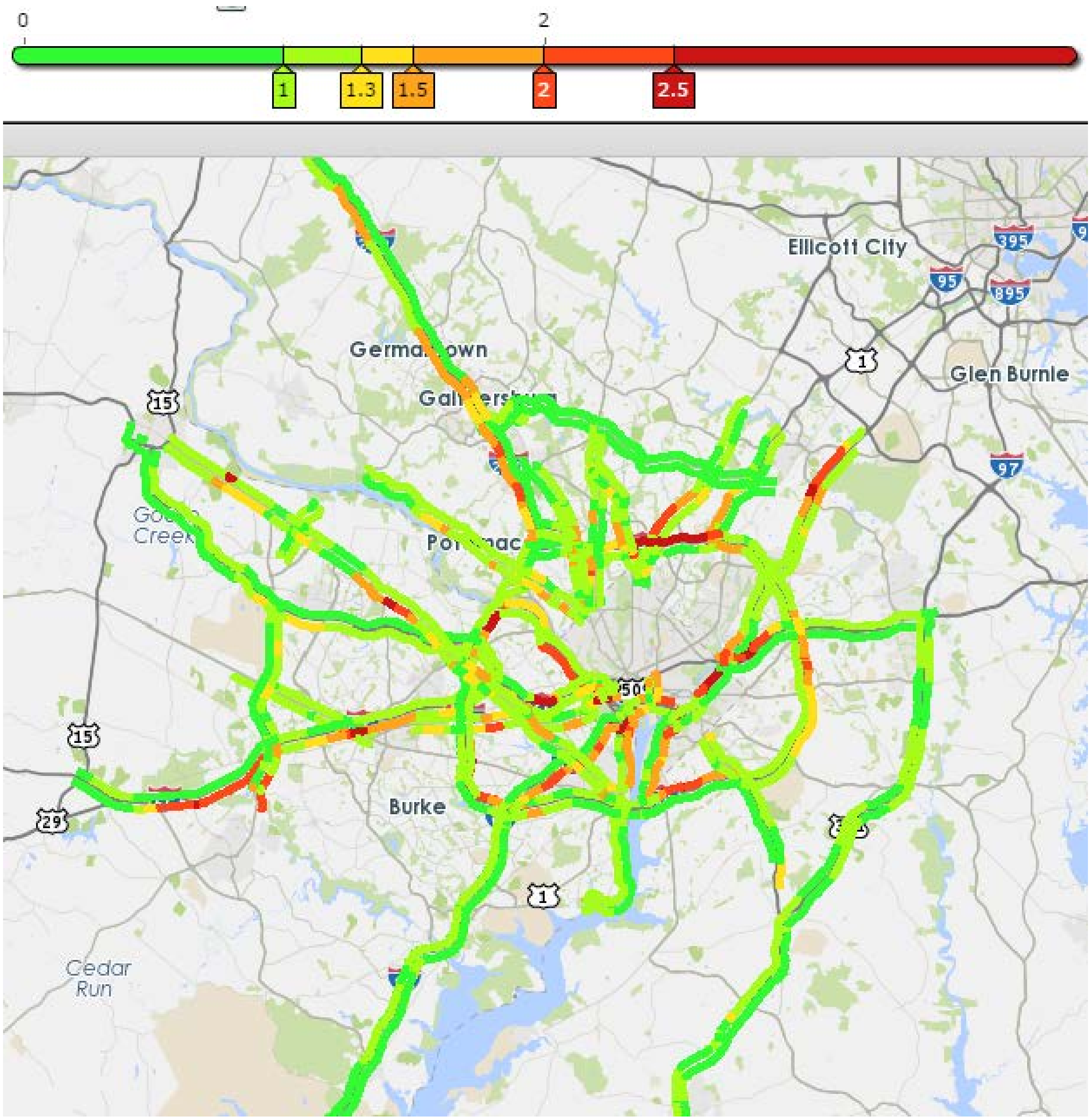
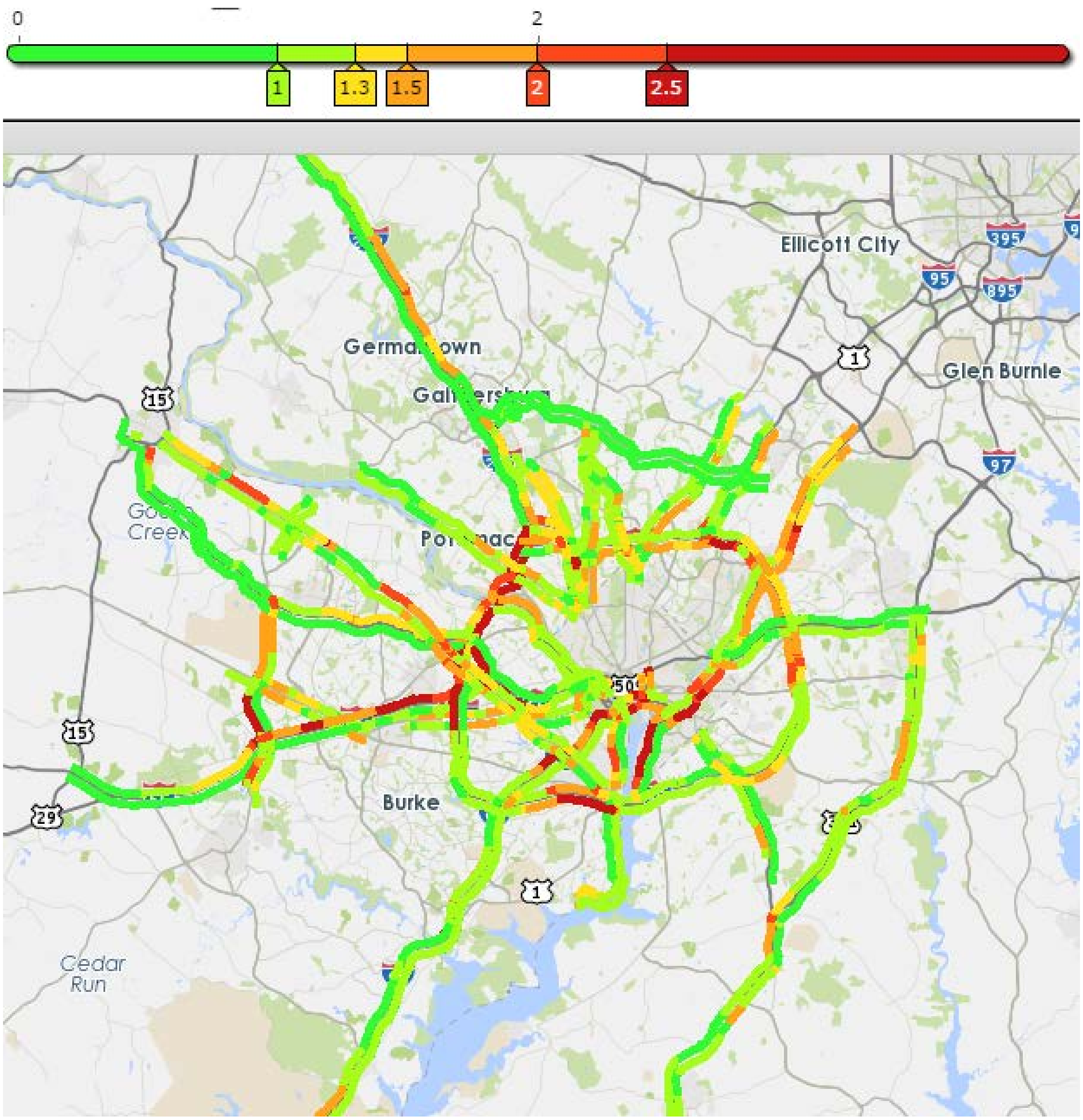


Figure 4. Travel Time Index during weekday 5:00-6:00 P.M. in 2nd Quarter 2016



2016Q2 SPOTLIGHT –SAFETRACK SURGES 1-4

Introduction

SafeTrack is an accelerated track work plan of the Washington Metropolitan Area Transit Authority (WMATA) to address safety recommendations and rehabilitate the Metrorail system to improve safety and reliability. SafeTrack accelerates three years' worth of work into approximately one year. The plan significantly expands maintenance time on weeknights, weekends, and midday hours, and includes 15 "Safety Surges" – long-duration track outages for major projects in key parts of the system.[1] The schedule and impacted Metro lines, stations, and ridership of Safety Surges 1, 2, 3 and 4 were provided by WMATA and summarized in Table 1.

This quarterly spotlight provides an overview of the traffic conditions during SafeTrack Safety Surges 1, 2, 3 and 4 from a regional perspective and identifies the most-impacted time periods and road segments.

Table 1. Schedule and Estimated Ridership Impact of Safety Surges 1, 2, 3 and 4

Surge	Dates	Metro Lines	Work Zone	Number of Impacted Peak Trips per Day	Impacted Trips as a Percentage of Average Weekday Trips*
1	6/4 – 6/16	Orange, Silver	Single tracking between East Falls Church and Ballston	255,000	36%
2	6/18 – 7/3	Orange, Silver, Blue	Shutdown between Eastern Market and Minnesota Ave. / Benning Road	293,000	41%
3	7/5 – 7/11	Yellow, Blue	Shutdown between DCA and Braddock Road	204,000	29%
4	7/12-7/18	Yellow, Blue	Shutdown between DCA and Pentagon City	204,000	29%

* According WMATA, the number of average weekday trips of Metrorail in 2015 was 713,000.

Methodology

The analysis uses roadway travel time and speed data reported by INRIX, Inc. for the I-95 Corridor Coalition Vehicle Probe Project to analyze traffic conditions in the TPB Planning Area. This data source monitors about 5,500 directional miles of roads in the region, including 720 miles of freeways and 4,780 miles of arterials. In general, this analysis compares the average traffic conditions during the weekdays of each safety surge to conditions observed during the same time period last year.

Summary Findings

Weekday peak period traffic congestion generally increased during the first four SafeTrack safety surges compared to the same time period last year (Table 2). Safety Surge 1 had the most significant congestion increases among all four safety surges. Peak spreading and intensifying were observed in both AM and PM

[1]WMATA, SafeTrack: http://www.wmata.com/rail/safetrack.cfm

peaks. Average freeway congestion, indicated by the Travel Time Index (the ratio of actual travel time to free-flow travel time), was 10% and 15% higher in the 7:00-8:00 A.M. hour and the 4:00-5:00 P.M. hour than for the same period last year (Figure 5). During Safety Surge 2, the AM peak period saw a 5% increase in congestion while no notable change was seen during the typical PM peak. There was, however, a 7% increase in congestion during the early afternoon hours between 2:00-4:00 P.M. Safety Surge 3 had the least congestion increase of all four safety surges. There was only a 3-5% increase between 6:00-8:00 A.M.; for 5:00 P.M. and later, congestion was actually lower than for the same period last year. During Safety Surge 4, the AM peak saw a 6% increase in congestion between 7:00-9:00 A.M., and a 5-7% increase between 5:00-8:00 P.M.

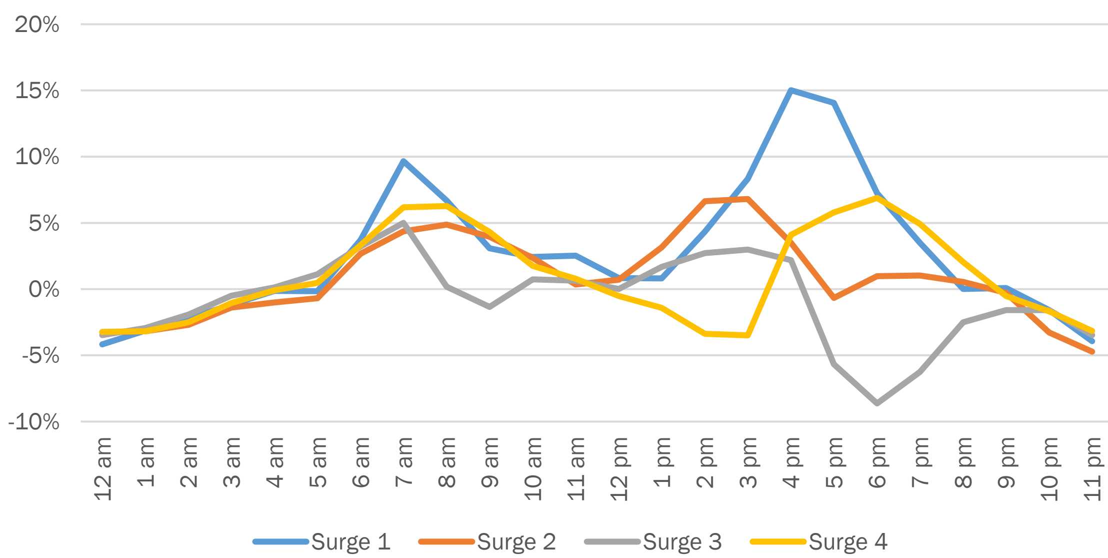
The magnitude of change of congestion on the region's non-freeway arterials (not shown in the figures) was significantly less than the magnitude of change experienced on freeways.

A seasonal decrease of traffic congestion was observed from Safety Surge 1 through Safety Surge 4, as was observed during the same time period last year as summer began and schools closed for summer break. This may have helped to partially offset traffic increases that may have been introduced by Safety Surges 2 through 4.

Table 2. Summary of Congestion Increases in Safety Surges 1, 2, 3 and 4

Surge	**Time Periods with 3% or More Congestion Increases**			**Highest Congestion Increase**			
	Time Periods	Number of Hours	Average Increase	Morning		Afternoon	
				Hour	Increase	Hour	Increase
1	6:00-10:00 A.M. 2:00-8:00 P.M.	10	8%	7:00-8:00 A.M.	10%	4:00-5:00 P.M.	15%
2	7:00-10:00 A.M. 1:00-5:00 P.M.	7	5%	8:00-9:00 A.M.	5%	3:00-4:00 P.M.	7%
3	6:00-8:00 A.M.	2	4%	7:00-8:00 A.M.	5%	3:00-4:00 P.M.	2.98%
4	7:00-10:00 A.M. 4:00-8:00 P.M.	7	5%	8:00-9:00 A.M.	6%	6:00-7:00 P.M.	7%

Figure 5. Freeway Congestion Changes Compared to Same Time 2015

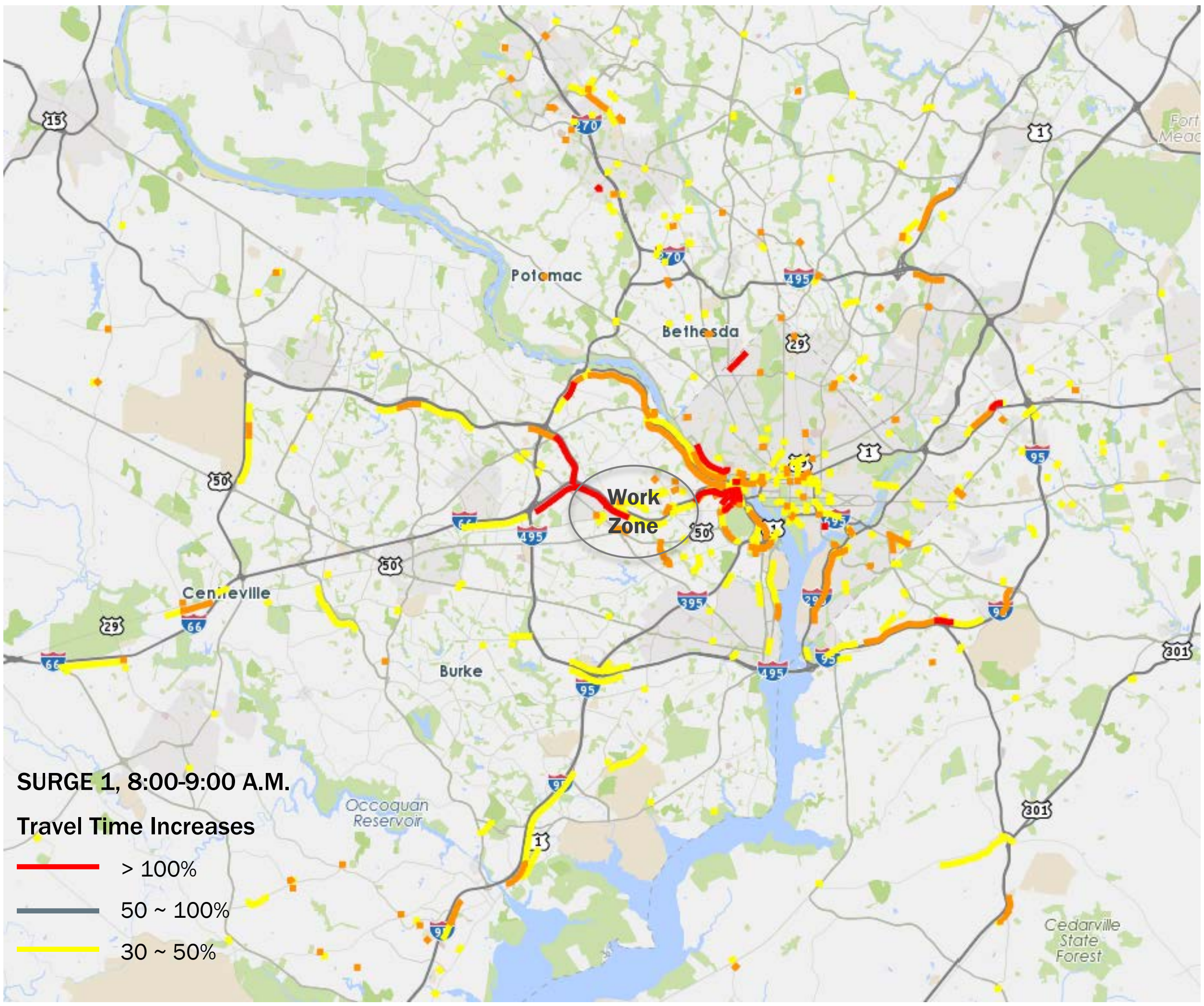


Road segments with the most significant congestion increases were often found in the vicinity of SafeTrack work zones, especially during the AM peak hour (8:00-9:00 A.M.): During Safety Surge 1, the greatest increases in congestion occurred in the triangle formed by I-66 EB inside the Beltway, the George Washington Memorial Parkway, I-495 and VA-267 (Figure 6); During Safety Surge 2, the largest congestion increases were observed along inbound routes towards DC along I-295 NB, the Baltimore-Washington Parkway and DC-295 SB, US-50 WB, and East Capitol St. N.E. WB; During Safety Surge 3, congestion increase along I395 NB and US-1 NB in northern Virginia were noticeable; During Safety Surge 4, I-395 NB, US-1 NB, and George Washington Memorial Parkway NB saw over 100% increases in travel times.

In the PM peak hour (5:00-6:00 P.M.), congestion increases seemed to be away from SafeTrack work zones during Safety Surges 1-3. During Safety Surge 4, increases around the work zone such as US-1 SB, George Washington Memorial Parkway SB, I-395 SB and the nearby Beltway were notable. During all four Safety Surges, congestion increases tended to concentrate in DC in the PM peak hour.

More detailed information regarding this analysis can be found in the TPB news article "How SafeTrack has impacted traffic on area roadways" and the memorandum "Traffic Conditions During SafeTrack Safety Surges 1, 2, 3 and 4".

Figure 5. Travel Time Increases in AM Peak Hour (8:00-9:00 A.M.) in Surge 1 Compared to the Same Time in 2015



BACKGROUND

Motivation

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

Methodology

Travel Time Index (TTI)

TTI is defined as the ratio of actual travel time to free-flow travel time, measures the intensity of congestion. The higher the index, the more congested traffic conditions it represents, e.g., TTI = 1.00 means free flow conditions, while TTI = 1.30 indicates the actual travel time is 30% longer than the free-flow travel time. For more information, please refer to Travel Time Reliability: Making It There On Time, All The Time, a report published by the Federal Highway Administration and produced by the Texas Transportation Institute with Cambridge Systematics, Inc. This report uses the following method to calculate TTI:

1. Download INRIX 5-minute raw data from the I-95 Traffic Monitoring website (http://i95.inrix.com) or the VPP Suite website (https://vpp.ritis.org).
2. Aggregate the raw data to monthly average data by day of the week and hour of the day. Harmonic Mean was used to average the speeds and reference speeds (Harmonic Mean is only used here; other averages used are all Arithmetic Mean). For each segment (TMC), the monthly data have 168 observations (7 days in a week * 24 hours a day) in a month.
3. Calculate TTI = reference speed / speed in the monthly data. If TTI < 1 then make TTI = 1. If constraint TTI >= 1 was not imposed, some congestion could be cancelled by conditions with TTI < 1.
4. Calculate regional average TTI for the Interstate system, non-Interstate NHS, non-NHS, and all roads for AM peak (6:00-10:00 am) and PM Peak (3:00-7:00 pm) respectively, using segment length as the weight.
5. Calculate the average TTI of the AM Peak and PM Peak to obtain an overall congestion indicator.

Planning Time Index (PTI)

PTI is defined as the ratio of 95th percentile travel time to free flow travel time, measures travel time reliability. The higher the index, the less reliable traffic conditions it represents, e.g., PTI = 1.30 means a traveler has to budget 30% longer than the uncongested travel time to arrive on time 95% of the times (i.e., 19 out of 20 trips), while TTI = 1.60 indicates that one has to budget 60% longer than the uncongested travel time to arrive on time most of the times. For more information, please refer to Travel Time Reliability: Making It There On Time, All The Time, a report published by the Federal Highway Administration and produced by the Texas Transportation Institute with Cambridge Systematics, Inc. This report uses the following method to calculate PTI:

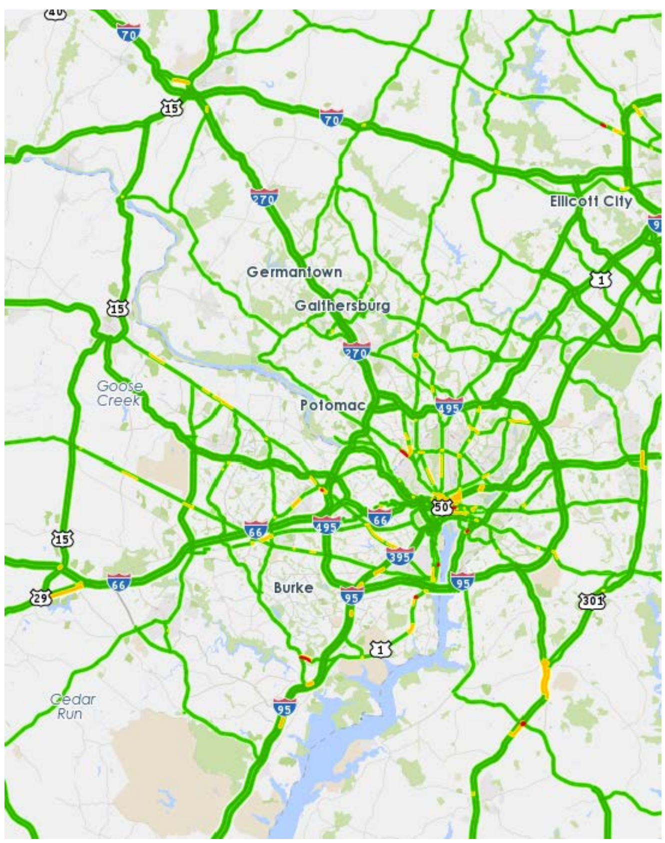
1. Calculate TTI = reference speed / speed in the monthly data obtained in step 2 of the above TTI methodology. Do not impose constraint TTI >= 1, since the purpose of this calculation is to rank the TTIs to find the 95th percentile, not to average the TTIs.
2. Calculate monthly average PTI: including sorting the data obtained in step 1 by segment, peak period, and month, finding the 95th percentile TTI and this TTI is PTI by definition, and averaging the PTIs using segment length as the weight to get regional summaries (for the Interstate system, non-Interstate NHS, non-NHS, and all roads for AM peak (6:00-10:00 am) and PM Peak (3:00-7:00 pm) respectively).
3. Calculate yearly average PTI: including sorting the data obtained in step 1 by segment and peak period, finding the 95th percentile TTI and this TTI is PTI by definition, and averaging the PTIs using segment length as the weight to get regional summaries.
4. Calculate the average PTI of the AM Peak and PM Peak to obtain an overall travel time reliability indicator.

National Highway System (NHS) – the October 1, 2012 designation of NHS was used in this report. In compliance with the MAP-21 requirements, all principal arterials have been added to the NHS.

Transit-Significant Roads –areroad segments with at least 6 buses in the AM Peak Hour (equivalent to one bus in either direction in every 10 minutes). More detailed definition and analysis can be found in the 2015Q1 and 2015Q2 Congestion Reports.

All Roads (in Figures 1 and 2) – are the roads covered by the I-95 Corridor Coalition Vehicle Probe Project/INRIX data, as shown below.

Figure 8. I-95 Vehicle Probe Project/INRIX data coverage in the National Capital Region



Bottlenecks

The VPP adopted an improved bottleneck algorithm on August 31, 2016. Starting from this report, the top 10 bottlenecks will be ranked by this new algorithm. The remaining portion of this section was extracted from the VPP Suite Bottleneck section.

The Need for Change

The original bottleneck algorithm, while innovative and often sufficient at identifying the general locations of the worst bottlenecks within a road network, contained a number of challenges and deficiencies that made it fall short of being the best that it could be. Some of these challenges include:

- Duplicate occurrence counting
- Issues with moving, merging, and diverging bottleneck queues
- High processing costs

Congestion, and bottlenecks by extension, are dynamic. They grow, shrink, change locations, merge, and split apart over time. Identifying the actual source (head) location of the congestion is critical to identifying problem areas. The new algorithm better identifies the specific locations of bottlenecks by more accurately tracking the movement of congestion on the roadway and calculating the impact for each individual contributing location.

New Algorithm

Terminology

The following terms are used for defining how congestion is tracked and analyzed to identify bottleneck locations:

- Occurrence - Congestion, whose head is at a given point on the road at a single point in time
- Element - Congestion, whose head is at a given point on the road, that can change in length over time
- Blob - A collection of spatially and temporally adjacent congestion elements

Occurrences

The foundation of tracking congestion and identifying bottlenecks is based on analyzing a probe speed data set at each reading interval to identify groups of consecutive congested road segments, or occurrences. Road segments are considered congested if the reported speed falls below 60% of the reference (or free-flow) speed.

Upon identification, each occurrence is assigned a set of attributes derived from the source data, including head location (defined as the furthest downstream segment), the date and time at which the occurrence was observed, the set of road segments included, and an impact value. The impact of an occurrence is currently calculated as the total length for all road segments included in the occurrence.

Elements

Occurrences from sequential probe speed data readings that share identical head locations are combined into elements. Occurrences that do not share an identical head location to any occurrence from the previous reading interval will become a new element. Each sequential reading interval analyzed will produce its own set of occurrences that will be used to either update the attributes of existing elements from the previous reading or create a element.

Elements are assigned a set of attributes derived from the occurrences they are comprised of, including a head location, a start date and time (derived from the earliest occurrence), the unioned set of road segments included in all occurrences, and an impact value equal to the sum of the individual occurrence impact values.

Elements are also assigned an end date and time when there are no longer any occurrences identified with a matching head location to an active element.

The final state of an element's attributes provides a good indication of the total effect congestion at the element's location had on the roadway. Because of this, elements serve as the primary building block from which bottleneck locations are identified and ranked.

Blobs

While elements do a great job of focusing on specific locations on a roadway, there are benefits to identifying the relationships between different congested locations. These relationships may be useful in identifying larger stretches of road with multiple bottleneck locations that regularly impact each other or in filtering out short-lived congestion that is either insignificant or caused by a momentary lapse in data quality. To enable these benefits, elements that are spatially and temporally adjacent to each other are grouped together into a blob.

Similar to how elements are built from a collection of occurrences, blobs are built from a collection of elements. The main difference is that while all occurrences that make up an element must share an identical head location, a blob includes all elements that move into, merge into, or diverge from each other.

Blobs are assigned attributes that are derived from the elements they are comprised of, including a head location (the furthest downstream head location from all elements), a tail location (the furthest upstream head location from all elements), a start date and time (the earliest start time of all elements), and end date and time (the latest end time of all elements), the unioned set of road segments included in all elements, and an impact value equal to the sum of the individual element impact values.

Bottleneck location maps and spiral charts are all screen shots from the VPP Suite.

Congestion Maps

The maps were generated by the "Trend Map" tool in the VPP Suite. Since the VPP Suite limits the total number of segments of a query, the maps only show the freeways and some major arterials.

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