I-95 Corridor Coalition

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

Monthly Report: New Jersey

I-95 CORRIDOR COALITION

December 2012

I-95 CORRIDOR COALITION VEHICLE PROBE PROJECT VALIDATION OF INRIX DATA DECEMBER 2012

Monthly Report

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December 2012

Evaluation Results for the State of New Jersey

Executive Summary

The data from the Vehicle Probe Project is validated using Bluetooth™ Traffic Monitoring (BTM) technology on a near monthly basis. BTMs sensor were deployed on the beginning and ending points of nine different segments along the Garden State Parkway (GSP) between GSP exit 98 (NJ-34) in the south and GSP exit 127 (NJ-440) in the north. Travel time data was collected for both directions along the freeway. The data was collected between September 11th 2012 and September 20th 2012 with the assistance of New Jersey Department of Transportation (NJDOT) personnel. The dataset collected represents approximately 1413 hours of observations along nine freeway segments, totaling approximately 28 miles. The number of effective five-minute travel time samples observed was 16,960 in total.

ES Table 1, below summarizes the results of the comparison between the validation data and the INRIX data for freeway segments during the above noted periods. As shown, the average absolute speed error (AASE) and Speed Error Bias (SEB) were within specification for all speed bins. Even when errors are measured against the mean (rather than the SEM band) the data meets contract specifications for the AASE in all speed bins.

ES Table 1 - New Jersey Evaluation Summary for Freeway Segments

	Absolute Speed Error (<10mph)		**Speed Error Bias** (<5mph)		Number of 5 Minute Samples	Hours of Data Collection
Speed Bin	Comparison with SEM Band	Comparison with Mean	Comparison with SEM Band	Comparison with Mean		
0-30 MPH	**2.80**	5.10	**2.50**	3.80	30	2.5
30-45 MPH	**4.70**	8.60	**3.80**	5.30	87	7.3
45-60 MPH	**3.60**	7.10	**2.30**	4.60	1165	97.1
> 60 MPH	**1.20**	3.20	**-0.10**	-0.10	15678	1306.5
All Speeds	1.39	3.50	0.09	0.26	16960	1413.3

Based upon data collected from September 11, 2012 through September 20, 2012 across 28.4 miles of roadway.

As part of the on-going validation process, vehicle probe data from each state is validated on a rotating basis. Since the inception of the validation process, data on roadways in New Jersey was validated on ten occasions: September/October 2008, April 2009, June 2009, September 2009, October 2009, May/June 2010, June 2010, April 2011, May/June 2011 and September 2012. These ten validations represent nearly 13,640 hours of observations along more than 116 miles of freeway segments in New Jersey. ES Table 2 provides a summary of the cumulative validation effort. As shown, the absolute average speed error is within specification for all speed bins.

ES Table 2 - New Jersey - Cumulative to Date						
	Absolute Speed Error (<10mph)		**Speed Error Bias** (<5mph)			
Speed Bin	Comparison with SEM Band	Comparison with Mean	Comparison with SEM Band	Comparison with Mean	Number of 5 Minute Samples	Hours of Data Collection
0-30 MPH	**7.09**	8.38	**5.14**	5.81	2852	237.7
30-45 MPH	**7.54**	10.32	**4.98**	6.68	2685	223.8
45-60 MPH	**2.40**	4.72	**0.80**	1.94	20523	1710.3
> 60 MPH	**2.46**	4.88	**-2.03**	-3.64	137617	11468.1
All Speeds	2.62	5.01	-1.44	-2.60	163677	13639.8

Data Collection

The data from the Vehicle Probe Project is validated using Bluetooth™ Traffic Monitoring (BTM) technology on a near monthly basis. BTMs sensor were deployed on the beginning and ending points of nine different segments along I-95 corridor. The study area stretches from Garden State Parkway exit 98 (NJ-34) in the south to Garden State Parkway exit 127 (NJ-440) in the north. Travel time data was collected for both directions along the freeway. The data was collected between September 11, 2012 and September 20, 2012 with the assistance of New Jersey Department of Transportation (NJDOT) personnel. This round of data collections in New Jersey was designed to capture the traffic data on a sample of freeways specifically during a busy weekend anticipated to have significant beech traffic. Segment locations are chosen with a high-likelihood of observing recurrent and non-recurrent congestions during peak or off-peak periods.

Figure 1 presents an overview snapshot of the roadway segments over which Bluetooth sensors were deployed along the I-95 corridor in Garden State Parkway in New Jersey. Blue segments represent freeway segments selected for analysis.

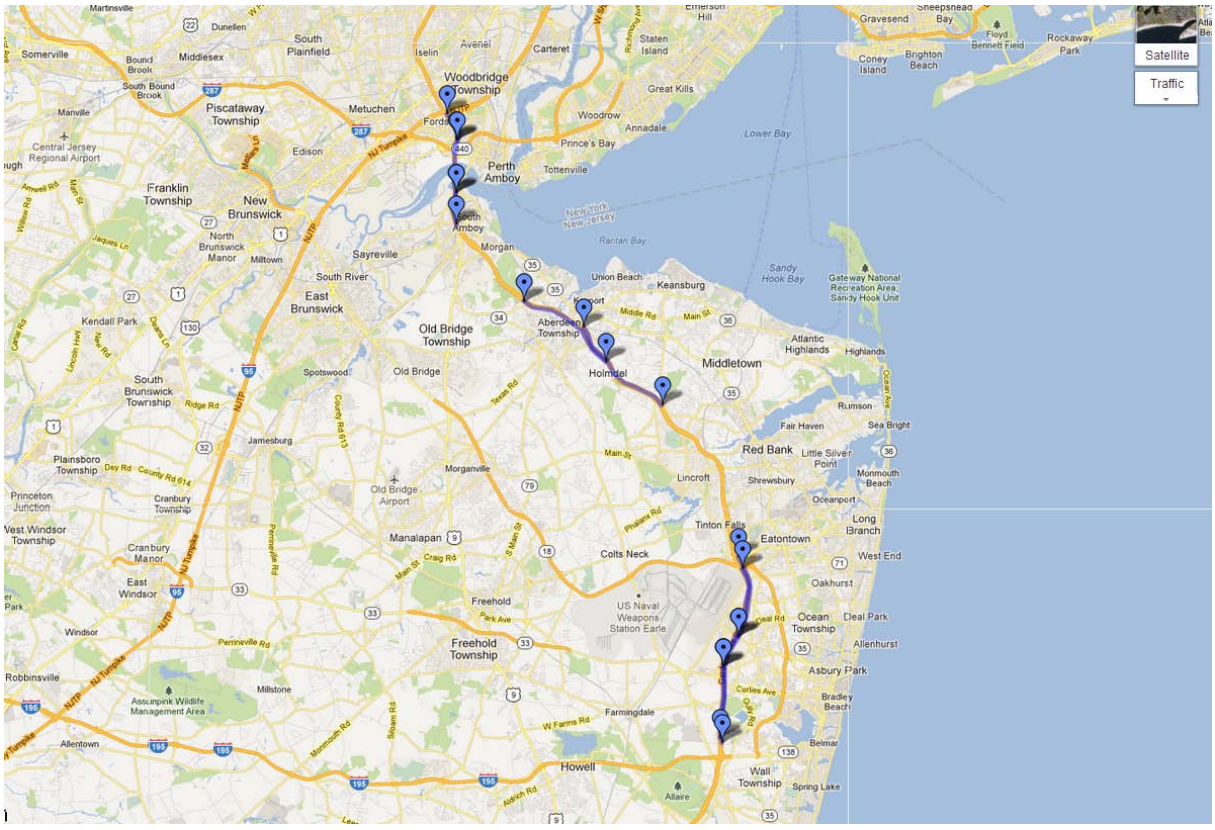

Figure 1 — Locations of all segments selected for analysis in New Jersey

TMC segments selected for validation in New Jersey

Table 1 presents a list of data collection segments from New Jersey. In total, these segments cover a total length of approximately 28.4 freeway 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 freeways. When appropriate, consecutive TMC segments are combined to form a data collection segment longer than one mile. The results of validation performed on nine freeway segments are included in this report. Table 1 contains summary information on each data collection segment. The latitude/longitude coordinates of the locations at which the Bluetooth sensors were deployed throughout the state of New Jersey are provided in Table 1 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 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. Details of the algorithm used to estimate equivalent path travel times based on INRIX data feeds for individual data collection segments are provided in a 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.

Table 1
Segments selected for validation in New Jersey

SEGMENT (Map Link)	DESCRIPTION			TMC CODES		Deployment		
	Highway	State	Starting at	Begin	Number	Begin Lat/Lon		Length
	Direction	County	Ending at	End	Length	End Lat/Lon		% Diff
FREEWAYS								All Lengths in Miles
F1	Garden State Pkwy	New Jersey	King Georges Post Rd	120+04652	3	40.5248298	-74.299173	1.17
(120+04652)	Northbound	Middlesex	US-9/NJ-440/Exit 127	120P04653	1.3	40.5397244	-74.3073598	-7.93%
F2	Garden State Pkwy	New Jersey	New Brunswick Ave	120-04650	5	40.5249188	-74.2995468	2.12
(120-04650)	Southbound	Middlesex	Chevalier Ave/Exit 125	120-04648	2.1	40.495158	-74.300739	2.48%
F3	Garden State Pkwy	New Jersey	Chevalier Ave/Exit 125	120N04648	3	40.495158	-74.300739	1.29
(120N04648)	Southbound	Middlesex	Main St/Exit 124	120-04646	1.3	40.4765448	-74.2998526	-3.52%
F4	Garden State Pkwy	New Jersey	NJ-18/Exit 105	120-04636	2	40.278345	-74.08415	4.35
(120-04636)	Southbound	Monmouth	NJ-66/Exit 100	120-04634	4.2	40.2217062	-74.0989058	4.06%
F5	Garden State Pkwy	New Jersey	NJ-66/Exit 100	120N04634	4	40.2217062	-74.0989058	2.70
(120N04634)	Southbound	Monmouth	NJ-34/Exit 98	120-04632	2.8	40.1816596	-74.1012472	-2.68%
F6	Garden State Pkwy	New Jersey	NJ-34/Exit 98	120+04633	5	40.178464	-74.099464	4.35
(120+04633)	Northbound	Monmouth	Asbury Ave/Exit 102	120+04635	4.3	40.239497	-74.087085	0.09%
F7	Garden State Pkwy	New Jersey	Asbury Ave/Exit 102	120P04635	4	40.239497	-74.087085	3.37
(120P04635)	Northbound	Monmouth	NJ-18/Exit 105	120P04637	3.6	40.285892	-74.087264	-6.71%
F8	Garden State Pkwy	New Jersey	Red Hill Rd/Exit 114	120+04640	3	40.372653	-74.144936	4.60
(120+04640)	Northbound	Monmouth	NJ-36/Exit 117	120+04641	4.6	40.4177218	-74.2034832	0.31%
F9	Garden State Pkwy	New Jersey	Matawan Rd/Exit 120	120-04642	4	40.432582	-74.249099	4.37
(120-04642)	Southbound	Monmouth	Telegraph Hill Rd/Exit 116	120-04640	4.2	40.397849	-74.18697	3.05%
TOTALS				-	9	-	-	28.32
				-	28.4	-	-	-

Analysis of Freeway 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: 0-30 MPH, 30-45 MPH, 45-60 MPH, and > 60 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, and are highlighted in Table 2. AASE below 10 MPH meet contract specifications. AASE below 5 MPH are considered exceptional quality. As shown, the average absolute speed error (AASE) and Speed Error Bias (SEB) were within specification for all speed bins.

TABLE 2
Data quality measures for freeway segments in New Jersey

SPEED BIN	Data Quality Measures				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		
0-30	2.5	2.8	3.8	5.1	30	3
30-45	3.8	4.7	5.3	8.6	87	7
45-60	2.3	3.6	4.6	7.1	1165	97
60+	-0.1	1.2	-0.1	3.2	15678	1307

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

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 freeway data segments in New Jersey.

Table 3 Percent observations meeting data quality criteria for freeway segments greater than one mile in New Jersey

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	
0-30	43%	83%	0%	67%	30
30-45	23%	66%	0%	41%	87
45-60	29%	69%	0%	30%	1165
60+	53%	94%	0%	80%	15678

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

Tables 4 and 5 present detailed data for individual TMC segments in New Jersey 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 freeway validation segments greater than one mile in the state of New Jersey

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	
NJ10+0001	1.30	1.17	0-30	1.1	1.5	1.2	2.8	9*
			30-45	1.9	3.1	4.4	6.9	14*
			45-60	0.8	3.0	3.9	6.8	106
			60+	-0.5	1.0	-1.1	3.3	1781
NJ10+0002	2.10	2.12	0-30	-	-	-	-	0
			30-45	6.5	6.7	7.3	8.0	9*
			45-60	3.4	3.5	6.7	7.0	124
			60+	0.8	1.2	1.6	3.0	1905
NJ10+0003	1.30	1.29	0-30	13.1	13.1	33.1	33.1	1*
			30-45	6.1	6.1	18.5	18.5	3*
			45-60	-2.2	2.2	-3.5	5.5	224
			60+	-5.8	5.8	-9.1	9.1	332
NJ10+0004	4.20	4.35	0-30	-	-	-	-	0
			30-45	1.7	2.0	2.1	2.7	11*
			45-60	4.1	4.5	6.2	6.8	42
			60+	0.0	0.8	0.1	2.7	1700
NJ10+0005	2.80	2.70	0-30	-	-	-	-	0
			30-45	3.3	3.3	4.4	4.4	4*
			45-60	4.9	5.0	7.2	7.8	38
			60+	-0.7	1.3	-1.1	3.3	1792
NJ10+0006	4.30	4.35	0-30	-	-	-	-	0
			30-45	-	-	-	-	0
			45-60	2.8	2.8	6.3	7.0	13*
			60+	-0.8	1.1	-1.4	2.9	1940
NJ10+0007	3.60	3.37	0-30	-	-	-	-	0
			30-45	7.8	7.8	24.4	24.4	2*
			45-60	2.2	2.3	8.0	8.5	204
			60+	-0.3	0.9	0.1	3.5	1369
NJ10+0008	4.60	4.60	0-30	2.3	2.3	5.1	5.1	2*
			30-45	0.0	0.0	-0.2	7.1	2*
			45-60	4.9	4.9	11.8	11.8	4*
			60+	-0.5	0.9	-1.1	2.7	1468
NJ10+0009	4.20	4.37	0-30	3.4	3.4	4.2	4.7	15*
			30-45	0.9	3.6	-3.4	9.3	14*
			45-60	1.9	3.0	3.3	6.1	26*
			60+	0.2	0.8	0.6	2.4	1591

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

Table 5
Observations meeting data quality criteria for individual freeway validation segments greater than one mile in the state of New Jersey

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	
NJ10+0001	0-30	2	22%	9	100%	0	0%	7	78%	9*
	30-45	4	29%	10	71%	0	0%	7	50%	14*
	45-60	39	37%	86	81%	0	0%	32	30%	106
	60+	1068	60%	1694	95%	3	0%	1380	77%	1781
NJ10+0002	0-30	-	-	-	-	-	-	-	-	0
	30-45	0	0%	5	56%	0	0%	5	56%	9*
	45-60	28	23%	84	68%	0	0%	35	28%	124
	60+	864	45%	1826	96%	1	0%	1588	83%	1905
NJ10+0003	0-30	0	0%	0	0%	0	0%	0	0%	1*
	30-45	0	0%	2	67%	0	0%	0	0%	3*
	45-60	120	54%	186	83%	0	0%	112	50%	224
	60+	34	10%	151	45%	0	0%	44	13%	332
NJ10+0004	0-30	-	-	-	-	-	-	-	-	0
	30-45	3	27%	10	91%	0	0%	10	91%	11*
	45-60	8	19%	26	62%	0	0%	13	31%	42
	60+	1001	59%	1651	97%	0	0%	1456	86%	1700
NJ10+0005	0-30	-	-	-	-	-	-	-	-	0
	30-45	0	0%	4	100%	0	0%	3	75%	4*
	45-60	7	18%	24	63%	0	0%	10	26%	38
	60+	952	53%	1687	94%	3	0%	1462	82%	1792
NJ10+0006	0-30	-	-	-	-	-	-	-	-	0
	30-45	-	-	-	-	-	-	-	-	0
	45-60	7	54%	9	69%	0	0%	5	38%	13*
	60+	1080	56%	1836	95%	2	0%	1616	83%	1940
NJ10+0007	0-30	-	-	-	-	-	-	-	-	0
	30-45	0	0%	1	50%	0	0%	0	0%	2*
	45-60	84	41%	163	80%	0	0%	47	23%	204
	60+	881	64%	1304	95%	0	0%	1026	75%	1369
NJ10+0008	0-30	1	50%	2	100%	0	0%	1	50%	2*
	30-45	2	100%	2	100%	0	0%	0	0%	2*
	45-60	2	50%	3	75%	0	0%	0	0%	4*
	60+	879	60%	1428	97%	0	0%	1248	85%	1468

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

Table 5 (Cont'd)
Observations meeting data quality criteria for individual freeway validation segments greater than one mile in the state of New Jersey

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	
NJ10+0009	0-30	8	53%	11	73%	0	0%	11	73%	15*
	30-45	4	29%	10	71%	0	0%	3	21%	14*
	45-60	8	31%	21	81%	0	0%	12	46%	26*
	60+	913	57%	1558	98%	0	0%	1427	90%	1591

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