LAW OFFICES OF
STEPHEN P. SINISI, ESQ., LLC

ATTORNEYS & COUNSELORS AT LAW

STEPHEN P. SINISI

ROBERT L. FALKENSTERN (NJ, NY & USPTO)

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OF COUNSEL

VANESSA S. FALKENSTERN

May 29, 2026

Via Email (lgara@raritan-nj.org) & UPS Overnight
Lou Gara, Interim Board Secretary
Combined Land Use Board, as Zoning Board
Borough of Raritan
9 West Somerset Street
Raritan, NJ, 08869

Re: IAAT Services LLC ("Applicant")
1137 Route 202, Raritan, NJ; Block 31, Lot 1
Development Application: Proposed Double-Sided Digital Billboard

Dear Chairman and Zoning Board Members:

Please be reminded that we serve as development counsel for IAAT Services LLC ("Applicant") in connection with its proposed development. Supplementing our recent correspondence, enclosed please find 20 sets of a report entitled "Safety, Environmental & Visual Impacts" prepared by Simoff Engineering Associates, Inc. and dated 5/26/26.

Kindly inform our office when the Board and/or its staff has issued its "completeness" determination and assigned a date for the hearing, in order to enable the Applicant to satisfy its formal notice requirements for this application.

Naturally, should you require additional information or documentation, please do not hesitate to contact me and we shall endeavor to promptly address your request.

Very truly yours,

LAW OFFICES OF
STEPHEN P. SINISI, ESQ., LLC

By: /s/ *Stephen P. Sinisi*
Stephen P. Sinisi, Esq.

SPS:ld
Enclosures
Bcc via email: Jeff Bellew, Property Owner
Cc via email: Client and Project Team

SEA
Simoff Engineering Associates, Inc.
Engineers - Transportation Engineering,
Development and Planning Consultants

2 Shunpike Road
Madison, NJ 07940

WWW.SIMOFF.COM
Ph: (973) 966-9000
Fax: (973) 805-2310

SAFETY, ENVIRONMENTAL & VISUAL IMPACTS
OF PROPOSED
Outdoor Advertising Sign
IAAT SERVICES
Route 202 NB
Block 31 Lot 1
Borough of Raritan
Somerset County, New Jersey
May 26, 2026
Our File No. 26-104

PREPARED BY:

Hal Simoff, P.E., P.P.
P.E. License No. 28278
P.P. License No. 2664

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INTRODUCTION

SIMOFF ENGINEERING ASSOCIATES, INC. (SEA) has prepared this Traffic Safety Environmental, and Visual Impact analysis for a proposed billboard, on the property located adjacent to Route 202, known as Block 31 Lot 1, in Borough of Raritan, Somerset County, New Jersey. The sign is at milepost 22.87 ± of Route 202 Northbound. New Jersey Department of Transportation Straight Line Diagram depicting the site location is noted as Figure 2 of this report.

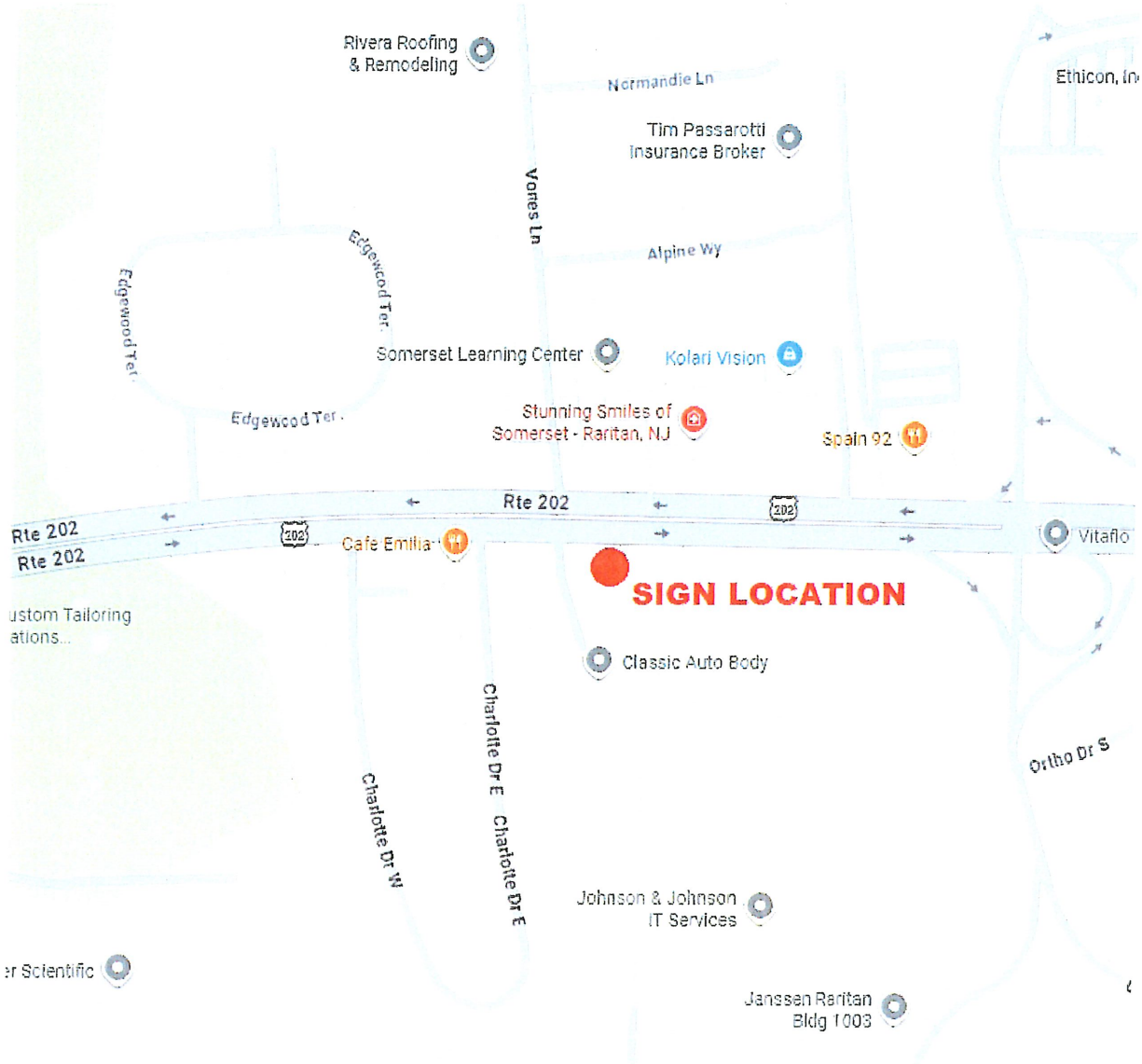


Figure 1. Location Map

The proposed sign dimensions are as follows:

Overall Height:	50.00'
Sign Width:	48'
Sign Height:	14'

The purpose of this analysis is to evaluate the traffic safety, visual and environmental impacts of the construction of the proposed outdoor advertising sign. Accordingly, this analysis includes the following:

- A review of the Site Plan prepared by L2A Land Design
- A review of existing roadways and traffic conditions in the vicinity of the site;
- Perform a "Cone of Vision" Analysis, to evaluate if the proposed sign will be located within the peripheral vision of the drivers, and if so, will not create any safety hazards;
- Crash records compiled for Route 202, and
- Conclusions of this study.

Our findings indicate that construction of the sign will not have any detrimental effects on safety and traffic flow along Route 202. The conclusion confirms that there are no detrimental impacts to traffic safety the analysis further confirms that the proposed billboard can be constructed without any negative environmental impacts.

ANALYSIS

In this area, Route 202 is straight and level and separated by a median. The roadway has two lanes in each direction, plus shoulders. As noted above, the proposed sign will be located at approximately milepost 22.87 on Route 202. Figure 2 shows the sign location on the NJDOT Straight Line Diagram.

We reviewed the NJDOT count station on Route 202 between Charlotte Drive and Ortho Drive to evaluate traffic volumes at the site. The station reported an Annual Average Daily Traffic (AADT) of 25,803 vehicles northbound and 27,324 vehicles southbound in

2013. We used these counts in our analysis as a conservative assumption, because higher traffic volumes would result in lower crash rates.

A "Cone of Vision" analysis was performed using the methodology outlined in the FHWA publication **DRIVER VISUAL BEHAVIOR IN THE PRESENCE OF COMMERCIAL ELECTRONIC VARIABLE MESSAGE SIGNS (CEVMS)**, issued in coordination with the U.S. Department of Transportation and the Federal Highway Administration. The purpose of the analysis was to determine whether the proposed sign falls within the driver's cone of vision and to evaluate the distance and time during which drivers can observe it. Exhibit B shows the cone of vision for approaching traffic.

We analyzed the sign location using an assumed reading distance of 800 feet and calculated the time during which drivers can view the sign copy. The posted speed limit on Route 202 is 55 mph, or 80.7 feet per second. Visibility distance is based on the motorist's viewing angle in each direction, taking into account horizontal and vertical roadway alignment. Based on these factors, the proposed sign will be visible within the cone of vision as follows:

- Route 202 NB –705 feet, 8.7 seconds
- Route 202 SB – 640 feet 7.9 seconds

The FHWA study titled **DRIVER VISUAL BEHAVIOR IN THE PRESENCE OF COMMERCIAL ELECTRONIC VARIABLE MESSAGE SIGNS (CEVMS)**, summarized in Exhibit D, found that motorists' average glance duration at billboards was 0.3 seconds. By comparison, the cone-of-vision analysis indicates that the proposed sign will be visible for 7.9 to 8.7 seconds. The sign's placement and height will allow motorists to observe it without distraction from the driving task. The study also found that billboards were not associated with long glances away from the driver's field of view.

The 40-degree cone-of-vision analysis shows that drivers will have more than adequate time for the sign to remain within their field of view.

The billboard will not negatively affect highway safety or the time motorists need to see and react to highway signs and perform other driving tasks. This conclusion is supported by U.S. Department of Transportation research.

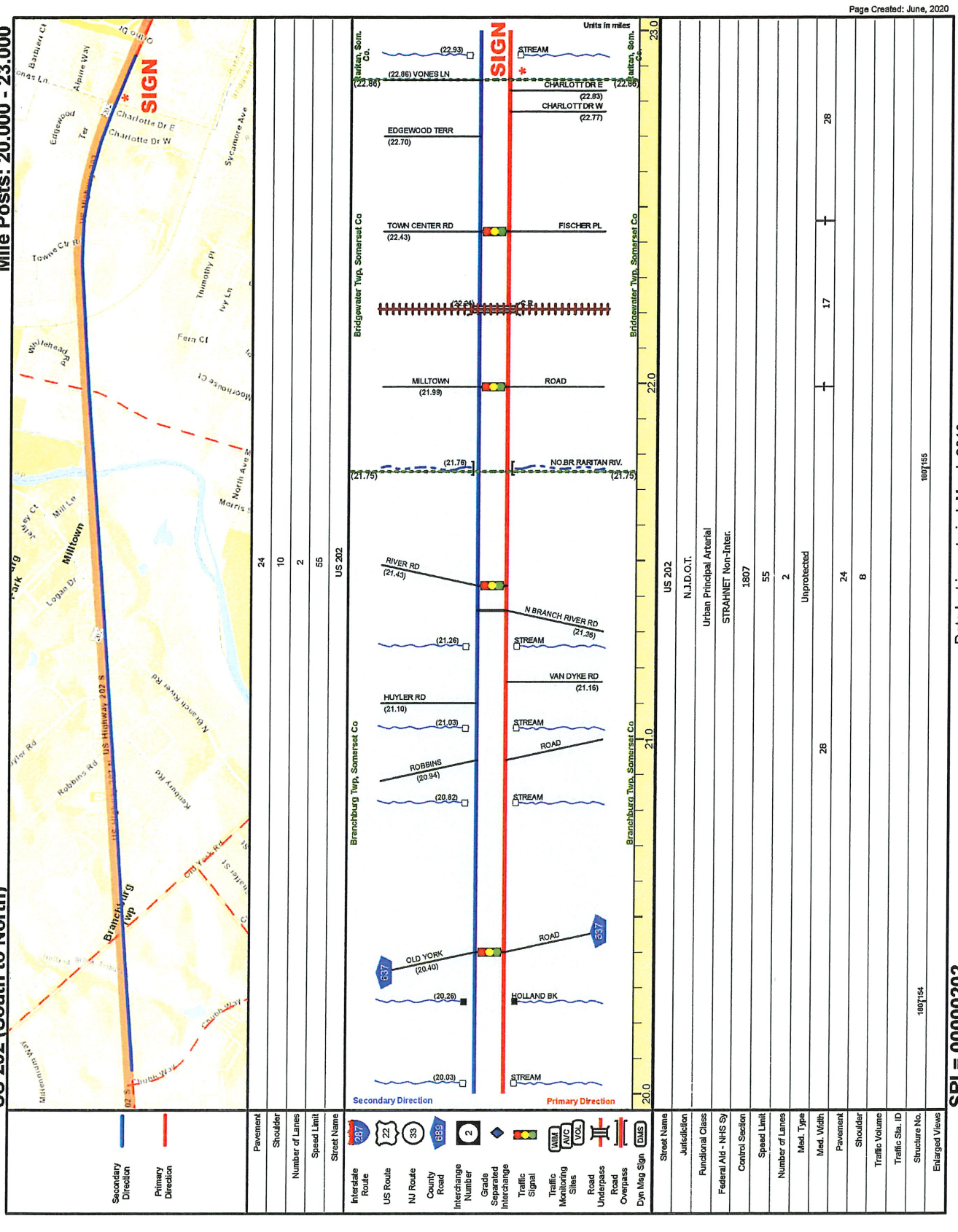


Figure 2. Straight Line Diagram.

EXISTING CRASH RATES

We reviewed crash rates along the section of Route 202 where the sign will be visible to passing motorists. NJDOT data for 2022 through 2024, the most recent years available, were analyzed. The 0.15-mile northbound and 0.15-mile southbound segments from which the proposed billboard is visible showed the following number of crashes:

YEAR	CRASHES	
	Northbound	Southbound
2022	4	0
2023	0	5
2024	1	2
Three-year average	1.7 crashes/year	2.3 crashes/year

Using the published AADT of 25,803 vehicles northbound on Route 202, approximately 9.4 million vehicles pass the site northbound each year. Using the southbound AADT of 27,324 vehicles, approximately 10.0 million vehicles pass the site southbound each year. The billboard visibility study area is 0.15 mile (800 feet). Crash rates are calculated based on traffic volume and crash frequency and are expressed as crashes per million vehicle miles (MVM). The resulting crash rates for the proposed billboard viewing area are 1.2 crashes per MVM northbound and 1.8 crashes per MVM southbound. These figures indicate very low crash rates.

CONCLUSION

Based on what has been presented in the previous sections, the following summarized view can be concluded:

- The geometric alignment of Route 202 in the vicinity of the proposed sign provides the motorists with proper viewing angles. Therefore, it will not present any unsafe distractions or safety hazards;
- A "Cone of Vision" Analysis was performed, and it determines that the proposed sign will be located within the driver's cone of vision for significant distance without creating loss of forward view of the billboard and/or conflicts;
- The existing crash rates in the viewing area of the proposed billboard are low and based on the reference material there is no indication that the rate will increase.

Vehicles travelling at 55 Miles per hour i.e., 80.7 feet per second will have more than adequate time to digest the copy of the billboard without being distracted from the driving task. Grant of the variance relief will not create adverse impacts from a traffic engineering point of view.

In conclusion, the findings of this analysis indicate that the construction of the billboard on Lot 1 in Block 31 can be implemented without adversely impacting driver safety and without detriment to the health, safety, and welfare of the community.

EXHIBIT A

CONE OF VISION, HORZONTAL ALIGNMENT

VIEWING STUDY

PROPOSED MULTIMESSAGE BILLBOARD
1137 U.S. HIGHWAY ROUTE 202
BLOCK 31, LOT 1, TAX MAP 6
BOROUGH OF RARITAN, SOMERSET COUNTY, NEW JERSEY

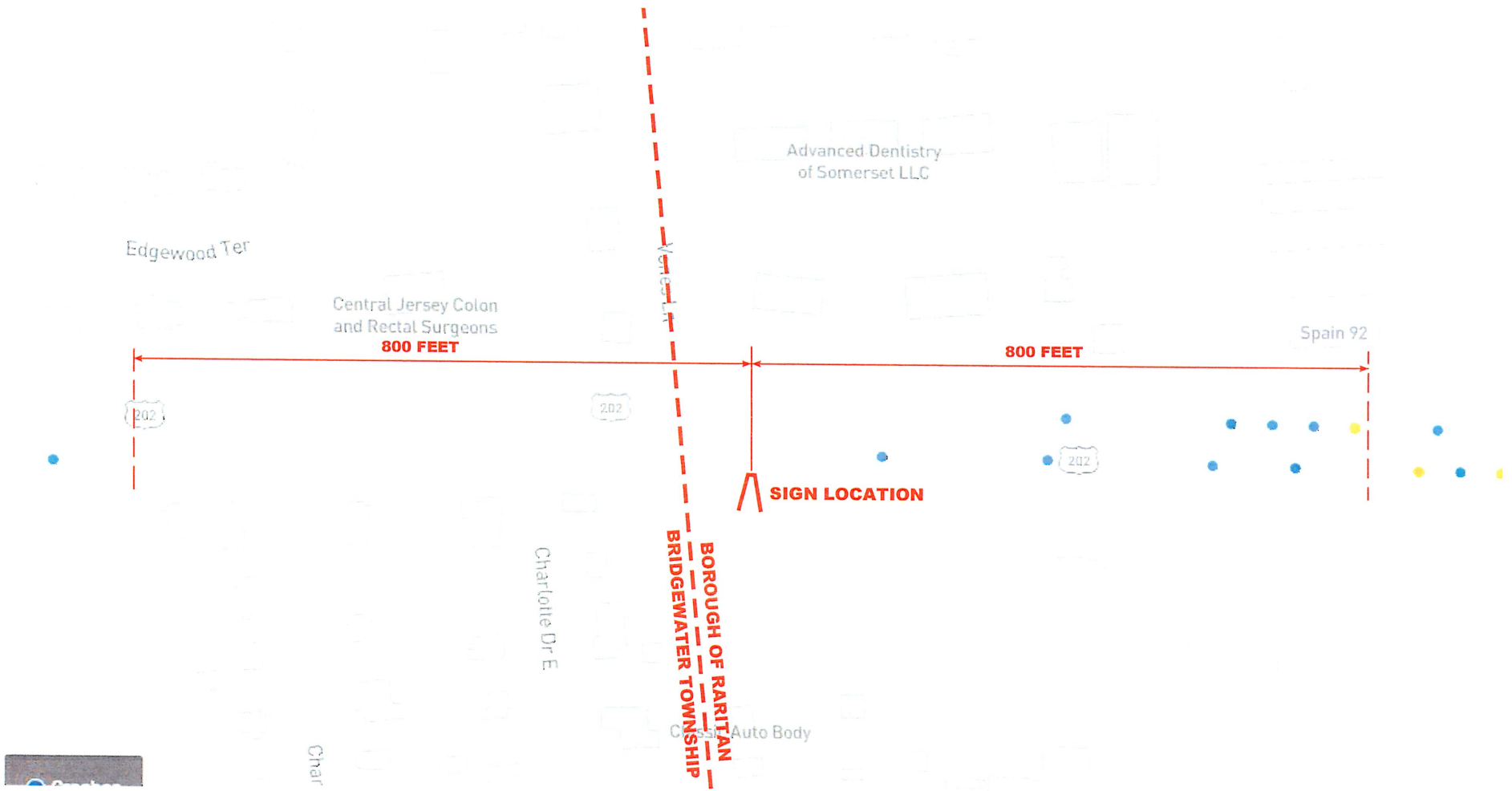
FILE No: 26-104

EXHIBIT "A"

EXHIBIT B

2022, 2023 & 2024 CRASH DATA

CRASH PLOTTING 2022
SOURCE: NJDOT DATA



CRASH PLOTTING 2023
SOURCE: NJDOT DATA

CRASH PLOTTING 2024.
SOURCE: NJDOT DATA

EXHIBIT C

NJDOT TRAFFIC COUNTS

N... Je...ey ...pa...ner...f T...ns...ta...n

Daily Volume from 10/15/2013 through 10/27/2013

Site Names: 120065, , US 202-22.85, 00000202__, Bridgewater Twp
County: SOMERSET
Funct. Class: Urban Principal Arterial - Other
Location: Bet Charlotte Drive and Ortho Drive

Seasonal Factor Group: RG3_FC14
Daily Factor Group: RG3_FC14
Axle Factor Group: RG3_FC14
Growth Factor Group: RG3_FC14

	Sun 10/13/2013			Mon 10/14/2013			Tue 10/15/2013			Wed 10/16/2013			Thu 10/17/2013			Fri 10/18/2013			Sat 10/19/2013		
	ROAD	S	N	ROAD	S	N	ROAD	S	N	ROAD	S	N	ROAD	S	N	ROAD	S	N	ROAD	S	N
00:00							133		133	172		172	181		181	211		211	243		243
01:00							114		114	106		106	119		119	119		119	95		95
02:00							82		82	94		94	87		87	87		87	78		78
03:00							112		112	130		130	112		112	139		139	73		73
04:00							250		250	261		261	258		258	256		256	93		93
05:00							774		774	703		703	697		697	667		667	238		238
06:00							1,959		1,959	1,975		1,975	1,919		1,919	1,744		1,744	593		593
07:00							2,257		2,257	2,441		2,441	2,457		2,457	2,272		2,272	850		850
08:00							1,456		1,456	2,192		2,192	2,219		2,219	2,119		2,119	1,161		1,161
09:00							2,033		2,033	1,837		1,837	1,771		1,771	1,668		1,668	1,468		1,468
10:00							1,506		1,506	1,526		1,526	1,542		1,542	1,587		1,587	1,695		1,695
11:00							1,475		1,475	1,489		1,489	1,559		1,559	1,592		1,592	1,729		1,729
12:00							1,517		1,517	1,590		1,590	1,634		1,634	1,652		1,652	1,789		1,789
13:00							1,572		1,572	1,605		1,605	1,547		1,547	1,701		1,701	1,812		1,812
14:00							1,650		1,650	1,620		1,620	1,616		1,616	1,837		1,837	1,924		1,924
15:00							1,831		1,831	1,824		1,824	1,970		1,970	1,923		1,923	1,998		1,998
16:00							1,774		1,774	1,778		1,778	1,702		1,702	1,806		1,806	2,023		2,023
17:00							1,697		1,697	1,720		1,720	1,591		1,591	1,857		1,857	1,968		1,968
18:00							1,696		1,696	1,638		1,638	1,765		1,765	1,800		1,800	1,818		1,818
19:00							1,147		1,147	1,200		1,200	1,201		1,201	1,414		1,414	1,422		1,422
20:00							821		821	918		918	829		829	1,021		1,021	975		975
21:00							631		631	538		538	650		650	732		732	887		887
22:00							358		358	423		423	368		368	631		631	693		693
23:00							297		297	264		264	288		288	498		498	474		474
Volume							27,142		27,142	28,044		28,044	28,082		28,082	29,333		29,333	26,099		26,099
AM Peak Vol							2,257		2,257	2,441		2,441	2,457		2,457	2,272		2,272	1,729		1,729
AM Peak Fct							1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
AM Peak Hr							7:00		7:00	7:00		7:00	7:00		7:00	7:00		7:00	11:00		11:00
PM Peak Vol							1,831		1,831	1,824		1,824	1,970		1,970	1,923		1,923	2,023		2,023
PM Peak Fct							1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
PM Peak Hr							15:00		15:00	15:00		15:00	15:00		15:00	15:00		15:00	16:00		16:00
Seasonal Fct							0.983		0.983	0.983		0.983	0.983		0.983	0.983		0.983	0.983		0.983
Daily Fct							1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000
Axle Fct							0.487		0.487	0.487		0.487	0.487		0.487	0.487		0.487	0.487		0.487
Pulse Fct							2.000		2.000	2.000		2.000	2.000		2.000	2.000		2.000	2.000		2.000

Collected by: NJDOT
Created 06/25/2015 6:30:29PM

ROAD AADT 25,803 **S AADT 0** **N AADT 25,803**

Daily Volume from 10/16/2013 through 10/27/2013

Site Names: 120067, , US 202-23.73, 00000202__, Raritan Boro
County: SOMERSET
Funct. Class: Urban Principal Arterial - Other
Location: Bet RT 567 First Avenue and Ortho Pharmaceutical Driveway

Seasonal Factor Group: RG3_FC14
Daily Factor Group: RG3_FC14
Axle Factor Group: RG3_FC14
Growth Factor Group: RG3_FC14

	Sun 10/20/2013			Mon 10/21/2013			Tue 10/22/2013			Wed 10/23/2013			Thu 10/24/2013			Fri 10/25/2013			Sat 10/26/2013		
	ROAD	N	S	ROAD	N	S	ROAD	N	S	ROAD	N	S	ROAD	N	S	ROAD	N	S	ROAD	N	S
00:00	331		331	117		117	285		285	168		168	170		170	201		201	304		304
01:00	282		282	96		96	113		113	90		90	99		99	114		114	165		165
02:00	126		126	64		64	77		77	83		83	70		70	100		100	95		95
03:00	72		72	80		80	89		89	97		97	96		96	84		84	107		107
04:00	108		108	205		205	240		240	250		250	257		257	255		255	171		171
05:00	179		179	547		547	548		548	575		575	506		506	499		499	328		328
06:00	283		283	1,274		1,274	1,324		1,324	1,317		1,317	1,258		1,258	1,173		1,173	506		506
07:00	544		544	1,936		1,936	2,088		2,088	2,034		2,034	2,107		2,107	1,926		1,926	701		701
08:00	867		867	2,286		2,286	2,332		2,332	2,270		2,270	2,324		2,324	2,053		2,053	1,021		1,021
09:00	1,157		1,157	1,693		1,693	1,812		1,812	1,638		1,638	1,778		1,778	1,610		1,610	1,417		1,417
10:00	1,673		1,673	1,386		1,386	1,362		1,362	1,294		1,294	1,412		1,412	1,467		1,467	1,641		1,641
11:00	1,951		1,951	1,517		1,517	1,398		1,398	1,417		1,417	1,501		1,501	1,645		1,645	2,019		2,019
12:00	2,085		2,085	1,685		1,685	1,659		1,659	1,575		1,575	1,750		1,750	1,866		1,866	2,127		2,127
13:00	2,079		2,079	1,673		1,673	1,624		1,624	1,671		1,671	1,813		1,813	1,985		1,985	2,078		2,078
14:00	1,500		1,500	1,739		1,739	1,822		1,822	1,874		1,874	1,883		1,883	2,110		2,110	2,079		2,079
15:00	1,794		1,794	1,974		1,974	1,980		1,980	2,122		2,122	2,104		2,104	2,245		2,245	2,013		2,013
16:00	1,701		1,701	2,193		2,193	2,137		2,137	2,233		2,233	2,105		2,105	2,263		2,263	2,017		2,017
17:00	1,784		1,784	2,097		2,097	2,111		2,111	2,105		2,105	2,145		2,145	2,136		2,136	1,752		1,752
18:00	1,551		1,551	2,042		2,042	2,085		2,085	2,127		2,127	2,136		2,136	1,985		1,985	1,697		1,697
19:00	1,241		1,241	1,616		1,616	1,656		1,656	1,679		1,679	1,807		1,807	1,754		1,754	1,343		1,343
20:00	974		974	1,066		1,066	1,198		1,198	1,247		1,247	1,272		1,272	1,174		1,174	1,123		1,123
21:00	723		723	783		783	912		912	948		948	1,046		1,046	1,213		1,213	987		987
22:00	470		470	470		470	502		502	568		568	711		711	777		777	717		717
23:00	262		262	297		297	281		281	319		319	386		386	514		514	583		583
Volume	23,737		23,737	28,836		28,836	29,635		29,635	29,701		29,701	30,736		30,736	31,149		31,149	26,991		26,991
AM Peak Vol	1,951		1,951	2,286		2,286	2,332		2,332	2,270		2,270	2,324		2,324	2,053		2,053	2,019		2,019
AM Peak Fct	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
AM Peak Hr	11:00		11:00	8:00		8:00	8:00		8:00	8:00		8:00	8:00		8:00	8:00		8:00	11:00		11:00
PM Peak Vol	2,085		2,085	2,193		2,193	2,137		2,137	2,233		2,233	2,145		2,145	2,263		2,263	2,127		2,127
PM Peak Fct	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
PM Peak Hr	12:00		12:00	16:00		16:00	16:00		16:00	16:00		16:00	17:00		17:00	16:00		16:00	12:00		12:00
Seasonal Fct	0.983		0.983	0.983		0.983	0.983		0.983	0.983		0.983	0.983		0.983	0.983		0.983	0.983		0.983
Daily Fct	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000
Axle Fct	0.487		0.487	0.487		0.487	0.487		0.487	0.487		0.487	0.487		0.487	0.487		0.487	0.487		0.487
Pulse Fct	2.000		2.000	2.000		2.000	2.000		2.000	2.000		2.000	2.000		2.000	2.000		2.000	2.000		2.000

Collected by: NJDOT
Created 06/25/2015 6:30:31PM

ROAD AADT 27,324 **N AADT 0** **S AADT 27,324**

EXHIBIT D

EXECUTIVE SUMMARY OF FHWA REPORT

DRIVER VISUAL BEHAVIOR IN THE PRESENCE OF COMMERCIAL ELECTRONIC VARIABLE MESSAGE SIGNS (CEVMS)

SEPTEMBER 2012

U.S. Department of Transportation
Federal Highway Administration

FHWA-HEP-

FOREWORD

The advent of electronic billboard technologies, in particular the digital Light-Emitting Diode (LED) billboard, has necessitated a reevaluation of current legislation and regulation for controlling outdoor advertising. In this case, one of the concerns is possible driver distraction. In the context of the present report, outdoor advertising signs employing this new advertising technology are referred to as Commercial Electronic Variable Message Signs (CEVMS). They are also commonly referred to as Digital Billboards and Electronic Billboards.

The present report documents the results of a study conducted to investigate the effects of CEVMS used for outdoor advertising on driver visual behavior in a roadway driving environment. The report consists of a brief review of the relevant published literature related to billboards and visual distraction, the rationale for the Federal Highway Administration research study, the methods by which the study was conducted, and the results of the study, which used an eye tracking system to measure driver glances while driving on roadways in the presence of CEVMS, standard billboards, and other roadside elements. The report should be of interest to highway engineers, traffic engineers, highway safety specialists, the outdoor advertising industry, environmental advocates, Federal policymakers, and State and local regulators of outdoor advertising.

Monique R. Evans
Director, Office of Safety
Research and Development

Nelson Castellanos
Director, Office of Real Estate
Services

TECHNICAL DOCUMENTATION PAGE

1. Report No. FHWA-HRT-	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Driver Visual Behavior in the Presence of Commercial Electronic Variable Message Signs (CEVMS)		5. Report Date 6. Performing Organization Code
7. Author(s) William A. Perez, Mary Anne Bertola, Jason F. Kennedy, and John A. Molino		8. Performing Organization Report No.
9. Performing Organization Name and Address SAIC 6300 Georgetown Pike McLean, VA 22101		10. Work Unit No. (TRAIS) 11. Contract or Grant No.
12. Sponsoring Agency Name and Address Office of Real Estate Services Federal Highway Administration 1200 New Jersey Avenue SE Washington, DC 20590		13. Type of Report and Period Covered 14. Sponsoring Agency Code

15. Supplementary Notes
The Contracting Officer's Technical Representatives (COTR) were Christopher Monk and Thomas Granda.

16. Abstract
This study was conducted to investigate the effect of CEVMS on driver visual behavior in a roadway driving environment. An instrumented vehicle with an eye tracking system was used. Roads containing CEVMS, standard billboards, and control areas with no off-premise advertising were selected. Data were collected on arterials and freeways in the day and nighttime. Field studies were conducted in two cities where the same methodology was used but there were differences in the roadway visual environment. The gazes to the road ahead were high across the conditions; however, the CEVMS and billboard conditions resulted in a lower probability of gazes as compared to the control conditions (roadways not containing off-premise advertising) with the exception of arterials in Richmond where none of the conditions differed from each other. Examination of where drivers gazed in the CEVMS and standard billboard conditions showed that gazes away from the road ahead were not primarily to the billboards. Average and maximum fixations to CEVMS and standard billboards were similar across all conditions. However, four long dwell times were found (sequential and multiple fixations) that were greater than 2,000 ms. One was to a CEVMS on a freeway in the day time, two were to the same standard billboard on a freeway once in the day and once at night; and one was to a standard billboard on an arterial at night. In Richmond, the results showed that drivers gazed more at CEVMS than at standard billboards at night; however, in Reading the drivers were equally likely to gaze towards CEVMS or standard billboards in day and night. The results of the study are consistent with research and theory on the control of gaze behavior in natural environments. The demands of the driving task tend to affect the driver's self-regulation of gaze behavior.

17. Key Words	18. Distribution Statement
Driver visual behavior, visual environment, billboards, eye tracking system, commercial electronic variable message signs, CEVMS, visual complexity	No restrictions.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified		

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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LIST OF ACRONYMS AND SYMBOLS

CEVMS	Commercial Electronic Variable Message Sign
EB	Empirical Bayes
DCZ	Data Collection Zone
ROI	Region of Interest
LED	Light-Emitting Diode
IR	Infra-Red
CCD	Charge-Coupled Device
MAPPS	Multiple-Analysis of Psychophysical and Performance Signals
GEE	Generalized Estimating Equations
FHWA	Federal Highway Administration
DOT	Department of Transportation

EXECUTIVE SUMMARY

This study examines where drivers look when driving past commercial electronic variable message signs (CEVMS), standard billboards, or no off-premise advertising. The results and conclusions are presented in response to the three research questions listed below:

1. Do CEVMS attract drivers' attention away from the forward roadway and other driving-relevant stimuli?

2. Do glances to CEVMS occur that would suggest a decrease in safety?

3. Do drivers look at CEVMS more than at standard billboards?

This study follows a Federal Highway Administration (FHWA) review of the literature on the possible distracting and safety effects of off-premise advertising and CEVMS in particular. The review considered laboratory studies, driving simulator studies, field research vehicle studies, and crash studies. The published literature indicated that there was no consistent evidence showing a safety or distraction effect due to off-premise advertising. However, the review also enumerated potential limitations in the previous research that may have resulted in the finding of no distraction effects for off-premise advertising. The study team recommended that additional research be conducted using instrumented vehicle research methods with eye tracking technology.

The eyes are constantly moving and they fixate (focus on a specific object or area), perform saccades (eye movements to change the point of fixation), and engage in pursuit movements (track moving objects). It is during fixations that we take in detailed information about the environment. Eye tracking allows one to determine to what degree off-premise advertising may divert attention away from the forward roadway. A finding that areas containing CEVMS result in significantly more gazes to the billboards at a cost of not gazing toward the forward roadway would suggest a potential safety risk. In addition to measuring the degree to which CEVMS may distract from the forward roadway, an eye tracking device would allow an examination of the duration of fixations and dwell times (multiple sequential fixations) to CEVMS and standard billboards. Previous research conducted by the National Highway Traffic Safety Administration (NHTSA) led to the conclusion that taking your eyes off the road for 2 seconds or more presents a safety risk. Measuring fixations and dwell times to CEVMS and standard billboards would also allow a determination as to the degree to which these advertising signs lead to potentially unsafe gaze behavior.

Most of the literature concerning eye gaze behavior in dynamic environments suggests that task demands tend to override visual salience (an object that stands out because of its physical properties) in determining attention allocation. When extended to driving, it would be expected that visual attention will be directed toward task-relevant areas and objects (e.g., the roadway, other vehicles, speed limit signs) and that other salient objects, such as billboards, would not necessarily capture attention. However, driving is a somewhat automatic process and conditions generally do not require constant, undivided attention. As a result, salient stimuli, such as CEVMS, might capture driver attention and produce an unwanted increase in driver distraction. The present study addresses this concern.

This study used an instrumented vehicle with an eye tracking system to measure where drivers were looking when driving past CEVMS and standard billboards. The CEVMS and standard billboards were measured with respect to luminance, location, size, and other relevant variables to characterize these visual stimuli extensively. Unlike previous studies on digital billboards, the present study examined CEVMS as deployed in two United States cities. These billboards did not contain dynamic video or other dynamic elements, but changed content approximately every 8 to 10 seconds. The eye tracking system had nearly a 2-degree level of resolution that provided significantly more accuracy in determining what objects the drivers were looking at compared to an earlier naturalistic driving study. This study assessed two data collection efforts that employed the same methodology in two cities.

In each city, the study examined eye glance behavior to four CEVMS, two on arterials and two on freeways. There were an equal number of signs on the left and right side of the road for arterials and freeways. The standard billboards were selected for comparison with CEVMS such that one standard billboard environment matched as closely as possible that of each of the CEVMS. Two control locations were selected that did not contain off-premise advertising, one on an arterial and the other on a freeway. This resulted in 10 data collection zones in each city that were approximately 1,000 feet in length (the distance from the start of the data collection zone to the point that the CEVMS or standard billboard disappeared from the data collection video).

In Reading, Pennsylvania, 14 participants drove at night and 17 drove during the day. In Richmond, Virginia, 10 participants drove at night and 14 drove during the day. Calibration of the eye tracking system, practice drive, and the data collection drive took approximately 2 hours per participant to accomplish.

The following is a summary of the study results and conclusions presented in reference to the three research questions the study aimed to address.

Do CEVMS attract drivers' attention away from the forward roadway and other driving relevant stimuli?

- On average, the drivers in this study devoted between 73 and 85 percent of their visual attention to the road ahead for both CEVMS and standard billboards. This range is consistent with earlier field research studies. In the present study, the presence of CEVMS did not appear to be related to a decrease in looking toward the road ahead.

Do glances to CEVMS occur that would suggest a decrease in safety?

- The average fixation duration to CEVMS was 379 ms and to standard billboards it was 335 ms across the two cities. The average fixation durations to CEVMS and standard billboards were similar to the average fixation duration to the road ahead.

- The longest fixation to a CEVMS was 1,335 ms and to a standard billboard it was 1,284 ms. The current widely accepted threshold for durations of glances away from the road ahead that result in higher crash risk is 2,000 ms. This value comes from a NHTSA

naturalistic driving study that showed a significant increase in crash odds when glances away from the road ahead were 2,000 ms or longer.

- Four dwell times (aggregate of consecutive fixations to the same object) greater than 2,000 ms were observed across the two studies. Three were to standard billboards and one was to a CEVMS. The long dwell time to the CEVMS occurred in the daytime to a billboard viewable from a freeway. Review of the video data for these four long dwell times showed that the signs were not far from the forward view while participant's gaze dwelled on them. Therefore, the drivers still had access to information about what was in front of them through peripheral vision.

- The results did not provide evidence indicating that CEVMS, as deployed and tested in the two selected cities, were associated with unacceptably long glances away from the road. When dwell times longer than the currently accepted threshold of 2,000 ms occurred, the road ahead was still in the driver's field of view. This was the case for both CEVMS and standard billboards.

Do drivers look at CEVMS more than at standard billboards?

- When comparing the probability of a gaze at a CEVMS versus a standard billboard, the drivers in this study were generally more likely to gaze at CEVMS than at standard billboards. However, some variability occurred between the two locations and between the types of roadway (arterial or freeway).

- In Reading, when considering the proportion of time spent looking at billboards, the participants looked more often at CEVMS than at standard billboards when on arterials (63 percent to CEVMS and 37 percent to a standard billboard), whereas they looked more often at standard billboards when on freeways (33 percent to CEVMS and 67 percent to a standard billboard). In Richmond, the drivers looked at CEVMS more than standard billboards no matter the type of road they were on, but as in Reading, the preference for gazing at CEVMS was greater on arterials (68 percent to CEVMS and 32 percent to standard billboards) than on freeways (55 percent to CEVMS and 45 percent to standard billboards). When a gaze was to an off-premise advertising sign, the drivers were generally more likely to gaze at a CEVMS than at a standard billboard.

- In Richmond, the drivers showed a preference for gazing at CEVMS versus standard billboards at night, but in Reading the time of day did not affect gaze behavior. In Richmond, drivers gazed at CEVMS 71 percent and at standard billboards 29 percent at night. On the other hand, in the day the drivers gazed at CEVMS 52 percent and at standard billboards 48 percent.

- In Reading, the average gaze dwell time for CEVMS was 981 ms and for standard billboards it was 1,386 ms. The difference in these average dwell times was not statistically significant. In contrast, the average dwell times to CEVMS and standard billboards were significantly different in Richmond (1,096 ms and 674 ms, respectively).

The present data suggest that the drivers in this study directed the majority of their visual attention to areas of the roadway that were relevant to the task at hand (e.g., the driving task). Furthermore, it is possible, and likely, that in the time that the drivers looked away from the forward roadway, they may have elected to glance at other objects in the surrounding environment (in the absence of billboards) that were not relevant to the driving task. When billboards were present, the drivers in this study sometimes looked at them, but not such that overall attention to the forward roadway decreased.

It also should be noted that, like other studies in the available literature, this study adds to the knowledge base on the issues examined, but does not present definitive answers to the research questions investigated.

INTRODUCTION

SIMOFF ENGINEERING ASSOCIATES, INC. (SEA) has prepared this Traffic Safety Environmental, and Visual Impact analysis for a proposed billboard, on the property located adjacent to Route 202, known as Block 31 Lot 1, in Borough of Raritan, Somerset County, New Jersey. The sign is at milepost 22.87 ± of Route 202 Northbound. New Jersey Department of Transportation Straight Line Diagram depicting the site location is noted as Figure 2 of this report.

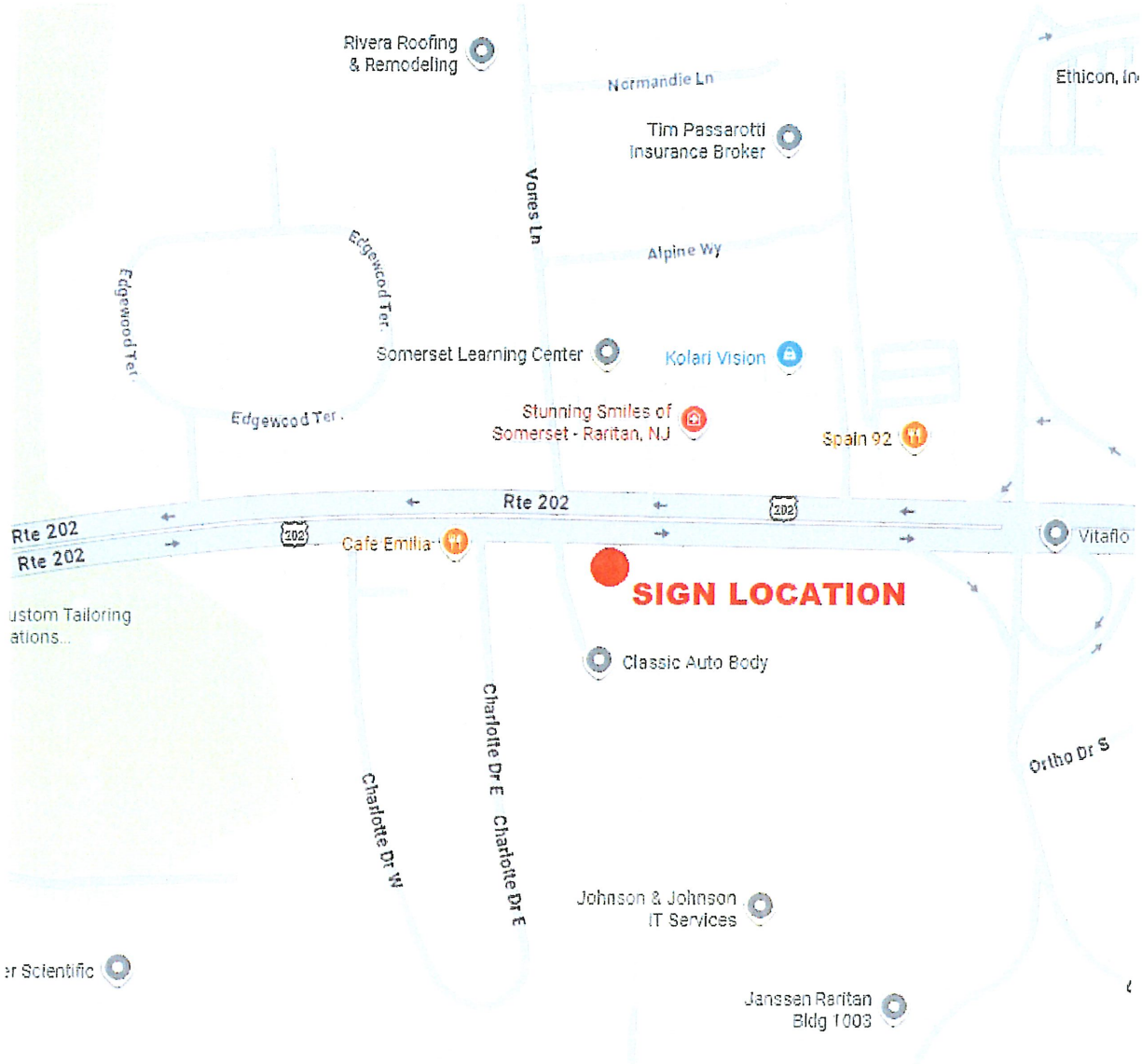


Figure 1. Location Map

The proposed sign dimensions are as follows:

Overall Height:	50.00'
Sign Width:	48'
Sign Height:	14'

The purpose of this analysis is to evaluate the traffic safety, visual and environmental impacts of the construction of the proposed outdoor advertising sign. Accordingly, this analysis includes the following:

- A review of the Site Plan prepared by L2A Land Design
- A review of existing roadways and traffic conditions in the vicinity of the site;
- Perform a "Cone of Vision" Analysis, to evaluate if the proposed sign will be located within the peripheral vision of the drivers, and if so, will not create any safety hazards;
- Crash records compiled for Route 202, and
- Conclusions of this study.

Our findings indicate that construction of the sign will not have any detrimental effects on safety and traffic flow along Route 202. The conclusion confirms that there are no detrimental impacts to traffic safety the analysis further confirms that the proposed billboard can be constructed without any negative environmental impacts.

ANALYSIS

In this area, Route 202 is straight and level and separated by a median. The roadway has two lanes in each direction, plus shoulders. As noted above, the proposed sign will be located at approximately milepost 22.87 on Route 202. Figure 2 shows the sign location on the NJDOT Straight Line Diagram.

We reviewed the NJDOT count station on Route 202 between Charlotte Drive and Ortho Drive to evaluate traffic volumes at the site. The station reported an Annual Average Daily Traffic (AADT) of 25,803 vehicles northbound and 27,324 vehicles southbound in

2013. We used these counts in our analysis as a conservative assumption, because higher traffic volumes would result in lower crash rates.

A "Cone of Vision" analysis was performed using the methodology outlined in the FHWA publication **DRIVER VISUAL BEHAVIOR IN THE PRESENCE OF COMMERCIAL ELECTRONIC VARIABLE MESSAGE SIGNS (CEVMS)**, issued in coordination with the U.S. Department of Transportation and the Federal Highway Administration. The purpose of the analysis was to determine whether the proposed sign falls within the driver's cone of vision and to evaluate the distance and time during which drivers can observe it. Exhibit B shows the cone of vision for approaching traffic.

We analyzed the sign location using an assumed reading distance of 800 feet and calculated the time during which drivers can view the sign copy. The posted speed limit on Route 202 is 55 mph, or 80.7 feet per second. Visibility distance is based on the motorist's viewing angle in each direction, taking into account horizontal and vertical roadway alignment. Based on these factors, the proposed sign will be visible within the cone of vision as follows:

- Route 202 NB –705 feet, 8.7 seconds
- Route 202 SB – 640 feet 7.9 seconds

The FHWA study titled **DRIVER VISUAL BEHAVIOR IN THE PRESENCE OF COMMERCIAL ELECTRONIC VARIABLE MESSAGE SIGNS (CEVMS)**, summarized in Exhibit D, found that motorists' average glance duration at billboards was 0.3 seconds. By comparison, the cone-of-vision analysis indicates that the proposed sign will be visible for 7.9 to 8.7 seconds. The sign's placement and height will allow motorists to observe it without distraction from the driving task. The study also found that billboards were not associated with long glances away from the driver's field of view.

The 40-degree cone-of-vision analysis shows that drivers will have more than adequate time for the sign to remain within their field of view.

The billboard will not negatively affect highway safety or the time motorists need to see and react to highway signs and perform other driving tasks. This conclusion is supported by U.S. Department of Transportation research.

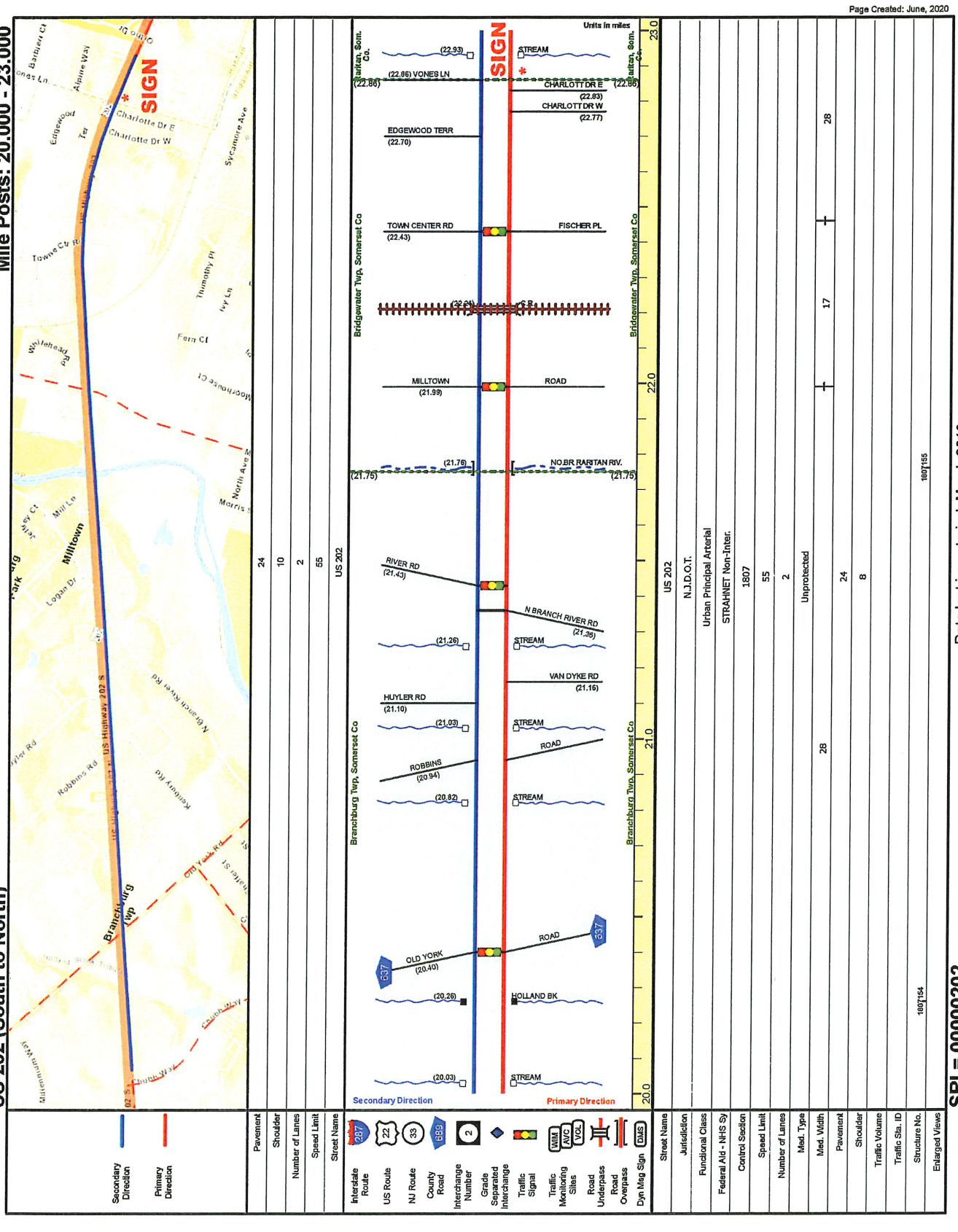


Figure 2. Straight Line Diagram.

EXISTING CRASH RATES

We reviewed crash rates along the section of Route 202 where the sign will be visible to passing motorists. NJDOT data for 2022 through 2024, the most recent years available, were analyzed. The 0.15-mile northbound and 0.15-mile southbound segments from which the proposed billboard is visible showed the following number of crashes:

YEAR	CRASHES	
	Northbound	Southbound
2022	4	0
2023	0	5
2024	1	2
Three-year average	1.7 crashes/year	2.3 crashes/year

Using the published AADT of 25,803 vehicles northbound on Route 202, approximately 9.4 million vehicles pass the site northbound each year. Using the southbound AADT of 27,324 vehicles, approximately 10.0 million vehicles pass the site southbound each year. The billboard visibility study area is 0.15 mile (800 feet). Crash rates are calculated based on traffic volume and crash frequency and are expressed as crashes per million vehicle miles (MVM). The resulting crash rates for the proposed billboard viewing area are 1.2 crashes per MVM northbound and 1.8 crashes per MVM southbound. These figures indicate very low crash rates.

CONCLUSION

Based on what has been presented in the previous sections, the following summarized view can be concluded:

- The geometric alignment of Route 202 in the vicinity of the proposed sign provides the motorists with proper viewing angles. Therefore, it will not present any unsafe distractions or safety hazards;
- A "Cone of Vision" Analysis was performed, and it determines that the proposed sign will be located within the driver's cone of vision for significant distance without creating loss of forward view of the billboard and/or conflicts;
- The existing crash rates in the viewing area of the proposed billboard are low and based on the reference material there is no indication that the rate will increase.

Vehicles travelling at 55 Miles per hour i.e., 80.7 feet per second will have more than adequate time to digest the copy of the billboard without being distracted from the driving task. Grant of the variance relief will not create adverse impacts from a traffic engineering point of view.

In conclusion, the findings of this analysis indicate that the construction of the billboard on Lot 1 in Block 31 can be implemented without adversely impacting driver safety and without detriment to the health, safety, and welfare of the community.

EXHIBIT A

CONE OF VISION, HORZONTAL ALIGNMENT

VIEWING STUDY

PROPOSED MULTIMESSAGE BILLBOARD
1137 U.S. HIGHWAY ROUTE 202
BLOCK 31, LOT 1, TAX MAP 6
BOROUGH OF RARITAN, SOMERSET COUNTY, NEW JERSEY

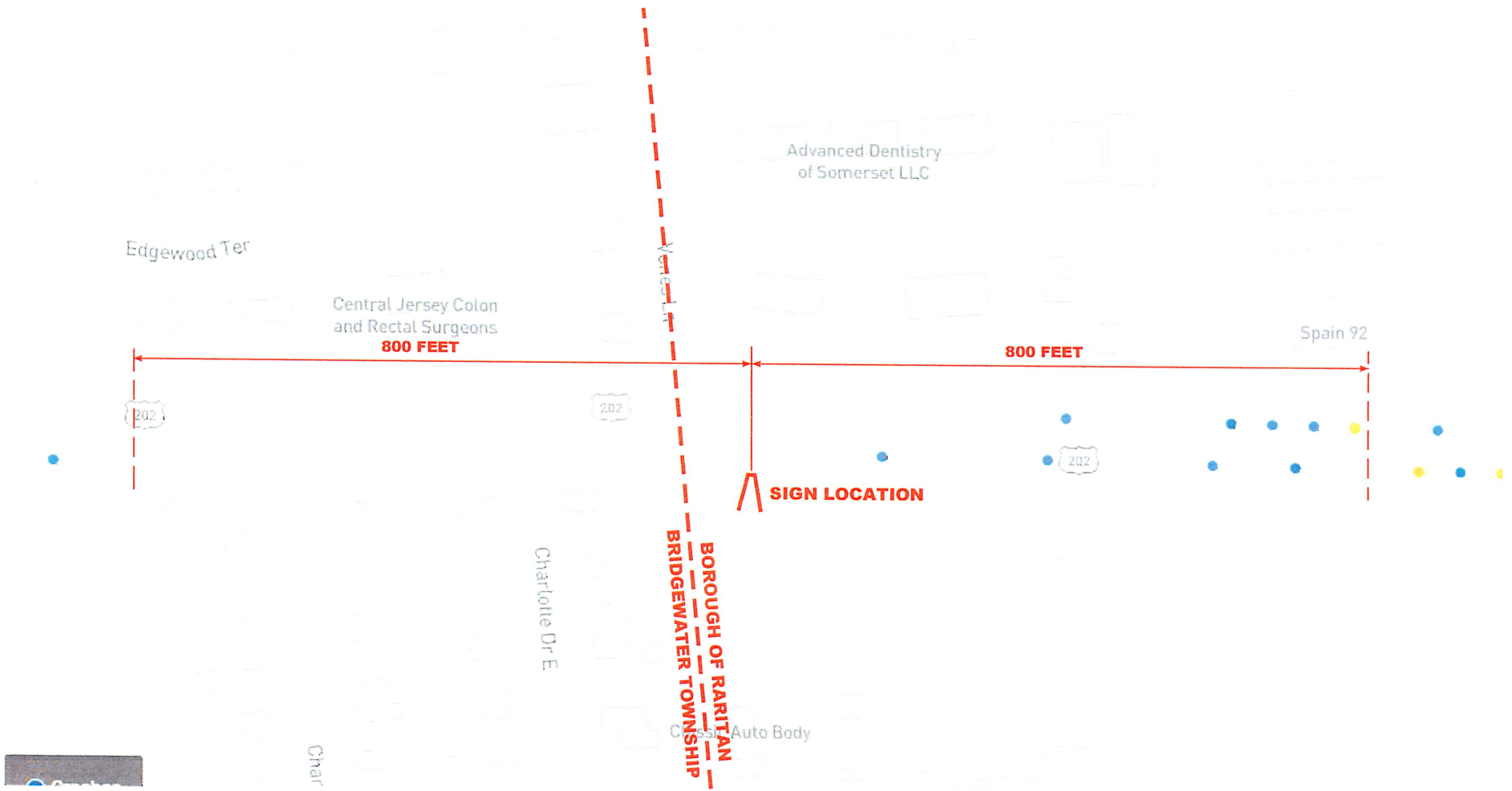
FILE No: 26-104

EXHIBIT "A"

EXHIBIT B

2022, 2023 & 2024 CRASH DATA

CRASH PLOTTING 2022
SOURCE: NJDOT DATA



CRASH PLOTTING 2023
SOURCE: NJDOT DATA

CRASH PLOTTING 2024.
SOURCE: NJDOT DATA

EXHIBIT C

NJDOT TRAFFIC COUNTS

N... Je...ey ...pa...ner...f T...ns...ta...n

Daily Volume from 10/15/2013 through 10/27/2013

Site Names: 120065, , US 202-22.85, 00000202__, Bridgewater Twp
County: SOMERSET
Funct. Class: Urban Principal Arterial - Other
Location: Bet Charlotte Drive and Ortho Drive

Seasonal Factor Group: RG3_FC14
Daily Factor Group: RG3_FC14
Axle Factor Group: RG3_FC14
Growth Factor Group: RG3_FC14

	Sun 10/13/2013			Mon 10/14/2013			Tue 10/15/2013			Wed 10/16/2013			Thu 10/17/2013			Fri 10/18/2013			Sat 10/19/2013		
	ROAD	S	N	ROAD	S	N	ROAD	S	N	ROAD	S	N	ROAD	S	N	ROAD	S	N	ROAD	S	N
00:00							133		133	172		172	181		181	211		211	243		243
01:00							114		114	106		106	119		119	119		119	95		95
02:00							82		82	94		94	87		87	87		87	78		78
03:00							112		112	130		130	112		112	139		139	73		73
04:00							250		250	261		261	258		258	256		256	93		93
05:00							774		774	703		703	697		697	667		667	238		238
06:00							1,959		1,959	1,975		1,975	1,919		1,919	1,744		1,744	593		593
07:00							2,257		2,257	2,441		2,441	2,457		2,457	2,272		2,272	850		850
08:00							1,456		1,456	2,192		2,192	2,219		2,219	2,119		2,119	1,161		1,161
09:00							2,033		2,033	1,837		1,837	1,771		1,771	1,668		1,668	1,468		1,468
10:00							1,506		1,506	1,526		1,526	1,542		1,542	1,587		1,587	1,695		1,695
11:00							1,475		1,475	1,489		1,489	1,559		1,559	1,592		1,592	1,729		1,729
12:00							1,517		1,517	1,590		1,590	1,634		1,634	1,652		1,652	1,789		1,789
13:00							1,572		1,572	1,605		1,605	1,547		1,547	1,701		1,701	1,812		1,812
14:00							1,650		1,650	1,620		1,620	1,616		1,616	1,837		1,837	1,924		1,924
15:00							1,831		1,831	1,824		1,824	1,970		1,970	1,923		1,923	1,998		1,998
16:00							1,774		1,774	1,778		1,778	1,702		1,702	1,806		1,806	2,023		2,023
17:00							1,697		1,697	1,720		1,720	1,591		1,591	1,857		1,857	1,968		1,968
18:00							1,696		1,696	1,638		1,638	1,765		1,765	1,800		1,800	1,818		1,818
19:00							1,147		1,147	1,200		1,200	1,201		1,201	1,414		1,414	1,422		1,422
20:00							821		821	918		918	829		829	1,021		1,021	975		975
21:00							631		631	538		538	650		650	732		732	887		887
22:00							358		358	423		423	368		368	631		631	693		693
23:00							297		297	264		264	288		288	498		498	474		474
Volume							27,142		27,142	28,044		28,044	28,082		28,082	29,333		29,333	26,099		26,099
AM Peak Vol							2,257		2,257	2,441		2,441	2,457		2,457	2,272		2,272	1,729		1,729
AM Peak Fct							1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
AM Peak Hr							7:00		7:00	7:00		7:00	7:00		7:00	7:00		7:00	11:00		11:00
PM Peak Vol							1,831		1,831	1,824		1,824	1,970		1,970	1,923		1,923	2,023		2,023
PM Peak Fct							1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
PM Peak Hr							15:00		15:00	15:00		15:00	15:00		15:00	15:00		15:00	16:00		16:00
Seasonal Fct							0.983		0.983	0.983		0.983	0.983		0.983	0.983		0.983	0.983		0.983
Daily Fct							1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000
Axle Fct							0.487		0.487	0.487		0.487	0.487		0.487	0.487		0.487	0.487		0.487
Pulse Fct							2.000		2.000	2.000		2.000	2.000		2.000	2.000		2.000	2.000		2.000

Collected by: NJDOT
Created 06/25/2015 6:30:29PM

ROAD AADT 25,803 **S AADT 0** **N AADT 25,803**

Daily Volume from 10/16/2013 through 10/27/2013

Site Names: 120067, , US 202-23.73, 00000202__, Raritan Boro
County: SOMERSET
Funct. Class: Urban Principal Arterial - Other
Location: Bet RT 567 First Avenue and Ortho Pharmaceutical Driveway

Seasonal Factor Group: RG3_FC14
Daily Factor Group: RG3_FC14
Axle Factor Group: RG3_FC14
Growth Factor Group: RG3_FC14

	Sun 10/20/2013			Mon 10/21/2013			Tue 10/22/2013			Wed 10/23/2013			Thu 10/24/2013			Fri 10/25/2013			Sat 10/26/2013		
	ROAD	N	S	ROAD	N	S	ROAD	N	S	ROAD	N	S	ROAD	N	S	ROAD	N	S	ROAD	N	S
00:00	331		331	117		117	285		285	168		168	170		170	201		201	304		304
01:00	282		282	96		96	113		113	90		90	99		99	114		114	165		165
02:00	126		126	64		64	77		77	83		83	70		70	100		100	95		95
03:00	72		72	80		80	89		89	97		97	96		96	84		84	107		107
04:00	108		108	205		205	240		240	250		250	257		257	255		255	171		171
05:00	179		179	547		547	548		548	575		575	506		506	499		499	328		328
06:00	283		283	1,274		1,274	1,324		1,324	1,317		1,317	1,258		1,258	1,173		1,173	506		506
07:00	544		544	1,936		1,936	2,088		2,088	2,034		2,034	2,107		2,107	1,926		1,926	701		701
08:00	867		867	2,286		2,286	2,332		2,332	2,270		2,270	2,324		2,324	2,053		2,053	1,021		1,021
09:00	1,157		1,157	1,693		1,693	1,812		1,812	1,638		1,638	1,778		1,778	1,610		1,610	1,417		1,417
10:00	1,673		1,673	1,386		1,386	1,362		1,362	1,294		1,294	1,412		1,412	1,467		1,467	1,641		1,641
11:00	1,951		1,951	1,517		1,517	1,398		1,398	1,417		1,417	1,501		1,501	1,645		1,645	2,019		2,019
12:00	2,085		2,085	1,685		1,685	1,659		1,659	1,575		1,575	1,750		1,750	1,866		1,866	2,127		2,127
13:00	2,079		2,079	1,673		1,673	1,624		1,624	1,671		1,671	1,813		1,813	1,985		1,985	2,078		2,078
14:00	1,500		1,500	1,739		1,739	1,822		1,822	1,874		1,874	1,883		1,883	2,110		2,110	2,079		2,079
15:00	1,794		1,794	1,974		1,974	1,980		1,980	2,122		2,122	2,104		2,104	2,245		2,245	2,013		2,013
16:00	1,701		1,701	2,193		2,193	2,137		2,137	2,233		2,233	2,105		2,105	2,263		2,263	2,017		2,017
17:00	1,784		1,784	2,097		2,097	2,111		2,111	2,105		2,105	2,145		2,145	2,136		2,136	1,752		1,752
18:00	1,551		1,551	2,042		2,042	2,085		2,085	2,127		2,127	2,136		2,136	1,985		1,985	1,697		1,697
19:00	1,241		1,241	1,616		1,616	1,656		1,656	1,679		1,679	1,807		1,807	1,754		1,754	1,343		1,343
20:00	974		974	1,066		1,066	1,198		1,198	1,247		1,247	1,272		1,272	1,174		1,174	1,123		1,123
21:00	723		723	783		783	912		912	948		948	1,046		1,046	1,213		1,213	987		987
22:00	470		470	470		470	502		502	568		568	711		711	777		777	717		717
23:00	262		262	297		297	281		281	319		319	386		386	514		514	583		583
Volume	23,737		23,737	28,836		28,836	29,635		29,635	29,701		29,701	30,736		30,736	31,149		31,149	26,991		26,991
AM Peak Vol	1,951		1,951	2,286		2,286	2,332		2,332	2,270		2,270	2,324		2,324	2,053		2,053	2,019		2,019
AM Peak Fct	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
AM Peak Hr	11:00		11:00	8:00		8:00	8:00		8:00	8:00		8:00	8:00		8:00	8:00		8:00	11:00		11:00
PM Peak Vol	2,085		2,085	2,193		2,193	2,137		2,137	2,233		2,233	2,145		2,145	2,263		2,263	2,127		2,127
PM Peak Fct	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
PM Peak Hr	12:00		12:00	16:00		16:00	16:00		16:00	16:00		16:00	17:00		17:00	16:00		16:00	12:00		12:00
Seasonal Fct	0.983		0.983	0.983		0.983	0.983		0.983	0.983		0.983	0.983		0.983	0.983		0.983	0.983		0.983
Daily Fct	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000		1.000
Axle Fct	0.487		0.487	0.487		0.487	0.487		0.487	0.487		0.487	0.487		0.487	0.487		0.487	0.487		0.487
Pulse Fct	2.000		2.000	2.000		2.000	2.000		2.000	2.000		2.000	2.000		2.000	2.000		2.000	2.000		2.000

Collected by: NJDOT
Created 06/25/2015 6:30:31PM

ROAD AADT 27,324 **N AADT 0** **S AADT 27,324**

EXHIBIT D

EXECUTIVE SUMMARY OF FHWA REPORT

DRIVER VISUAL BEHAVIOR IN THE PRESENCE OF COMMERCIAL ELECTRONIC VARIABLE MESSAGE SIGNS (CEVMS)

SEPTEMBER 2012

U.S. Department of Transportation
Federal Highway Administration

FHWA-HEP-

FOREWORD

The advent of electronic billboard technologies, in particular the digital Light-Emitting Diode (LED) billboard, has necessitated a reevaluation of current legislation and regulation for controlling outdoor advertising. In this case, one of the concerns is possible driver distraction. In the context of the present report, outdoor advertising signs employing this new advertising technology are referred to as Commercial Electronic Variable Message Signs (CEVMS). They are also commonly referred to as Digital Billboards and Electronic Billboards.

The present report documents the results of a study conducted to investigate the effects of CEVMS used for outdoor advertising on driver visual behavior in a roadway driving environment. The report consists of a brief review of the relevant published literature related to billboards and visual distraction, the rationale for the Federal Highway Administration research study, the methods by which the study was conducted, and the results of the study, which used an eye tracking system to measure driver glances while driving on roadways in the presence of CEVMS, standard billboards, and other roadside elements. The report should be of interest to highway engineers, traffic engineers, highway safety specialists, the outdoor advertising industry, environmental advocates, Federal policymakers, and State and local regulators of outdoor advertising.

Monique R. Evans
Director, Office of Safety
Research and Development

Nelson Castellanos
Director, Office of Real Estate
Services

TECHNICAL DOCUMENTATION PAGE

1. Report No. FHWA-HRT-	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Driver Visual Behavior in the Presence of Commercial Electronic Variable Message Signs (CEVMS)		5. Report Date 6. Performing Organization Code
7. Author(s) William A. Perez, Mary Anne Bertola, Jason F. Kennedy, and John A. Molino		8. Performing Organization Report No.
9. Performing Organization Name and Address SAIC 6300 Georgetown Pike McLean, VA 22101		10. Work Unit No. (TRAIS) 11. Contract or Grant No.
12. Sponsoring Agency Name and Address Office of Real Estate Services Federal Highway Administration 1200 New Jersey Avenue SE Washington, DC 20590		13. Type of Report and Period Covered 14. Sponsoring Agency Code

15. Supplementary Notes
The Contracting Officer's Technical Representatives (COTR) were Christopher Monk and Thomas Granda.

16. Abstract
This study was conducted to investigate the effect of CEVMS on driver visual behavior in a roadway driving environment. An instrumented vehicle with an eye tracking system was used. Roads containing CEVMS, standard billboards, and control areas with no off-premise advertising were selected. Data were collected on arterials and freeways in the day and nighttime. Field studies were conducted in two cities where the same methodology was used but there were differences in the roadway visual environment. The gazes to the road ahead were high across the conditions; however, the CEVMS and billboard conditions resulted in a lower probability of gazes as compared to the control conditions (roadways not containing off-premise advertising) with the exception of arterials in Richmond where none of the conditions differed from each other. Examination of where drivers gazed in the CEVMS and standard billboard conditions showed that gazes away from the road ahead were not primarily to the billboards. Average and maximum fixations to CEVMS and standard billboards were similar across all conditions. However, four long dwell times were found (sequential and multiple fixations) that were greater than 2,000 ms. One was to a CEVMS on a freeway in the day time, two were to the same standard billboard on a freeway once in the day and once at night; and one was to a standard billboard on an arterial at night. In Richmond, the results showed that drivers gazed more at CEVMS than at standard billboards at night; however, in Reading the drivers were equally likely to gaze towards CEVMS or standard billboards in day and night. The results of the study are consistent with research and theory on the control of gaze behavior in natural environments. The demands of the driving task tend to affect the driver's self-regulation of gaze behavior.

17. Key Words	18. Distribution Statement
Driver visual behavior, visual environment, billboards, eye tracking system, commercial electronic variable message signs, CEVMS, visual complexity	No restrictions.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified		

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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LIST OF ACRONYMS AND SYMBOLS

CEVMS	Commercial Electronic Variable Message Sign
EB	Empirical Bayes
DCZ	Data Collection Zone
ROI	Region of Interest
LED	Light-Emitting Diode
IR	Infra-Red
CCD	Charge-Coupled Device
MAPPS	Multiple-Analysis of Psychophysical and Performance Signals
GEE	Generalized Estimating Equations
FHWA	Federal Highway Administration
DOT	Department of Transportation

EXECUTIVE SUMMARY

This study examines where drivers look when driving past commercial electronic variable message signs (CEVMS), standard billboards, or no off-premise advertising. The results and conclusions are presented in response to the three research questions listed below:

1. Do CEVMS attract drivers' attention away from the forward roadway and other driving-relevant stimuli?

2. Do glances to CEVMS occur that would suggest a decrease in safety?

3. Do drivers look at CEVMS more than at standard billboards?

This study follows a Federal Highway Administration (FHWA) review of the literature on the possible distracting and safety effects of off-premise advertising and CEVMS in particular. The review considered laboratory studies, driving simulator studies, field research vehicle studies, and crash studies. The published literature indicated that there was no consistent evidence showing a safety or distraction effect due to off-premise advertising. However, the review also enumerated potential limitations in the previous research that may have resulted in the finding of no distraction effects for off-premise advertising. The study team recommended that additional research be conducted using instrumented vehicle research methods with eye tracking technology.

The eyes are constantly moving and they fixate (focus on a specific object or area), perform saccades (eye movements to change the point of fixation), and engage in pursuit movements (track moving objects). It is during fixations that we take in detailed information about the environment. Eye tracking allows one to determine to what degree off-premise advertising may divert attention away from the forward roadway. A finding that areas containing CEVMS result in significantly more gazes to the billboards at a cost of not gazing toward the forward roadway would suggest a potential safety risk. In addition to measuring the degree to which CEVMS may distract from the forward roadway, an eye tracking device would allow an examination of the duration of fixations and dwell times (multiple sequential fixations) to CEVMS and standard billboards. Previous research conducted by the National Highway Traffic Safety Administration (NHTSA) led to the conclusion that taking your eyes off the road for 2 seconds or more presents a safety risk. Measuring fixations and dwell times to CEVMS and standard billboards would also allow a determination as to the degree to which these advertising signs lead to potentially unsafe gaze behavior.

Most of the literature concerning eye gaze behavior in dynamic environments suggests that task demands tend to override visual salience (an object that stands out because of its physical properties) in determining attention allocation. When extended to driving, it would be expected that visual attention will be directed toward task-relevant areas and objects (e.g., the roadway, other vehicles, speed limit signs) and that other salient objects, such as billboards, would not necessarily capture attention. However, driving is a somewhat automatic process and conditions generally do not require constant, undivided attention. As a result, salient stimuli, such as CEVMS, might capture driver attention and produce an unwanted increase in driver distraction. The present study addresses this concern.

This study used an instrumented vehicle with an eye tracking system to measure where drivers were looking when driving past CEVMS and standard billboards. The CEVMS and standard billboards were measured with respect to luminance, location, size, and other relevant variables to characterize these visual stimuli extensively. Unlike previous studies on digital billboards, the present study examined CEVMS as deployed in two United States cities. These billboards did not contain dynamic video or other dynamic elements, but changed content approximately every 8 to 10 seconds. The eye tracking system had nearly a 2-degree level of resolution that provided significantly more accuracy in determining what objects the drivers were looking at compared to an earlier naturalistic driving study. This study assessed two data collection efforts that employed the same methodology in two cities.

In each city, the study examined eye glance behavior to four CEVMS, two on arterials and two on freeways. There were an equal number of signs on the left and right side of the road for arterials and freeways. The standard billboards were selected for comparison with CEVMS such that one standard billboard environment matched as closely as possible that of each of the CEVMS. Two control locations were selected that did not contain off-premise advertising, one on an arterial and the other on a freeway. This resulted in 10 data collection zones in each city that were approximately 1,000 feet in length (the distance from the start of the data collection zone to the point that the CEVMS or standard billboard disappeared from the data collection video).

In Reading, Pennsylvania, 14 participants drove at night and 17 drove during the day. In Richmond, Virginia, 10 participants drove at night and 14 drove during the day. Calibration of the eye tracking system, practice drive, and the data collection drive took approximately 2 hours per participant to accomplish.

The following is a summary of the study results and conclusions presented in reference to the three research questions the study aimed to address.

Do CEVMS attract drivers' attention away from the forward roadway and other driving relevant stimuli?

- On average, the drivers in this study devoted between 73 and 85 percent of their visual attention to the road ahead for both CEVMS and standard billboards. This range is consistent with earlier field research studies. In the present study, the presence of CEVMS did not appear to be related to a decrease in looking toward the road ahead.

Do glances to CEVMS occur that would suggest a decrease in safety?

- The average fixation duration to CEVMS was 379 ms and to standard billboards it was 335 ms across the two cities. The average fixation durations to CEVMS and standard billboards were similar to the average fixation duration to the road ahead.

- The longest fixation to a CEVMS was 1,335 ms and to a standard billboard it was 1,284 ms. The current widely accepted threshold for durations of glances away from the road ahead that result in higher crash risk is 2,000 ms. This value comes from a NHTSA

naturalistic driving study that showed a significant increase in crash odds when glances away from the road ahead were 2,000 ms or longer.

- Four dwell times (aggregate of consecutive fixations to the same object) greater than 2,000 ms were observed across the two studies. Three were to standard billboards and one was to a CEVMS. The long dwell time to the CEVMS occurred in the daytime to a billboard viewable from a freeway. Review of the video data for these four long dwell times showed that the signs were not far from the forward view while participant's gaze dwelled on them. Therefore, the drivers still had access to information about what was in front of them through peripheral vision.

- The results did not provide evidence indicating that CEVMS, as deployed and tested in the two selected cities, were associated with unacceptably long glances away from the road. When dwell times longer than the currently accepted threshold of 2,000 ms occurred, the road ahead was still in the driver's field of view. This was the case for both CEVMS and standard billboards.

Do drivers look at CEVMS more than at standard billboards?

- When comparing the probability of a gaze at a CEVMS versus a standard billboard, the drivers in this study were generally more likely to gaze at CEVMS than at standard billboards. However, some variability occurred between the two locations and between the types of roadway (arterial or freeway).

- In Reading, when considering the proportion of time spent looking at billboards, the participants looked more often at CEVMS than at standard billboards when on arterials (63 percent to CEVMS and 37 percent to a standard billboard), whereas they looked more often at standard billboards when on freeways (33 percent to CEVMS and 67 percent to a standard billboard). In Richmond, the drivers looked at CEVMS more than standard billboards no matter the type of road they were on, but as in Reading, the preference for gazing at CEVMS was greater on arterials (68 percent to CEVMS and 32 percent to standard billboards) than on freeways (55 percent to CEVMS and 45 percent to standard billboards). When a gaze was to an off-premise advertising sign, the drivers were generally more likely to gaze at a CEVMS than at a standard billboard.

- In Richmond, the drivers showed a preference for gazing at CEVMS versus standard billboards at night, but in Reading the time of day did not affect gaze behavior. In Richmond, drivers gazed at CEVMS 71 percent and at standard billboards 29 percent at night. On the other hand, in the day the drivers gazed at CEVMS 52 percent and at standard billboards 48 percent.

- In Reading, the average gaze dwell time for CEVMS was 981 ms and for standard billboards it was 1,386 ms. The difference in these average dwell times was not statistically significant. In contrast, the average dwell times to CEVMS and standard billboards were significantly different in Richmond (1,096 ms and 674 ms, respectively).

The present data suggest that the drivers in this study directed the majority of their visual attention to areas of the roadway that were relevant to the task at hand (e.g., the driving task). Furthermore, it is possible, and likely, that in the time that the drivers looked away from the forward roadway, they may have elected to glance at other objects in the surrounding environment (in the absence of billboards) that were not relevant to the driving task. When billboards were present, the drivers in this study sometimes looked at them, but not such that overall attention to the forward roadway decreased.

It also should be noted that, like other studies in the available literature, this study adds to the knowledge base on the issues examined, but does not present definitive answers to the research questions investigated.