I-95 Corridor Coalition

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

Report for Pennsylvania (#9)
PA-3, PA-23 and US-30

I-95 CORRIDOR COALITION

September 2016

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

Report for Pennsylvania (#9)
PA-3, PA-23 and US-30

Prepared for:

I-95 Corridor Coalition

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Evaluation Results for the State of Pennsylvania

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 sensors were deployed at the beginning and ending points of 15 different segments along the PA-3, PA-23 and US-30 corridors.
A summary the corridor characteristics follows:

Roadway	# of Lanes per Direction	Average Signal Density	Average Annual Daily Traffic	Speed Limit
PA-3	2 - 3	4 per mile	28,660	35 to 40 mph
PA-23	1 - 2	2 per mile	10,610	30 to 35 mph
US-30	2 – 3	5 per mile	23,200	25 to 40 mph

The Bluetooth sensor deployment covers the range from Providence Rd to State Rd along PA-3, Spring Mill Rd to US-1/ City Ave along PA-23 and Waterloo Rd to US-1/ City Ave along US-30. Travel time data was collected for both directions along each arterial, between April 20 and May 5, 2016. Due to data quality considerations, four segments were dropped from final validation resulting in 11 bidirectional and 3 directional segments for analysis. The dataset collected represents approximately 931 hours of observations along 14 arterial segments, totaling approximately 19 bidirectional and five directional miles. The total number of effective five-minute travel time samples observed was 11,169.

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 also within specifications for all speed bins. 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	3.4	5.4	3.3	5.2	1085	90
15-25 MPH	1.7	4.0	1.1	2.2	5217	435
25-35 MPH	1.3	4.2	-0.1	-0.2	3440	287
>35 MPH	2.0	6.9	-1.8	-5.4	1427	119
All Speeds	1.8	4.6	0.6	0.7	11169	931
Based upon data collected from April 20, 2016 through May 5, 2016 across 43 miles of roadway.						

Data Collection

Travel time samples were collected along 14 arterial segments with the assistance of Pennsylvania Department of Transportation (PennDOT) personnel. Arterial segments studied were located on the PA-3 corridor from Providence Rd to State Rd, on PA-23 corridor from Spring Mill Rd to US-1/ City Ave and on US-30 corridor from Waterloo Rd to US-1/ City. Travel time data was collected for both directions along PA-3, PA-23 and US-30 corridors between April 20 and May 5, 2016. Segment locations were chosen with a high-likelihood of observing recurrent and non-recurrent congestion during peak and off-peak periods.

Figure 1, 2 and 3 present an overview snapshot of the placement of sensors for the collection of data on the PA-3, PA-23 and US-30 corridors in Pennsylvania respectively. Blue segments represent arterial segments selected for analysis. A summary the corridor characteristics for these roadways follows:

Roadway	# of Lanes per Direction	Average Signal Density	Average Annual Daily Traffic	Speed Limit
PA-3	2 - 3	4 per mile	28,660	35 to 40 mph
PA-23	1 - 2	2 per mile	10,610	30 to 35 mph
US-30	2 – 3	5 per mile	23,200	25 to 40 mph

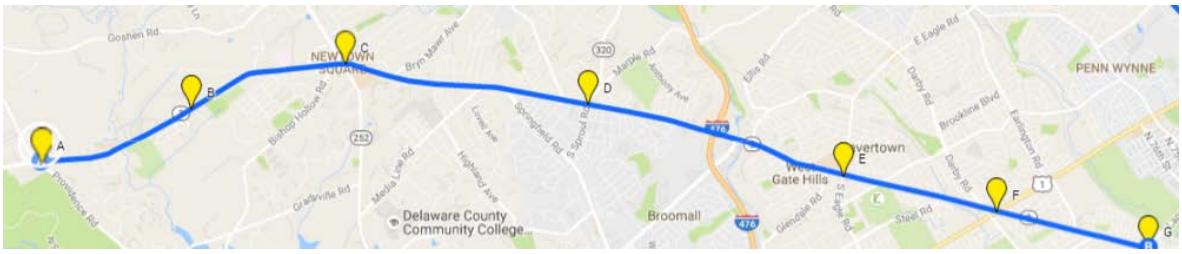

Figure 1 — Locations of all segments selected on PA-3 for analysis in Pennsylvania

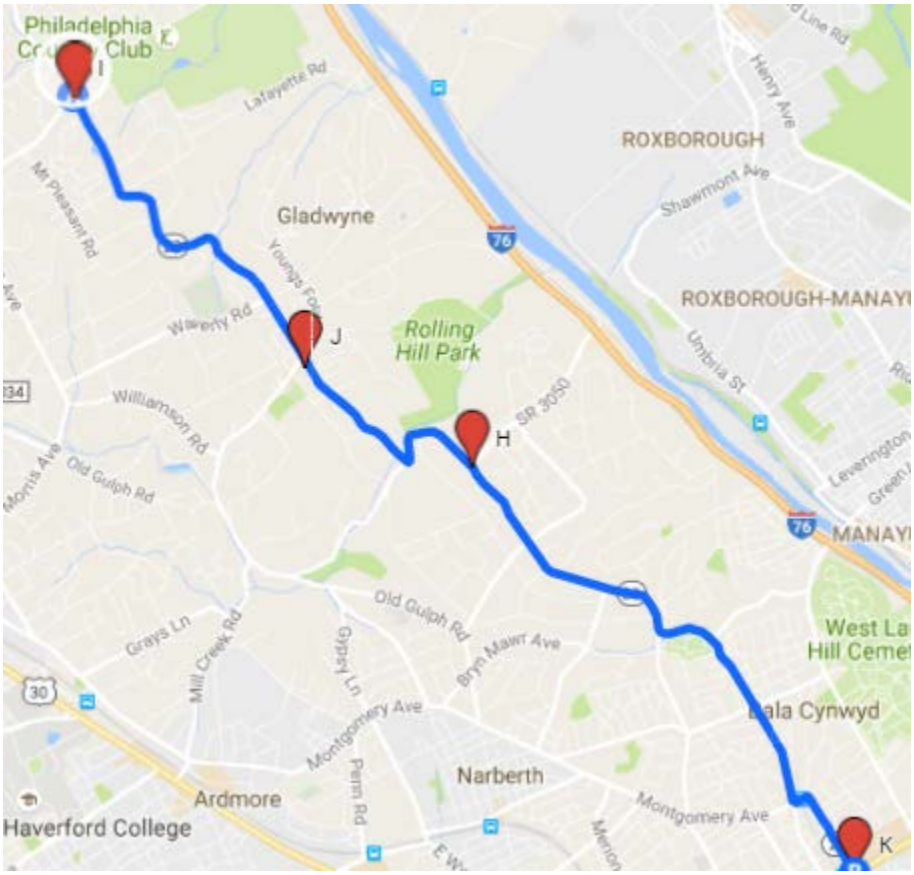

Figure 2 — Locations of all segments selected on PA-23 for analysis in Pennsylvania

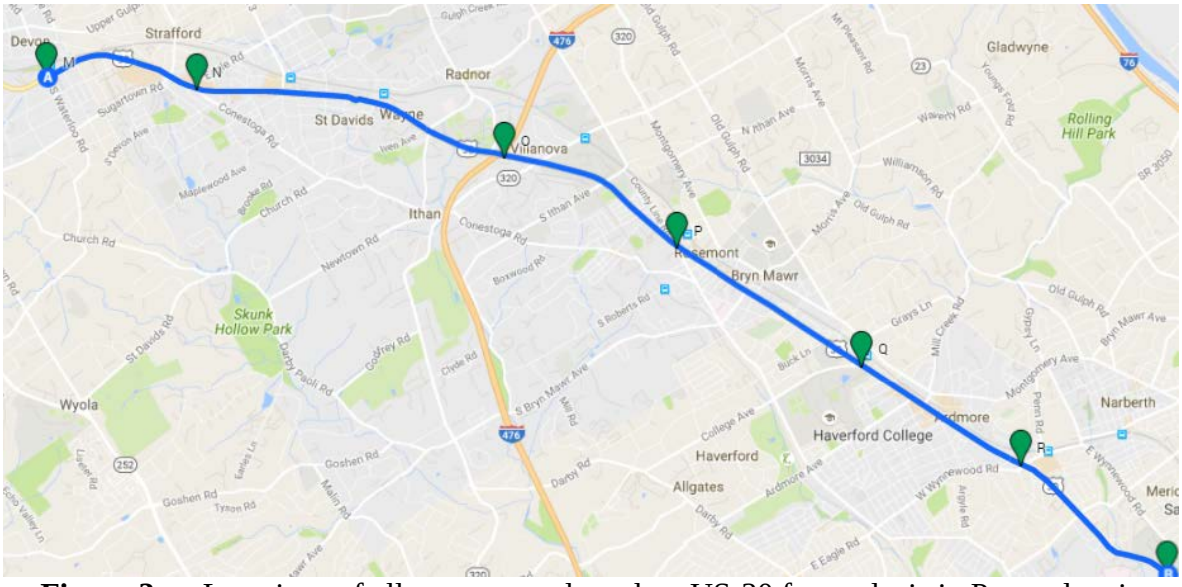

Figure 3 — Locations of all segments selected on US-30 for analysis in Pennsylvania

Table 1 presents the data collection segments from Pennsylvania. As a whole, these segments cover a total length of 19 bidirectional and 5 directional arterial miles. Data collection segments are comprised of one or more Traffic Message Channel (TMC) base segments, such that total length of the data collection segment is one mile long or greater for arterials. When appropriate, consecutive TMC segments are combined to form a data collection segment longer than one mile. The results of validation performed on the 11 bidirectional and 3 directional arterial segments are included in this report. Table 1 contains summary information on each data collection segment including the latitude/longitude coordinates of the locations at which the Bluetooth sensors were deployed along PA-3, PA-23 and US-30 in Pennsylvania 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 Bluetooth™ Traffic Monitoring (BTM) sensors placed on the roadway. An algorithm was developed and documented in a separate report[1] 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 Pennsylvania

SEGMENT (Map Link)	DESCRIPTION			TMC CODES		Deployment		
	Highway Direction	State County	Starting at Ending at	Begin End	Number Length	Begin Lat/Lon End Lat/Lon		Length % Diff
Arterial								All Lengths in Miles
A1	PA-3	Pennsylvania	Providence Rd	103P06963	2	39.9746	-75.4502	1.42
PA09-0001	Eastbound	Delaware	Alice Grim Blvd/Campus Blvd	103+05401	2.52	39.9811	-75.4251	-43.64%
A2	PA-3	Pennsylvania	Alice Grim Blvd/Campus Blvd	103+05401	2	39.9811	-75.4251	1.37
PA09-0002	Eastbound	Delaware	PA-252/N Newtown Street Rd	103+05401	2.77	39.9867	-75.4008	-50.62%
A3	PA-3	Pennsylvania	PA-252/N Newtown Street Rd	103P05401	7	39.9867	-75.4008	2.17
PA09-0003	Eastbound	Delaware	PA-320/N Sproul Rd	103P05403	2.14	39.9818	-75.3611	1.62%
A4	PA-3	Pennsylvania	PA-320/N Sproul Rd	103+05404	3	39.9818	-75.3611	2.28
PA09-0004	Eastbound	Delaware	Eagle Rd	103+05405	2.29	39.9730	-75.3196	-0.3%
A5	PA-3	Pennsylvania	Eagle Rd	103+05406	2	39.9730	-75.3196	1.36
PA09-0005	Eastbound	Delaware	US-1/E Township Line Rd	103P05406	1.36	39.9685	-75.2946	-0.25%
A6	PA-3	Pennsylvania	US-1/E Township Line Rd	103+06964	1	39.9685	-75.2946	1.33
PA09-0006	Eastbound	Delaware	State Rd	103+06964	1.33	39.9640	-75.2701	0.21%
A7	PA-3	Pennsylvania	N State Rd	103-05406	1	39.9640	-75.2701	1.33
PA09-0007	Westbound	Delaware	US-1/E Township Line Rd	103-05406	1.32	39.9686	-75.2943	0.76%
A8	PA-3	Pennsylvania	US-1/E Township Line Rd	103N05406	2	39.9686	-75.2943	1.36
PA09-0008	Westbound	Delaware	Eagle Rd	103-05405	1.38	39.9731	-75.3196	-1.25%
A9	PA-3	Pennsylvania	Eagle Rd	103-05404	3	39.9731	-75.3196	2.28
PA09-0009	Westbound	Delaware	PA-320/N Sproul Rd	103-05403	2.29	39.9819	-75.3611	-0.30%
A10	PA-3	Pennsylvania	PA-320/N Sproul Rd	103N05403	7	39.9819	-75.3611	2.18
PA09-0010	Westbound	Delaware	PA-252/N Newtown Street Rd	103N05401	2.16	39.9868	-75.4012	0.89%

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

SEGMENT (Map Link)	DESCRIPTION			TMC CODES		Deployment		
	Highway Direction	State County	Starting at Ending at	Begin End	Number Length	Begin Lat/Lon End Lat/Lon		Length % Diff
Arterial								All Lengths in Miles
A11	PA-3	Pennsylvania	PA-252/N Newtown Street Rd	103-06963	2	39.9868	-75.4012	1.37
PA09-0011	Westbound	Delaware	Alice Grim Blvd/Campus Blvd	103-06963	2.79	39.9811	-75.4251	-50.94%
A12	PA-3	Pennsylvania	Alice Grim Blvd/Campus Blvd	103-06963	1	39.9811	-75.4251	1.42
PA09-0012	Westbound	Delaware	Providence Rd	103-06963	2.53	39.9747	-75.4503	-43.77%
A13	PA-23	Pennsylvania	Spring Mill Rd	103N04847	2	40.0581	-75.3011	1.96
PA09-0013	Eastbound	Montgomery	Youngsford Rd	103-04846	1.96	40.0391	-75.2793	0.13%
A14	PA-23	Pennsylvania	Youngsford Rd	103-04845	2	40.0391	-75.2793	1.29
PA09-0014	Eastbound	Montgomery	Hollow Rd	103-04844	1.31	40.031	-75.2631	-1.35%
A15	PA-23	Pennsylvania	Hollow Rd	103-04843	5	40.031	-75.2631	3.12
PA09-0015	Eastbound	Montgomery	US-1/City Ave	103-04840	3.12	40.0013	-75.2264	0.09%
A16	PA-23	Pennsylvania	US-1/City Ave	103+04841	5	40.0013	-75.2264	3.12
PA09-0016	Westbound	Montgomery	Hollow Rd	103+04844	3.12	40.031	-75.2631	0.09%
A17	PA-23	Pennsylvania	Hollow Rd	103+04845	2	40.031	-75.2631	1.29
PA09-0017	Westbound	Montgomery	Youngsford Rd	103+04846	1.31	40.0391	-75.2793	-1.35%
A18	PA-23	Pennsylvania	Youngsford Rd	103+04847	2	40.0391	-75.2793	1.96
PA09-0018	Westbound	Montgomery	Spring Mill Rd	103P04847	1.96	40.0581	-75.3011	0.13%
A19	US-30	Pennsylvania	Waterloo Rd	103-05517	1	40.0458	-75.4234	1.27
PA09-0019	Eastbound	Chester	Conestoga Rd	103-05517	1.29	40.0444	-75.4008	-1.64%
A20	US-30	Pennsylvania	Conestoga Rd	103-05518	3	40.0444	-75.4008	2.53
PA09-0020	Eastbound	Delaware	I-476	103N05518	2.57	40.0373	-75.3556	-1.69%

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

SEGMENT (Map Link)	DESCRIPTION			TMC CODES		Deployment		
	Highway Direction	State County	Starting at Ending at	Begin End	Number Length	Begin Lat/Lon End Lat/Lon		Length % Diff
Arterial								All Lengths in Miles
A21	US-30	Pennsylvania	I-476	103-07015	2	40.0373	-75.3556	1.69
PA09-0021	Eastbound	Delaware	County Line Rd	103-07015	3.70	40.0262	-75.3283	-54.35%
A22	US-30	Pennsylvania	County Line Rd	103-07015	1	40.0262	-75.3283	1.74
PA09-0022	Eastbound	Delaware	Railroad Ave	103-07015	3.34	40.0126	-75.3005	-47.91%
A23	US-30	Pennsylvania	Railroad Ave	103-05519	3	40.0126	-75.3005	1.49
PA09-0023	Eastbound	Montgomery	Wynnewood Rd	103-05519	1.51	40.0012	-75.2762	-1.10%
A24	US-30	Pennsylvania	Wynnewood Rd	103-05520	1	40.0012	-75.2762	1.54
PA09-0024	Eastbound	Montgomery	US-1/City Ave	103-05520	1.51	39.9883	-75.2540	1.75%
A25	US-30	Pennsylvania	US-1/City Ave	103+05519	1	39.9883	-75.2540	1.54
PA09-0025	Westbound	Montgomery	Wynnewood Rd	103+05519	1.51	40.0012	-75.2762	1.75%
A26	US-30	Pennsylvania	Wynnewood Rd	103+07015	3	40.0012	-75.2762	1.49
PA09-0026	Westbound	Montgomery	Railroad Ave	103+07015	1.51	40.0126	-75.3005	-1.10%
A27	US-30	Pennsylvania	Railroad Ave	103+05518	1	40.0126	-75.3005	1.74
PA09-0027	Westbound	Delaware	County Line Rd	103+05518	3.30	40.0262	-75.3283	-47.33%
A28	US-30	Pennsylvania	County Line Rd	103+05518	2	40.0262	-75.3283	1.69
PA09-0028	Westbound	Delaware	I-476	103+05518	3.64	40.0373	-75.3556	-53.35%
A29	US-30	Pennsylvania	I-476	103P05518	3	40.0373	-75.3556	2.53
PA09-0029	Westbound	Delaware	Conestoga Rd	103+05517	2.61	40.0444	-75.4008	-2.95%
A30	US-30	Pennsylvania	Conestoga Rd	103+05516	1	40.0444	-75.4008	1.26
PA09-0030	Westbound	Chester	Waterloo Rd	103+05516	1.29	40.0458	-75.4234	-2.41%

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 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 bin. 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 95^{th} 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 bins 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 also within specifications for all speed bins.

TABLE 2
Data quality measures for arterial segments in Pennsylvania.

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 (contract specifications)	SEB	AASE		
0-15	3.3	3.4	5.2	5.4	2066	172
15-25	1.1	1.7	2.2	4.0	9952	829
25-35	-0.1	1.3	-0.2	4.2	6764	564
35+	-1.8	2.0	-5.4	6.9	2832	236

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 Pennsylvania.

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

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	25%	75%	0%	55%	2066
15-25	48%	89%	0%	70%	9952
25-35	58%	91%	0%	68%	6764
35+	57%	84%	0%	43%	2832

Tables 4 and 5 present detailed data for individual TMC segments in Pennsylvania 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 small number of observations.

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

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	
PA09-0004	2.28	2.28	0-15	4.0	4.0	5.0	5.0	92
			15-25	1.7	1.9	3.0	3.9	484
			25-35	0.1	1.0	0.3	3.2	164
			35+	-5.8	5.8	-8.7	8.7	12
PA09-0005	1.37	1.36	0-15	3.6	3.6	6.8	6.8	50
			15-25	1.1	1.5	2.2	3.8	1198
			25-35	-1.3	1.6	-3.8	5.1	234
			35+	-3.4	3.4	-11.1	11.1	18
PA09-0006	1.33	1.33	0-15	5.5	5.5	7.8	7.8	50
			15-25	1.8	1.9	4.5	5.3	522
			25-35	-0.4	1.2	-1.0	3.9	684
			35+	-3.4	3.4	-7.8	7.8	28
PA09-0007	1.32	1.33	0-15	4.8	4.8	8.7	8.7	84
			15-25	1.3	1.5	3.4	4.4	840
			25-35	-0.3	0.9	-0.9	3.8	478
			35+	-3.6	3.6	-7.1	7.6	32
PA09-0008	1.38	1.36	0-15	2.2	2.3	3.5	3.9	282
			15-25	1.3	1.8	2.2	3.9	1240
			25-35	-1.0	1.3	-2.4	4.2	78
			35+	-	-	-	-	-
PA09-0009	2.29	2.28	0-15	1.8	1.8	3.3	3.4	36
			15-25	0.6	1.0	1.4	2.9	312
			25-35	-0.8	1.2	-2.3	3.7	262
			35+	-2.9	3.6	-6.2	7.8	62
PA09-0010	2.17	2.18	0-15	2.2	2.5	2.9	3.7	70
			15-25	0.1	1.6	-0.1	3.6	428
			25-35	-0.6	2.3	-1.7	5.3	158
			35+	-2.6	2.6	-4.9	5.9	24
PA09-0011	2.80	1.37	0-15	20.0	20.0	25.4	25.4	6
			15-25	9.0	9.0	15.5	15.5	124
			25-35	3.1	3.2	7.9	8.4	624
			35+	-0.2	0.8	0.4	4.2	456
PA09-0012	2.80	1.42	0-15	-	-	-	-	-
			15-25	7.8	7.8	10.5	10.5	18
			25-35	1.5	1.8	4.1	5.5	238
			35+	-1.8	2.0	-6.2	7.2	1992
PA09-0013	1.96	1.96	0-15	5.1	5.1	5.7	5.7	4
			15-25	2.6	2.7	4.0	4.3	106
			25-35	-0.1	0.9	-0.1	2.5	398
			35+	-3.7	3.7	-5.4	5.4	12

*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 Pennsylvania

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	
PA09-0014	1.31	1.31	0-15	6.3	6.3	7.0	7.1	62
			15-25	1.4	2.0	2.3	3.8	208
			25-35	-0.5	0.9	-0.9	2.7	304
			35+	-4.9	4.9	-7.9	7.9	2
PA09-0017	1.31	1.31	0-15	6.6	6.6	8.0	8.0	8
			15-25	2.2	2.7	3.9	4.9	74
			25-35	-0.5	0.9	-1.2	2.8	372
			35+	-3.5	3.5	-6.0	6.0	10
PA09-0018	1.96	1.96	0-15	12.4	12.4	13.2	13.2	2
			15-25	2.6	2.6	5.2	5.2	52
			25-35	0.4	0.9	1.2	2.6	418
			35+	-3.9	3.9	-5.6	5.6	4
PA09-0019	1.29	1.27	0-15	3.2	3.2	5.9	6.1	136
			15-25	1.0	1.5	2.0	3.8	498
			25-35	0.0	0.7	-0.5	3.1	56
			35+	-	-	-	-	-
PA09-0020	2.58	2.53	0-15	3.8	3.9	6.1	6.4	80
			15-25	1.3	2.3	1.7	4.2	220
			25-35	-3.5	3.6	-4.9	5.7	22
			35+	-	-	-	-	-
PA09-0021	3.35	1.69	0-15	2.0	2.0	3.2	3.4	324
			15-25	-0.3	0.7	-0.8	2.4	802
			25-35	-2.0	2.0	-5.9	6.0	206
			35+	-8.1	8.1	-13.4	13.4	18
PA09-0022	3.35	1.74	0-15	1.4	1.4	4.6	4.8	76
			15-25	-0.3	1.0	-0.4	2.9	252
			25-35	-1.4	1.4	-5.1	5.1	16
			35+	-	-	-	-	-
PA09-0024	1.52	1.54	0-15	1.9	1.9	3.3	4.0	10
			15-25	0.5	1.4	1.4	3.9	382
			25-35	-0.8	1.2	-1.9	3.9	818
			35+	-3.9	3.9	-9.3	9.4	56
PA09-0025	1.52	1.54	0-15	-	-	-	-	-
			15-25	2.1	2.1	5.2	5.5	172
			25-35	0.0	0.9	-0.1	3.6	966
			35+	-2.8	2.8	-7.4	7.5	92
PA09-0026	1.51	1.49	0-15	7.9	7.9	10.6	10.7	186
			15-25	4.3	4.9	6.6	7.6	172
			25-35	0.6	0.7	0.7	2.8	12
			35+	-	-	-	-	-

*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 Pennsylvania

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	
PA09-0027	3.28	1.74	0-15	0.3	0.3	3.1	3.4	26
			15-25	-0.4	1.0	-0.7	2.8	326
			25-35	-2.7	2.7	-5.8	5.8	40
			35+	-11.9	11.9	-14.3	14.3	4
PA09-0028	3.28	1.68	0-15	2.1	2.1	3.7	3.9	418
			15-25	0.2	0.6	0.7	2.3	800
			25-35	-1.7	1.7	-5.9	5.9	102
			35+	-10.4	10.4	-14.9	14.9	4
PA09-0029	2.64	2.53	0-15	6.3	6.3	10.0	10.0	14
			15-25	0.5	1.2	1.8	3.3	118
			25-35	-1.6	1.6	-3.2	3.8	8
			35+	-7.9	7.9	-13.1	13.1	2
PA09-0030	1.29	1.26	0-15	4.9	4.9	9.0	9.0	50
			15-25	1.7	2.0	3.6	4.6	604
			25-35	-0.7	0.9	-1.5	3.6	106
			35+	-3.7	3.7	-8.1	8.1	4

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

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

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	
PA09-0004	0-15	1	1%	49	53%	0	0%	43	47%	92
	15-25	44	9%	367	76%	1	0%	341	70%	484
	25-35	32	20%	140	85%	0	0%	128	78%	164
	35+	0	0%	0	0%	0	0%	0	0%	12
PA09-0005	0-15	2	4%	22	44%	0	0%	18	36%	50
	15-25	145	12%	927	77%	0	0%	847	71%	1198
	25-35	34	15%	159	68%	0	0%	133	57%	234
	35+	2	11%	4	22%	0	0%	2	11%	18
PA09-0006	0-15	2	4%	14	28%	0	0%	14	28%	50
	15-25	63	12%	330	63%	0	0%	272	52%	522
	25-35	134	20%	547	80%	0	0%	487	71%	684
	35+	0	0%	9	32%	0	0%	4	14%	28
PA09-0007	0-15	0	0%	24	29%	0	0%	20	24%	84
	15-25	118	14%	611	73%	0	0%	530	63%	840
	25-35	105	22%	388	81%	1	0%	339	71%	478
	35+	2	6%	9	28%	0	0%	8	25%	32
PA09-0008	0-15	25	9%	202	72%	0	0%	187	66%	282
	15-25	147	12%	942	76%	0	0%	852	69%	1240
	25-35	11	14%	60	77%	0	0%	51	65%	78
	35+	-	-	-	-	-	-	-	-	-
PA09-0009	0-15	1	3%	29	81%	0	0%	27	75%	36
	15-25	58	19%	273	88%	0	0%	258	83%	312
	25-35	46	18%	211	81%	0	0%	187	71%	262
	35+	4	6%	28	45%	0	0%	18	29%	62
PA09-0010	0-15	8	11%	50	71%	0	0%	48	69%	70
	15-25	55	13%	333	78%	0	0%	313	73%	428
	25-35	13	8%	105	66%	0	0%	89	56%	158
	35+	3	13%	14	58%	0	0%	14	58%	24
PA09-0011	0-15	0	0%	0	0%	0	0%	0	0%	6
	15-25	0	0%	9	7%	0	0%	3	2%	124
	25-35	49	8%	241	39%	0	0%	142	23%	624
	35+	129	28%	369	81%	0	0%	311	68%	456
PA09-0012	0-15	-	-	-	-	-	-	-	-	-
	15-25	0	0%	3	17%	0	0%	0	0%	18
	25-35	35	15%	152	64%	0	0%	119	50%	238
	35+	339	17%	1125	56%	0	0%	802	40%	1992
PA09-0013	0-15	0	0%	2	50%	0	0%	2	50%	4
	15-25	7	7%	62	58%	0	0%	59	56%	106
	25-35	68	17%	369	93%	0	0%	352	88%	398
	35+	0	0%	8	67%	0	0%	8	67%	12

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

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	
PA09-0014	0-15	1	2%	26	42%	0	0%	24	39%	62
	15-25	24	12%	160	77%	0	0%	149	72%	208
	25-35	75	25%	272	89%	0	0%	258	85%	304
	35+	0	0%	0	0%	0	0%	0	0%	2
PA09-0017	0-15	0	0%	2	25%	0	0%	1	13%	8
	15-25	3	4%	49	66%	0	0%	42	57%	74
	25-35	58	16%	337	91%	0	0%	329	88%	372
	35+	0	0%	4	40%	0	0%	2	20%	10
PA09-0018	0-15	0	0%	0	0%	0	0%	0	0%	2
	15-25	2	4%	31	60%	0	0%	24	46%	52
	25-35	76	18%	381	91%	0	0%	369	88%	418
	35+	0	0%	2	50%	0	0%	2	50%	4
PA09-0019	0-15	5	4%	65	48%	0	0%	59	43%	136
	15-25	68	14%	377	76%	0	0%	346	69%	498
	25-35	15	27%	52	93%	0	0%	45	80%	56
	35+	-	-	-	-	-	-	-	-	-
PA09-0020	0-15	4	5%	42	53%	0	0%	33	41%	80
	15-25	20	9%	152	69%	0	0%	144	65%	220
	25-35	3	14%	13	59%	0	0%	12	55%	22
	35+	-	-	-	-	-	-	-	-	-
PA09-0021	0-15	20	6%	272	84%	0	0%	258	80%	324
	15-25	156	19%	749	93%	0	0%	721	90%	802
	25-35	8	4%	117	57%	0	0%	85	41%	206
	35+	0	0%	1	6%	0	0%	0	0%	18
PA09-0022	0-15	4	5%	54	71%	0	0%	38	50%	76
	15-25	41	16%	226	90%	0	0%	210	83%	252
	25-35	0	0%	11	69%	0	0%	7	44%	16
	35+	-	-	-	-	-	-	-	-	-
PA09-0024	0-15	3	30%	7	70%	0	0%	7	70%	10
	15-25	51	13%	299	78%	0	0%	254	66%	382
	25-35	162	20%	661	81%	0	0%	586	72%	818
	35+	0	0%	12	21%	0	0%	8	14%	56
PA09-0025	0-15	-	-	-	-	-	-	-	-	-
	15-25	12	7%	103	60%	0	0%	82	48%	172
	25-35	201	21%	803	83%	0	0%	711	74%	966
	35+	7	8%	38	41%	0	0%	25	27%	92
PA09-0026	0-15	2	1%	31	17%	0	0%	28	15%	186
	15-25	9	5%	68	40%	0	0%	52	30%	172
	25-35	3	25%	10	83%	0	0%	10	83%	12
	35+	-	-	-	-	-	-	-	-	-

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

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	
PA09-0027	0-15	7	27%	23	88%	0	0%	19	73%	26
	15-25	56	17%	290	89%	0	0%	271	83%	326
	25-35	4	10%	21	53%	0	0%	14	35%	40
	35+	0	0%	0	0%	0	0%	0	0%	4
PA09-0028	0-15	33	8%	313	75%	0	0%	284	68%	418
	15-25	207	26%	748	94%	0	0%	734	92%	800
	25-35	5	5%	57	56%	0	0%	45	44%	102
	35+	0	0%	0	0%	0	0%	0	0%	4
PA09-0029	0-15	0	0%	1	7%	0	0%	1	7%	14
	15-25	23	19%	99	84%	0	0%	90	76%	118
	25-35	2	25%	6	75%	0	0%	6	75%	8
	35+	0	0%	0	0%	0	0%	0	0%	2
PA09-0030	0-15	3	6%	17	34%	0	0%	15	30%	50
	15-25	63	10%	409	68%	0	0%	359	59%	604
	25-35	24	23%	91	86%	0	0%	82	77%	106
	35+	0	0%	0	0%	0	0%	0	0%	4

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