



I-95 Corridor Coalition

I-95 Corridor Coalition Vehicle Probe Project: Validation of INRIX Data

Report for Maryland (#10)
US-1 and US-29



June 2016

I-95 CORRIDOR COALITION VEHICLE PROBE PROJECT VALIDATION OF INRIX DATA JUNE 2016

Report for Maryland (#10) US-1 and US-29

Prepared for:

I-95 Corridor Coalition

Sponsored by:

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Evaluation Results for the State of Maryland

Executive Summary

The data from the Vehicle Probe Project is validated using Bluetooth™ Traffic Monitoring (BTM) technology on a near monthly basis. The validation of arterial data is similar to that of freeway data, however the following should be noted. The boundaries of the speed bins used for arterials are different than those used for freeways to accommodate the lower speeds on this type of corridor.

BTMs sensor were deployed at the beginning and ending points of 17 different segments along the US-1 and US-29 corridors. The number of lanes varies between 1 and 3 per direction for US-1 and between 2 and 3 per direction for US-29. The average signal density is approximately two signals per mile for US-1 and one signal per mile for US-29. Average Annual Daily Traffic (AADT) is 27,100 along US-1 and 61,620 along US-29. The speed limit varies between 40 to 50 MPH for US-1 and between 40 to 55 MPH for US-29.

The Bluetooth sensor deployment covers the range from Leeds Ave to Whiskey Bottom Rd along US-1 and Old Columbia Rd to MD-193 along US-29. Travel time data was collected for both directions along each arterial, between March 25 and April 10, 2016. During this period, the area experienced seven days with precipitation. Due to data quality considerations four segments were dropped from final validation resulting in 13 bidirectional segments and 3 unidirectional segments for analysis. The dataset collected represents approximately 3,373 hours of observations along the remained arterial segments, totaling approximately 24 miles. The total number of effective five-minute travel time samples observed was 40,475.

ES Table 1, below summarizes the results of the comparison between the BTM reference data and the INRIX data for arterial segments during the above noted time period. As shown, the average absolute speed error (AASE) was within specification in all speed bins. The Speed Error Bias (SEB) was within specifications for all speed bins except 0-15 MPH. Although the data are compared to these specifications, caution should be used when using probe data on arterial roadways. Other factors including signal density and traffic volume should be considered.

ES Table 1 – Maryland Evaluation Summary for Arterial						
Speed Bin	Average Absolute Speed Error (<10mph)		Speed Error Bias (<5mph)		Number of 5 Minute Samples	Hours of Data Collection
	Comparison with SEM Band	Comparison with Mean	Comparison with SEM Band	Comparison with Mean		
0-15 MPH	5.6	8.6	5.5	8.5	288	24
15-25 MPH	3.6	9	3.5	8.4	2773	231
25-35 MPH	2.3	6.1	1.8	4	11092	924
>35 MPH	2.4	7	-0.2	0.2	26322	2194
All Speeds	2.5	6.9	0.7	1.9	40475	3373

Based upon data collected from March 25, 2016 through April 10, 2016 across 24 miles of roadway.

Data Collection

Travel time samples were collected along 17 bidirectional arterial segments with the assistance of Maryland Department of Transportation (MDOT) personnel. Arterial segments studied were located on the US-1 corridor from Leeds Ave to Whiskey Bottom Rd and on US-29 corridor from Old Columbia Rd to MD-193. Travel time data was collected for both directions along US-1 and US-29 between March 25 and April 10, 2016. Segment locations were chosen with a high-likelihood of observing recurrent and non-recurrent congestion during peak and off-peak periods.

Figure 1 and 2 present an overview snapshot of the placement of sensors for the collection of data on the US-1 and US-29 corridors in Maryland, respectively. Blue segments represent arterial segments selected for analysis. The number of lanes varies between 1 and 3 per direction for US-1 and the average signal density is around 2 signal per mile. The Average Annual Daily Traffic (AADT) is 27,100 along US-1 and the speed limit varies between 40 to 50 MPH.

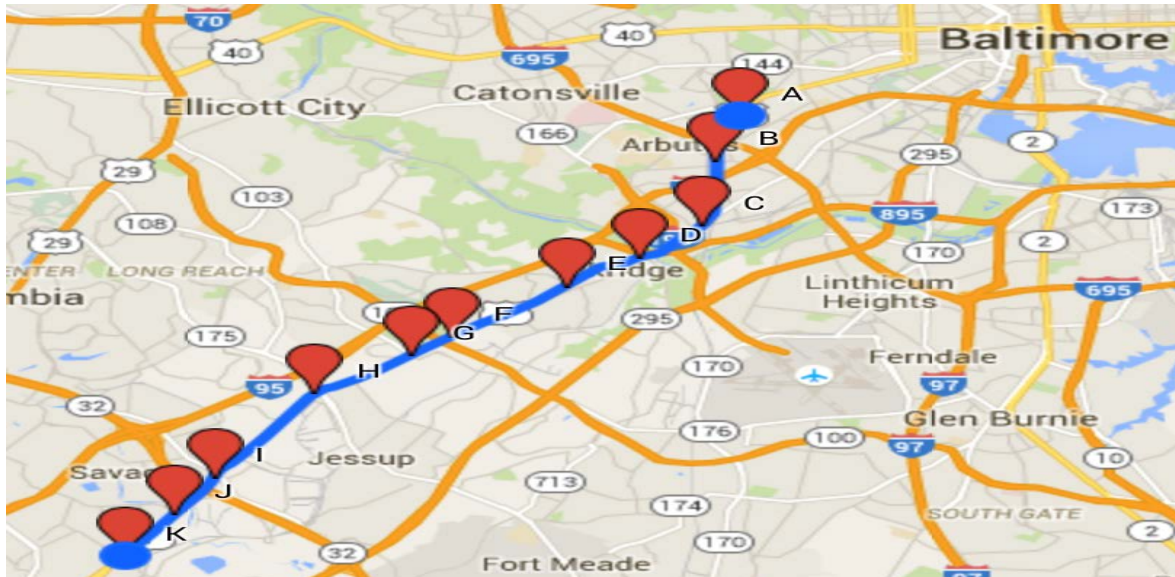


Figure 1 — Locations of all segments selected on US-1 for analysis in Maryland

The number of lanes varies between 2 and 3 per direction for US-29 and the average signal density is approximately one signal per mile for US-29. The Average Annual Daily Traffic (AADT) 61,620 along US-29 and the speed limit varies between 40 to 55 MPH for US-29.

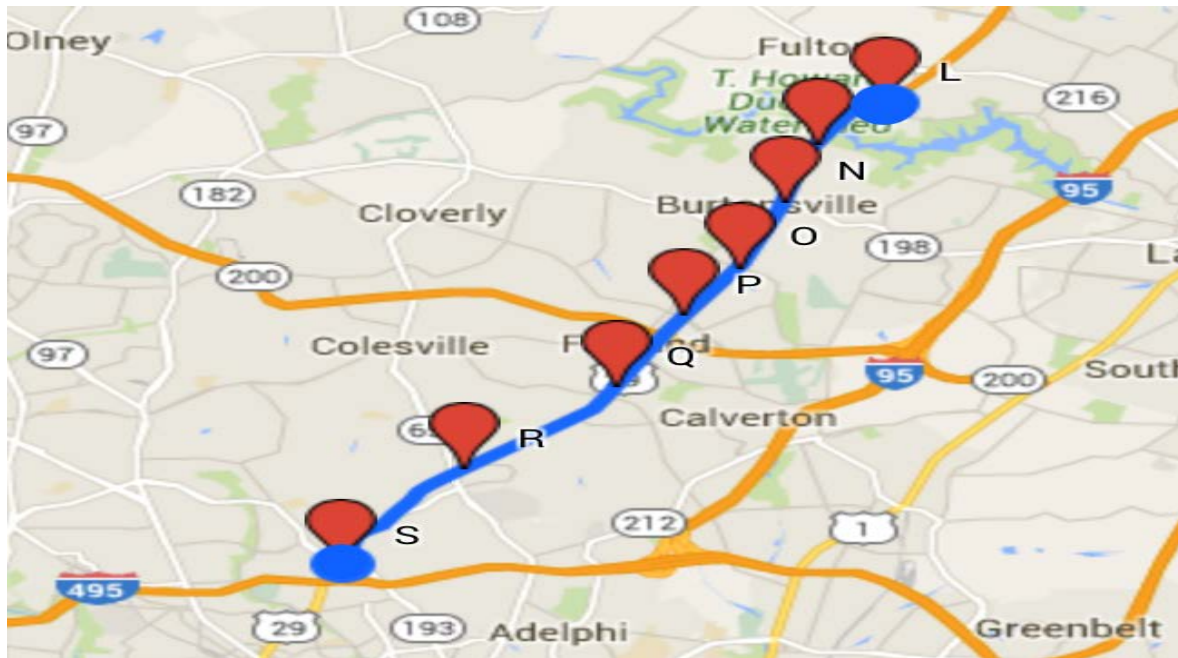


Figure 2 — Locations of all segments selected on US-29 for analysis in Maryland

TMC segments selected for validation in Maryland

Table 1 presents the data collection segments from Maryland. As a whole, these segments cover a total length of 24 arterial miles. Data collection segments are comprised of one or more Traffic Message Channel (TMC) base segments, such that the total length of the data collection segment is in most cases one mile long or greater for arterials. When appropriate, consecutive TMC segments are combined to form a data collection segment longer than one mile. Due to data quality considerations four segments were dropped from final validation. The results of the validation performed on 13 bidirectional arterial segments and 3 unidirectional segments are included in this report. Table 1 contains the summary information on each data collection segment including the latitude/longitude coordinates of the locations at which the Bluetooth sensors were deployed along US-1 and US-29 in Maryland as well as an active map link to view the data collection segment in detail. Click on the map link to see a detailed map for the respective data collection segment. It should be noted that the configuration of the test segments is often such that the endpoint of one segment coincides with the start point of the next segment, so that one Bluetooth sensor covers both data collection segments.

Table 1 also provides data on the precise length of the TMCs comprising the test segment as compared to the measured length between BluetoothTM Traffic Monitoring (BTM) sensors

placed on the roadway. An algorithm was developed and documented in a separate report¹ as part of the initial VPP project and is being used for the validation of all vendors in VPPII. Details of the algorithm used to estimate equivalent path travel times based on INRIX data feeds for individual data collection segments are provided in this separate report. This algorithm finds an equivalent INRIX travel time (and therefore travel speed) corresponding to each sample BTM travel time observation on the test segment of interest.

¹ Ali Haghani, Masoud Hamedi, Kaveh Farokhi Sadabadi, Estimation of Travel Times for Multiple TMC Segments, prepared for I-95 Corridor Coalition, February 2010 ([link](#))

Table 1
Segments selected for validation in Maryland

SEGMENT (Map Link)	DESCRIPTION			TMC CODES		Deployment		All Lengths in Miles
	Highway Maryland	State County	Starting at Ending at	Begin End	Length Number	Begin Lat/Lon End Lat/Lon	Length % Diff	
Arterials								
A2 MD10-0002	US-1 Southbound	Maryland Baltimore	Sulphur Spring Rd US-1/Washington Blvd	110-09555 110-09555	1.42 1	39.247925 39.227891	-76.691477 -76.694749	1.52 6.84%
A3 MD10-0003	US-1 Southbound	Maryland Baltimore	US-1/Washington Blvd I-895/Harbor Tunnel Trwy	110-09554 110N09553	0.93 4	39.227891 39.218047	-76.694749 -76.706175	1.13 21.60%
A4 MD10-0004	US-1 Southbound	Maryland Howard	I-895/Harbor Tunnel Trwy Montgomery Rd	110-09552 110-09552	1.39 1	39.218047 39.207073	-76.706175 -76.72717	1.17 -15.84%
A5 MD10-0005	US-1 Southbound	Maryland Howard	Montgomery Rd MD-100	110-09551 110-09551	1.85 1	39.207073 39.190565	-76.72717 -76.754239	1.87 1.08%
A6 MD10-0006	US-1 Southbound	Maryland Howard	MD-100 MD-103	110N09551 110-09550	0.68 2	39.190565 39.183989	-76.754239 -76.763757	0.66 -2.93%
A7 MD10-0007	US-1 Southbound	Maryland Howard	MD-103 MD-175	110-09549 110N09549	1.50 2	39.183989 39.171306	-76.763757 -76.786147	1.52 1.33%
A8 MD10-0008	US-1 Southbound	Maryland Howard	MD-175 MD-32	110-09548 110-09548	2.42 1	39.171306 39.142115	-76.786147 -76.810623	2.36 -2.48%
A9 MD10-0009	US-1 Southbound	Maryland Howard	MD-32 Gorman Rd	110N09548 110N09547	0.93 3	39.142115 39.130643	-76.810623 -76.819313	0.99 6.48%
A10 MD10-0010	US-1 Southbound	Maryland Howard	Gorman Rd Whiskey Bottom Rd	110-09546 110-09546	1.19 1	39.130643 39.116275	-76.819313 -76.831489	1.17 -1.68%
A11 MD10-0011	US-1 Northbound	Maryland Howard	Whiskey Bottom Rd Gorman Rd	110+09547 110+09547	1.19 1	39.116275 39.130566	-76.831489 -76.819175	1.16 -2.52%
A12 MD10-0012	US-1 Northbound	Maryland Howard	Gorman Rd MD-32	110P09547 110P09548	0.96 3	39.130566 39.142571	-76.819175 -76.810257	0.98 2.07%

Table 1 (Cont'd)
Segments selected for validation in Maryland

SEGMENT (Map Link)	DESCRIPTION			TMC CODES		Deployment		All Lengths in Miles
	Freeway Maryland	State County	Starting at Ending at	Begin End	Length Number	Begin Lat/Lon End Lat/Lon	Length % Diff	
Arterials								
A13 MD10-0013	US-1 Northbound	Maryland Howard	MD-32 MD-175/Waterloo Rd	110+09549 110+09549	2.34 1	39.142571 39.170706	-76.810257 -76.786497	2.37 1.28%
A14 MD10-0014	US-1 Northbound	Maryland Howard	MD-175/Waterloo Rd MD-103	110P09549 110+09550	1.54 2	39.170706 39.183911	-76.786497 -76.763672	1.51 -1.95%
A15 MD10-0015	US-1 Northbound	Maryland Howard	MD-103 MD-100	110+09551 110P09551	0.69 2	39.183911 39.190469	-76.763672 -76.754087	0.67 -2.92%
A16 MD10-0016	US-1 Northbound	Maryland Howard	MD-100 Montgomery Rd	110+09552 110+09552	1.85 1	39.190469 39.207073	-76.754087 -76.72717	1.87 1.08%
A17 MD10-0017	US-1 Northbound	Maryland Baltimore	Montgomery Rd I-895/Harbor Tunnel Trwy	110+09553 110+09553	1.43 1	39.207073 39.218202	-76.72717 -76.705371	1.17 -18.13%
A18 MD10-0018	US-1 Northbound	Maryland Baltimore	I-895/Harbor Tunnel Trwy US-1/Washington Blvd	110P09553 110+09555	0.84 4	39.218202 39.227318	-76.705371 -76.695168	1.13 34.56%
A22 MD10-0022	US-29 Southbound	Maryland Montgomery	Dustin Rd MD-198/Sandy Spring Rd	110N06887 110N05902	1.08 3	39.126873 39.112097	-76.922937 -76.929166	1.06 -1.85%
A23 MD10-0023	US-29 Southbound	Maryland Montgomery	MD-198/Sandy Spring Rd Greencastle Rd	110-05901 110-05901	1.23 1	39.112097 39.095646	-76.929166 -76.938143	1.25 1.62%
A24 MD10-0024	US-29 Southbound	Maryland Montgomery	Greencastle Rd Briggs Chaney Rd	110-05900 110N05900	1.06 2	39.095646 39.082702	-76.938143 -76.948835	0.99 -6.59%
A25 MD10-0025	US-29 Southbound	Maryland Montgomery	Briggs Chaney Rd Cherry Hill Rd/Randolph Rd	110-05899 110-05898	1.33 3	39.082702 39.065812	-76.948835 -76.960838	1.43 7.50%
A26 MD10-0026	US-29 Southbound	Maryland Montgomery	Cherry Hill Rd/Randolph Rd MD-650	110N05898 110-05897	2.12 2	39.065812 39.045094	-76.960838 -76.989367	2.13 0.47%

Table 1 (Cont'd)
Segments selected for validation in Maryland

SEGMENT (Map Link)	DESCRIPTION			TMC CODES		Deployment		All Lengths in Miles
	Highway Maryland	State County	Starting at Ending at	Begin End	Length Number	Begin Lat/Lon End Lat/Lon	Length % Diff	
Arterials								
A27 MD10-0027	US-29 Southbound	Maryland Montgomery	MD-650 MD-193/University Blvd	110N05897 110-05896	2.18 2	39.045094 39.020388	-76.989367 -77.012784	2.17 -0.46%
A28 MD10-0028	US-29 Northbound	Maryland Montgomery	MD-193/University Blvd MD-650	110+05897 110P05897	2.21 2	39.020308 39.019712	-77.012641 -77.013182	2.17 -1.81%
A29 MD10-0029	US-29 Northbound	Maryland Montgomery	MD-650 Cherry Hill Rd/Randolph Rd	110+05898 110P05898	2.09 2	39.019712 39.045238	-77.013182 -76.988839	2.14 2.39%
A30 MD10-0030	US-29 Northbound	Maryland Montgomery	Cherry Hill Rd/Randolph Rd Briggs Chaney Rd	110+05899 110+05900	1.05 3	39.045238 39.065569	-76.988839 -76.960647	1.43 36.08%
A31 MD10-0031	US-29 Northbound	Maryland Montgomery	Briggs Chaney Rd Greencastle Rd	110P05900 110+05901	1.35 2	39.065569 39.065569	-76.960647 -76.960647	0.99 -26.61%
A32 MD10-0032	US-29 Northbound	Maryland Montgomery	Greencastle Rd MD-198/Sandy Spring Rd	110+05902 110+05902	0.93 1	39.079051 39.079051	-76.951499 -76.951499	1.26 35.44%
A33 MD10-0033	US-29 Northbound	Maryland Montgomery	MD-198/Sandy Spring Rd Dustin Rd	110P05902 110P06887	1.33 3	39.095535 39.095535	-76.937874 -76.937874	1.05 -21.06%
A34 MD10-0034	US-29 Northbound	Maryland Howard	Dustin Rd Old Columbia Rd	110+05241 110+05242	1.04 2	39.126133 39.136748	-76.923265 -76.910612	1.03 -0.96%

Analysis of Arterial Results

Table 2 summarizes the data quality measures obtained as a result of comparison between Bluetooth and all reported INRIX speeds. Specifications used for comparison include the Average Absolute Speed Error (AASE) and the Speed Error Bias (SEB).

Average Absolute Speed Error (AASE)

The AASE is defined as the mean absolute value of the difference between the mean speed reported from the VPP and the ground truth mean speed for a specified time period. The AASE is the primary accuracy metric. Based on the contract specifications, the speed data from the VPP shall have a maximum average absolute error of 10 miles per hour (MPH) in each of four speed ranges: 0-15 MPH, 15-25 MPH, 25-35 MPH, and > 35 MPH.

Speed Error Bias (SEB)

The SEB is defined as the average speed error (not the absolute value) in each speed range. SEB is a measure of whether the speed reported in the VPP consistently under or over estimates speed as compared to ground truth speed. Based on the contract specifications, the VPP data shall have a maximum SEB of +/- 5 MPH in each of speed ranges as defined above.

The results are presented as compared against the mean of the ground truth data as well as the 95th percent confidence interval for the mean, referred to as the Standard Error of the Mean (SEM) band. The SEM band takes into account any uncertainty in the ground truth speed as measured by BTM equipment due to limited samples and/or data variance. Contract specifications are assessed against the SEM band. (See the *Vehicle Probe Project: Data Use and Application Guide* for additional details on the validation process.) The AASE in the lower two speed bands have proven to be the critical specification (and most difficult) to attain. As shown, the average absolute speed error (AASE) was within specification for all the speed bins. The Speed Error Bias (SEB) was within specifications except for the speed bin 0-15 MPH.

TABLE 2 Data quality measures for arterial segments in Maryland

SPEED BIN	Data Quality Measures for				No. of 5 Minute Samples	Hours of Data Collection
	1.96 SEM Band		Mean			
	SEB 5 mph (contract specifications)	AASE 10 mph	SEB	AASE		
0-15	5.5	5.6	8.5	8.6	288	24
15-25	3.5	3.6	8.4	9	2773	231
25-35	1.8	2.3	4	6.1	11092	924
35+	-0.2	2.4	0.2	7	26322	2194

Table 3 shows the percentage of the time INRIX data falls within 5 mph of the SEM band and the mean for each speed bin for all arterial data segments in this validation report.

Table 3 Percent observations meeting data quality criteria for arterial segments in Maryland

SPEED BIN	Data Quality Measures for				No. of Obs.
	1.96 SEM Band		Mean		
	Percentage falling inside the band	Percentage falling within 5 mph of the band	Percentage equal to the mean	Percentage within 5 mph of the mean	
0-15	18%	64%	0%	50%	288
15-25	38%	70%	0%	29%	2773
25-35	54%	83%	0%	50%	11092
35+	53%	81%	0%	44%	26322

Tables 4 and 5 present detailed data for individual TMC segments in this validation in a similar format as Tables 2 and 3, respectively. Note that for some segments and in some speed bins the comparison results may not be reliable due to the small number of observations.

Table 4
Data quality measures for individual arterial validation segments in the state of Maryland

TMC	Standard TMC length	Bluetooth distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SEM Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
MD10-0002	1.42	1.52	0-15	-	-	-	-	-
			15-25	-	-	-	-	-
			25-35	3.8	3.8	7.4	7.4	11*
			35+	-1.4	1.6	-3.1	4.1	471
MD10-0003	0.93	1.13	0-15	-	-	-	-	-
			15-25	-	-	-	-	-
			25-35	0.2	1.1	1.3	4.5	225
			35+	-2.1	2.2	-5.3	6.3	498
MD10-0004	1.39	1.17	0-15	22.9	22.9	25.8	25.8	2*
			15-25	2.8	2.9	1.7	5.8	7*
			25-35	0.6	1.4	2.1	5.7	103
			35+	-2.4	2.5	-6.0	7.1	1052
MD10-0005	1.85	1.87	0-15	20.9	20.9	26.9	26.9	5*
			15-25	4.5	4.6	13.8	13.9	94
			25-35	2.0	2.2	5.6	6.4	401
			35+	-0.6	1.0	-1.3	4.0	224
MD10-0006	0.69	0.66	0-15	-	-	-	-	-
			15-25	2.2	2.2	7.4	7.9	28*
			25-35	0.2	1.1	1.5	5.9	396
			35+	-2.8	2.9	-6.4	7.7	914
MD10-0007	1.5	1.52	0-15	2.9	2.9	6.0	6.4	58
			15-25	1.2	1.3	4.7	5.7	265
			25-35	-0.5	1.0	-1.6	4.7	365
			35+	-3.6	3.6	-8.3	8.7	74
MD10-0008	2.42	2.36	0-15	12.9	12.9	21.8	21.8	17*
			15-25	4.2	4.2	12.8	12.8	160
			25-35	1.1	1.4	4.0	5.4	409
			35+	-1.3	1.5	-3.6	5.6	110
MD10-0009	0.92	0.99	0-15	11.7	11.9	14.2	14.7	4*
			15-25	3.8	3.8	8.8	9.3	265
			25-35	0.5	0.9	2.0	5.6	631
			35+	-2.5	2.6	-6.8	8.1	341
MD10-0011	1.19	1.16	0-15	8.5	8.5	13.6	13.6	6*
			15-25	4.5	4.7	8.8	9.4	156
			25-35	0.9	1.3	3.0	4.9	1200
			35+	-1.5	1.7	-4.1	5.3	408
MD10-0012	0.96	0.98	0-15	10.7	10.7	13.4	13.4	21*
			15-25	4.1	4.3	8.0	8.9	544
			25-35	0.7	1.1	2.5	5.3	559
			35+	-1.4	1.4	-6.3	7.0	164

*Results in the specified row may not be reliable due to small number of observations

Table 4 (Cont'd)
Data quality measures for individual arterial validation segments in the state of Maryland

TMC	Standard TMC length	Bluetooth distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SEM Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
MD10-0013	2.34	2.37	0-15	3.3	3.3	9.3	9.5	16*
			15-25	1.6	1.7	7.2	7.7	138
			25-35	-0.4	0.9	-0.8	3.8	401
			35+	-3.0	3.1	-7.5	7.8	139
MD10-0014	1.54	1.51	0-15	6.0	6.0	11.5	11.5	5*
			15-25	2.0	2.2	5.2	6.5	182
			25-35	0.0	0.8	-0.1	4.2	541
			35+	-3.2	3.2	-9.0	9.2	111
MD10-0015	0.69	0.67	0-15	12.1	12.1	18.3	18.3	12*
			15-25	3.6	3.6	10.2	10.3	445
			25-35	0.5	0.7	3.5	5.4	586
			35+	-1.9	2.0	-5.5	6.7	179
MD10-0016	1.85	1.87	0-15	16.1	16.1	23.8	23.8	5*
			15-25	3.5	3.5	14.6	14.6	57
			25-35	1.6	1.8	4.4	5.3	343
			35+	-0.9	1.2	-2.0	3.7	364
MD10-0017	1.43	1.17	0-15	8.5	8.5	20.1	20.1	1*
			15-25	6.6	6.6	16.6	16.6	39
			25-35	2.2	2.2	8.2	8.4	533
			35+	-0.4	0.9	0.0	4.4	606
MD10-0018	0.84	1.13	0-15	-	-	-	-	-
			15-25	7.0	7.0	9.4	9.4	3*
			25-35	0.9	1.7	2.9	5.0	256
			35+	-2.0	2.1	-4.6	5.7	378
MD10-0022	1.08	1.06	0-15	-	-	-	-	-
			15-25	-	-	-	-	-
			25-35	17.7	17.7	22.0	22.0	1*
			35+	2.0	2.2	5.9	6.7	2145
MD10-0023	1.23	1.25	0-15	-	-	-	-	-
			15-25	7.5	7.5	10.2	10.2	6*
			25-35	4.0	4.8	5.5	7.3	41
			35+	-2.0	2.6	-4.5	7.6	2043
MD10-0024	1.06	0.99	0-15	-	-	-	-	-
			15-25	-	-	-	-	-
			25-35	11.0	11.0	20.9	20.9	77
			35+	0.9	1.8	4.7	8.3	2149
MD10-0025	1.34	1.43	0-15	-	-	-	-	-
			15-25	16.2	16.2	23.6	23.6	2*
			25-35	9.2	9.5	13.4	13.8	203
			35+	2.2	3.3	5.9	9.9	1926
MD10-0026	2.12	2.13	0-15	1.9	1.9	2.6	2.8	45
			15-25	7.4	7.5	9.3	9.8	21*
			25-35	4.7	4.9	7.7	8.3	459
			35+	0.9	1.9	2.2	4.5	1132

*Results in the specified row may not be reliable due to small number of observations

Table 4 (Cont'd)
Data quality measures for individual arterial validation segments in the state of Maryland

TMC	Standard TMC length	Bluetooth distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SEM Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
MD10-0027	2.18	2.17	0-15	2.0	2.0	2.9	2.9	30*
			15-25	2.2	2.3	3.7	4.1	111
			25-35	0.6	1.4	1.3	3.5	1023
			35+	-1.6	1.9	-3.4	4.7	336
MD10-0028	1.21	1.17	0-15	2.9	2.9	3.8	3.8	31
			15-25	3.6	3.6	5.7	5.8	85
			25-35	1.8	2.0	3.9	4.8	1091
			35+	0.1	0.9	0.4	3.4	374
MD10-0029	2.09	2.14	0-15	4.0	4.0	4.7	4.7	21*
			15-25	5.0	5.1	6.6	6.9	95
			25-35	3.8	4.1	6.7	7.6	642
			35+	-0.4	1.6	-0.1	5.8	905
MD10-0030	1.05	1.43	0-15	-	-	-	-	-
			15-25	8.4	8.4	14.7	14.8	7*
			25-35	7.2	7.5	10.7	11.8	314
			35+	1.7	2.8	3.9	8.1	1428
MD10-0031	1.35	0.99	0-15	11.4	11.4	14.3	14.3	9*
			15-25	6.5	6.5	11.4	11.5	25*
			25-35	7.8	8.1	12.7	13.5	40
			35+	0.0	1.8	0.2	6.6	2162
MD10-0032	0.93	1.26	0-15	-	-	-	-	-
			15-25	17.0	17.0	20.7	20.7	10*
			25-35	10.2	10.2	16.8	16.8	169
			35+	2.4	3.0	6.9	8.7	1883
MD10-0033	1.33	1.05	0-15	-	-	-	-	-
			15-25	3.0	3.9	3.5	5.4	27*
			25-35	4.1	4.7	4.5	7.0	23*
			35+	-4.2	4.3	-8.4	8.6	2033
MD10-0034	1.04	1.03	0-15	-	-	-	-	-
			15-25	8.7	8.7	9.6	9.6	1*
			25-35	5.7	5.7	7.0	7.1	49
			35+	1.3	1.6	3.1	4.6	1773

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Table 5
Observations meeting data quality criteria for individual arterial validation segments
in the state of Maryland

TMC	SPEED BIN	Data Quality Measures for								No. of Obs.
		1.96 SEM Band				Mean				
		Speed Error Bias		Average Absolute Speed Error		Speed Error Bias		Average Absolute Speed Error		
		No. falling inside the band	% falling inside the band	No. falling within 5 mph of the band	% falling within 5 mph of the band	No. equal to the mean	% equal to the mean	No. within 5 mph of the mean	% within 5 mph of the mean	
MD10-0002	0-15	-	-	-	-	-	-	-	-	-
	15-25	-	-	-	-	-	-	-	-	-
	25-35	2	18%	4	36%	0	0%	3	27%	11*
	35+	69	15%	351	75%	0	0%	324	69%	471
MD10-0003	0-15	-	-	-	-	-	-	-	-	-
	15-25	-	-	-	-	-	-	-	-	-
	25-35	34	15%	174	77%	0	0%	144	64%	225
	35+	92	18%	308	62%	0	0%	239	48%	498
MD10-0004	0-15	0	0%	0	0%	0	0%	0	0%	2*
	15-25	1	14%	6	86%	0	0%	5	71%	7*
	25-35	17	17%	69	67%	0	0%	47	46%	103
	35+	144	14%	577	55%	2	0%	456	43%	1052
MD10-0005	0-15	0	0%	0	0%	0	0%	0	0%	5*
	15-25	1	1%	12	13%	0	0%	7	7%	94
	25-35	45	11%	214	53%	0	0%	160	40%	401
	35+	55	25%	177	79%	0	0%	154	69%	224
MD10-0006	0-15	-	-	-	-	-	-	-	-	-
	15-25	3	11%	10	36%	0	0%	7	25%	28*
	25-35	91	23%	269	68%	0	0%	195	49%	396
	35+	162	18%	490	54%	1	0%	367	40%	914
MD10-0007	0-15	5	9%	33	57%	0	0%	29	50%	58
	15-25	49	18%	171	65%	0	0%	130	49%	265
	25-35	96	26%	279	76%	0	0%	219	60%	365
	35+	9	12%	32	43%	0	0%	22	30%	74
MD10-0008	0-15	0	0%	0	0%	0	0%	0	0%	17*
	15-25	6	4%	30	19%	0	0%	16	10%	160
	25-35	79	19%	276	67%	0	0%	214	52%	409
	35+	13	12%	72	65%	0	0%	60	55%	110
MD10-0009	0-15	0	0%	1	25%	0	0%	1	25%	4*
	15-25	34	13%	112	42%	0	0%	75	28%	265
	25-35	165	26%	461	73%	1	0%	318	50%	631
	35+	64	19%	192	56%	0	0%	135	40%	341
MD10-0011	0-15	0	0%	0	0%	0	0%	0	0%	6*
	15-25	9	6%	46	29%	0	0%	34	22%	156
	25-35	243	20%	865	72%	1	0%	695	58%	1200
	35+	91	22%	269	66%	0	0%	224	55%	408
MD10-0012	0-15	0	0%	4	19%	0	0%	1	5%	21*
	15-25	59	11%	210	39%	0	0%	148	27%	544
	25-35	133	24%	410	73%	0	0%	302	54%	559
	35+	29	18%	97	59%	0	0%	67	41%	164

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Table 5 (Cont'd)
Observations meeting data quality criteria for individual arterial validation segments
in the state of Maryland

TMC	SPEED BIN	Data Quality Measures for								No. of Obs.
		1.96 SEM Band				Mean				
		Speed Error Bias		Average Absolute Speed Error		Speed Error Bias		Average Absolute Speed Error		
		No. falling inside the band	% falling inside the band	No. falling within 5 mph of the band	% falling within 5 mph of the band	No. equal to the mean	% equal to the mean	No. within 5 mph of the mean	% within 5 mph of the mean	
MD10-0013	0-15	1	6%	7	44%	0	0%	6	38%	16*
	15-25	8	6%	58	42%	0	0%	39	28%	138
	25-35	89	22%	334	83%	0	0%	288	72%	401
	35+	7	5%	56	40%	0	0%	41	30%	139
MD10-0014	0-15	0	0%	2	40%	0	0%	2	40%	5*
	15-25	22	12%	111	61%	0	0%	84	46%	182
	25-35	156	29%	426	79%	0	0%	357	66%	541
	35+	7	6%	41	37%	0	0%	27	24%	111
MD10-0015	0-15	0	0%	1	8%	0	0%	0	0%	12*
	15-25	32	7%	143	32%	1	0%	70	16%	445
	25-35	178	30%	436	74%	0	0%	311	53%	586
	35+	40	22%	114	64%	0	0%	80	45%	179
MD10-0016	0-15	0	0%	0	0%	0	0%	0	0%	5*
	15-25	1	2%	4	7%	0	0%	1	2%	57
	25-35	43	13%	225	66%	1	0%	172	50%	343
	35+	84	23%	289	79%	0	0%	269	74%	364
MD10-0017	0-15	0	0%	0	0%	0	0%	0	0%	1*
	15-25	0	0%	4	10%	0	0%	1	3%	39
	25-35	37	7%	213	40%	0	0%	120	23%	533
	35+	174	29%	484	80%	1	0%	386	64%	606
MD10-0018	0-15	-	-	-	-	-	-	-	-	-
	15-25	0	0%	1	33%	0	0%	0	0%	3*
	25-35	45	18%	178	70%	0	0%	154	60%	256
	35+	68	18%	251	66%	0	0%	209	55%	378
MD10-0022	0-15	-	-	-	-	-	-	-	-	-
	15-25	-	-	-	-	-	-	-	-	-
	25-35	0	0%	0	0%	0	0%	0	0%	1*
	35+	318	15%	1204	56%	1	0%	896	42%	2145
MD10-0023	0-15	-	-	-	-	-	-	-	-	-
	15-25	0	0%	4	67%	0	0%	2	33%	6*
	25-35	5	12%	24	59%	0	0%	18	44%	41
	35+	409	20%	1155	57%	1	0%	829	41%	2043
MD10-0024	0-15	-	-	-	-	-	-	-	-	-
	15-25	-	-	-	-	-	-	-	-	-
	25-35	1	1%	1	1%	0	0%	1	1%	77
	35+	498	23%	1201	56%	0	0%	742	35%	2149
MD10-0025	0-15	-	-	-	-	-	-	-	-	-
	15-25	0	0%	0	0%	0	0%	0	0%	2*
	25-35	10	5%	47	23%	0	0%	34	17%	203
	35+	340	18%	899	47%	0	0%	570	30%	1926
MD10-0026	0-15	3	7%	38	84%	0	0%	38	84%	45
	15-25	2	10%	8	38%	0	0%	7	33%	21*
	25-35	17	4%	157	34%	0	0%	109	24%	459
	35+	166	15%	833	74%	0	0%	719	64%	1132

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Table 5 (Cont'd)
Observations meeting data quality criteria for individual arterial validation segments
in the state of Maryland

TMC	SPEED BIN	Data Quality Measures for								No. of Obs.
		1.96 SEM Band				Mean				
		Speed Error Bias		Average Absolute Speed Error		Speed Error Bias		Average Absolute Speed Error		
		No. falling inside the band	% falling inside the band	No. falling within 5 mph of the band	% falling within 5 mph of the band	No. equal to the mean	% equal to the mean	No. within 5 mph of the mean	% within 5 mph of the mean	
MD10-0027	0-15	1	3%	26	87%	0	0%	26	87%	30*
	15-25	11	10%	83	75%	0	0%	75	68%	111
	25-35	180	18%	830	81%	0	0%	742	73%	1023
	35+	52	15%	237	71%	0	0%	212	63%	336
MD10-0028	0-15	0	0%	26	84%	0	0%	26	84%	31
	15-25	4	5%	56	66%	1	1%	47	55%	85
	25-35	119	11%	731	67%	0	0%	612	56%	1091
	35+	72	19%	327	87%	0	0%	297	79%	374
MD10-0029	0-15	0	0%	15	71%	0	0%	13	62%	21*
	15-25	1	1%	41	43%	0	0%	35	37%	95
	25-35	59	9%	296	46%	0	0%	210	33%	642
	35+	190	21%	606	67%	0	0%	467	52%	905
MD10-0030	0-15	-	-	-	-	-	-	-	-	-
	15-25	2	29%	3	43%	0	0%	3	43%	7*
	25-35	15	5%	78	25%	0	0%	59	19%	314
	35+	247	17%	739	52%	2	0%	532	37%	1428
MD10-0031	0-15	0	0%	4	44%	0	0%	3	33%	9*
	15-25	2	8%	11	44%	0	0%	9	36%	25*
	25-35	5	13%	13	33%	0	0%	6	15%	40
	35+	576	27%	1417	66%	5	0%	1046	48%	2162
MD10-0032	0-15	-	-	-	-	-	-	-	-	-
	15-25	0	0%	0	0%	0	0%	0	0%	10*
	25-35	1	1%	8	5%	0	0%	5	3%	169
	35+	214	11%	801	43%	0	0%	554	29%	1883
MD10-0033	0-15	-	-	-	-	-	-	-	-	-
	15-25	2	7%	21	78%	0	0%	20	74%	27*
	25-35	5	22%	13	57%	0	0%	11	48%	23*
	35+	109	5%	644	32%	0	0%	427	21%	2033
MD10-0034	0-15	-	-	-	-	-	-	-	-	-
	15-25	0	0%	0	0%	0	0%	0	0%	1*
	25-35	3	6%	26	53%	0	0%	24	49%	49
	35+	387	22%	1323	75%	0	0%	1105	62%	1773