



I-95 Corridor Coalition

I-95 Corridor Coalition Vehicle Probe Project: Validation of INRIX Data on Freeway Segments Monthly Report New Jersey



September 2011

I-95 CORRIDOR COALITION VEHICLE PROBE PROJECT: VALIDATION OF INRIXDATA ON FREEWAY SEGMENTS SEPTEMBER 2011

Monthly Report

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September 2011

Evaluation Results for the State of New Jersey

Executive Summary

Travel time samples were collected along a total length of approximately 16 freeway miles and nearly six ramp miles from Monday, April 10, 2011 through Friday, April 29, 2011 in New Jersey. Freeway segments studied were located along I-95 (New Jersey Turnpike) in Bergen, Hudson and Essex Counties and included some local and express lanes and along I-80 in Bergen County. The ramp segments studied were interconnecting I-80/I-95/New Jersey Turnpike in Bergen County and included local and express ramps. The results of the ramp data collection are presented in a separate report. Data collected for freeways was compared with travel time and speed data reported by INRIX as part of the I-95 Vehicle Probe Project. The freeway validation data below represents nearly 1300 hours of observations along eight freeway segments, totaling more than 16 miles.

ES Table 1, below summarizes the results of the comparison between the validation data and the INRIX data for freeway segments during this period. As shown, both the average absolute speed error and speed error bias were within specification for all speed bins.

ES Table 1 - New Jersey Evaluation Summary for Freeways						
Speed Bin	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		
0-30 MPH	2.60	7.10	0.60	4.20	95	7.9
30-45 MPH	3.30	11.30	2.60	10.20	147	12.3
45-60 MPH	0.90	2.80	0.40	1.10	4246	353.8
> 60 MPH	1.80	4.20	-1.50	-3.30	10941	911.8
All Speeds	1.57	3.90	-0.93	-1.91	15429	1285.8
Based upon data collected from April 10, 2011 through April 29, 2011 across 16 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 eight occasions: September/October 2008, April 2009, June 2009, September 2009, and October 2009, May/June 2010, June 2010 and April 2011. These eight validations represent more than 11,400 hours of observations along nearly 180 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. The speed error bias is within specification for all speed bins except the 0-30 MPH bin.

ES Table 2 - New Jersey - Cumulative to Date						
Speed Bin	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		
0-30 MPH	7.23	8.43	5.16	5.74	2611	217.6
30-45 MPH	7.71	10.49	4.67	6.32	2173	181.1
45-60 MPH	2.26	4.44	0.53	1.45	17582	1465.2
> 60 MPH	2.72	5.20	-2.40	-4.26	114521	9543.4
All Speeds	2.83	5.24	-1.77	-3.17	136887	11407.3

Data Collection

Bluetooth sensor deployments in New Jersey started on Monday, April 10, 2011. The actual deployments in New Jersey were performed with the assistance of New Jersey Department of Transportation (NJDOT) personnel. Sensors remained in the same position until they were retrieved more than two weeks later on Friday, April 29, 2011. This round of data collection in New Jersey was designed to cover segments of the highway and ramps along which both recurrent and non-recurrent congestions could be expected during both peak and off-peak periods. The results of the ramp data collection are presented in a separate report.

Figure 1 presents snapshot of the roadway segments over which Bluetooth sensors were deployed in New Jersey. Table 1 presents a list of specific *traffic message channel* (TMC) segments that were selected as the validation sample in New Jersey. These segments cover a total length of about 16 freeway miles. Since some TMC segments in this corridor are less than one mile long, when appropriate, consecutive TMC segments are combined to form path segments longer than one mile. This document includes the results of validation performed on eight freeway segments, five of which are path segments combined from multiple standard TMC segments. The coordinates of the locations at which the BluetoothTM traffic monitoring (BTM) sensors were deployed throughout the state of New Jersey are highlighted in Table 2. It should be noted that the configuration of consecutive TMC segments is such that the endpoint of one TMC segment and the start point of the next TMC segment are overlapping, so one BTM sensor in that location is covering both TMC segments.

Finally, Table 3 summarizes the segment definitions used in the validation process which also presents the distances that have been used in the estimation of BTM measured speeds based on observed travel times. Details of the algorithm used to estimate equivalent path travel times based on INRIX data feeds for individual TMC segments are provided in a separate report. This algorithm finds an equivalent INRIX travel time (and therefore travel speed) corresponding to each sample Bluetooth travel time observation on the path segment of interest.

Analysis of Results

Table 4 summarizes the data quality measures obtained as a result of comparison between Bluetooth and all reported INRIX speeds. In all speed bins, INRIX data meets the data quality measures set forth in the contract when errors are measured as a distance from the 1.96 times the standard error band.

Table 5 shows the percentage of the time intervals that fall within 5 mph of the SEM band and the mean for each speed bin for all TMC segments in New Jersey. Tables 6 and 7 present detailed data for individual TMC segments in New Jersey in similar format as Tables 4 and 5, respectively. Note that for some segments and in some speed bins the comparison results may not be reliable due to small number of observations.

Figures 2 and 3 show the overall speed error biases for different speed bins, and the average absolute speed errors for all validation segments in New Jersey, respectively. These figures correspond to Table 4.

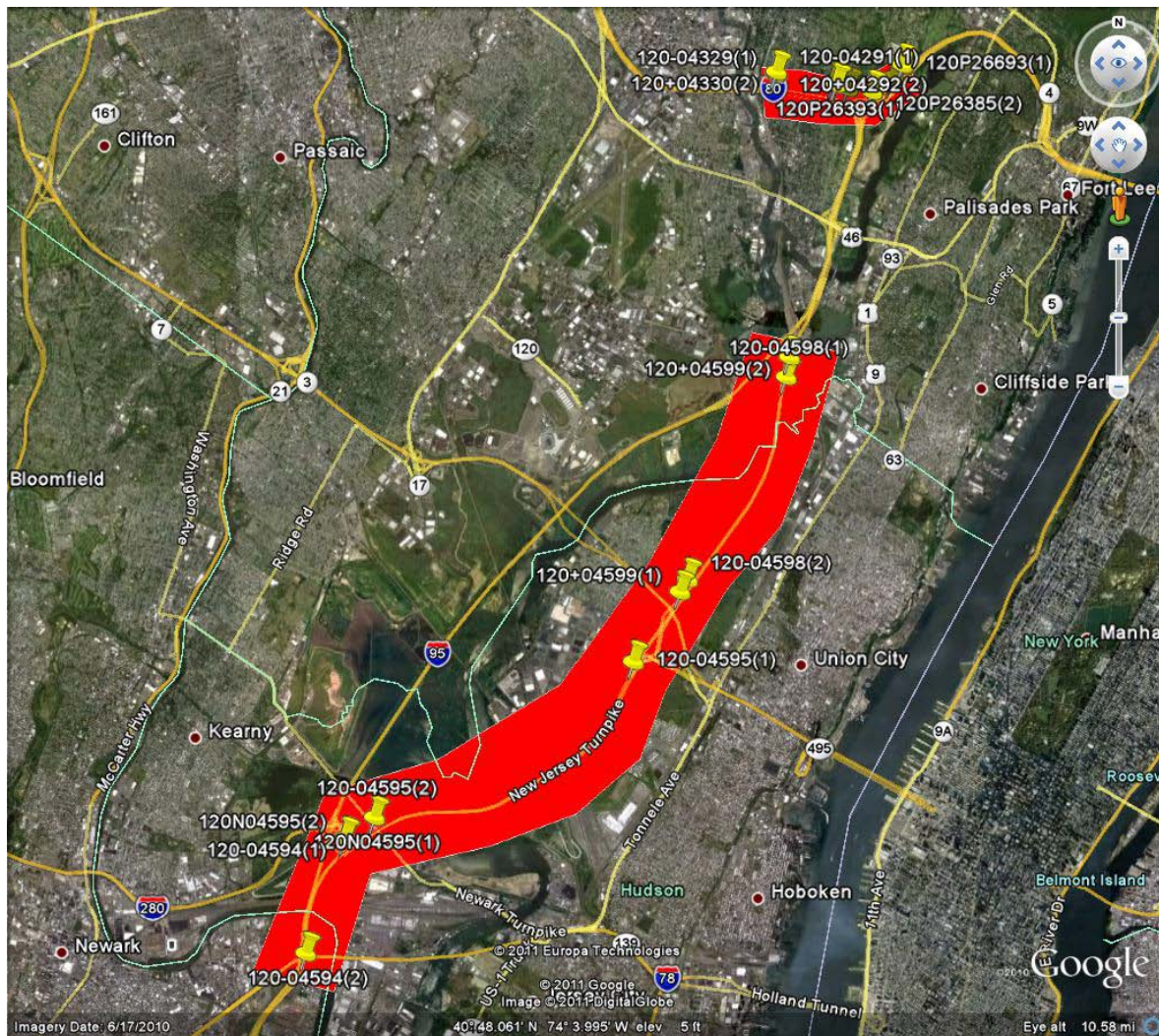


Figure 1
TMC segments selected for validation in New Jersey

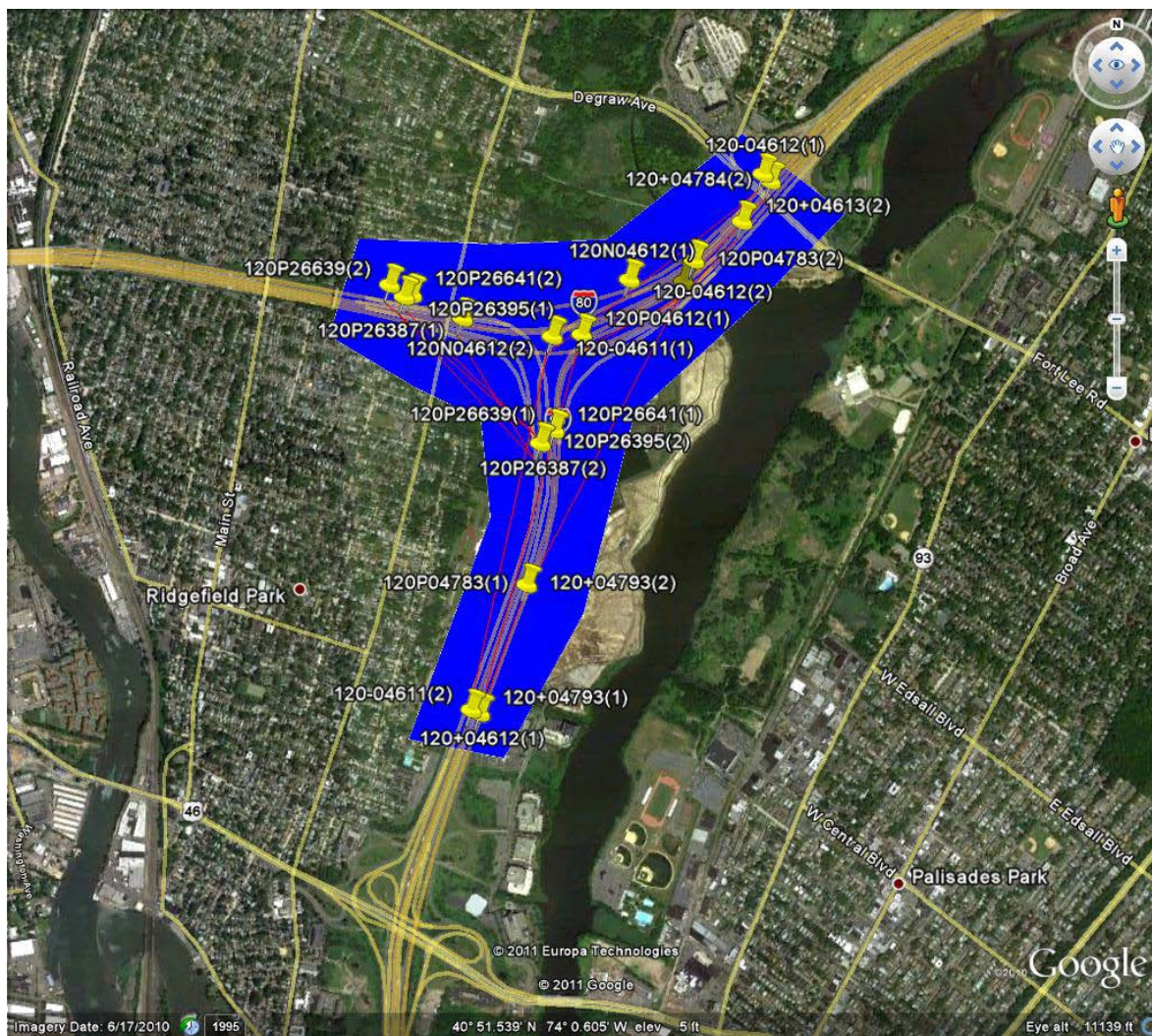


Figure 1
TMC segments selected for validation in New Jersey (Cont'd)

Table 1
Traffic Message Channel segments picked for validation in New Jersey

							LENGTH
TYPE	TMC	HIGHWAY	STARTING AT	ENDING AT	COUNTY	DIRECTION	(mile)
Freeway	120+04599	I-95	EXIT 17	New Jersey Tpke W Spur	BERGEN	Northbound	2.8
Freeway	120-04595	I-95	Lincoln Tunnel Toll Plaza	I-280/Exit 15	HUDSON	Southbound	3.4
Freeway	120-04598	I-95	New Jersey Tpke W Spur	NJ-3/Exit 17	HUDSON	Southbound	2.4
Freeway	120N04595	I-95	I-280/Exit 15	I-280/Exit 15	HUDSON	Southbound	0.4
Freeway	120-04594	I-95	I-280/Exit 15	I-95	ESSEX	Southbound	1.3
Freeway	120P26693	I-95	Degraw Ave/Exit 70	Exit 69	BERGEN	I-80 Westbound	0.8
Freeway	120+04330	I-80 Exp	Exit 69	2nd St/Exit 67	BERGEN	Westbound	0.6
Freeway	120P26721	I-95	Degraw Ave/Exit 70	Exit 69	BERGEN	I-80 Westbound (Express Ln)	0.8
Freeway	120+04292	I-80	Exit 69	2nd St/Exit 67	BERGEN	Westbound	0.7
Freeway	120-04329	I-80 Exp	2nd St/Exit 67	I-95/New Jersey Tpke	BERGEN	Eastbound	0.8
Freeway	120P26385	I-80 Exp	I-95/New Jersey Tpke	Exit 68B	BERGEN	I-95 Northbound and E Degraw Ave	0.3
Freeway	120P26383	I-80 Exp	Exit 68B	Degraw Ave/Exit 70	BERGEN	I-95 Northbound	0.2
Freeway	120-04291	I-80	2nd St/Exit 67	I-95/New Jersey Tpke/Exit 68	BERGEN	Eastbound	0.6
Freeway	120P26393	I-80	I-95/New Jersey Tpke/Exit 68	Exit 68B	BERGEN	I-95 Northbound (Express Ln)	0.6
TOTAL							15.7

Table 2
TMC segment lengths and distances between sensor deployment locations in the state of New Jersey

SEGMENT TYPE	TMC	STANDARD TMC					SENSOR DEPLOYMENT			
		Endpoint (1)		Endpoint (2)		Length (mile)	Endpoint (1)		Endpoint (2)	
		Lat	Long	Lat	Long		Lat	Long	Lat	Long
Freeway	120+04599	40.788048	-74.049046	40.823804	-74.026983	2.8	40.7885	-74.04845	40.8247	-74.02671
Freeway	120-04595	40.777408	-74.058455	40.753674	-74.110521	3.4	40.77654	-74.05944	40.75381	-74.11018
Freeway	120-04598	40.820763	-74.027645	40.7899566	-74.047550	2.4	40.81932	-74.02802	40.79021	-74.04768
Freeway	120N04595	40.753674	-74.110521	40.7504848	-74.116487	0.4	40.75381	-74.11018		
Freeway	120-04594	40.7504848	-74.116487	40.7329534	-74.124340	1.3			40.73326	-74.12427
Freeway	120P26693	40.8683152	-74.004164	40.8657004	-74.018131	0.8	40.86892	-74.00361		
Freeway	120+04330	40.8657004	-74.018131	40.867225	-74.029605	0.6			40.86743	-74.03031
Freeway	120P26721	40.868096	-74.004026	40.865407	-74.017254	0.8	40.86892	-74.00361		
Freeway	120+04292	40.865407	-74.017254	40.867084	-74.029666	0.7			40.86743	-74.03031
Freeway	120-04329	40.866862	-74.029763	40.864714	-74.015249	0.8	40.86676	-74.03005		
Freeway	120P26385	40.864714	-74.015249	40.864255	-74.010337	0.3				
Freeway	120P26383	40.864255	-74.010337	40.8658536	-74.006363	0.2				
Freeway	120-04291	40.8669952	-74.029705	40.865337	-74.017552	0.6	40.86676	-74.03005		
Freeway	120P26393	40.865337	-74.017552	40.86649	-74.005952	0.6				
TOTAL						15.7				

Table 3
Path segments identified for validation in New Jersey

Type	Validation Segment	STANDARD SEGMENTS INCLUDED				STARTING AT	ENDING AT	LENGTH (MILE)			
		TMC(1)	TMC(2)	TMC(3)	TMC(4)			Standard	Deployment	Error (%)	
Freeway	120+04599	120+04599	120-04594	120+04330	120+04613	EXIT 17	NEW JERSEY TPKE W SPUR	2.8	2.80	0.35%	
Freeway	120-04595	120-04595				LINCOLN TUNNEL TOLL PLAZA	I-280/EXIT 15	3.4	3.32	-2.10%	
Freeway	120-04598	120-04598				NEW JERSEY TPKE W SPUR	NJ-3/EXIT 17	2.4	2.30	-4.95%	
Freeway	NJ08-0001	120N04595				I-280/EXIT 15	I-95	1.7	1.70	-0.20%	
Freeway	NJ08-0008	120P04329				DEGRAW AVE/EXIT 70	2ND ST/EXIT 67	1.4	1.49	6.70%	
Freeway	NJ08-0009	120P26721				DEGRAW AVE/EXIT 70	2ND ST/EXIT 67	1.4	1.52	6.60%	
Freeway	NJ08-0011	120-04329				120N04329	I-95/NEW JERSEY TPKE	DEGRAW AVE/EXIT 70	1.5	1.58	8.91%
Freeway	NJ08-0012	120-04329				120P26385	I-95/NEW JERSEY TPKE	DEGRAW AVE/EXIT 70	1.5	1.54	1.66%
TOTAL								16.1	16.25	0.92%	

Table 4
Data quality measures for freeway segments greater than one mile in New Jersey

SPEED BIN	Data Quality Measures for				No. of Obs.
	1.96 SE Band		Mean		
	Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
0-30	0.6	2.6	4.2	7.1	95
30-45	2.6	3.3	10.2	11.3	147
45-60	0.4	0.9	1.1	2.8	4246
60+	-1.5	1.8	-3.3	4.2	10941

Table 5
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 SE 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	22%	88%	0%	80%	95
30-45	26%	73%	0%	37%	147
45-60	63%	96%	0%	85%	4246
60+	45%	88%	0%	66%	10941

Table 6
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 SE Band		Mean		
				Speed Error Bias	Average Absolut e Speed Error	Speed Error Bias	Average Absolute Speed Error	
120+04599	2.8	2.8	0-30					2*
			30-45	2.2	2.2	19.8	19.8	228
			45-60	1.7	1.7	4.8	4.8	1994
			60+	-0.3	0.8	-1.1	2.7	
120-04595	3.4	3.3	0-30	-0.2	2.0	2.8	6.0	89
			30-45	2.0	2.7	9.6	10.8	128
			45-60	0.1	0.7	0.1	2.4	1498
			60+	-1.6	1.8	-3.7	4.3	834
120-04598	2.4	2.3	0-30	18.7	18.7	39.4	39.4	1*
			30-45	10.9	10.9	18.5	18.5	3*
			45-60	1.5	1.5	4.2	4.3	307
			60+	-0.3	0.9	-1.1	2.9	1720
NJ08-0001	1.7	1.7	0-30	13.8	13.8	15.4	15.4	2*
			30-45	9.5	9.5	11.6	11.6	9*
			45-60	0.7	0.9	1.6	2.5	864
			60+	-0.8	1.3	-2.1	3.3	1754
NJ08-0008	1.4	1.5	0-30					1*
			30-45	0.0	0.0	12.1	12.1	570
			45-60	-0.3	0.5	-1.1	2.4	989
			60+	-3.3	3.3	-6.9	6.9	
NJ08-0009	1.4	1.5	0-30					1*
			30-45	0.0	0.0	-4.7	4.7	413
			45-60	0.4	1.2	2.1	3.5	1146
			60+	-1.6	1.8	-3.8	4.6	
NJ08-0011	1.5	1.6	0-30	0.0	0.0	10.0	10.0	1*
			30-45	6.5	6.5	31.5	31.5	1*
			45-60	0.1	0.3	0.5	2.1	119
			60+	-3.5	3.5	-6.4	6.5	1317
NJ08-0012	1.5	1.5	0-30	13.1	13.1	32.0	32.0	2*
			30-45	3.3	3.3	16.3	16.3	2*
			45-60	0.3	0.6	1.5	2.7	247
			60+	-2.4	2.6	-4.4	5.0	1187

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

Table 7
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 SE 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	
120+04599	0-30	0	0%	2	100%	0	0%	0	0%	2*
	30-45	101	44%	202	89%	0	0%	136	60%	228
	45-60	1213	61%	1929	97%	1	0%	1715	86%	1994
	60+									
120-04595	0-30	20	22%	82	92%	0	0%	76	85%	89
	30-45	34	27%	101	79%	0	0%	52	41%	128
	45-60	931	62%	1459	97%	0	0%	1346	90%	1498
	60+	270	32%	766	92%	0	0%	532	64%	834
120-04598	0-30	0	0%	0	0%	0	0%	0	0%	1*
	30-45	0	0%	0	0%	0	0%	0	0%	3*
	45-60	157	51%	275	90%	0	0%	210	68%	307
	60+	1073	62%	1645	96%	0	0%	1424	83%	1720
NJ08-0001	0-30	0	0%	0	0%	0	0%	0	0%	2*
	30-45	1	11%	2	22%	0	0%	2	22%	9*
	45-60	506	59%	821	95%	4	0%	753	87%	864
	60+	809	46%	1662	95%	0	0%	1385	79%	1754
NJ08-0008	0-30									
	30-45	1	100%	1	100%	0	0%	0	0%	1*
	45-60	428	75%	561	98%	0	0%	514	90%	570
	60+	244	25%	719	73%	0	0%	303	31%	989
NJ08-0009	0-30									
	30-45	1	100%	1	100%	0	0%	1	100%	1*
	45-60	285	69%	387	94%	0	0%	327	79%	413
	60+	573	50%	996	87%	0	0%	706	62%	1146
NJ08-0011	0-30	1	100%	1	100%	0	0%	0	0%	1*
	30-45	0	0%	0	0%	0	0%	0	0%	1*
	45-60	103	87%	118	99%	0	0%	111	93%	119
	60+	249	19%	926	70%	0	0%	462	35%	1317
NJ08-0012	0-30	0	0%	1	50%	0	0%	0	0%	2*
	30-45	1	50%	1	50%	0	0%	0	0%	2*
	45-60	174	70%	239	97%	0	0%	217	88%	247
	60+	471	40%	964	81%	0	0%	707	60%	1187

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

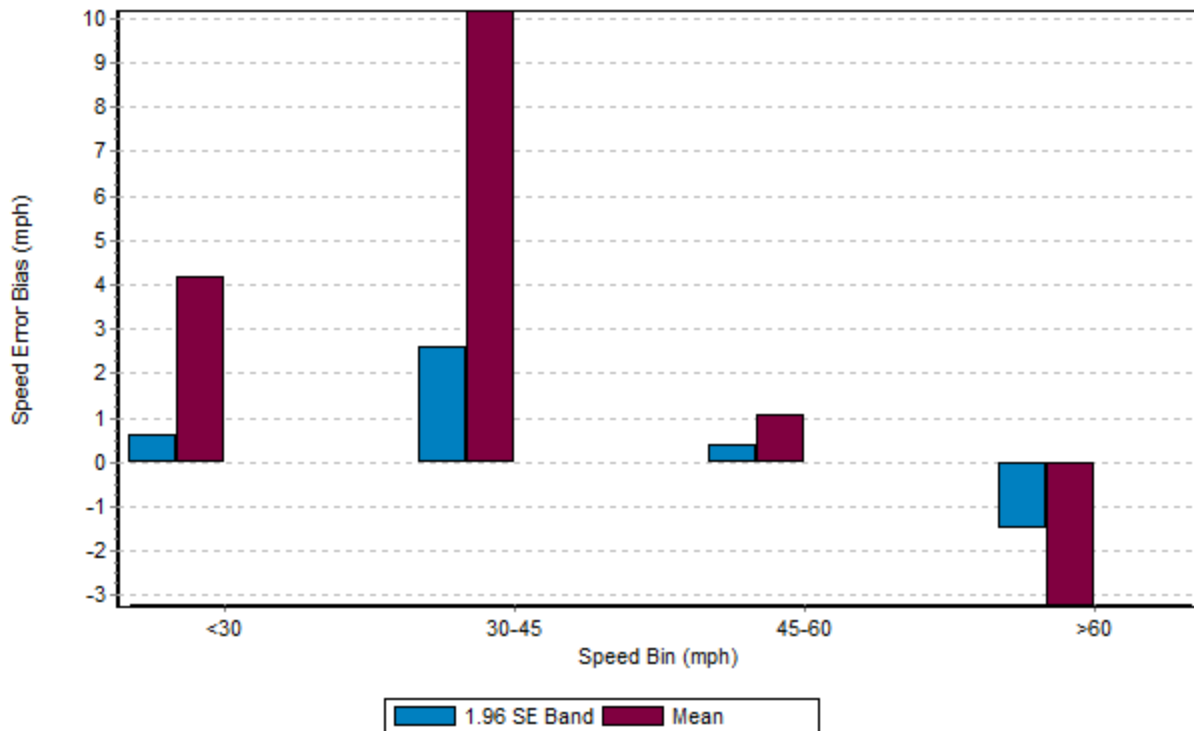


Figure 2
Speed error bias for freeway segments greater than one mile in New Jersey

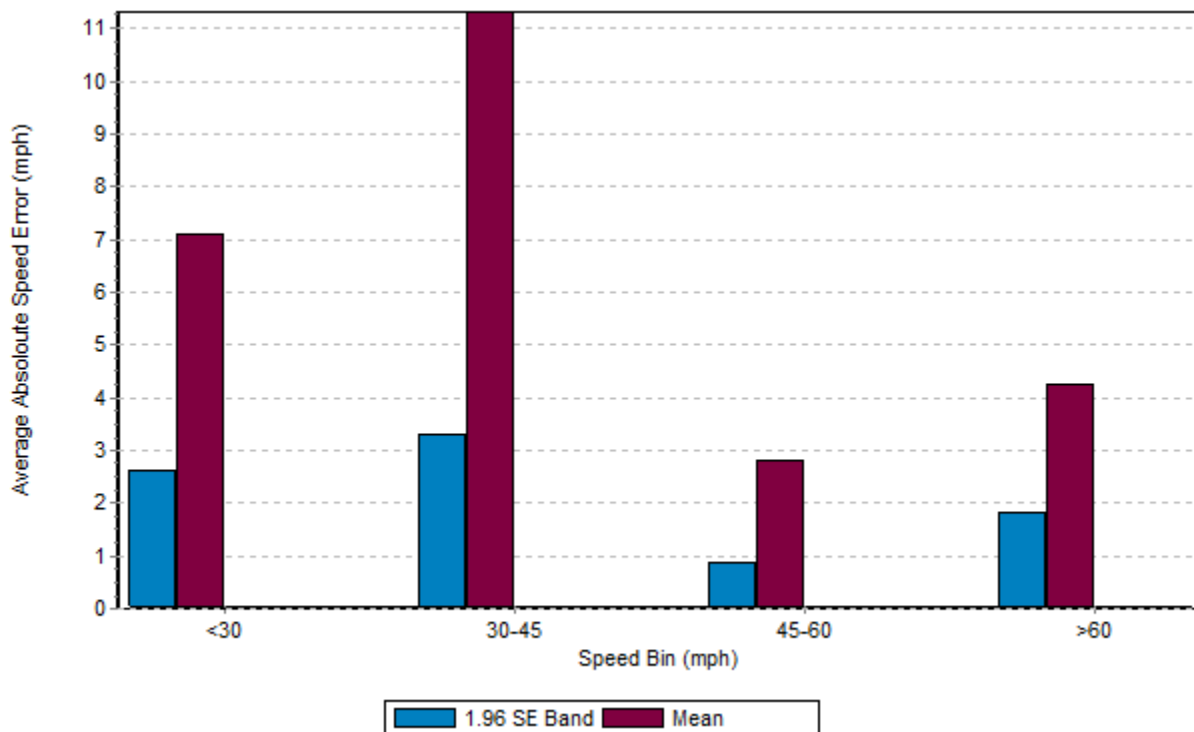


Figure 3
Average absolute speed error for freeway segments greater than one mile in New Jersey