Reliability Trends

Another measure of roadway operation relates to the variability or unreliability of the system. This is especially important since roadway users normally accept some level of congestion during the peak hour of travel. If travel times vary greatly it becomes more difficult for motorists to plan their trip to arrive on time. This increases driver frustration and has a cost associated with the additional travel time. The cost varies by trip purpose and nature and the importance to that particular motorist. For example, to catch a flight, have a freight delivery occur on time or just to be able to make a child's event may have very high costs to that particular person or business. A more reliable freeway system allows for trips to be better planned and meet expectations of the motorists using the network.

Incidents including vehicular breakdowns, crashes, weather and lane reductions through work zones greatly impact reliability. This non-recurring congestion impacts automobiles, trucks and on-street transit services. Reliability is critical for transit operations. Variations in travel time make it difficult for transit operators to provide reliable schedules. This in turn can lead to a decrease in rider confidence and the potential to reduce ridership on the impacted routes.

Trip reliability is measured by the Planning Time Index (PTI). The PTI represents the total time motorists should allow to make sure they arrive at their destination on-time while taking into account potential impacts due to non-recurrent congestion. As evaluated in Maryland, this represents the 95th percentile travel time for a section of roadway. Motorists travelling in free flow conditions that take 5 minutes to traverse a section of roadway should allow for 15 minutes to ensure arriving on time when the PTI is 3.0. The lower the PTI number, the more reliable the trip while the higher the number, the less reliable and longer a trip could possibly take. Statewide and for the Baltimore / Washington region reliability maps presented in this report, categorize PTI for freeways/expressways as follows:

- Reliable (PTI < 1.5)
- Moderately Unreliable (1.5 < PTI < 2.5)
- Highly to Extremely Unreliable (PTI > 2.5)

1. Statewide Freeway/Expressway Peak Hour Reliability

The PTI was calculated on a statewide basis for the peak hours (8-9 AM and 5-6 PM) of the network. Figures 7 and 8 depict the results of the analysis.

Highly to extremely unreliable conditions (PTI > 2.5) occur on a total of 141 road miles (9% of the statewide freeway/expressway network) in the AM peak hour. This amounts to an estimated 16% of the morning peak hour VMT that occurs under these conditions.

There are a total of 211 road miles (13% of the statewide freeway/expressway network) that operate under highly to extremely unreliable conditions (PTI > 2.5) in the PM peak hour. The vehicle miles traveled under these unreliable conditions is estimated to be 23% of the afternoon peak hour, VMT.

Figure 7

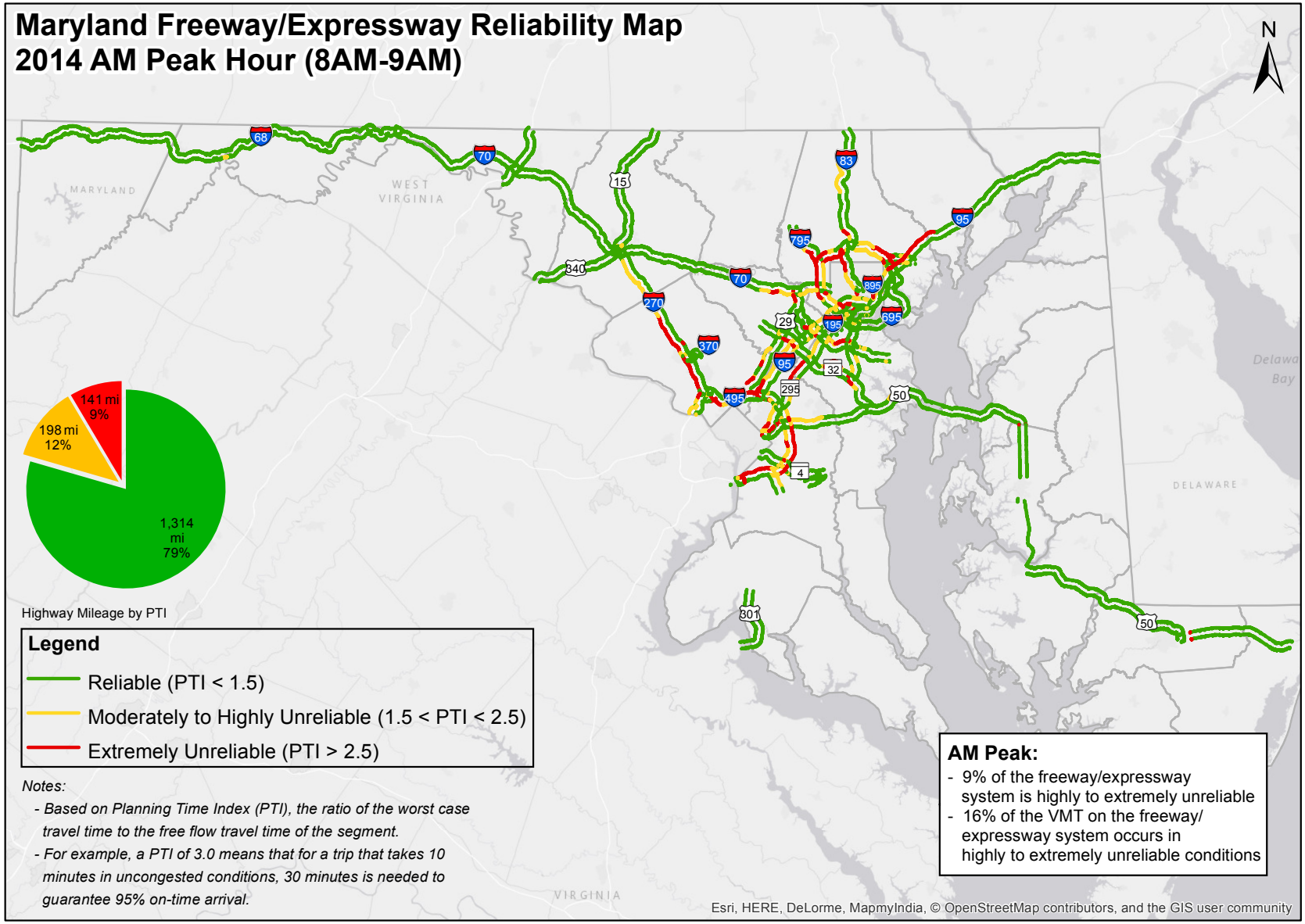
Maryland Freeway/Expressway Reliability Map
2014 AM Peak Hour (8AM-9AM)
N
MARYLAND
WEST VIRGINIA
VIRGINIA
DELAWARE
Delaware Bay
68
70
15
340
270
370
495
83
95
795
895
695
195
29
32
295
50
4
301
141 mi 9%
198 mi 12%
1,314 mi 79%
Highway Mileage by PTI
Legend
Reliable (PTI < 1.5)
Moderately to Highly Unreliable (1.5 < PTI < 2.5)
Extremely Unreliable (PTI > 2.5)
Notes:
- Based on Planning Time Index (PTI), the ratio of the worst case travel time to the free flow travel time of the segment.
- For example, a PTI of 3.0 means that for a trip that takes 10 minutes in uncongested conditions, 30 minutes is needed to guarantee 95% on-time arrival.
AM Peak:
- 9% of the freeway/expressway system is highly to extremely unreliable
- 16% of the VMT on the freeway/ expressway system occurs in highly to extremely unreliable conditions
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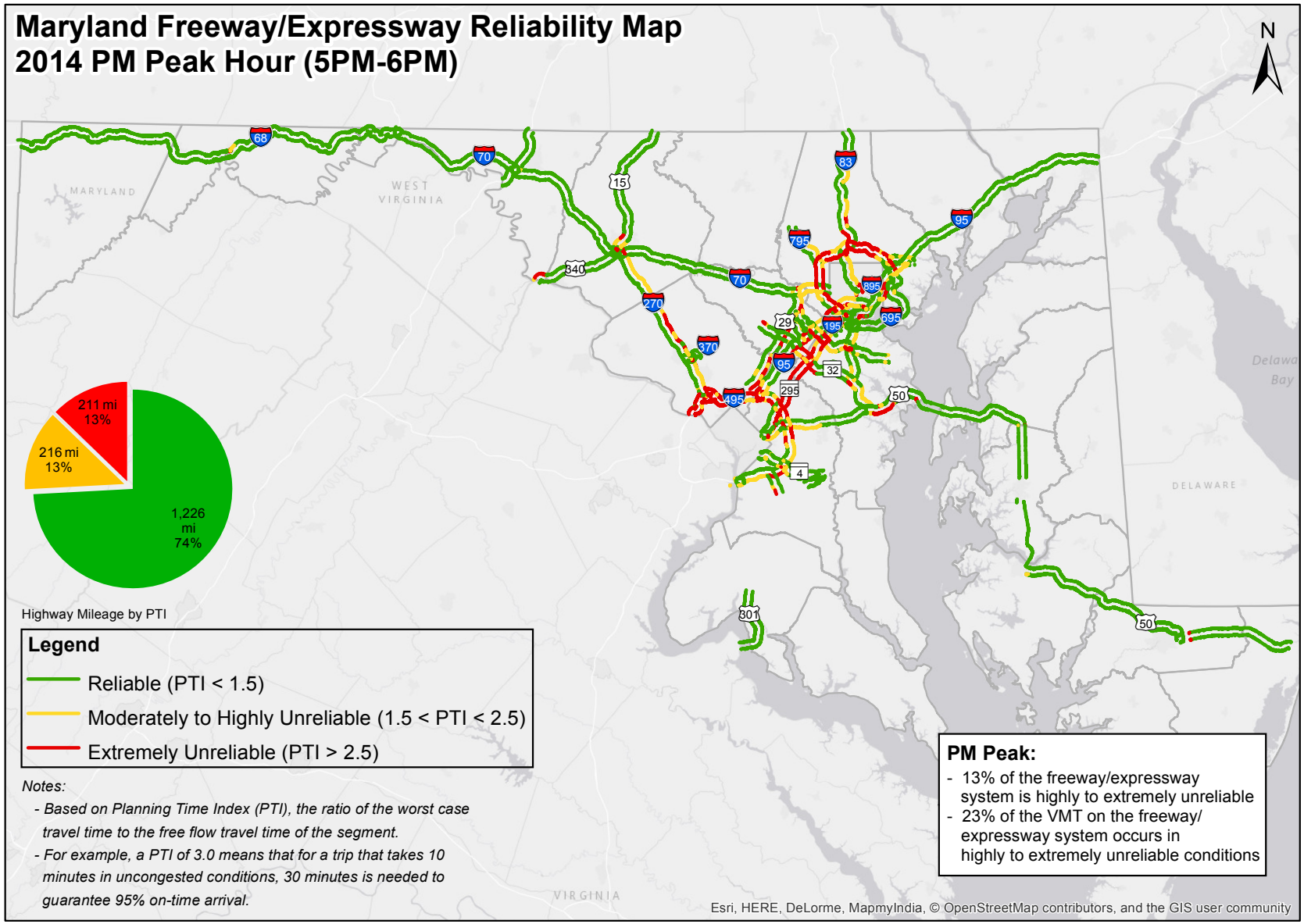
Figure 8


Maryland Freeway/Expressway Reliability Map
2014 PM Peak Hour (5PM-6PM)
N
MARYLAND
WEST VIRGINIA
VIRGINIA
DELAWARE
Delaware Bay
211 mi 13%
216 mi 13%
1,226 mi 74%
Highway Mileage by PTI
Legend
Reliable (PTI < 1.5)
Moderately to Highly Unreliable (1.5 < PTI < 2.5)
Extremely Unreliable (PTI > 2.5)
Notes:
- Based on Planning Time Index (PTI), the ratio of the worst case travel time to the free flow travel time of the segment.
- For example, a PTI of 3.0 means that for a trip that takes 10 minutes in uncongested conditions, 30 minutes is needed to guarantee 95% on-time arrival.
PM Peak:
- 13% of the freeway/expressway system is highly to extremely unreliable
- 23% of the VMT on the freeway/ expressway system occurs in highly to extremely unreliable conditions
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The 2014 reliability trends statewide indicate the freeway/expressway system have stayed relatively constant over the past year. A very slight decrease occurred in the number of roadway miles that occurred under highly to extremely unreliable conditions as depicted in the following chart.

STATEWIDE FREEWAY/EXPRESSWAY NETWORK
AVERAGE WEEKDAY AM & PM PEAK HOUR RELIABILITY SUMMARY

Highly to Extremely Unreliable Conditions	2014		2013		CHANGE	
	AM	PM	AM	PM	AM	PM
Number of Roadway Miles	141	211	145	213	-4	-2
Percent of Roadway Miles	9	13	9	13	0	0
Percent of Peak Hour VMT Impacted	16	23	17	22	-1	+1

2. Baltimore - Washington Region Peak Hour Reliability

In addition to statewide reliability trends, the Baltimore / Washington region freeway/expressway system was analyzed based on the PTI for the AM (8-9) and PM (5-6) peak hours. The reliability maps for the region are shown in Figures 9 and 10.

There was a total of 141 road miles (13% of network) where motorists experience highly to extremely unreliable (PTI > 2.5) conditions in the morning peak hour. Highly to extremely unreliable conditions occur during 18% of the morning peak hour VMT.

Motorists experience highly to extremely unreliable conditions (PTI > 2.5) on 208 road miles (19% of the network) within the Baltimore / Washington region during the PM peak hour. Twenty-seven (27)% of the afternoon peak hour VMT in the Baltimore / Washington region occurs in highly or extremely unreliable conditions.

In the AM and PM peak hours for the Baltimore / Washington region highly to extremely unreliable conditions remained constant between 2014 and 2013. The Baltimore / Washington region accounts for approximately 99% of the highly to extremely unreliable roadways.

Figure 9

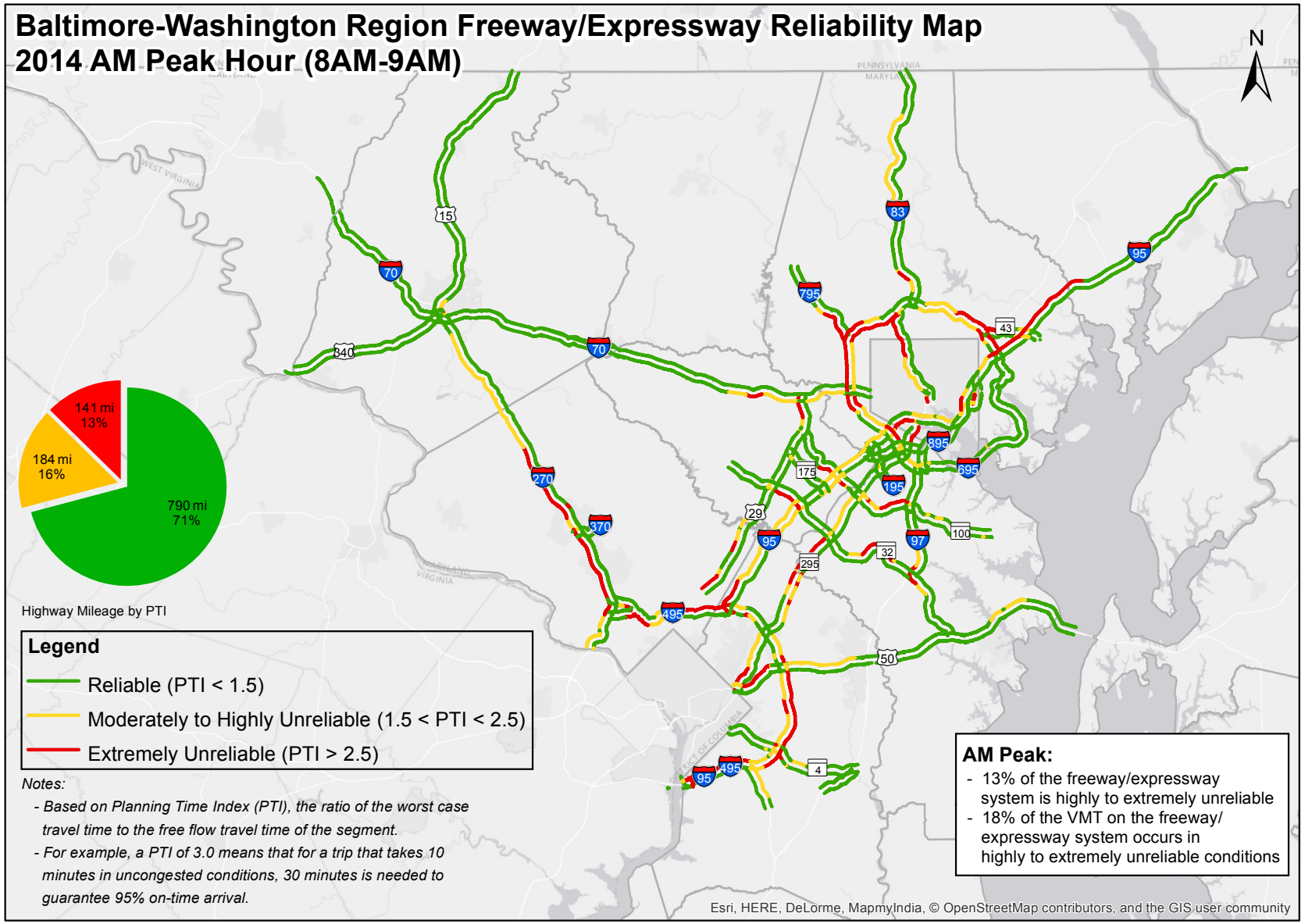
Baltimore-Washington Region Freeway/Expressway Reliability Map
2014 AM Peak Hour (8AM-9AM)
N
141 mi
13%
184 mi
16%
790 mi
71%
Highway Mileage by PTI
Legend
Reliable (PTI < 1.5)
Moderately to Highly Unreliable (1.5 < PTI < 2.5)
Extremely Unreliable (PTI > 2.5)
Notes:
- Based on Planning Time Index (PTI), the ratio of the worst case travel time to the free flow travel time of the segment.
- For example, a PTI of 3.0 means that for a trip that takes 10 minutes in uncongested conditions, 30 minutes is needed to guarantee 95% on-time arrival.
AM Peak:
- 13% of the freeway/expressway system is highly to extremely unreliable
- 18% of the VMT on the freeway/ expressway system occurs in highly to extremely unreliable conditions
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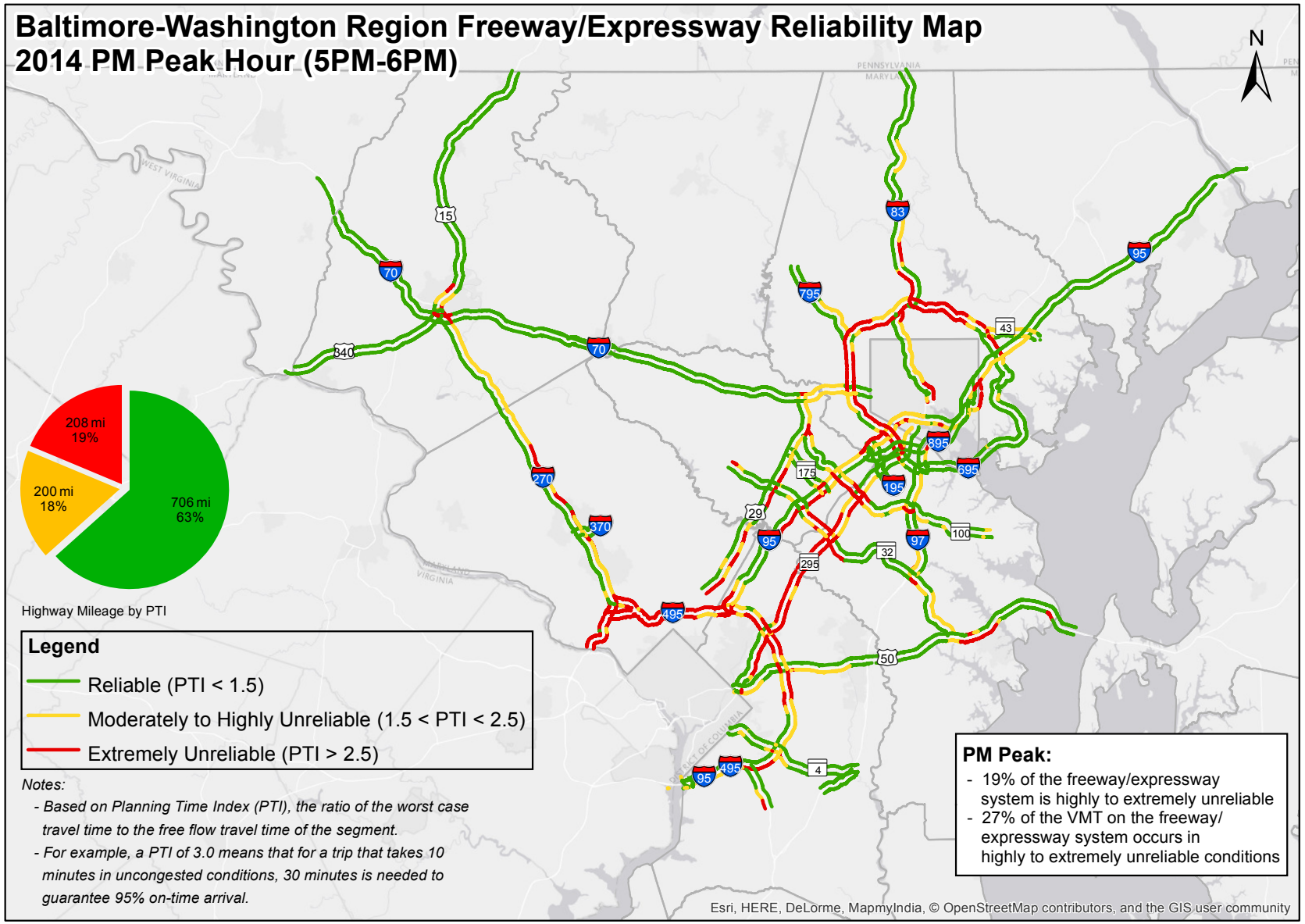
Figure 10


Baltimore-Washington Region Freeway/Expressway Reliability Map
2014 PM Peak Hour (5PM-6PM)
N
208 mi
19%
200 mi
18%
706 mi
63%
Highway Mileage by PTI
Legend
Reliable (PTI < 1.5)
Moderately to Highly Unreliable (1.5 < PTI < 2.5)
Extremely Unreliable (PTI > 2.5)
Notes:
- Based on Planning Time Index (PTI), the ratio of the worst case travel time to the free flow travel time of the segment.
- For example, a PTI of 3.0 means that for a trip that takes 10 minutes in uncongested conditions, 30 minutes is needed to guarantee 95% on-time arrival.
PM Peak:
- 19% of the freeway/expressway system is highly to extremely unreliable
- 27% of the VMT on the freeway/ expressway system occurs in highly to extremely unreliable conditions
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I-495 @ I-95

2. Congestion and Reliability Correlation

In general, there is a strong correlation between the average congestion (TTI based maps shown in Figures 1 - 4) and the reliability (PTI based maps in Figures 7-10). Roadways that experience high levels of average or recurring congestion are more vulnerable to failures due to incidents, weather, workzones, etc, hence more unreliable. Minor incidents can produce severe back-ups and system level unreliable conditions for hours. Conversely, roadways with lower TTI may have some reserve capacity to absorb the disruption caused by non-recurring congestion and show higher reliability.

The following table illustrates the correlation between the top five TTI ranked locations with their corresponding PTI rank.

AM Peak Hour			PM Peak Hour		
	TTI Rank	PTI Rank		TTI Rank	PTI Rank
I-495 @ MD 650	1	1	I-695 MD 139 to MD 45	1	4
I-495 MD 650 to MD 193	2	6	I-695 MD 45 to MD 146	2	8
I-495 Prince George's County Line to MD 650	3	2	I-495 Cabin John Parkway to MD 190	3	9
I-495 MD 193 to US 29	4	15	I-695 @ MD 146	4	10
I-695 MD 147 to MD 41	5	9	I-695 @ MD 139	5	2

Top 30 Unreliable Segments

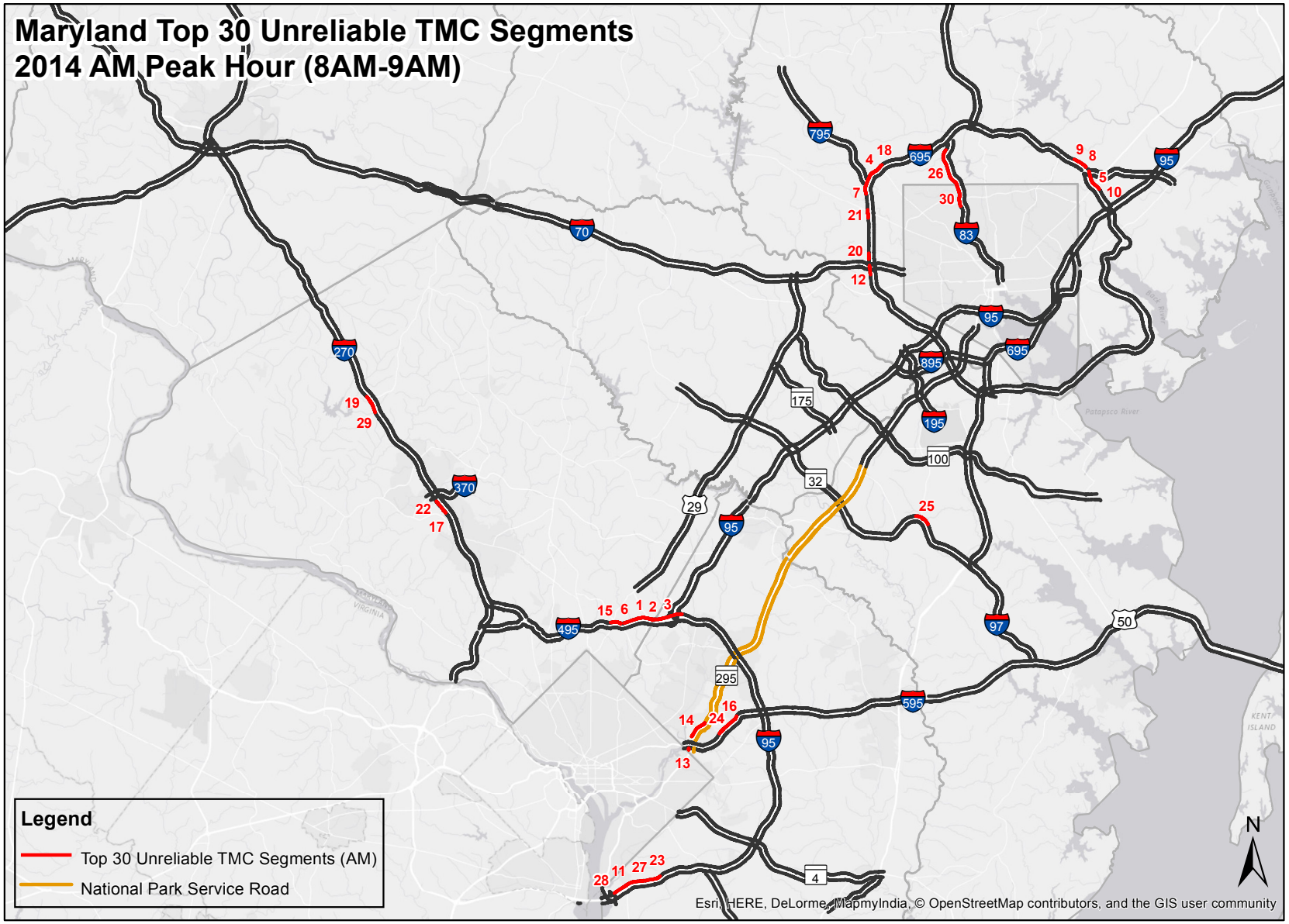
The top 30 most unreliable freeway/expressway segments based on the PTI for the AM peak hour (8-9 AM) and PM peak hour (5-6 PM) are listed in the following tables and shown in Figures 11 and 12:

2014 TOP 30 UNRELIABLE SEGMENTS AM PEAK

2014 RANK	ROAD	LOCATION	DIRECTION	2014 TTI	2013 RANK	RANK CHANGE 2013 TO 2014
1	I-495	@ MD 650	Outer Loop	9.01	1	0
2	I-495	Prince Georges Co/L to MD 650	Outer Loop	8.66	3	-1
3	I-495	I-95 to Montgomery Co/L	Outer Loop	8.58	2	1
4	I-695	MD 140 to I-795	Outer Loop	7.91	8	-4
5	I-695	US 1 to MD 43	Outer Loop	7.69	6	-1
6	I-495	MD 650 to MD 193	Outer Loop	7.51	10	-4
7	I-695	I-795 to MD 26*	Outer Loop	7.51	4	3
8	I-695	MD 43 to MD 147*	Outer Loop	7.23	5	3
9	I-695	MD 147 to MD 41*	Outer Loop	6.92	11	-2
10	I-695	@ US 1	Outer Loop	6.84	9	1
11	I-495	@ MD 210	Inner Loop	6.77	12	-1
12	I-695	I-70 to US 40	Outer Loop	6.25	7	5
13	MD-295	US 50 to Washington DC/L[1]	Southbound	5.80	24	-11
14	MD-295	MD 202 to US 50[1]	Southbound	5.77	20	-6
15	I-495	MD 193 to US 29	Outer Loop	5.75	22	-7
16	US-50	MD 410 to MD 202	Westbound	5.73	18	-2
17	I-270	Shady Grove Rd to MD 28 CD Lanes	Southbound	5.60	15	2
18	I-695	@ MD 140	Outer Loop	5.58	17	1
19	I-270	@ Father Hurley Blvd	Southbound	5.35	37	-18
20	I-695	MD 26 to MD 122	Outer Loop	5.21	13	7
21	I-695	@ MD 26	Outer Loop	5.20	21	0
22	I-270	I-370 to Shady Grove Rd	Southbound	5.14	42	-20
23	I-95	@ MD 414	Inner Loop	4.89	30	-7
24	US-50	MD 202 to MD 459	Westbound	4.87	27	-3
25	MD-32	Sappington Station Rd to MD 170	Westbound	4.87	26	-1
26	I-83	Ruxton Rd to Northern Pkwy	Southbound	4.70	38	-12
27	I-95	MD 414 to MD 210	Inner Loop	4.68	33	-6
28	I-95	MD 210 to I-295 CD Lanes	Inner Loop	4.63	40	-12
29	I-270	Father Hurley Blvd to MD 118	Southbound	4.62	57	-28
30	I-83	Northern Pkwy to Cold Spring Lane	Southbound	4.61	35	-5

[1] Owned by the National Park Service *Under or Nearby Construction

Figure 11

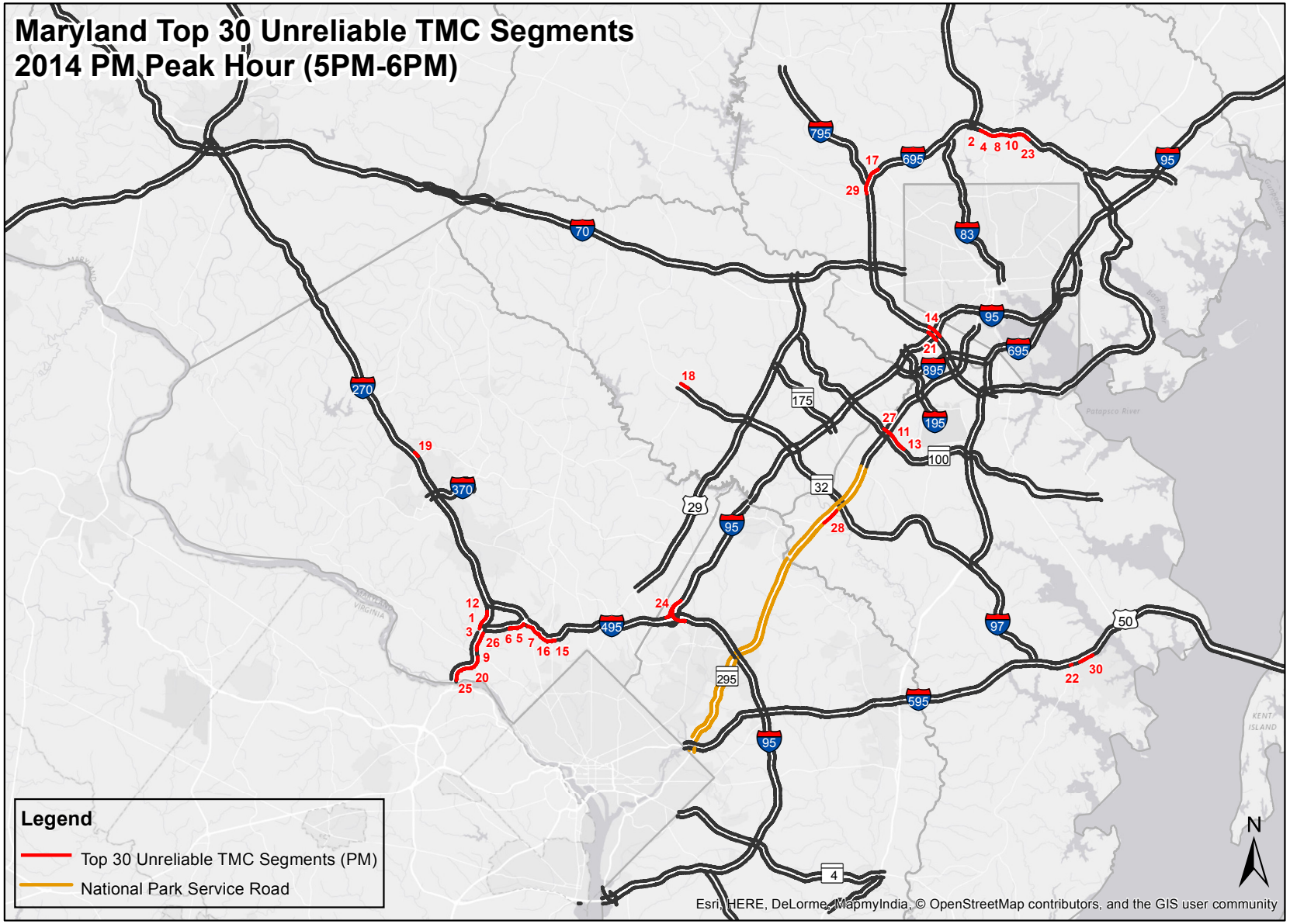

Maryland Top 30 Unreliable TMC Segments
2014 AM Peak Hour (8AM-9AM)
Legend
Top 30 Unreliable TMC Segments (AM)
National Park Service Road
N
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

2014 TOP 30 UNRELIABLE SEGMENTS PM PEAK

2014 RANK	ROAD	LOCATION	DIRECTION	2014 TTI	2013 RANK	RANK CHANGE 2013 TO 2014
1	I-270 Spur	@ Democracy Blvd	Southbound	11.65	1	0
2	I-695	@ MD 139	Inner Loop	10.01	6	-4
3	I-270 Spur	@ I-495	Southbound	9.63	2	1
4	I-695	MD 139 to MD 45	Inner Loop	9.51	5	-1
5	I-495	MD 187 to MD 355	Inner Loop	8.48	4	1
6	I-495	@ MD 187	Inner Loop	8.16	3	3
7	I-495	@ MD 355	Inner Loop	7.85	7	0
8	I-695	MD 45 to MD 146	Inner Loop	7.58	10	-2
9	I-495	Cabin John Pkwy to MD 190	Inner Loop	7.11	8	1
10	I-695	@ MD 146	Inner Loop	6.48	17	-7
11	MD-100	MD 713 to MD 295	Westbound	6.46	11	0
12	I-270 Spur	I-270 to Democracy Blvd	Southbound	6.42	18	-6
13	MD-100	MD 170 to MD 713	Westbound	6.40	24	-11
14	I-695	@ I-95*	Inner Loop	6.25	15	-1
15	I-495	@ MD 185	Inner Loop	5.97	44	-29
16	I-495	MD 355 to MD 185	Inner Loop	5.95	29	-13
17	I-695	MD 140 to I-795	Outer Loop	5.87	19	-2
18	MD-32	Great Star Dr to MD 108	Westbound	5.79	9	9
19	I-270	MD 124 to Middlebrook Rd	Northbound	5.66	37	-18
20	I-495	Clara Barton Pkwy to Cabin John Pkwy	Inner Loop	5.60	25	-5
21	I-695	@ I-95*	Outer Loop	5.58	21	0
22	US-50	@ MD 450	Eastbound	5.47	12	10
23	I-695	MD 146 to Providence Rd	Inner Loop	5.34	49	-26
24	I-95	MD 212 to I-495	Southbound	5.33	16	8
25	I-495	@ Clara Barton Pkwy	Inner Loop	5.32	39	-14
26	I-495	@ I-270Y Split	Inner Loop	5.31	30	-4
27	MD-100	MD 713 to MD 295	Westbound	5.25	41	-14
28	MD-295	MD 198 to MD 32[1]	Northbound	5.18	22	6
29	I-695	I-795 to MD 26*	Outer Loop	5.15	20	9
30	US-50	@ MD 70	Eastbound	5.13	23	7

[1] Owned by the National Park Service *Under or Nearby Construction

Figure 12


Maryland Top 30 Unreliable TMC Segments
2014 PM Peak Hour (5PM-6PM)
Legend
Top 30 Unreliable TMC Segments (PM)
National Park Service Road
N
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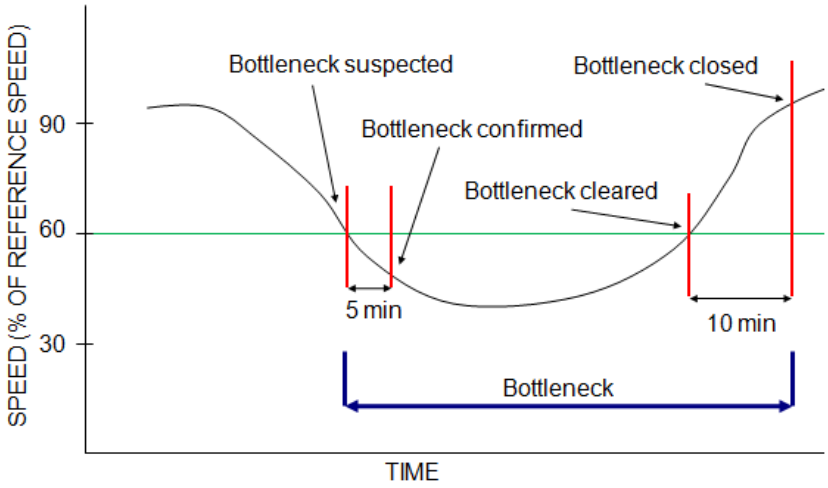
Top 30 Bottleneck Locations

Another measure of congestion is bottleneck locations. A bottleneck, as defined by the Vehicle Probe Project (VPP) Suite, occurs when, "the speeds observed for a roadway segment drop below 60% of the free flow speed for a period greater than 5 minutes. Adjacent roadway segments meeting this condition are joined together to form a bottleneck queue. The duration of the bottleneck is calculated till the time speeds are greater than 60% for more than 10 minutes. This definition uses minute-to-minute speeds available across the state highway system to determine congestion patterns for the entire day. The definition this report utilizes for a bottleneck is graphically shown below:



The top 30 bottleneck locations were identified in 2014. The analysis is based on INRIX probe data for interstates and major controlled access facilities available through the VPP Suite. This is based on speed observations used to calculate the number of bottleneck occurrences. The ranking of the segments is performed by computing the duration, intensity and frequency with which the bottlenecks occur during an entire average weekday. This is calculated by determining an impact factor (computed as the number of times a bottleneck occurs on a particular segment, times its duration times the average queue length). The following page identifies the Top 30 Bottlenecks. These are shown in Figure 13.

2014 TOP 30 BOTTLENECK LOCATIONS

2014 Rank	Location	Road	Direction	Q1	Q2	Q3	Q4	Average Duration	Average MAX Length	Impact Factor	2013 Rank	Rank Change 2013 to 2014
1	I-495 IL @ I-270 Spur	I-495	Inner Loop	225	201	160	176	168.75	12.3	1079316	1	0
2	I-95 OL @ Greenbelt Metro Dr/Exit 24**	I-95	Outer Loop	154	137	125	221	125.5	19.46	791840	7	-5
3	I-95 N @ MD-100/Exit 43	I-95	Northbound	133	229	158	139	120	9.41	704646	3	0
4	I-270 Spur S @ I-270	I-270	Southbound	95	106	106	119	111	10.78	479337	6	-2
5	MD-295 N @ I-195	MD-295	Northbound	74	94	71	78	138.5	13.21	472385	N/A	N/A
6	MD-295 N @ MD-175	MD-295	Northbound	116	80	83	96	150.5	8.66	444694	N/A	N/A
7	I-695 OL @ Edmondson Ave/Exit 14*	I-695	Outer Loop	142	156	112	98	121.5	8.82	414633	4	+3
8	I-695 IL @ I-795/Exit 19	I-695	Inner Loop	32	116	77	153	122.25	8.68	410551	276	-268
9	I-695 IL @ MD-147/Harford Rd/Exit 31*	I-695	Inner Loop	89	77	45	70	159.25	10.43	394232	2	+7
10	MD-295 N @ MD-197/EXIT 11[1]	MD-295	Northbound	116	73	91	108	169.75	6.33	386207	8	+2
11	I-695 IL @ MD-41/Perring Pkwy/Exit 30*	I-695	Inner Loop	65	108	145	161	107.25	7.59	357839	22	-11
12	I-95 OL @ US-50/Exit 19	I-95	Outer Loop	117	165	124	131	107.75	5.7	296350	30	-18
13	I-270 Local N @ MD 124	I-270	Northbound	168	147	139	145	126.5	4.17	262346	10	+3
14	I-95 S @ I-495/Exit 27-25	I-95	Southbound	206	189	176	163	92	5.43	250608	20	-6
15	I-95 IL @ MD-214/ Exit 15	I-95	Inner Loop	85	125	150	120	101.75	5.15	226712	27	-12
16	MD-295 S @ MD-193[1]	MD-295	Southbound	76	80	77	115	94.5	7.76	225998	11	+5
17	MD-295 S @ Powder Mill Rd[1]	MD-295	Southbound	112	133	125	113	97.5	5.12	221761	21	-4
18	I-695 IL @ I-83/MD-25/Exit 23	I-695	Inner Loop	122	110	136	83	86.5	6.6	217612	18	0
19	I-695 OL @ US-40/Exit 15	I-695	Outer Loop	65	89	128	145	82.5	6.68	214186	76	-57
20	I-270 N @ MD-80/Exit 26	I-270	Northbound	78	90	155	89	85.25	8.02	208159	9	+11
21	I-95 IL @ MD-4/Pennsylvania Ave/Exit 11	I-95	Inner Loop	51	87	43	74	105.25	7.25	193369	40	-19
22	MD-295 N @ MD-100[1]	MD 295	Northbound	76	137	126	70	87	6.11	191552	N/A	N/A
23	I-495 IL @ MD-97/Georgie Ave/Exit 31	I-495	Outer Loop	97	159	146	143	100.75	3.5	185054	24	-1
24	I-270 S @ MD-109/Exit 22	I-270	Southbound	124	172	156	108	78.5	4.15	168714	15	+9
25	I-270 N @ MD-109/Exit 22	I-270	Northbound	75	65	66	48	96.75	8.67	167063	70	-45
26	I-495 CCW @ MD-185/Connecticut Ave/Exit 33	I-495	Outer Loop	72	61	54	78	122.25	5.48	162545	17	+9
27	MD-295 N @ Powder Mill Rd[1]	MD-295	Northbound	166	163	173	144	85	3.16	157255	34	-7
28	I-270 N @ I-70/US-40	I-270	Northbound	114	106	180	108	68.75	8.06	155154	14	+14
29	I-270 Local S @ I-270	I-270	Southbound	131	159	133	145	82.5	4.53	153922	N/A	N/A
30	I-695 IL @ MD 26*	I-695	Inner Loop	47	67	78	59	107.75	6.24	152379	19	+11

Q1: Jan-Mar Q2: Apr-June Q3: July-Sept Q4: Oct-Dec

Occurrences: Number of Times Speed Dropped Below 60% of the Free Flow Speeds

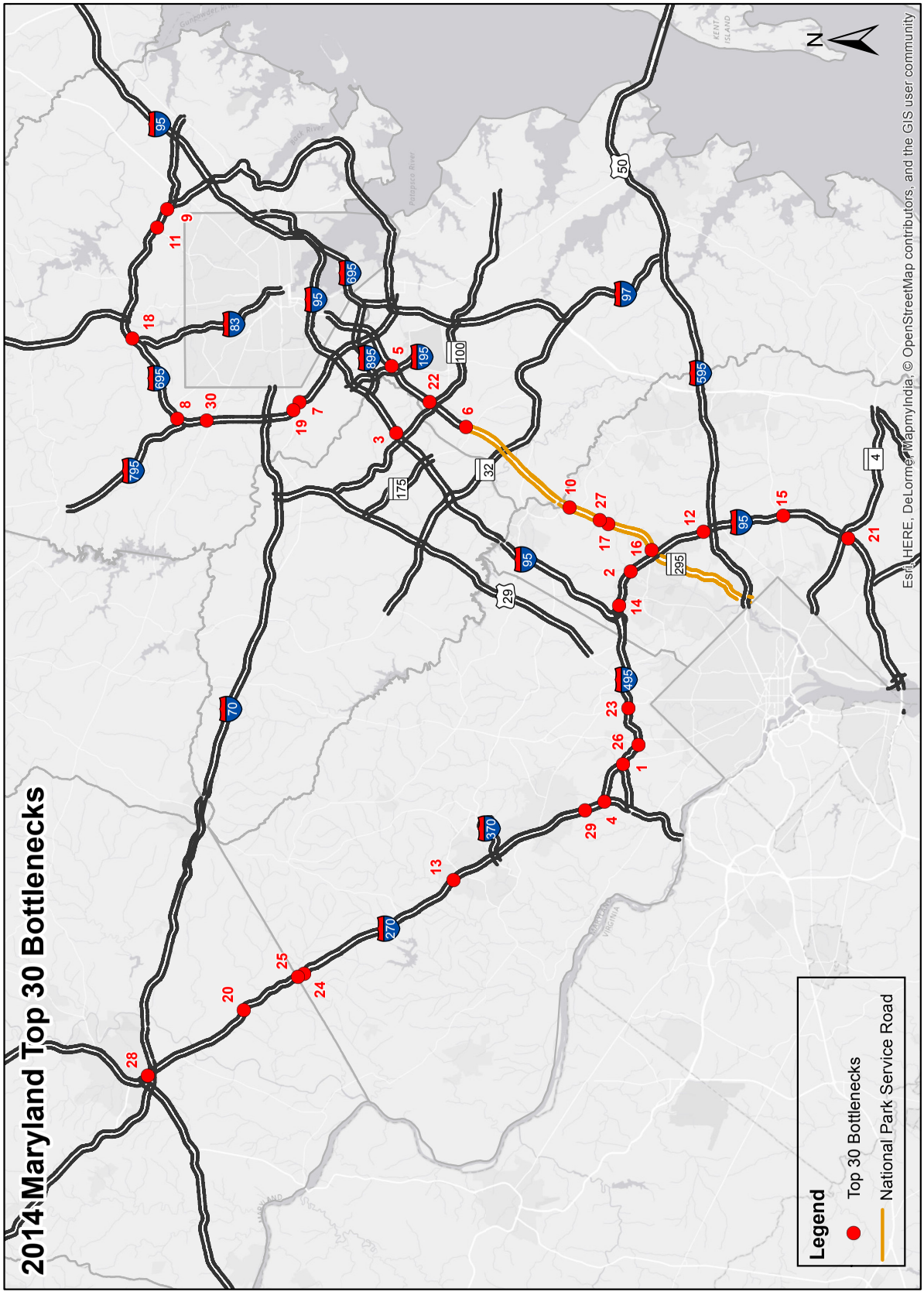
Impact Factor = Sum of Occurrence per Quarter x Avg. Duration per Quarter x Queue Length per Quarter

[1] Owned by National Park Service

* Under or Nearby Construction

** Under Review

Figure 13


2014 Maryland Top 30 Bottlenecks
Legend
Top 30 Bottlenecks
National Park Service Road
N
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