Specific Service Signs:

Full Service Food Logo Panel MUTCD Experiment

Performed by:
Suzanne E. Lee
Jeremy D. Sudweeks
The Virginia Tech Transportation Institute

and
Susan Willis-Walton
The Virginia Tech Center for Survey Research

Performed for:
The Virginia Department of Transportation
Re: FHWA Official Ruling Number 2-552(E):
More Than Six Logo Panels for Specific Service Category (FOOD).

Under the supervision of:
The Virginia Transportation Research Council

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ABSTRACT

In order to test the safety and acceptance of logo motherboards containing more than one service type, VDOT began a pilot program in 2000 in which seven interchanges (five initially in 2000 and two added in 2001/2002) spaced throughout the commonwealth had Full Service Food logo signs added to the camping motherboard. In some cases, these Full Service Food logo signs were installed on their own motherboards when no camping motherboard was present. The signs have recently been in place long enough to perform meaningful before-after safety evaluations. Two hypotheses were tested as part of this project. The first hypothesis of this experiment is that permitting two Full Service Food logos on another motherboard with vacant space, when there is already a motherboard with six Food logos, will provide more information to the motorist and thus a better level of service. This hypothesis was tested by gathering information on the traveling public's understanding (or lack of understanding) of "Full Service Food" via a telephone survey. Additionally, it is hypothesized that this change will be found to be no more distracting and/or confusing to the motorist than a motherboard having combinations of logos such as Camping/Attractions. If this is true, then there would be no additional safety risk caused by having more than six Food logos on two sign structures. This hypothesis was tested using a before-and-after crash database analysis of before-and-after crash rates for the interchanges of interest as well as for control interchanges.

The telephone survey was conducted with 804 Virginia residents and had a sampling error of ±3.5 percent. Overall results from the survey showed that people have strong opinions about the logo sign program and are willing to share them. People generally reported low levels of confusion with sharing motherboard space. It is interesting to note that almost 70 percent of drivers had not noticed the new category. A large number of open-ended responses appeared to associate the existing Food category with fast food, and the Full Service Food category with sit-down service. However, the open-ended responses also appeared to show some confusion about the meaning of Full Service Food. Many respondents thought that Full Service referred to multi-service facilities, such as combined restaurant/gas station/convenience store/hotel. Even with the confusion about meaning, most thought it would be useful to have this new category. There was also general agreement on the meaning of breakfast. The demographics appeared to be fairly representative of the traveling public in Virginia with the possible exception of the male/female ratio (60 percent of respondents were female).

Crash records from 1999 through 2003 were examined to obtain data on crashes occurring one year before and one year after each of the signs were installed at the test sites. Adjacent exits were used as control sites. Results from the crash analysis indicated that no additional safety risk was found to be caused by having more than six Food logos on two sign structures. The crash data generally showed no sign of an increased number of crashes at the test exits after the signs were installed. Where significant results were found, they were generally driven by changes in the control exits, and were neutral with respect to the test exit. There was nothing in the crash data results to suggest that the additional signs caused an increase in crashes: 1) either during the year after they were installed as compared to the year before they were installed, or 2) as compared to an adjacent, test exit without the signs. Based on the overall survey and database analysis results, changes to the Manual on Uniform Traffic Control Devices (MUTCD) are recommended to allow more than six Food logos spread over multiple motherboards.

SPECIFIC SERVICE SIGNS:
FULL SERVICE FOOD LOGO PANEL MUTCD EXPERIMENT

INTRODUCTION AND PROBLEM STATEMENT

The Virginia Department of Transportation (VDOT) currently follows the requirements of the 2003 Manual on Uniform Traffic Control Devices (MUTCD) in terms of the number and type of logo panels that can be placed on logo motherboards. The current standard limits the number of Specific Service signs ("sign structures") along an approach to an interchange or intersection, regardless of the number of service types displayed, to a maximum of four, with the five permissible service categories of Attractions, Camping, Lodging, Food, and Gas. The motherboards are to be displayed in that order in the direction of traffic flow. In addition, there is a standard that each sign assembly ("motherboard") shall be limited to no more than six logo panels and that no service type shall appear on more than one sign. Thus, if one motherboard is set up to display solely the Food category, there would be a limit of six food establishments represented with logo panels. A seventh food logo could not be placed on the existing food motherboard or any other motherboard that has a vacant spot.

With the existing standards, there is usually at least one motherboard that is underutilized; this is most often the camping motherboard. The Attractions category was added beginning with the 2000 MUTCD, and the Attractions logo panels are permitted to share space with the Camping motherboard. Virginia has recently adopted criteria to utilize the Attractions category.

As in most states, there is significant desire by the business community in Virginia to utilize the excess space (on motherboards that do not have six logo panels) by revising the standard that no service type shall be on more than one sign. Most of this desire occurs from businesses in the Food category. There is also a desire in Virginia to better serve motorists with a variety of food opportunities based upon the type of service and the quality of that service. At the time this study was conducted, Virginia was considering adding a Full Service Food category to its accepted service types. With high demand for space and the limit of six Food logos, it might be considered a disservice to the public to not be able to use the vacant space on other service category motherboards.

In order to test the safety and acceptance of logo motherboards containing more than one service type, VDOT began a pilot program in 2000/2002 in which seven interchanges spaced throughout the commonwealth had Full Service Food logo signs added to the camping motherboard (left side of Figure 1). In some cases, these Full Service Food logo signs were installed on their own motherboards when no camping motherboard was present (right side of Figure 1). These signs were installed over a time span of almost two years, from July 22, 2000 through July 10, 2002. The signs have only recently been in place long enough to perform meaningful before-after safety evaluations.

Figure 1. Full Service Food logo panels sharing space with a Camping motherboard (Exit 143 of I-95) and on its own motherboard where there is no camping motherboard (Exit 92 of I-95).

HYPOTHESES

1. The first hypothesis of this experiment is that permitting two Full Service Food logos on another motherboard with vacant space, when there is already a motherboard with six Food logos, will provide more information to the motorist and thus a better level of service. This hypothesis was tested by gathering information on the traveling public's understanding (or lack of understanding) of "full service food." A determination was also made of what constitutes/is expected for a breakfast meal. A rating scale was developed to assess whether the Full Service Food logos are perceived as providing a better level of service.

2. Additionally, it is hypothesized that this change will be found to be no more distracting and/or confusing to the motorist than a motherboard having combinations of logos such as Camping/Attractions. If this is true, then there would be no additional safety risk caused by having more than six Food logos on two sign structures. This hypothesis was tested using a before-and-after crash database analysis for the interchanges of interest as well as for control interchanges.

METHOD

The Virginia Tech Transportation Institute (VTTI) recently conducted a study of billboards in Charlotte, NC. Several measures of eyeglance location were used as primary measures of driver visual behavior. Additional measures, such as speed variation and lane deviation, were included to provide further insight into driving performance. The overall conclusion from this study was that the presence of billboards did not cause a measurable change in driver behavior in terms of visual behavior, speed maintenance, or lane keeping. One major finding was that significantly more time was spent with the eyes looking forward (eyes on road) for billboard and comparison sites, as compared to baseline sites.

Some of the comparison sites used in the billboard study were logo motherboards. In no case did the comparison sites (including the logo motherboards) show a significant difference from billboards. It would therefore be expected that a similar study with a focus on logo signs rather than billboards would produce similar results. However, the billboard study was time and resource intensive, and produced few significant findings. Therefore, a more basic approach was used for the current study; this approach made efficient use of the available resources while answering the questions raised in the hypotheses section. The approach combined a survey with an accident database analysis to determine the acceptability, understandability, and safety of logo motherboards containing more than one service type.

Permission was obtained from the Federal Highway Administration (FHWA) by VDOT to temporarily remove the standard that no service category (e.g., Food) can be displayed on more than one motherboard. This change has allowed Food logos to be displayed on excess space available on another motherboard (e.g., Full Service Food logo displayed on Camping motherboard when a Food motherboard with six Food logos already exists). There are seven interchanges in the Commonwealth of Virginia where Full Service Food logos have either been added in conjunction with other services (e.g., Camping) or stand alone, resulting in up to eight food logos for the approach to the interchange. These seven interchanges are located along three distinct interstate corridors (I-64, I-81, and I-95). These seven interchanges were used in the study, along with seven adjacent (control) interchanges. The control interchanges did not have more than six Food logo panels, and did not have two service types on any one logo motherboard. These interchange locations are shown below and in Figure 2:

- I-64 at Exit 124
- I-81 at Exit 118
- I-81 at Exit 150
- I-81 at Exit 264
- I-95 at Exit 92
- I-95 at Exit 126 (Southbound only)
- I-95 at Exit 143

The next two major sections of this report describe the specific methods and results used in the survey and in the accident database analysis. The final section proposes changes to the MUTCD based on the results of these two experiments and the Commonwealth of Virginia's experience in having the Food service type represented on more than one logo motherboard.

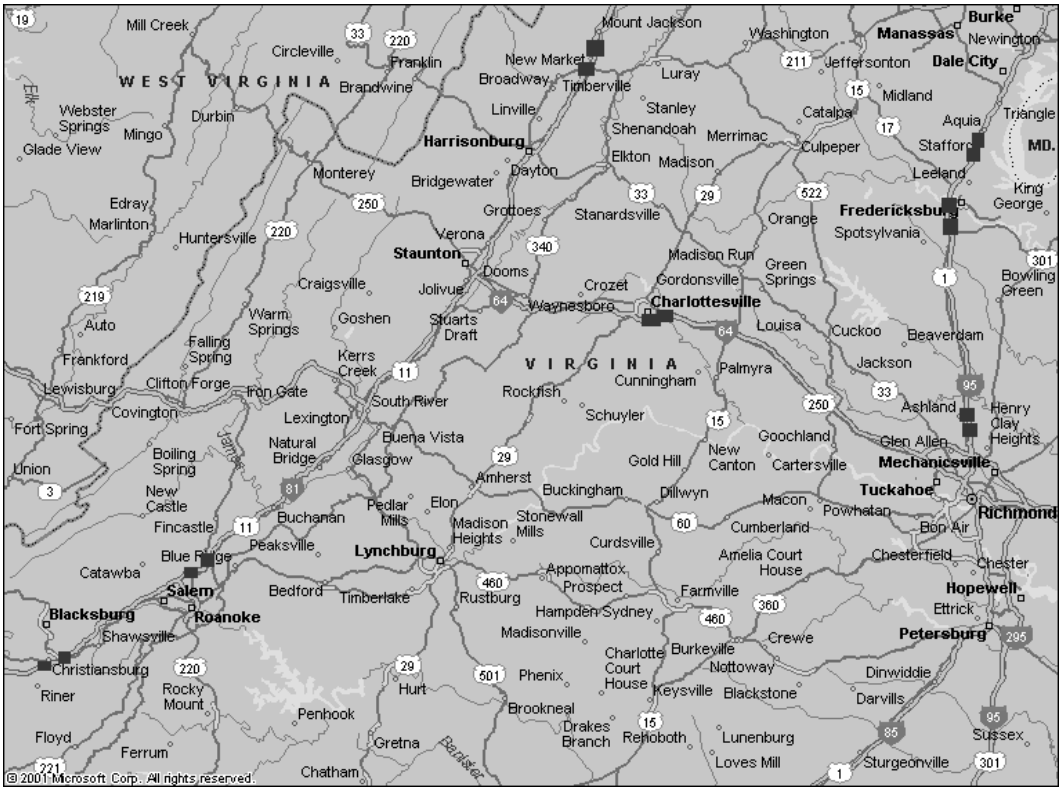


Figure 2. Map showing all of the test and control sites (rectangles). Scale is ~1 inch = 40 miles.

SURVEY

The Center for Human Factors Research (within VTTI) engaged the Virginia Tech Center for Survey Research (CSR) to conduct a survey of residents throughout Virginia regarding their opinions and perceptions about interstate road signage across the Commonwealth. The portion of the study contracted with CSR involved the administration of a telephone survey designed to assist VDOT in the development of policies regarding interstate logo signs that will best serve travelers on Virginia's interstates.

The CSR completed the survey portion of the study by conducting telephone interviews with 804 residents of the Commonwealth of Virginia. The data collection procedure used during the administration of this survey is presented below, followed by tabulations of the data.

A random-digit dialing (RDD) method was employed by the CSR for the administration of the survey. Both listed and unlisted telephone numbers were included in the sample for this project. CSR worked with Survey Sampling, Inc. of Fairfield, Connecticut to define the parameters of the sample. The survey sample was randomly generated from numbers available to Virginia residents. Because the survey questions required that respondents have specific knowledge of interstate travel and logo signs on interstates in the Commonwealth, screening questions were included in the survey to ensure that survey respondents: 1) had traveled at least 200 miles from

home in an automobile in the past year; and 2) that they had traveled in at least one of the following areas in the past year: Interstate 64 near Charlottesville, Interstate 81 near Roanoke, Harrisonburg, or Christiansburg, or Interstate 95 near Richmond or Fredericksburg. Sample members reporting no travel of at least 200 miles in an automobile in the past year, or no travel in the areas defined for the study, were eliminated from the eligible sample pool for calling. There were 416 sample members with this final call disposition code (329 members reporting no travel of at least 200 miles in an automobile in the past year, and 87 members reporting no travel in the past year in the areas qualifying for the study).

The call records were selected randomly from among available numbers in Virginia and all call records were added to the sample pool in randomized replicates (sets) by CSR. Once a replicate was added to the calling pool, all numbers were attempted numerous times until they could be ruled out as viable (the average number of attempts for non-respondents was 11.4).

Based on a total of 804 completed interviews, the survey has a sampling error of ±3.5 percent. This means that in 95 out of 100 surveys completed with this number of interviews using the same sampling methodology and parameters, the results obtained would fall in a range of ±3.5 percent of the results that would be achieved if interviews were completed with every potential adult respondent (in households with working telephones) residing in Virginia. Smaller sampling errors are present for items on which there is polarized response (e.g., 90 percent of respondents with the same response).

Survey Instrument Design

The Center for Human Factors Research provided the CSR with a draft document of proposed items to be included in the survey. The CSR developed the telephone survey instrument and provided several drafts of the survey to the Center for Human Factors Research for final approval prior to survey administration. The Center for Human Factors Research worked with VDOT to ensure that the survey instrument met the research objectives specified for the project. CSR also pre-tested the survey instrument in order to ensure an optimal cooperation rate for the survey and to ensure that the survey length did not exceed the contracted average (10 minutes). The survey pre-test revealed the need to clarify the wording of some survey items. After all wording changes to the survey instrument were approved by representatives of the Center for Human Factors Research (and VDOT) final changes to the calling program were made by CSR. A copy of the final survey instrument used by CSR for survey administration appears in Appendix A of this summary.

Data Collection Procedures

All telephone calls for the survey were made by CSR staff members utilizing a Computer-Assisted Telephone Interviewing (CATI) system at the Blacksburg, Virginia location of CSR. All calls were made during the period of April 13, 2005 and June 7, 2005. CSR wrote a calling program to be used with CATI for administering the VDOT Logo Motherboard Survey. The program provides scripted survey items, precludes out-of-range responses, and facilitates real-time data entry of all responses gathered on the telephone.

Each interviewer collecting data for the project participated in a project-specific training session. All interviewers working on the project had participated in multiple training sessions in both interviewing techniques and CATI. All interviews were monitored by a CSR Phonebank Supervisor in order to ensure accuracy and proper interviewing protocol.

Clarifying notes for specific survey items appeared on the CATI screens for interviewers to ensure that identical prompts were used for respondents requesting additional information about survey items or response categories. CSR programmed all call scheduling such that each sample member remaining as a non-respondent at the completion of the study was attempted to be reached numerous times at different times of day on different days of the week. A total of 3,985 phone numbers were attempted by CSR during the duration of the survey administration. Sample members reporting no qualifying automobile travel within the past year were excluded from the eligible sample pool (N=416); likewise, respondents who indicated a language or hearing barrier such that they could not respond or request that another adult in the household respond, were also excluded from the eligible sample pool (N=50). Cases in which a sample member reported having no adults residing in the household (N=29) were excluded from the eligible sample. Non-working telephone numbers (fax tones, out of service/disconnected numbers, automated disconnect/refusal services) were also excluded from the eligible sample pool (N=1,015). Non-residential numbers (N=356) were excluded from the eligible pool of sample members as well.

After the elimination of all the ineligible records described above, the remaining number of eligible sample members was 2,119. A total of 804 interviews were completed for this study. Table 1 provides an overview of the final call dispositions for all sample members. Many sample members were never reached after numerous attempts and a final disposition of “no answer” was assigned. Likewise, a number of fax tones were also reached. Therefore, the residency rate among these households is unknown. It may be assumed that a number of these households are ineligible sample members due to non-residence. All telephone numbers deemed to be temporarily disconnected were attempted periodically throughout the duration of the study.

Table 1. Disposition of full initial sample for telephone survey.

Total Initial Sample	3,985
Ineligible Sample: No automobile travel of at least 200 miles from home in past year (329) No travel in past year in qualifying areas (87) Non-working telephone number (fax tones, out of service/disconnected numbers, automated disconnect/refusal services) (1,015) Non-residential telephone number (356) Sample member reported having no adults in the household (29) Hearing/language barrier (50)	
Eligible Sample	2,119
Total Number of Completed Interviews	804
Non-respondents: Final disposition of no answer, busy, answering machine or callback after at least seven attempts (767) Refusals (548)	1,315

Data Compilation and Storage

A compact disc containing the SPSS dataset from which the tabulations in this summary were derived was provided to the VTTI research team. This respondent number could be used to link the open-ended responses with the data on the SPSS file because the unique identifying respondent number was also provided on the SPSS file. All variable and value labels are provided on the SPSS dataset.

CSR cleaned all open-ended responses (summarized in Appendix B) for clarity to eliminate spelling and grammatical errors and to allow for streamlined formatting and sorting of the responses for inclusion in this summary. All electronic files of the survey instrument and data are the property of the Center for Human Factors Research. However, CSR will retain copies of all project materials for a period of at least one year. No information from this survey will be shared by the CSR with anyone other than project team members from the Center for Human Factors Research without the express permission of that office. Permission to conduct the survey

was obtained from the Virginia Tech Institution Review Board before the telephone survey began. This is required for any projects involving human subjects.

Results

The response tabulations for all close-ended items appear below in Tables 2 through 27. Tables 2 through 5 are screening and general information questions. Tables 6 through 20 are relevant to Hypothesis 1, and Tables 21 through 27 show demographic information. County of residence information was also available, and is provided in Appendix C. Summaries of responses to open-ended survey items appear in Appendix B. These responses are sorted by survey item.

Table 2. Q1: Have you traveled at least 200 miles from home in an automobile in the past year?

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	804	100.0	100.0	100.0

Table 3. Q2: Have you traveled on Interstate 64 near Charlottesville in the past year?

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	470	58.5	58.5	58.5
No	328	40.8	40.8	99.3
DK/RF	6	.7	.7	100.0
Total	804	100.0	100.0	

Table 4. Q3: Have you traveled on Interstate 81 near Roanoke, Harrisonburg, or Christiansburg in the past year?

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	493	61.3	61.3	61.3
No	307	38.2	38.2	99.5
DK/RF	4	.5	.5	100.0
Total	804	100.0	100.0	

Table 5. Q4: Have you traveled on Interstate 95 near Richmond or Fredericksburg in the past year?

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	630	78.4	78.4	78.4
No	171	21.3	21.3	99.6
DK/RF	3	.4	.4	100.0
Total	804	100.0	100.0	

Table 6. Q5: How often do you travel on Virginia's interstates?

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Once a year or less	38	4.7	4.7	4.7
Once every six months	69	8.6	8.6	13.3
Once every three months	128	15.9	15.9	29.2
Once a month or more	568	70.6	70.6	99.9
DK/RF	1	.1	.1	100.0
Total	804	100.0	100.0	

Table 7. Q6: Would you say that having more than one service type on each sign would be very confusing, somewhat confusing, or not at all confusing to you while traveling?

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Very Confusing	68	8.5	8.5	8.5
Somewhat Confusing	203	25.2	25.2	33.7
Not At All Confusing	507	63.1	63.1	96.8
DK/No Preference	26	3.2	3.2	100.0
Total	804	100.0	100.0	

Table 8. Q7: If instead, the services were listed in random order to accommodate additional business listings on the signs, would that be very confusing, somewhat confusing, or not at all confusing for you?

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Very Confusing	104	12.9	12.9	12.9
Somewhat Confusing	235	29.2	29.2	42.2
Not At All Confusing	445	55.3	55.3	97.5
DK/No Preference	20	2.5	2.5	100.0
Total	804	100.0	100.0	

Table 9. Q8: If the same service were listed on multiple signs, would that be very useful, somewhat useful, not very useful, or not at all useful?

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Very Useful	207	25.7	25.7	25.7
Somewhat Useful	376	46.8	46.8	72.5
Not Very Useful [Reasons summarized in Appendix B]	97	12.1	12.1	84.6
Not At All Useful [Reasons summarized in Appendix B]	96	11.9	11.9	96.5
DK/No Preference	28	3.5	3.5	100.0
Total	804	100.0	100.0	

Table 10. Q9: Have you ever seen any of these signs for full service food establishments?

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	185	23.0	23.0	23.0
No	548	68.2	68.2	91.2
DK/RF	71	8.8	8.8	100.0
Total	804	100.0	100.0	

Table 11. Q10: How useful were these signs to you? (Answered by those who answered "Yes" to Question 9.)

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Very Useful	96	11.9	51.9	51.9
Somewhat Useful	58	7.2	31.4	83.2
Not Very Useful [Reasons summarized in Appendix B]	13	1.6	7.0	90.3
Not At All Useful [Reasons summarized in Appendix B]	7	.9	3.8	94.1
DK/No Preference	11	1.4	5.9	100.0
Total	185	23.0	100.0	

Table 12. Q11 How useful do you think it would be to you to have full service restaurants listed on their own full service food interstate signs? (Answered by those who answered "Yes" to Question 9.)

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Very Useful	201	25.0	32.5	32.5
Somewhat Useful	258	32.1	41.7	74.2
Not Very Useful [Reasons summarized in Appendix B]	72	9.0	11.6	85.8
Not At All Useful [Reasons summarized in Appendix B]	64	8.0	10.3	96.1
DK/No Preference	24	3.0	3.9	100.0
Total	619	77.0	100.0	

Table 13. Q12: How useful do you think it would be to include full service restaurants on signs with other service types, such as camping, if there was free space on the camping sign?

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Very Useful	219	27.2	27.2	27.2
Somewhat Useful	360	44.8	44.8	72.0
Not Very Useful [Reasons summarized in Appendix B]	104	12.9	12.9	85.0
Not At All Useful [Reasons summarized in Appendix B]	86	10.7	10.7	95.6
DK/No Preference	35	4.4	4.4	100.0
Total	804	100.0	100.0	

Table 14. Q13: What do you consider to be the primary differences in the services provided by those establishments on the standard food signs and those establishments on the full service food sign?

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Response Provided [Responses summarized in Appendix B]	409	50.9	50.9	50.9
Don't Know The Differences	391	48.6	48.6	99.5
RF	4	.5	.5	100.0
Total	804	100.0	100.0	

Table 15. Q14a: Please tell me your level of agreement that each of the items I mention should be served at breakfast: Coffee…

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly Agree	690	85.8	85.8	85.8
Somewhat Agree	75	9.3	9.3	95.1
Somewhat Disagree	7	.9	.9	96.0
Strongly Disagree	9	1.1	1.1	97.1
DK/No Preference	22	2.7	2.7	99.9
RF	1	.1	.1	100.0
Total	804	100.0	100.0	

Table 16. Q14b: Please tell me your level of agreement that each of the items I mention should be served at breakfast: Juice…

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly Agree	618	76.9	76.9	76.9
Somewhat Agree	139	17.3	17.3	94.2
Somewhat Disagree	25	3.1	3.1	97.3
Strongly Disagree	8	1.0	1.0	98.3
DK/No Preference	13	1.6	1.6	99.9
RF	1	.1	.1	100.0
Total	804	100.0	100.0	

Table 17. Q14c: Please tell me your level of agreement that each of the items I mention should be served at breakfast: Eggs…

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly Agree	608	75.6	75.6	75.6
Somewhat Agree	146	18.2	18.2	93.8
Somewhat Disagree	14	1.7	1.7	95.5
Strongly Disagree	13	1.6	1.6	97.1
DK/No Preference	22	2.7	2.7	99.9
RF	1	.1	.1	100.0
Total	804	100.0	100.0	

Table 18. Q14d: Please tell me your level of agreement that each of the items I mention should be served at breakfast: Breakfast meats such as bacon or sausage…

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly Agree	586	72.9	72.9	72.9
Somewhat Agree	165	20.5	20.5	93.4
Somewhat Disagree	15	1.9	1.9	95.3
Strongly Disagree	14	1.7	1.7	97.0
DK/No Preference	23	2.9	2.9	99.9
RF	1	.1	.1	100.0
Total	804	100.0	100.0	

Table 19. Q14e: Please tell me your level of agreement that each of the items I mention should be served at breakfast: breakfast grains such as biscuits, toast, pastries, or cereal…

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly Agree	585	72.8	72.8	72.8
Somewhat Agree	171	21.3	21.3	94.0
Somewhat Disagree	18	2.2	2.2	96.3
Strongly Disagree	13	1.6	1.6	97.9
DK/No Preference	16	2.0	2.0	99.9
RF	1	.1	.1	100.0
Total	804	100.0	100.0	

Table 20. Q15: Now, Is there anything else you would like to tell me about interstate signs for food establishments that we have not already discussed?

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Yes [Responses summarized in Appendix B]	161	20.0	20.0	20.0
No	643	80.0	80.0	100.0
Total	804	100.0	100.0	

Table 21. Q16: Would you say that your total combined household income before taxes last year was...

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
< $20,000	45	5.6	5.6	5.6
at least $20,000 but < $40,000	97	12.1	12.1	17.7
at least $40,000 but < $60,000	134	16.7	16.7	34.3
at least $60,000 but < $80,000	123	15.3	15.3	49.6
at least $80,000 but < $100,000	101	12.6	12.6	62.2
at least $100,000 but< $120,000	64	8.0	8.0	70.1
or $120,000 or more?	117	14.6	14.6	84.7
DK/RF	123	15.3	15.3	100.0
Total	804	100.0	100.0	

Table 22. Q17: Counting yourself, how many people live in your household currently?

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
1	125	15.5	15.5	15.5
2	296	36.8	36.8	52.4
3	132	16.4	16.4	68.8
4	148	18.4	18.4	87.2
5	63	7.8	7.8	95.0
6	13	1.6	1.6	96.6
7	3	.4	.4	97.0
8	4	.5	.5	97.5
9	1	.1	.1	97.6
DK/RF	19	2.4	2.4	100.0
Total	804	100.0	100.0	

Table 23: Q18: Counting yourself, how many of these people are 18 to 25 years of age?

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
0	550	68.4	68.4	68.4
1	93	11.6	11.6	80.0
2	104	12.9	12.9	92.9
3	25	3.1	3.1	96.0
4	9	1.1	1.1	97.1
5	1	.1	.1	97.3
DK/RF	22	2.7	2.7	100.0
Total	804	100.0	100.0	

Table 24. Q19: Counting yourself, how many of these people are 26 to 35? (This question only asked for those who did not account for all household members in previous question.)

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
0	546	67.9	73.1	73.1
1	87	10.8	11.6	84.7
2	88	10.9	11.8	96.5
3	1	.1	.1	96.7
DK/RF	25	3.1	3.3	100.0
Total	747	92.9	100.0	

Table 25. Q20: Counting yourself, how many of these people are 36 to 60? (This question only asked for those who did not account for all household members in previous questions.)

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
0	210	26.1	30.4	30.4
1	147	18.3	21.3	51.7
2	302	37.6	43.7	95.4
3	5	.6	.7	96.1
4	1	.1	.1	96.2
DK/RF	26	3.2	3.8	100.0
Total	691	85.9	100.0	

Table 26. Q21: Counting yourself, how many of these people are over 60 years of age? (This question only asked for those who did not account for all household members in previous questions.)

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
0	254	31.6	56.1	56.1
1	90	11.2	19.9	75.9
2	83	10.3	18.3	94.3
DK/RF	26	3.2	5.7	100.0
Total	453	56.3	100.0	

Table 27. Q22: Gender.

Response:	Frequency	Percent	Valid Percent	Cumulative Percent
Male	319	39.7	39.7	39.7
Female	485	60.3	60.3	100.0
Total	804	100.0	100.0	

Conclusions

Overall results from the survey showed that people have strong opinions about the logo sign program, and are willing to share them. People generally report low levels of confusion with sharing motherboard space. It is interesting to note that almost 70 percent of drivers had not noticed the new category. A large number of open-ended responses appeared to associate the existing Food category with fast food, and the Full Service Food category with sit-down service. However, the open-ended responses also appeared to show some confusion about the meaning of Full Service Food. Many respondents thought that Full Service referred to multi-service facilities, such as combined restaurant/gas station/convenience store/hotel. Even with the confusion about meaning, most thought it would be useful to have this new category. There was also general agreement on meaning of breakfast. The demographics appeared to be fairly representative of the traveling public in Virginia, with the possible exception of the male/female ratio (60 percent of respondents were female).

All of the open-ended responses were summarized and are presented in Appendix B. Two of the open-ended questions showed trends worth mentioning here. For Question 13, regarding the meaning of Full Service Food, 69 percent of the 410 responses contained the words "fast food" even though that was never mentioned by the interviewer. An additional 9 percent of the responses referred to concepts such as menu variety, quality, and service. Some degree of confusion was noted in about 7 percent of responses to this question, indicating confusion with multi-service facilities such as combination gas station/restaurants, combination convenience store/restaurants, etc. These answers contained the words "gas," "convenience store," "hotel," motel," or "everything." Question 15 was an open-ended question asking for any other opinions on the logo boards. There were 161 responses, of which 37 percent indicated a desire for better directions and mileage signs on the main logo placard (on the interstate rather than on the ramp). Another 12 percent wanted the signs to be easier to read, and 10 percent wanted more restaurant information included on the signs.

ACCIDENT DATABASE ANALYSIS

Method

VDOT provided an accident database of all accidents occurring from 1999 through 2003 on Interstates 64, 81, and 95. This database was then filtered to crashes to those occurring in a specific time frame and a specific range of locations. For each interchange of interest (test exit), a control interchange was also selected (control exit). This was always the nearest adjacent interchange to the test exit. A before-and-after analysis method was used. The before dates were restricted to 53 weeks prior to logo sign installation up to 1 week prior to installation. The after dates started one week after installation, and continued to 53 weeks after installation. There was thus one year of before data and one year of after data for each test exit and each control exit (the same date ranges were used for the control exits). These dates also allowed for a 2-week buffer period for the time when the signs were being installed. Those crashes occurring from 1,500 ft (actually 0.3 miles or 1,584 ft) before the Full Service Food logo sign up to the exit were used in the analyses. For control exits, those crashes occurring 1,584 ft before the first logo motherboard for that exit up to the exit were used. The variables of interest for these crashes included:

- Accident date
- Accident location (by mile marker, to the nearest one-tenth mile)
- Accident time
- Number of vehicles involved
- Weather
- Major contributing factor (e.g., driver distraction, weather, driving under the influence, etc.)
- Accident severity (e.g., fatality, injury, etc.)
- Driver variables (e.g., age, gender, driver contributing factors, etc.)

Data from both north and southbound (or east and west bound) directions were used, except for Exit 126 of I-95, which only has a Full Service Food logo sign in the southbound direction. The resulting database consisted of data for the vehicles involved in these accidents. The data were weighted by the number of vehicles to obtain the number of crashes (except for data reported on a vehicle or driver basis, for which no weighting was needed). In addition, the database was weighted for the number of vehicle miles driven through that county on that interstate for a particular year. This helped account for increased traffic over time and allowed for control of exposure in the before-and-after data.

Analysis

Chi-square tests were used to check for statistically significant differences in the raw frequency of crashes before and after sign installation for the test and control exits. A comparison of the graphical data was used to compare the raw data to the converted rate data (data presented in terms of crashes per million vehicle miles traveled: MVMT).

It should be noted that before-and-after methods of evaluation have been the traditional method of evaluating traffic safety countermeasures. However, in the past few years, researchers have pointed out a potential problem with this type of analysis. The problem is that sites for safety countermeasures are often selected on the basis of a recent surge in crashes at those sites. Crash rates fluctuate randomly over time, and what appears to be an elevated crash risk for one site will often drop back down towards the average level given time, even without safety countermeasures being used.

Traffic engineers will often deploy a safety countermeasure at a site immediately following one of these upswings in crash rates, and then declare the countermeasure a success when the rate drops in the following time period. This phenomenon is known among traffic safety researchers as regression to the mean. The problem is that there is no way of knowing whether the rate would have dropped even in the absence of the countermeasure. To control for this effect, control sites are also considered when this type of study is performed. The control site should be similar to the test site in as many ways as possible, but with no countermeasure applied. This was the method used for the current study. However, this method still does not totally account for regression to the mean.

An alternative approach has been advocated to deal with the problem of regression to the mean. This approach is called the Empirical Bayes approach (Hauer, 1997). The Empirical Bayes approach was not felt to be necessary for the current study, for the following reasons:

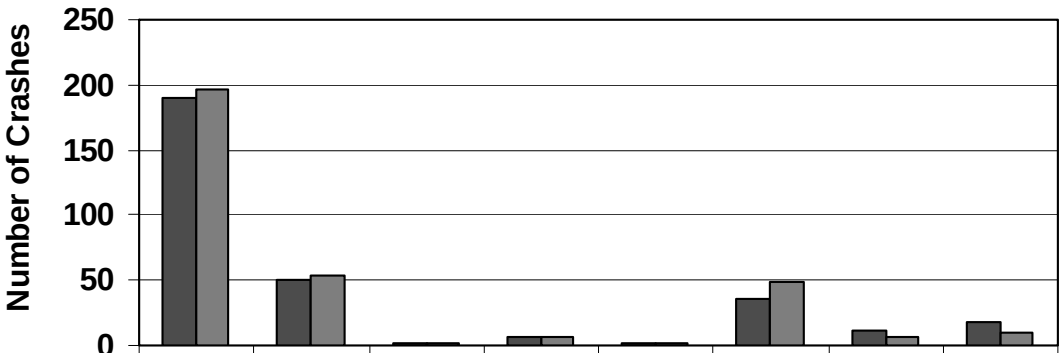
- The sites were not selected based on an upswing in crashes. That is, there was not a priority selection of sites based on poor safety records. The sites were equally likely to have been experiencing a downswing in crashes as part of the natural up and down pattern as to have been experiencing an upswing when the signs were installed. There should thus have been no regression to the mean bias in site selection.
- The experimental condition being studied was not developed as a crash countermeasure, and was not hypothesized to improve safety at the sites of interest.

- The results of the statistical analysis were neutral (neither positive nor negative). If strong results had been found in either direction, the Empirical Bayes approach could have been used as a more rigorous check of results.

For these reasons, the traditional before-after case study with control was considered to be the appropriate method for analyzing the crash data for these exits. The next section presents the results of these analyses.

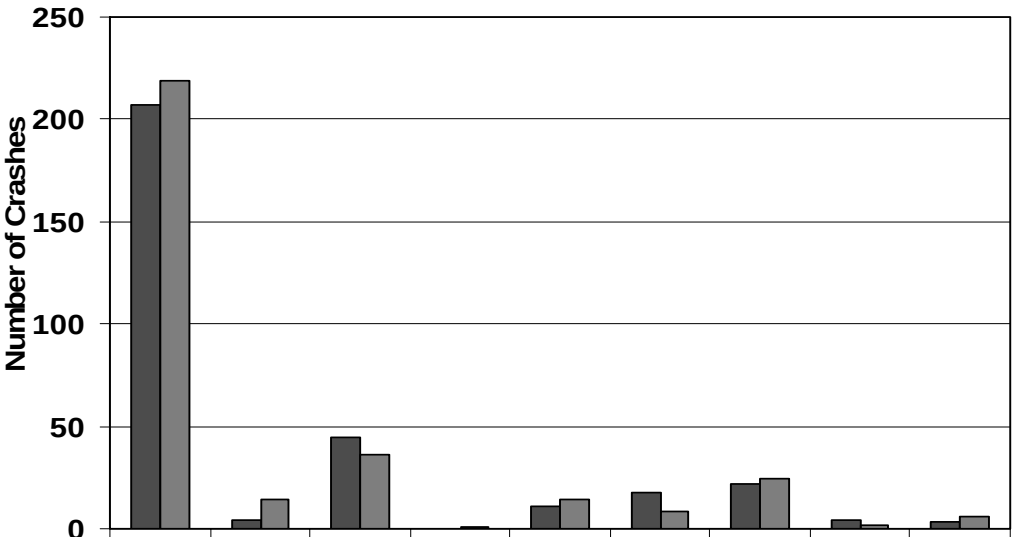
Results

The first set of analyses compares the control sites to the test sites for a number of areas in order to evaluate whether the test sites were appropriate for comparison. In order to ensure that test sites experienced the same weather, were driven by the same drivers, and experienced similar traffic density over time, the closest adjacent exit was always used as the control exit. The control exits were always at least 3 miles but never more than 5 miles from the test exits. Control sites were compared to test sites on several dimensions, including weather (Figure 3), major factor (Figure 4), severity (Figure 5), driver age (Figure 6), driver gender (Figure 7), and driver action (Figure 8). As can be seen in these figures, the test sites and control sites were in remarkable agreement for these variables.



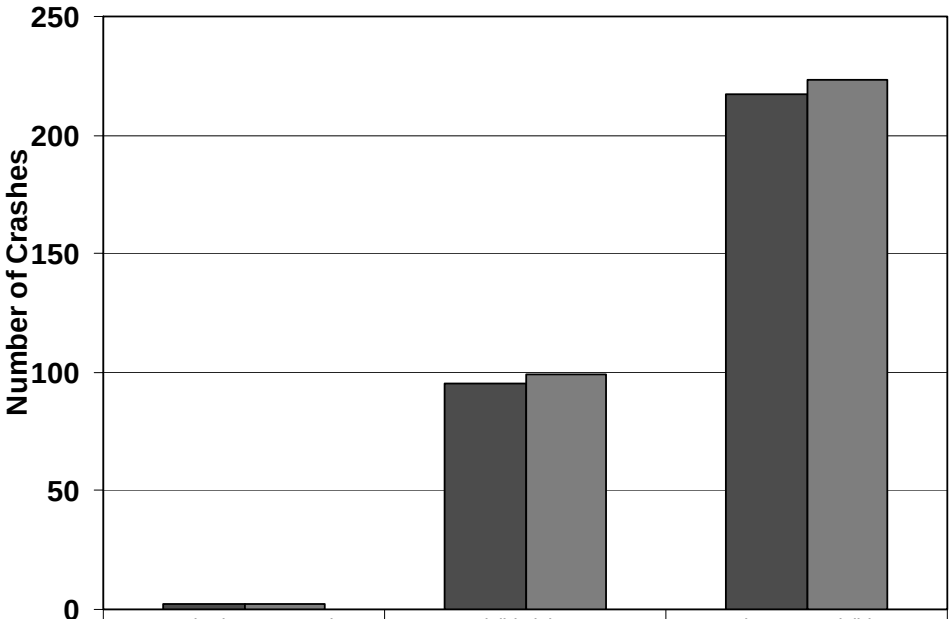
	Clear	Cloudy	Fog	Mist	Not Stated	Raining	Sleeting	Snowing
Control	190	50	2	7	1	35	11	18
Test	196	54	1	7	1	49	7	9

Figure 3. Number of crashes under various weather conditions for control and test sites.



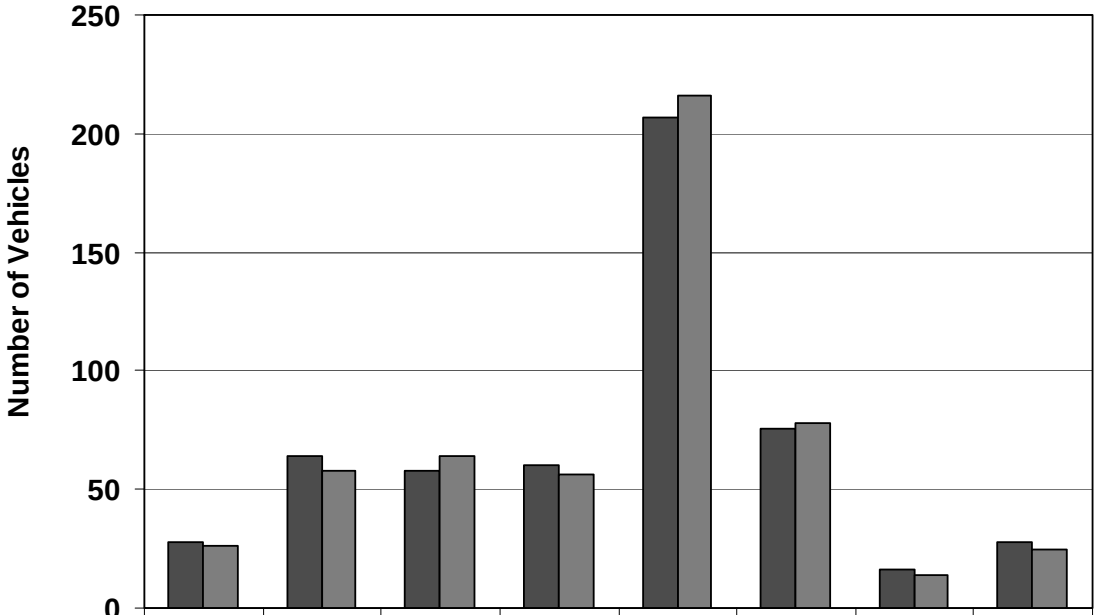
	Driver inattention/error	Drugs/ alcohol/ other	Miscellaneous	Road defect	Sleep/ fatigue/ill/ handicap	Slippery road	Speeding	Vehicle defect	Weather/ visibility
Control	207	4	45		11	18	22	4	3
Test	219	14	36	1	14	8	24	2	6

Figure 4. Number of crashes for major factor categories for control and test sites.



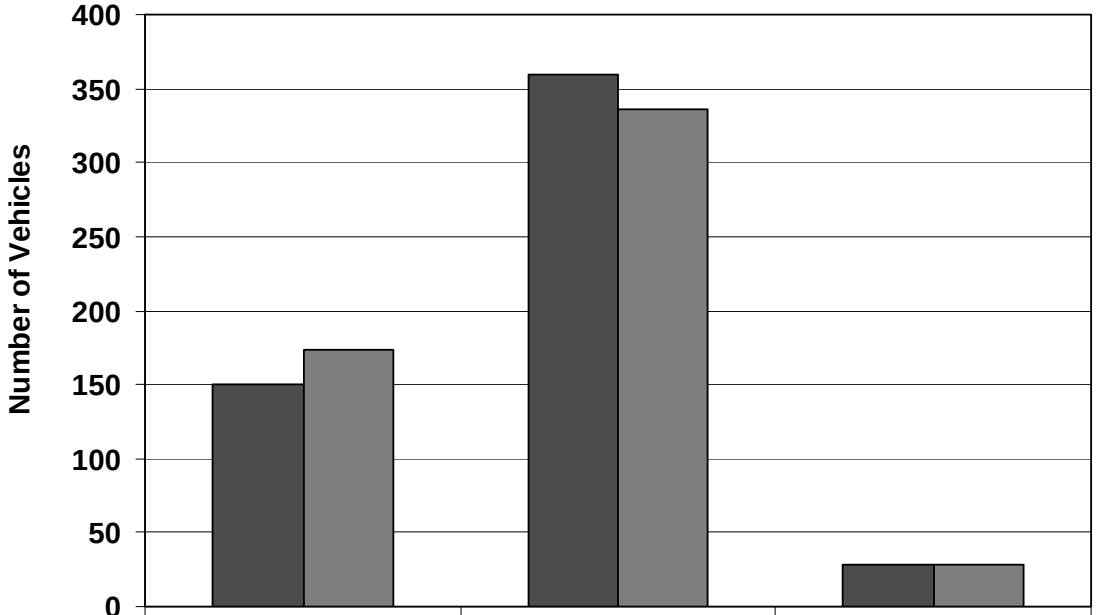
	Dead when reported	Visible injury	Injury, non-visible
Control	2	95	217
Test	2	99	223

Figure 5. Number of crashes by severity category for control and test sites.



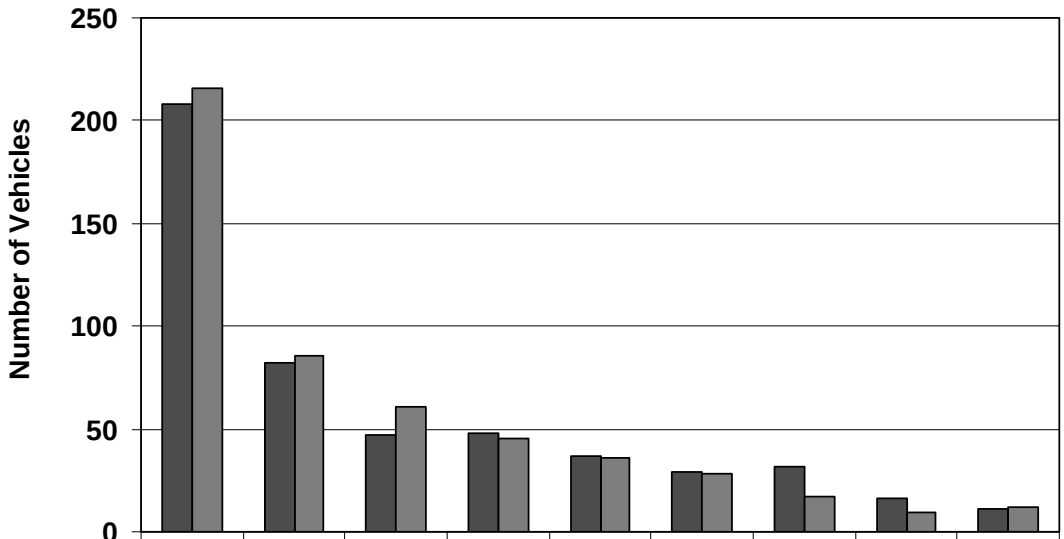
	<18 yrs.	19-21 yrs.	22-25 yrs.	26-30 yrs.	31-50 yrs.	51-65 yrs.	>65 yrs.	Unknown
Control	28	64	58	60	207	76	16	28
Test	26	58	64	56	216	78	14	25

Figure 6. Number of vehicles involved in crashes by driver age category for control and test sites.



	Female	Male	Not reported or NA
Control	150	359	28
Test	173	336	28

Figure 7. Number of vehicles involved in crashes by driver gender for control and test sites.



	None	Driver inattention	Following too close	Exceed safe speed	Exceed speed limit	Cutting in	Avoiding other vehicle	Other violations	Hit and run
Control	208	82	47	48	37	29	32	16	11
Test	216	86	61	45	36	28	17	9	12

Figure 8. Number of vehicles involved in crashes by driver action for control and test sites.

All sites combined. The next set of analyses considers crashes occurring at all sites combined. Figure 9 shows a map with all test and control sites marked in red. Figure 10 shows the raw number of crashes that occurred at these control and test sites. The number of crashes was not significantly different using a criterion of $p < 0.05$ (chi-square = 0.8084, $p = 0.3686$). The raw number of accidents was then weighted by the number of vehicle miles driven on those sections during the years of interest. The weighted number of accidents was then expressed in terms of crashes per million vehicle miles traveled (MVMT), which is a common measure of exposure in traffic safety. The weighted numbers are shown in Figure 11.

The final analysis examined the effects of both weather and inattention/error. Bad weather, when it occurs, can cause localized clusters of crashes. Therefore, the next analysis considered only crashes occurring in clear weather conditions. At the same time, only those crashes coded with inattention/error were included. This was done to examine the hypothesis that the additional logo signs would be found to be no more distracting and/or confusing to the motorist than a motherboard having combinations of logos such as Camping/Attractions. Figure 12 shows the results of this combined weather/distraction analysis. In this case, the results were significantly different (raw data chi-square = 4.5872, $p = 0.0322$). The significance was caused by the large before and after difference in the control site; the results were neutral with respect to the test site.

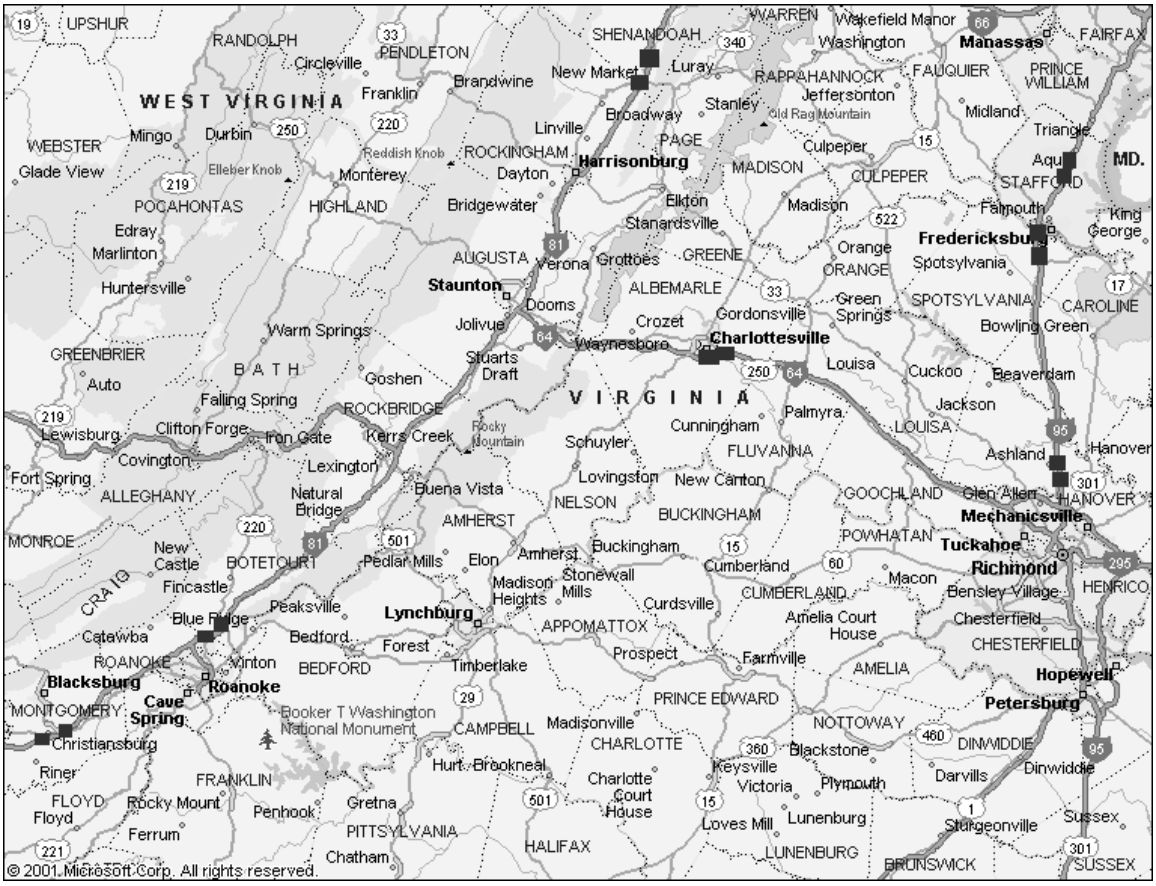


Figure 9. Map showing all of the test and control sites (rectangles). Scale is ~1 inch = 40 miles.

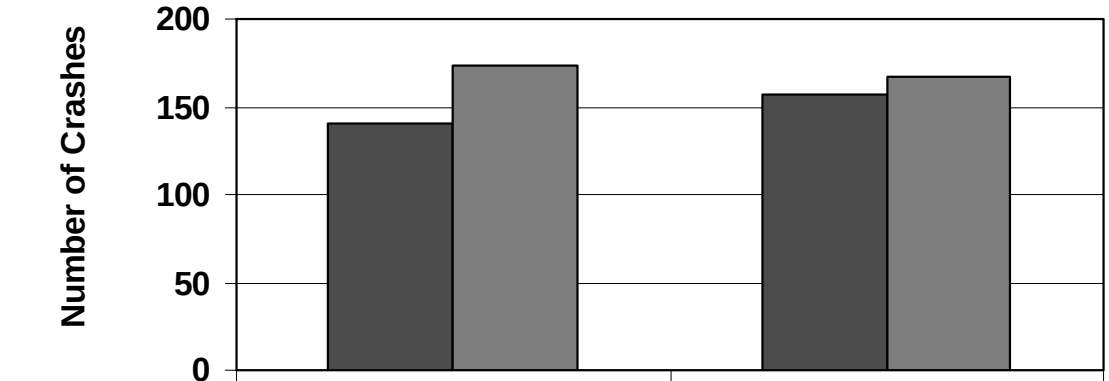


Figure 10. Raw number of crashes for all control and test sites before and after the logo signs were installed.

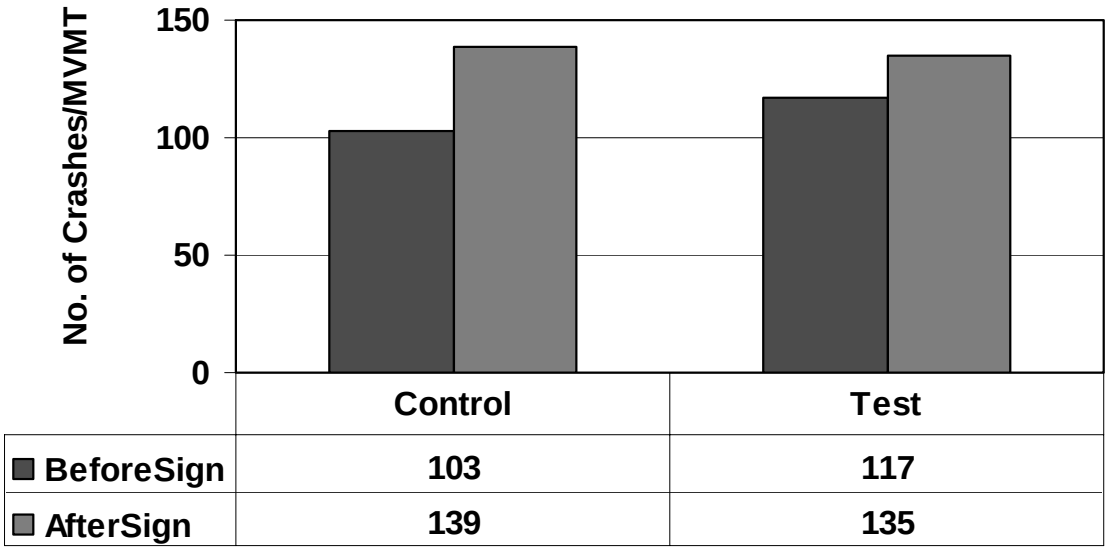


Figure 11. Crashes per MVMT for all control and test sites before and after the logo signs were installed.

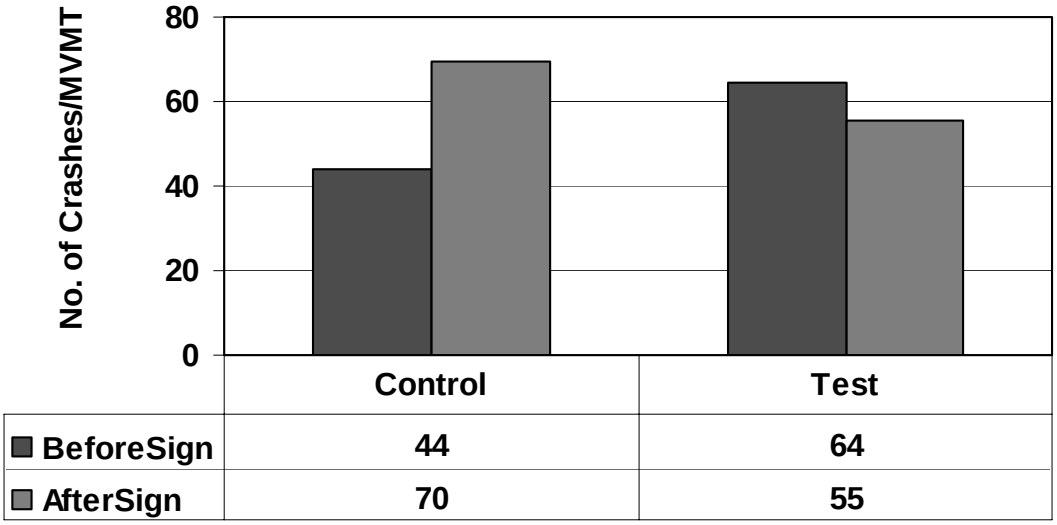


Figure 12. Crashes per MVMT occurring in clear weather and coded as due to inattention/error for all control and test sites before and after the logo signs were installed.

I-64 at Exit 124. The map for this study area is shown in Figure 13. The following conditions and techniques were used in analyzing the crashes for this exit:

- Erected July 10, 2002
- Analyzed July 3, 2001-July 3, 2002 as before sign and July 17, 2002-July 17, 2003 as after sign.
- Used Exit 121 as the control
- Deleted crashes with unknown node or milepost

- The following observed mileposts were then used as a final distance filter for the sign and the exits:
  - Exit 124 WB: Full Service Food sign at MP126.9; exit at MP124.8; 1500 ft = MP127.2 (1500 ft = .28 miles); range = 124.8-127.2 (2.4 mi)
  - Exit 124 EB: Full Service Food sign at 122.5; exit at 124.2; 1500 ft = 122.2; range = 122.2-124.2 (2.0 mi)
  - Exit 121 WB: first logo sign at 124.0; exit at 122.3; 1500 ft = 124.3; range = 122.3-124.3 (2.0 mi) (had to go back to raw data to expand range from first filter; this added 7 crashes: 6 from 2001 and 1 from 2002)
  - Exit 121 EB: first logo sign at 120.3; exit at 121.6; 1500 ft = 120.0; range = 120.0-121.6 (1.6 mi)

The total number of crashes per MVMT is shown in Figure 14. The differences were not significant (raw data chi-square = 0.0132, $p = 0.9086$). Those crashes in clear weather due to inattention/error are presented in Figure 15. In this case, there were not enough data points remaining to test statistically.

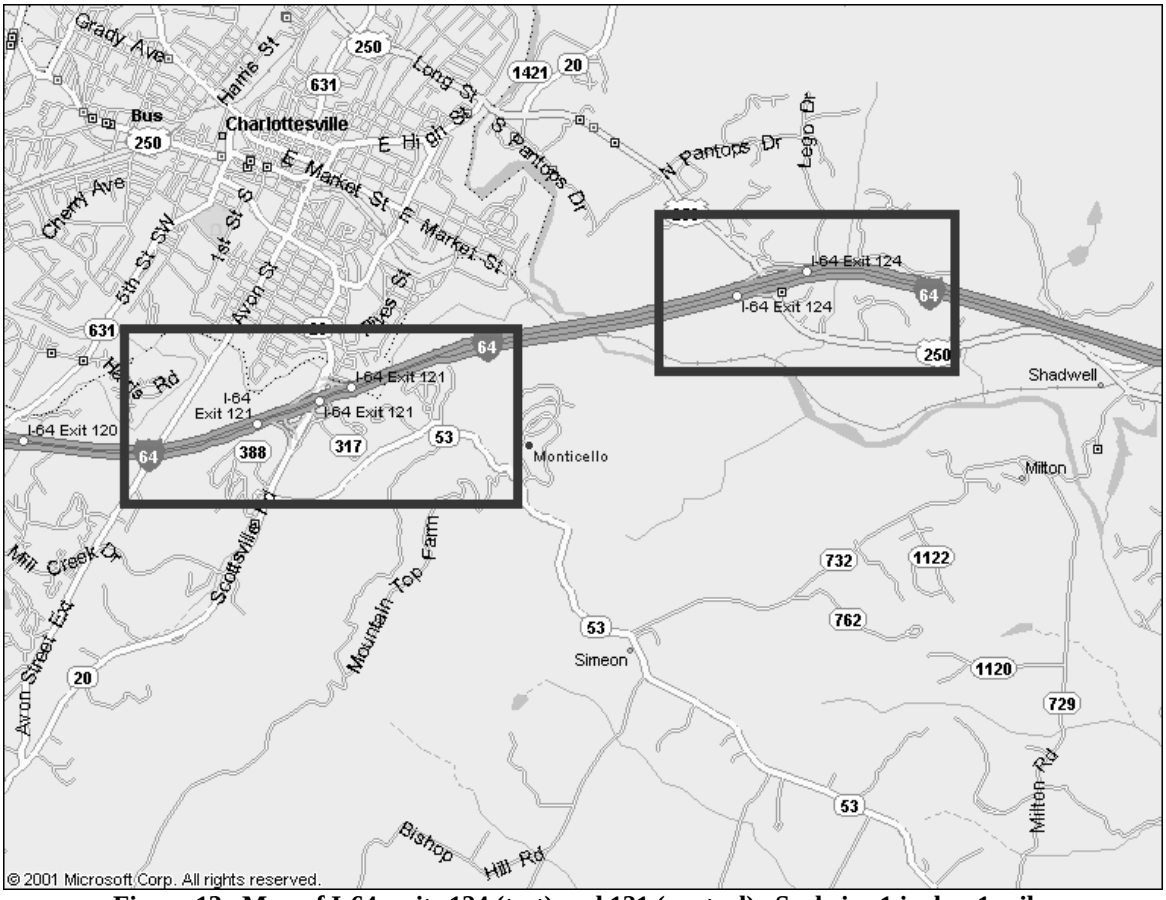


Figure 13. Map of I-64, exits 124 (test) and 121 (control). Scale is ~1 inch = 1 mile.

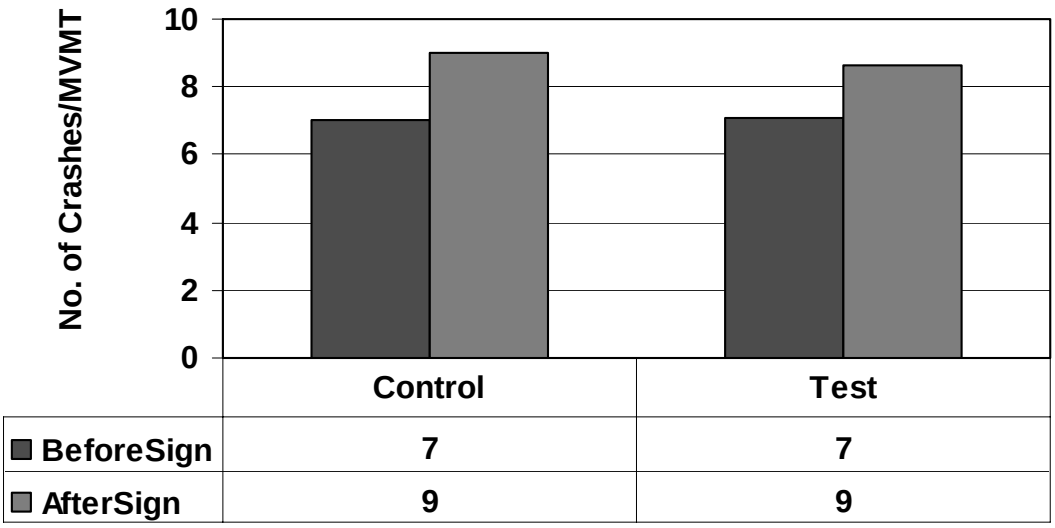


Figure 14. Crashes per MVMT for I-64, exits 124 (test) and 121 (control) before and after the logo signs were installed.

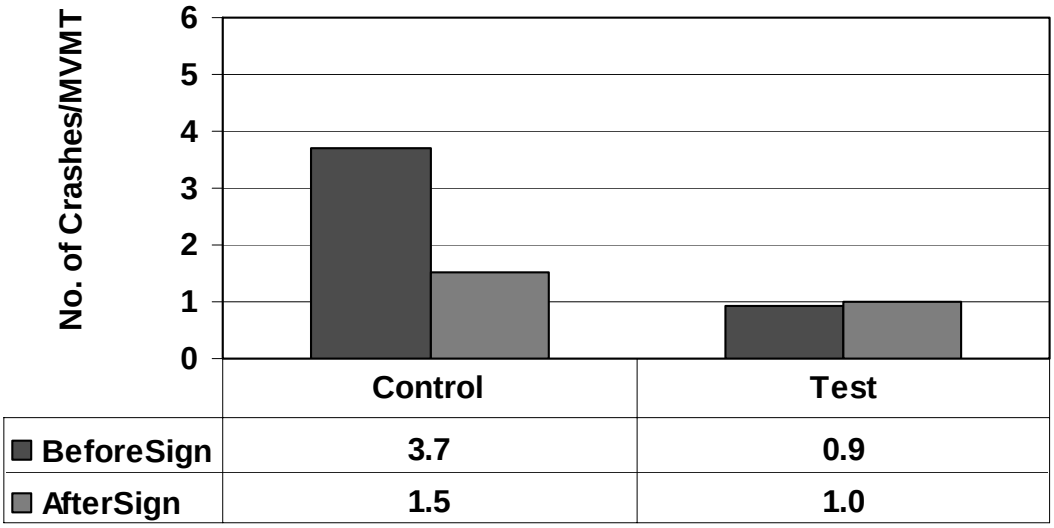


Figure 15. Crashes per MVMT occurring in clear weather and coded as due to inattention/error for I-64, exits 124 (test) and 121 (control) before and after the logo signs were installed.

I-81 at Exit 118. The map for this study area is shown in Figure 16. The following conditions and techniques were used in analyzing the crashes for this exit:

- Erected February 25, 2002
- Analyzed February 18, 2001- February 18, 2002 as before sign and March 4, 2002- March 4, 2003 as after sign.
- Used Exit 114 as the control
- Deleted crashes with unknown node or milepost
- The following observed mileposts were then used as a final distance filter for the sign and the exits:

- Exit 118 NB: Full Service Food sign at MP115.9; exit at MP116.6; 1500 ft = MP115.6 (1500 ft = .28 miles); range = 115.6-116.6 (1.0 mi)
- Exit 118 SB: Full Service Food sign at 119.9; exit at 119.3; 1500 ft = 120.2; range = 119.3-120.2 (0.9 mi)
- Exit 114 NB: first logo sign at 112.2; exit at 114.7; 1500 ft = 111.9; range = 111.9-114.7 (2.8 mi)
- Exit 114 SB: first logo sign at 115.7; exit at 114.7; 1500 ft = 116.0; range = 114.7-116.0 (1.3 mi)

The total number of crashes per MVMT is shown in Figure 17 (raw data chi square = 0.0288, p = 0.8653), while those crashes in clear weather due to inattention/error are presented in Figure 18 (in this case, there were too few raw data points to analyze statistically).

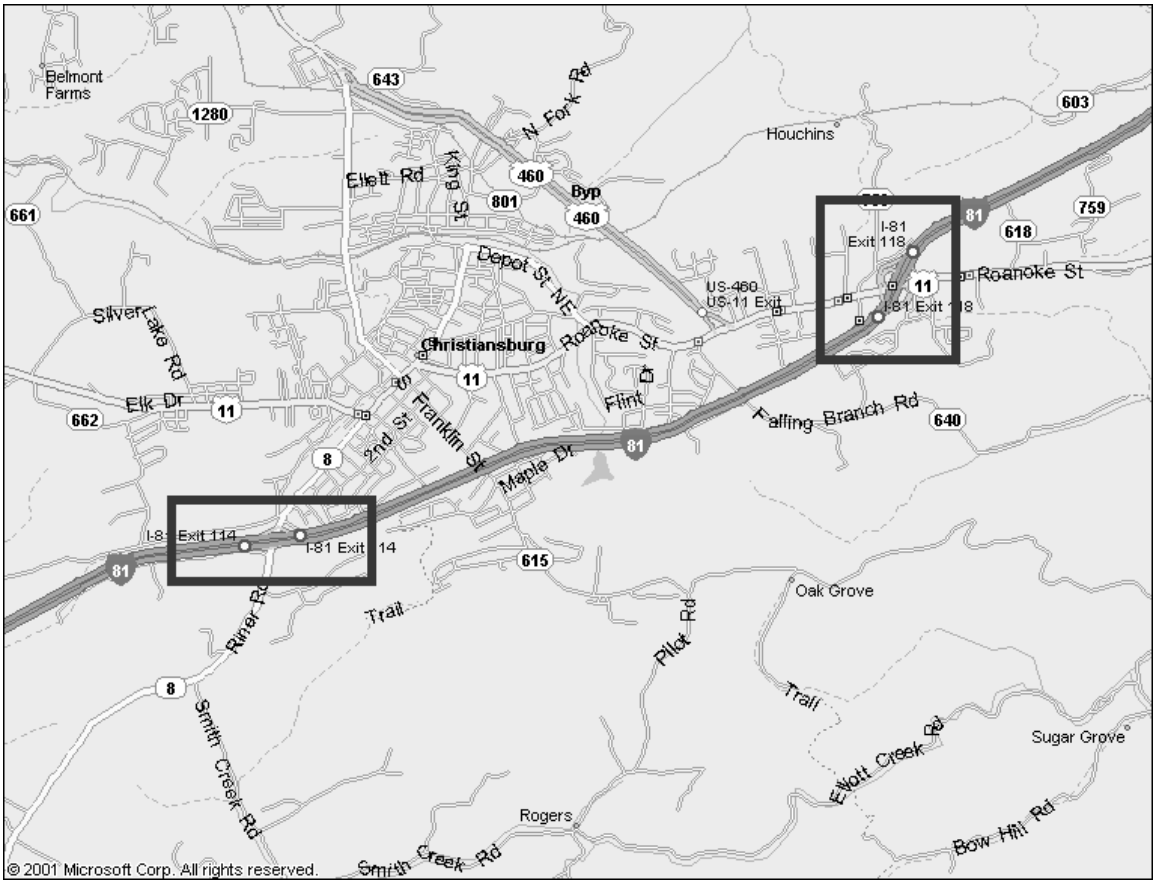


Figure 16. Map of I-81, exits 118 (test) and 114 (control). Scale is ~1 inch = 1.5 mile.

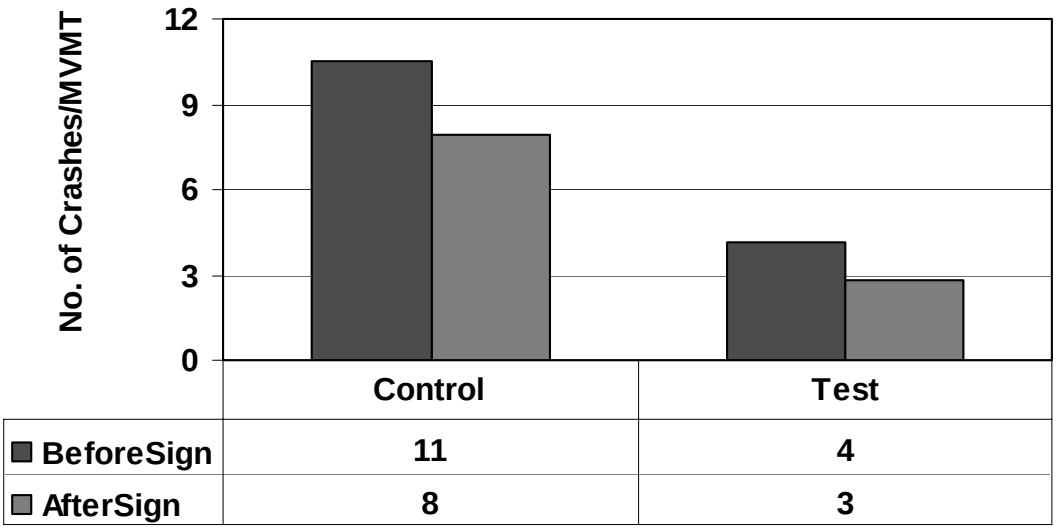


Figure 17. Crashes per MVMT for I-81, exits 118 (test) and 114 (control) before and after the logo signs were installed.

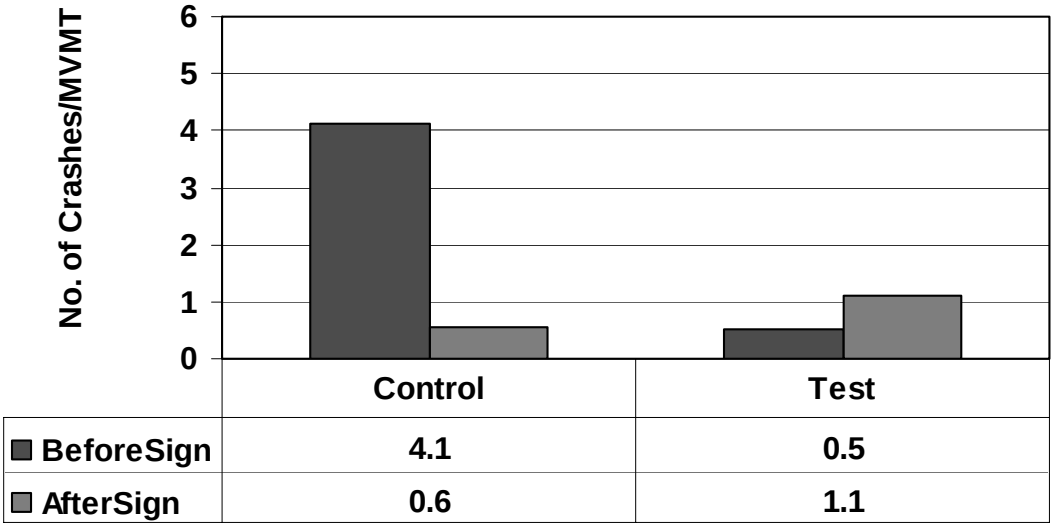


Figure 18. Crashes per MVMT occurring in clear weather and coded as due to inattention/error for I-81, exits 118 (test) and 114 (control) before and after the logo signs were installed.

I-81 at Exit 150. The map for this study area is shown in Figure 19. The following conditions and techniques were used in analyzing the crashes for this exit:

- Erected February 25, 2002
- Analyzed February 18, 2001- February 18, 2002 as before sign and March 4, 2002- March 4, 2003 as after sign.
- Used Exit 146 as the control
- Deleted crashes with unknown node or milepost

- The following observed mileposts were then used as a final distance filter for the sign and the exits:
  - Exit 150 NB: Full Service Food sign at MP147.9; exit at MP150.0; 1500 ft = MP147.6 (1500 ft = .28 miles); range = 147.6-150.0 (2.4 mi)
  - Exit 150 SB: Full Service Food sign at 152.6; exit at 150.7; 1500 ft = 152.9; range = 150.7-152.9 (2.2 mi)
  - Exit 146 NB: first logo sign at 144.8; exit at 146.2; 1500 ft = 144.5; range = 144.5-146.2 (1.7 mi)
  - Exit 146 SB: first logo sign at 149.2; exit at 146.8; 1500 ft = 149.5; range = 146.8-149.5 (2.7 mi)

The total number of crashes per MVMT for these exits is shown in Figure 20 (not significant; raw data chi-square = 0.3948, $p = 0.5298$), while those crashes in clear weather due to inattention/error are presented in Figure 21 (not enough raw data points to analyze).

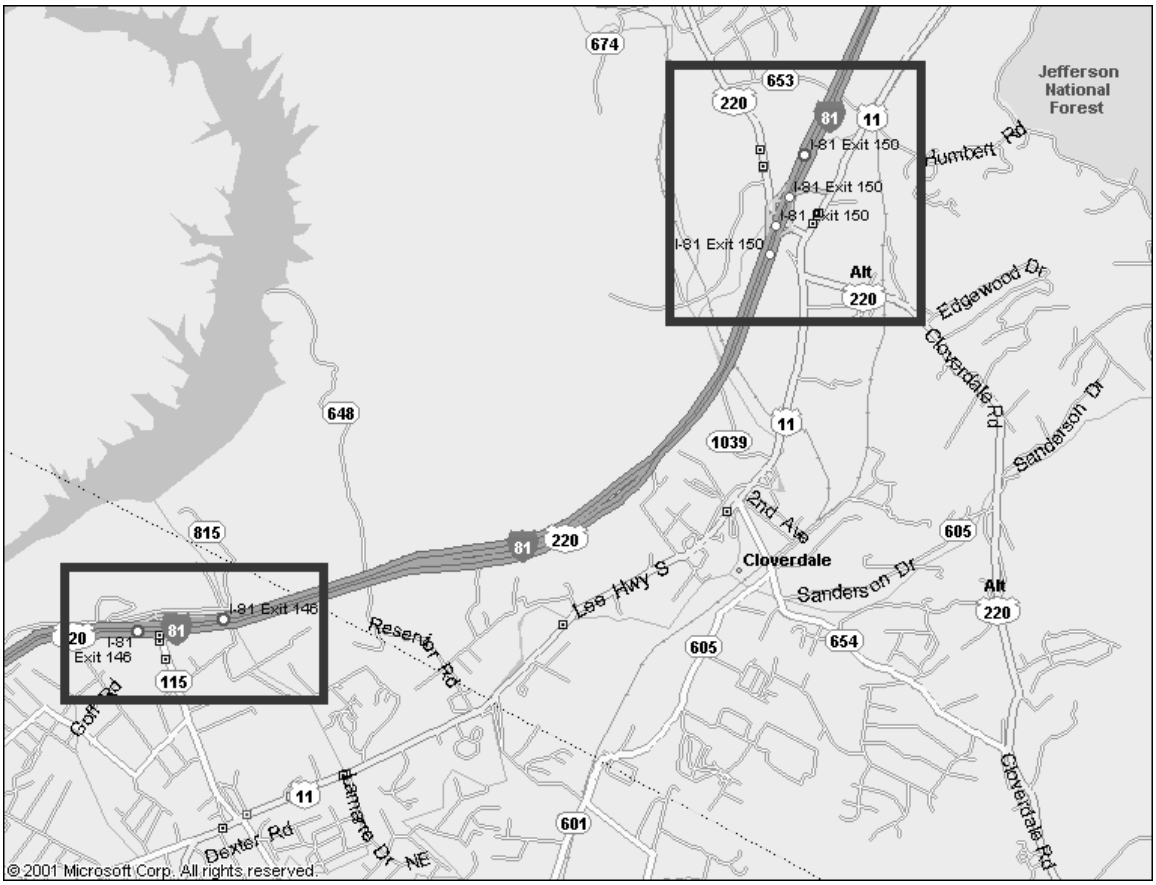


Figure 19. Map of I-81, exits 150 (test) and 146 (control). Scale is ~1 inch =1.5 mile.

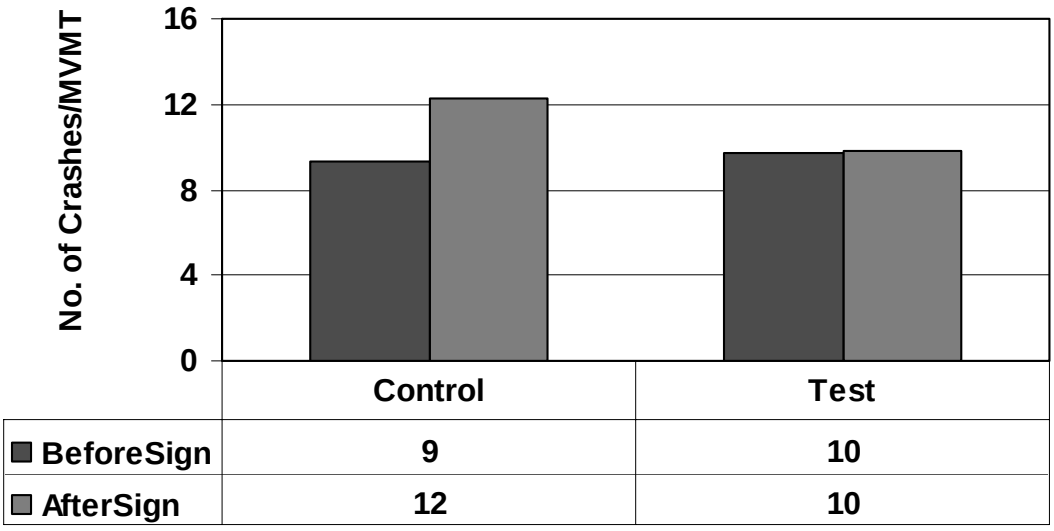


Figure 20. Crashes per MVMT for I-81, exits 150 (test) and 146 (control) before and after the logo signs were installed.

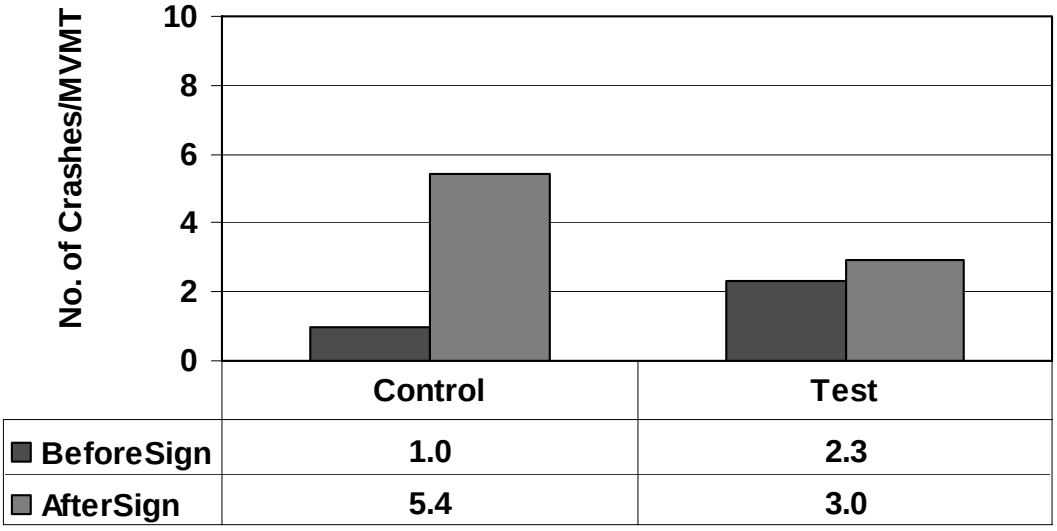


Figure 21. Crashes per MVMT occurring in clear weather and coded as due to inattention/error for I-81, exits 150 (test) and 146 (control) before and after the logo signs were installed.

I-81 at Exit 264. The map for this study area is shown in Figure 22. The following conditions and techniques were used in analyzing the crashes for this exit:

- Erected July 22, 2000
- Analyzed July 15, 1999-July 15, 2000 as before sign and July 29, 2000-July 29, 2001 as after sign.
- Used Exit 269 as the control
- Deleted crashes with unknown node or milepost

- The following observed mileposts were then used as a final distance filter for the sign and the exits:
  - Exit 264 NB: Full Service Food sign at MP262.9; exit at MP264.7; 1500 ft = MP262.6 (1500 ft = .28 miles); range = 262.6-264.7 (2.1 mi)
  - Exit 264 SB: Full Service Food sign at 267.7; exit at 265.2; 1500 ft = 268.0; range = 265.2-268.0 (2.8 mi)
  - Exit 269 NB: first logo sign at 267.5; exit at 268.9; 1500 ft = 267.2; range = 267.2-268.9 (1.7 mi)
  - Exit 269 SB: first logo sign at 270.5; exit at 269.3; 1500 ft = 270.8; range = 269.3-270.8 (1.5 mi)

The total number of crashes per MVMT for this set of exits is shown in Figure 23 (not significant; raw data chi-square = 0.7066, $p = 0.4006$). Crashes in clear weather due to inattention/ distraction are presented in Figure 24 (not enough raw data points to analyze).

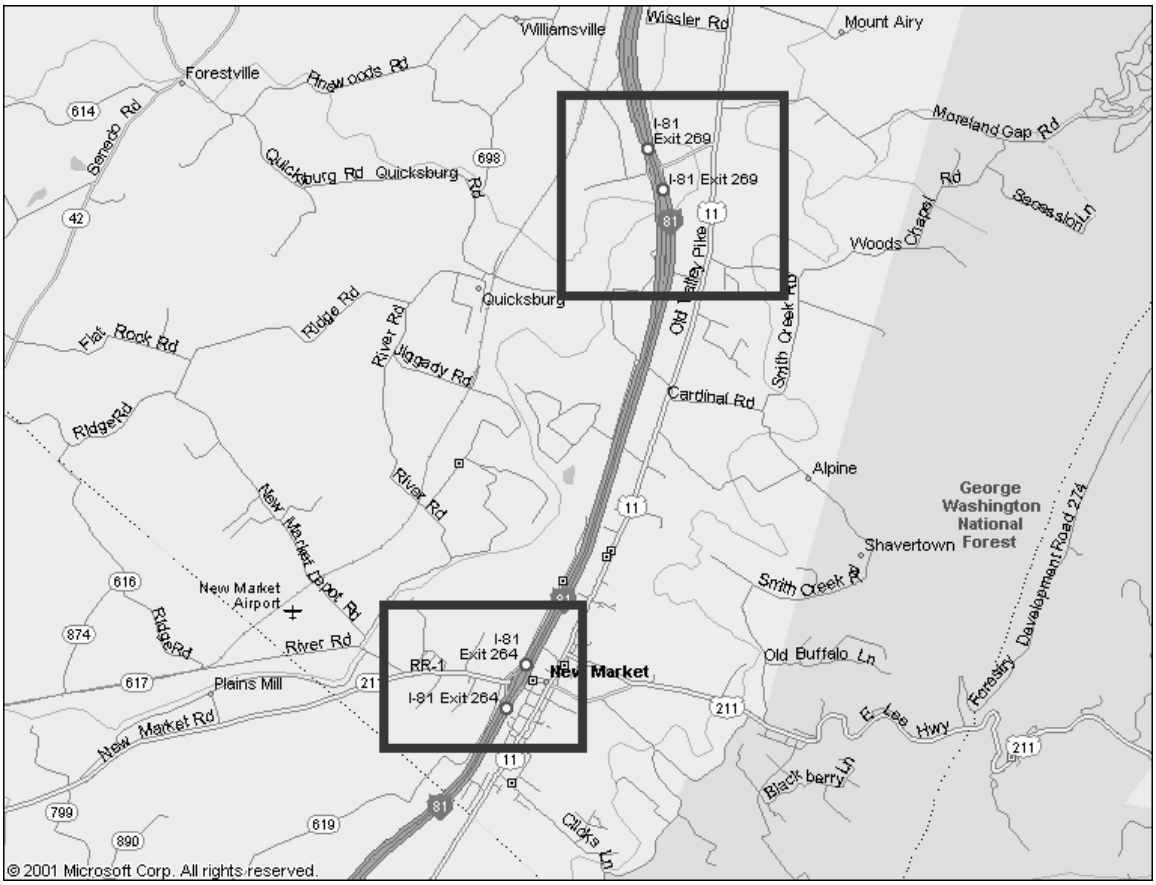


Figure 22. Map of I-81, exits 264 (test) and 269 (control). Scale is ~1 inch = 2 mile.

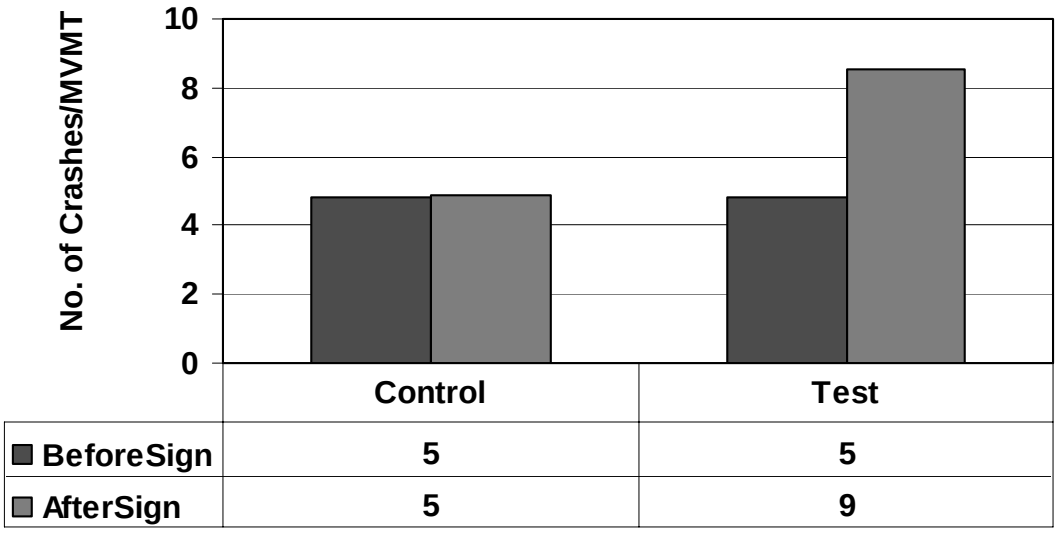


Figure 23. Crashes per MVMT for I-81, exits 264 (test) and 269 (control) before and after the logo signs were installed.

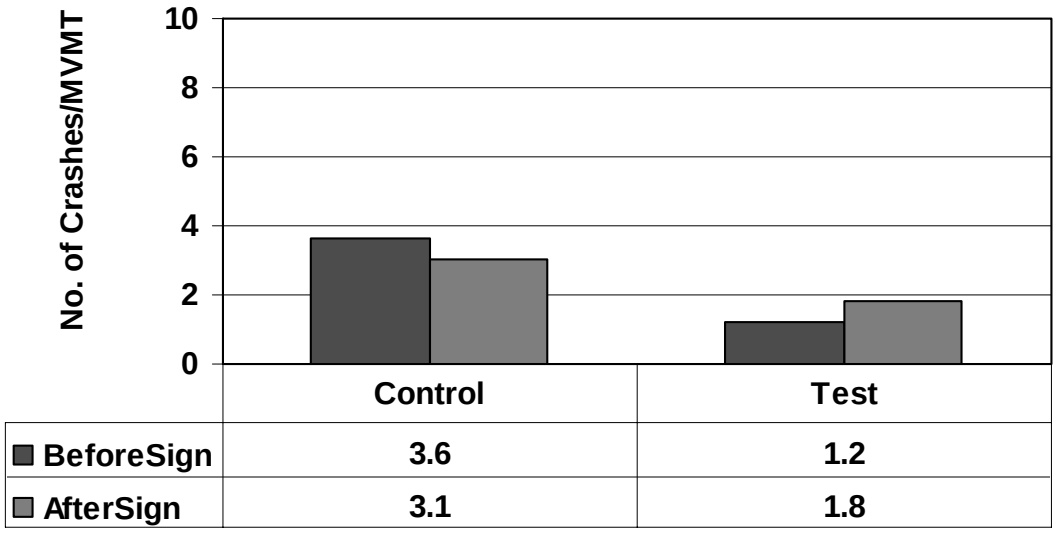


Figure 24. Crashes per MVMT occurring in clear weather and coded as due to inattention/error for I-81, exits 264 (test) and 269 (control) before and after the logo signs were installed.

I-95 at Exit 92. The map for this study area is shown in Figure 25. The following conditions and techniques were used in analyzing the crashes for this exit:

- Erected February 22, 2002
- Analyzed February 15, 2001- February 15, 2002 as before sign and March 1, 2002- March 1, 2003 as after sign.
- Used Exit 89 as the control
- Deleted crashes with unknown node or milepost

- The following observed mileposts were then used as a final distance filter for the sign and the exits:
  - Exit 92 NB: Full Service Food sign at MP90.0; exit at MP91.9; 1500 ft = MP89.7 (1500 ft = .28 miles); range = 89.7-91.9 (2.2 mi)
  - Exit 92 SB: Full Service Food sign at 94.1; exit at 92.6; 1500 ft = 94.4; range = 92.6-94.4 (1.8 mi)
  - Exit 89 NB: first logo sign at MP88.1; exit at MP89.2; 1500 ft = MP87.8 (1500 ft = .28 miles); range = 87.8-89.2 (1.4 mi)
  - Exit 89 SB: first logo sign at 91.1; exit at 89.6; 1500 ft = 91.4; range = 89.6-91.4 (1.8 mi)

The total number of crashes per MVMT for these exits is shown in Figure 26 (not significant; raw data chi-square < 0.0000, $p = 0.9975$). Crashes in clear weather due to inattention/ distraction are presented in Figure 27 (also not significant; raw data chi-square = 0.5118, $p = 0.4744$).

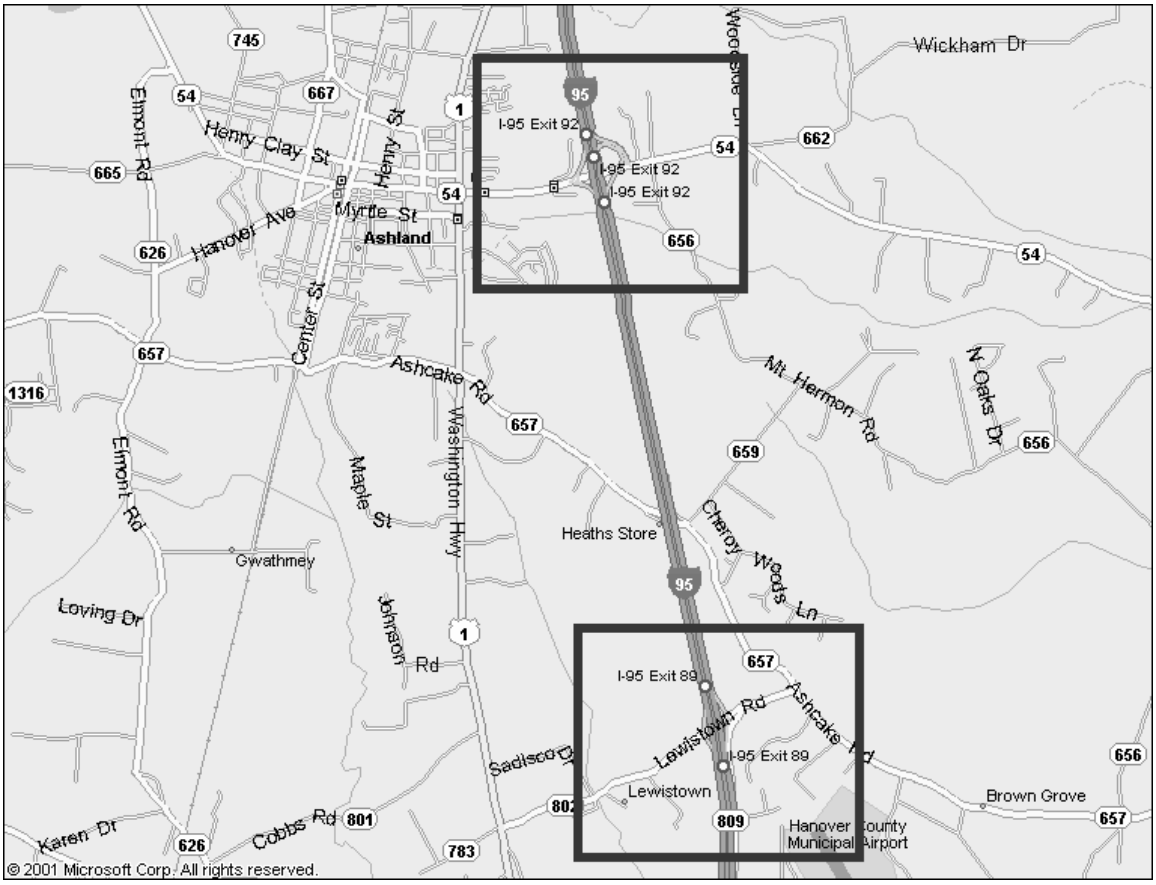


Figure 25. Map of I-95, exits 92 (test) and 89 (control). Scale is ~1 inch =1 mile.

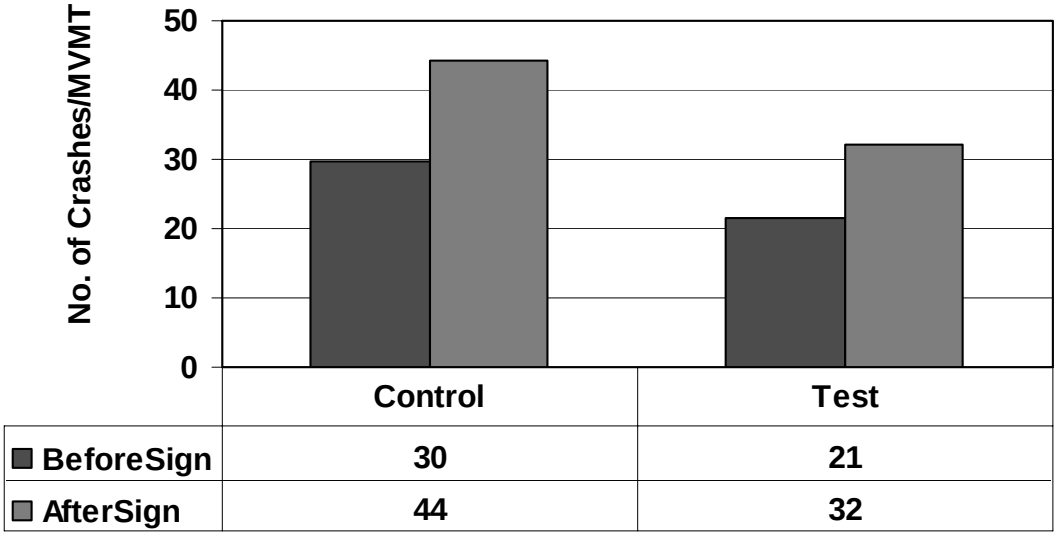


Figure 26. Crashes per MVMT for I-95, exits 92 (test) and 89 (control) before and after the logo signs were installed.

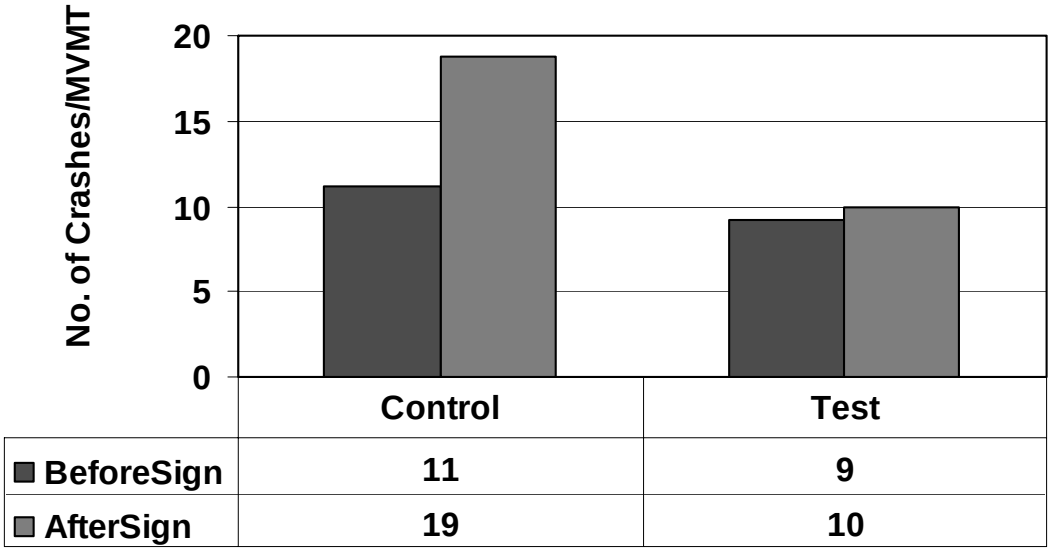


Figure 27. Crashes per MVMT occurring in clear weather and coded as due to inattention/error for I-95, exits 92 (test) and 89 (control) before and after the logo signs were installed.

I-95 at Exit 126. The map for this study area is shown in Figure 28. The following conditions and techniques were used in analyzing the crashes for this exit:

- Erected October 3, 2000
- Analyzed September 26, 1999-September 26, 2000 as before sign and October 10, 2000-October 10, 2001 as after sign.
- Used Exit 130 as the control
- Deleted crashes with unknown node or milepost

- I-95, exit 126 only has a Full Service board in the SB direction. It does not have a Full Service board in the NB direction. All NB crashes for Exits 126 and 130 were therefore deleted.
- The following observed mileposts were then used as a final distance filter for the sign and the exits:
  - Exit 126 SB: Full Service Food sign at 128.2; exit at 126.5; 1500 ft = 128.5; range = 126.5-128.5 (2.0 mi)
  - Exit 130 SB: first logo sign at 132.4; exit at 130.7; 1500 ft = 132.7; range = 130.7-132.7 (2.0 mi)

Since only southbound crashes were considered, the number of crashes for analysis was somewhat smaller than would otherwise be the case for this section of interstate. The total number of crashes per MVMT for these exits is shown in Figure 29 (significant; raw data chi-square = 5.1050, $p = 0.0239$). Once again, the significance was driven by a large before-after difference in the control site, while the test site had a neutral result. Crashes in clear weather due to inattention/ distraction are presented in Figure 30 (not enough raw data points to analyze).

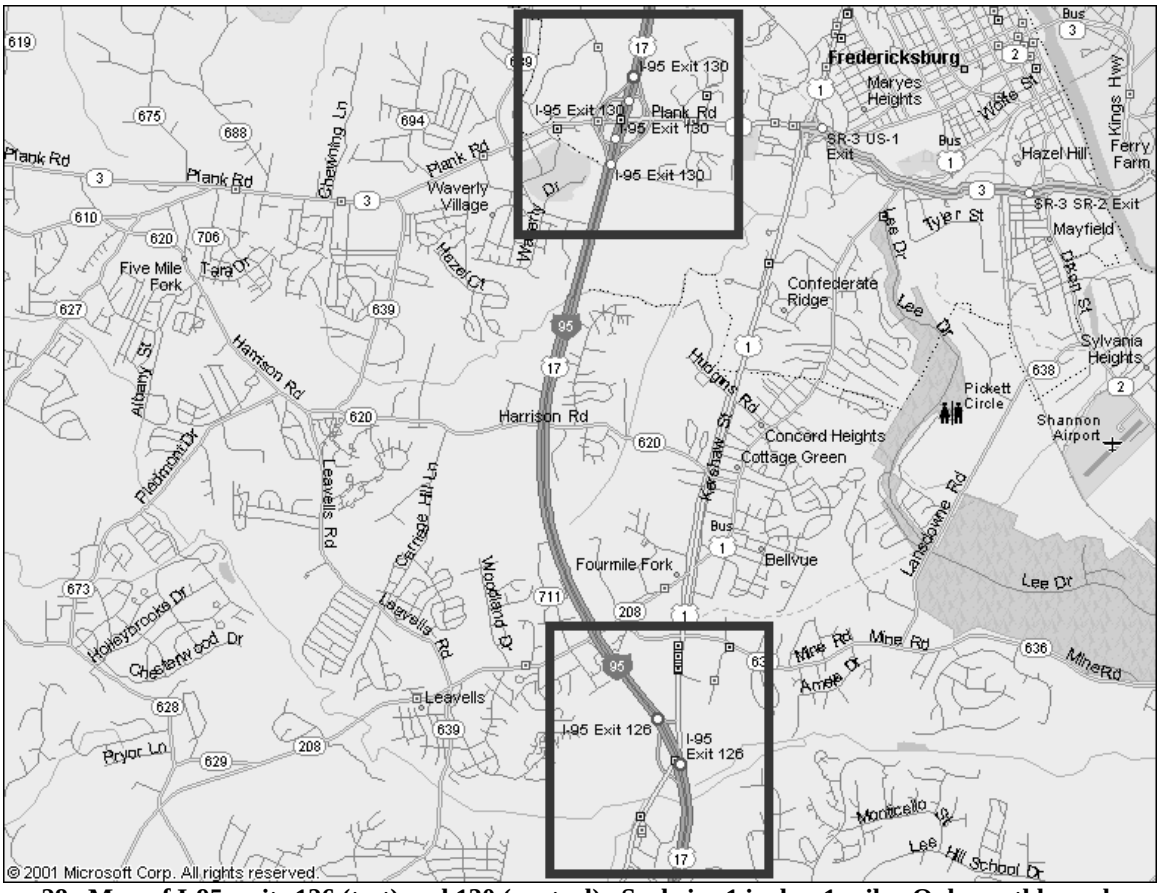


Figure 28. Map of I-95, exits 126 (test) and 130 (control). Scale is ~1 inch = 1 mile. Only southbound crashes were considered.

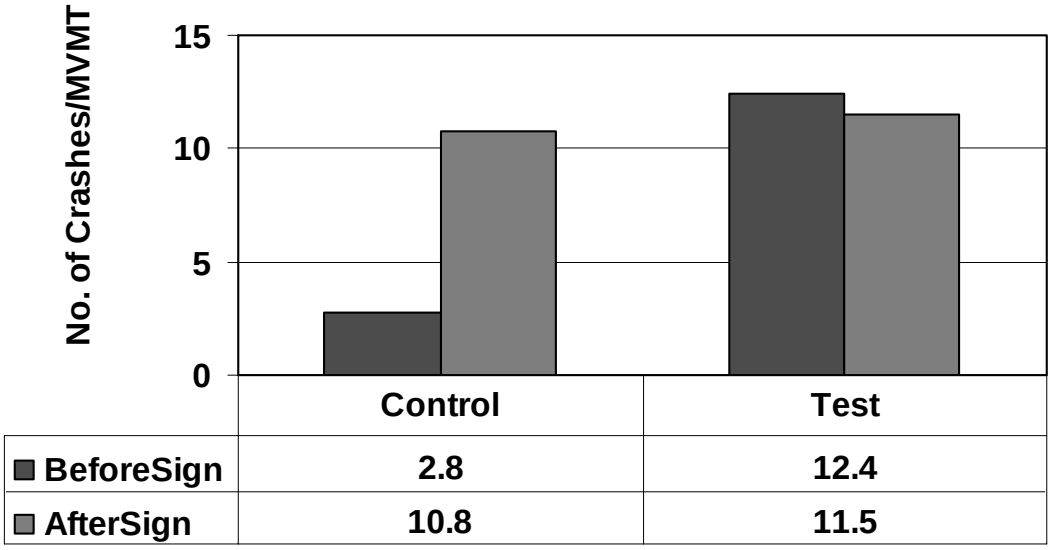


Figure 29. Crashes per MVMT for I-95, exits 126 (test) and 130 (control) before and after the logo signs were installed. Only southbound crashes were considered.

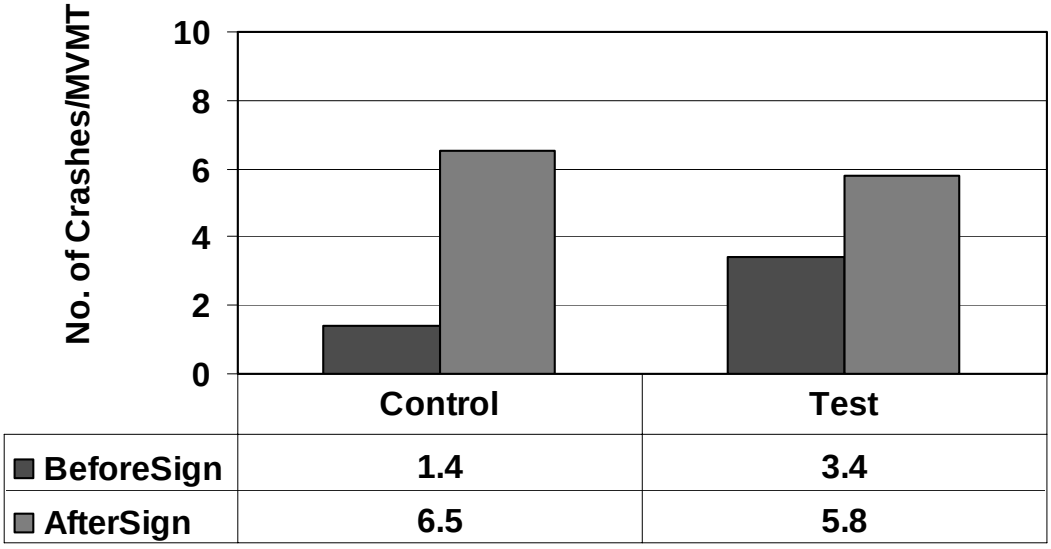


Figure 30. Crashes per MVMT occurring in clear weather and coded as due to inattention/error for I-95, exits 126 (test) and 130 (control) before and after the logo signs were installed. Only southbound crashes were considered.

I-95 at Exit 143. The map for this study area is shown in Figure 31. The following conditions and techniques were used in analyzing the crashes for this exit:

- Erected February 8, 2002
- Analyzed February 1, 2001-February 1, 2002 as before sign and February 15, 2002-February 15, 2003 as after sign.
- Used Exit 140 as the control
- Deleted crashes with unknown node or milepost

- The following observed mileposts were then used as a final distance filter for the sign and the exits:
  - Exit 143 NB: Full Service Food sign at MP141.2; exit at MP143.0; 1500 ft = MP140.9 (1500 ft = .28 miles); range = 140.9-143.0 (2.1 mi)
  - Exit 143 SB: Full Service Food sign at 145.7; exit at 144.0; 1500 ft = 146.0; range = 144.0-146.0 (2.0 mi)
  - Exit 140 NB: first logo sign at MP138.9; exit at MP140.3; 1500 ft = MP138.6 (1500 ft = .28 miles); range = 138.6-140.3 (1.7 mi)
  - Exit 140 SB: first logo sign at 142.2; exit at 140.7; 1500 ft = 142.5; range = 140.7-142.5 (1.8 mi)

The total number of crashes per MVMT for these exits is shown in Figure 32 (not significant; raw data chi-square = 0.3753, $p = 0.5402$). Crashes in clear weather due to inattention/distraction are presented in Figure 33. In this case, the differences were significant (raw data chi-square = 7.2738, $p = 0.0070$). However, the significance was driven by an increase in crashes at the control site with nearly the same magnitude decrease at the test site, so this finding is neutral with respect to the hypothesis.

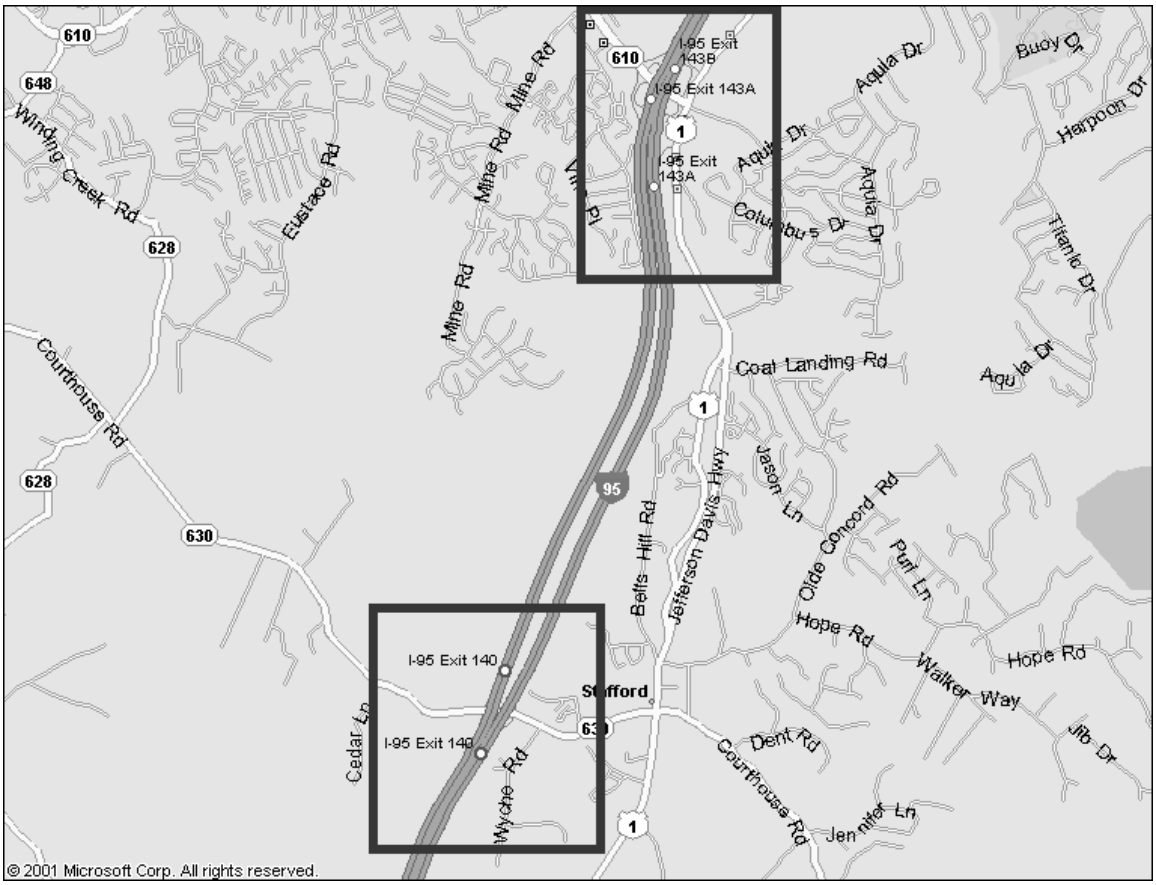


Figure 31. Map of I-95, exits 143 (test) and 140 (control). Scale is ~1 inch = 1 mile.

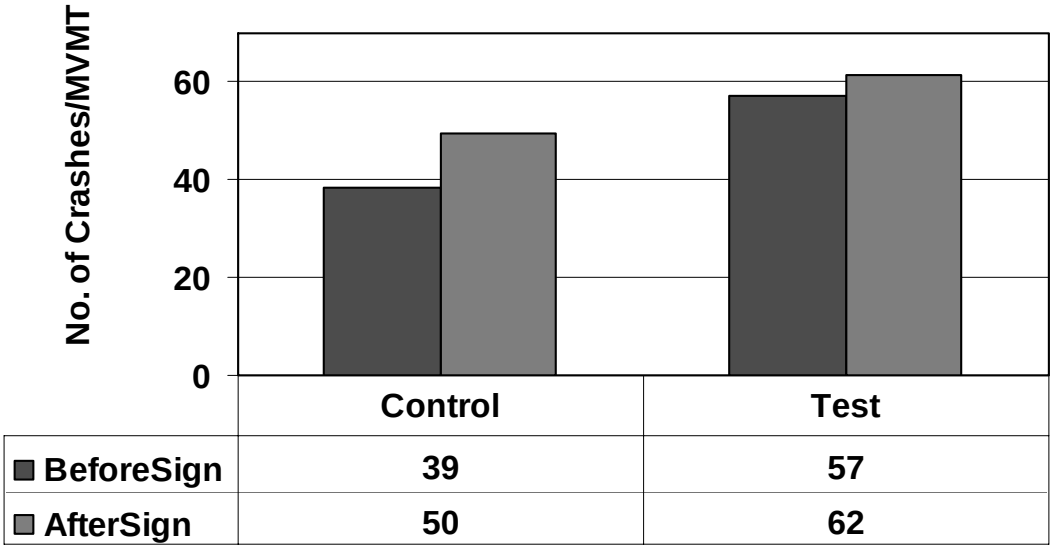


Figure 32. Crashes per MVMT for I-95, exits 143 (test) and 140 (control) before and after the logo signs were installed.

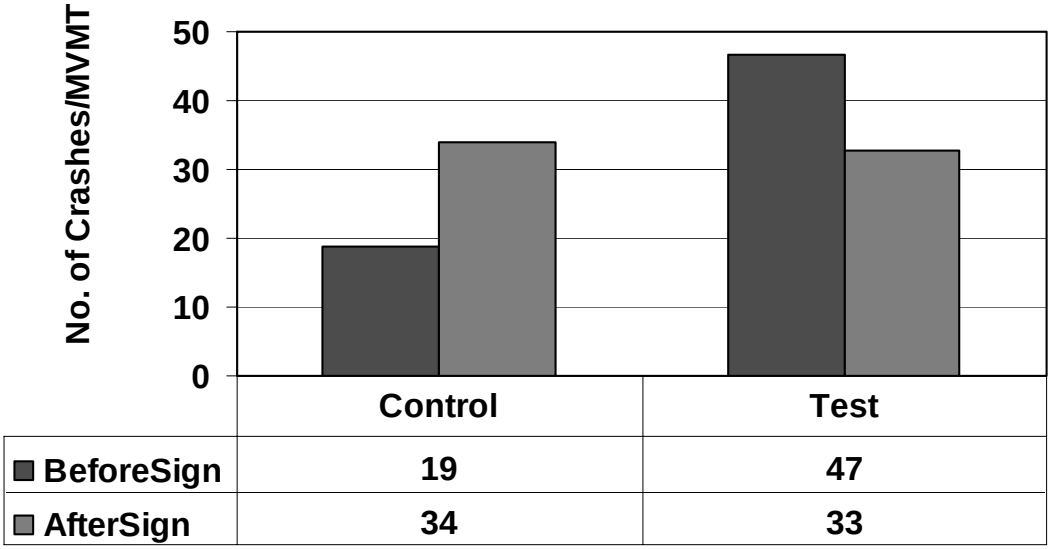


Figure 33. Crashes per MVMT occurring in clear weather and coded as due to inattention/error for I-95, exits 143 (test) and 140 (control) before and after sign installation.

At a preliminary presentation of these results, one audience member noted that this particular exit was in the vicinity of a great deal of maintenance work over the past few years, and that this could have contributed to the high numbers of crashes observed for this exit. It was noted that most or all of the maintenance work took place at night. An additional analysis was therefore conducted to examine the same data as shown in Figure 32, but now only including those crashes that occurred during daylight hours (to eliminate crashes that may have been caused by maintenance activities). As seen in Figure 34, the overall pattern remained the same, but the differences were no longer significant (raw data chi-square = 3.4667, $p = 0.0626$).

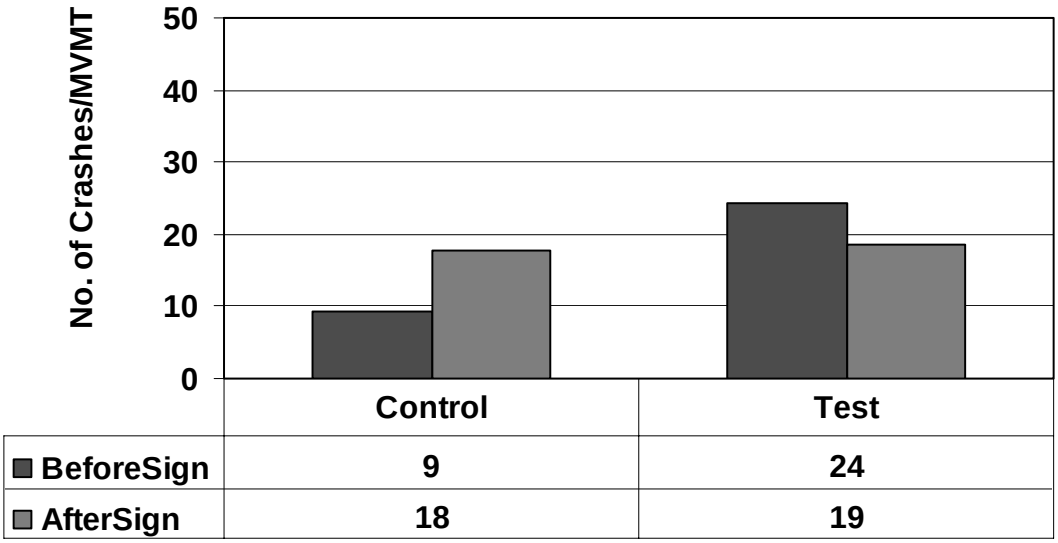


Figure 34. Crashes per MVMT occurring in *daylight,* in clear weather, and coded as due to inattention/error for I-95, exits 143 (test) and 140 (control) before and after sign installation.

Conclusions

Results from the crash analysis showed that the data support Hypothesis 2, in that no additional safety risk was found to be caused by having more than six Food logos on two sign structures. The crash data generally showed no sign of an increased number of crashes at the test exits after the signs were installed. Where significant results were found, they were generally driven by changes in the control exits, and were neutral with respect to the test exit. There was nothing in the crash data results to suggest that the additional signs created an increase in crashes: 1) either during the year after they were installed as compared to the year before they were installed, or 2) as compared to an adjacent, test exit without the signs. The findings held true even when only crashes coded with inattention/error occurring in good weather were examined.

RECOMMENDED CHANGES TO MUTCD

Although the study was intended to assess the potential benefit of adding a new service type, Full Service Food, the survey results showed some confusion with the meaning of this service type. Therefore, the recommended changes to the MUTCD are focused on the Food service type, rather than on adding a new service type (Full Service Food). With that in mind, the results of this study support a change to the MUTCD to allow more than six Food service logos spread across multiple motherboards. This would only require the modification of one sentence from the current version of the MUTCD (2003) as follows:

- Chapter 2, Section 2F.02, Standard, 2nd paragraph, 2nd to last sentence currently reads:
  - "No service type shall appear on more than one sign."
- Recommended change:
  - "No service type except for Food shall appear on more than one sign."

The other relevant requirements would continue in force, including:

- No more than three types of services shall be represented on any sign or sign assembly. If three types of services are shown on one sign, then the logo panels shall be limited to two for each service (for a total of six logo panels).[Chapter 2, Section 2F.02]
- The number of Specific Service signs along an approach to an interchange or intersection, regardless of the number of service types displayed, shall be limited to a maximum of four. [Chapter 2, Section 2F.02]
- Each Specific Service sign or sign assembly shall be limited to no more than six logo panels. There shall be no more than four logo panels for one of the two service types on the same sign or sign assembly. [Chapter 2, Section 2F.04]

REFERENCES

Hauer, E. (1997). *Observational before – after studies in road safety*. Amsterdam: Pergamon.

MUTCD (2003). (November, 2003). *Manual on Uniform Traffic Control Devices; Current Edition*. Available on-line at http://mutcd.fhwa.dot.gov/kno-2003.htm. Washington, DC: U.S. Dept. of Transportation, Federal Highway Administration.

APPENDIX A. VDOT LOGO MOTHERBOARD SURVEY

CALL RECORD

Record Number	**Priority**	**Callback Date/Time**
Phone Number	**Interviewer ID**	**Interviewer Message**
FIPS	**Number of Attempts**	**Current Begin Date/Time**
Respondent Number	**Last Contact**	**Current End Date/Time**
Status	**Last Disposition**	

Final Call Disposition

Answering Machine	Computer/Fax Tone	Language Barrier	Not Qualified -- Travel
Automated Refusal Service	Disconnected	No Adult in Home	Temporarily Disconnected
Busy Signal	Hard Refusal	No Answer	Soft Refusal
Callback	Hearing Barrier	Non-residential Number	
Complete	Incomplete	Not Qualified -- Interstates	

A. Hello, my name is _____ _____ and I'm calling from Virginia Tech on behalf of the Virginia Department of Transportation. We are studying the preferences and information needs of citizens who travel on Virginia's Interstates in order to improve services for Virginians. I need to speak with an adult in your household (AGE 18 or OLDER). Would that be you?

YES [GO TO Q1] 1
NO 2

B. May I speak with that person?

[REPEAT FIRST TWO SENTENCES OF A, GO TO Q1] YES 1
NO 2

C. So that I will know whom to ask for when I call back, what is (his/her) first name?

_____

Q1. Have you traveled at least 200 miles from home in an automobile in the past year?

YES [GO TO Q2] 1
NO 2
DK/RF 3

SURVEY END1. I'm sorry, our study requires that we speak with individuals who have traveled at least 200 miles from home in an automobile in the past year.

AUTOMATIC CATI CODE "NOT QUALIFIED -- TRAVEL"

Q2. Have you traveled on Interstate 64 near Charlottesville in the past year?

YES 1
NO 2
DK/RF 3

Q3. Have you traveled on Interstate 81 near Roanoke, Harrisonburg, or Christiansburg in the past year?

YES 1
NO 2
DK/RF 3

Q4. Have you traveled on Interstate 95 near Richmond or Fredericksburg in the past year?

YES 1
NO 2
DK/RF 3

Q5. How often do you travel on Virginia's interstates?

ONCE A YEAR OR LESS 1
ONCE EVERY SIX MONTHS 2
ONCE EVERY THREE MONTHS 3
ONCE AS MONTH OR MORE 4
DK/RF 5

IF Q2=1 OR Q3=1 OR Q4=1, GO TO Q6

SURVEY END2. I'm sorry, our study requires that we speak with individuals who have traveled on Interstates 64, 81, or 95 near at least one of the areas included in our study.

AUTOMATIC CATI CODE "NOT QUALIFIED -- INTERSTATE"

Q6. When traveling on Virginia's Interstates, you may have noticed the blue signs that include specific information about services like gas, food and lodging through the use of business logos. Currently most of these signs include only one service type. For example, signs for camping usually include information about camping sites only, even if there is blank space remaining on the sign. Would you say that having more than one service type on each sign would be very confusing, somewhat confusing, or not at all confusing to you while traveling?

VERY CONFUSING 1
SOMEWHAT CONFUSING 2
NOT AT ALL CONFUSING 3
DON'T KNOW/NO PREFERENCE 4
REFUSE 5

Q7. The specific services are normally listed in the order of camping, lodging, food and then gas as you approach the interchange. If instead, the services were listed in random order to accommodate additional business listings on the signs, would that be very confusing, somewhat confusing, or not at all confusing for you?

VERY CONFUSING 1
SOMEWHAT CONFUSING 2
NOT AT ALL CONFUSING 3
DON'T KNOW/NO PREFERENCE 4
REFUSE 5

Q8. Historically, each service has been limited to one sign. If the same service were listed on multiple signs, would that be very useful, somewhat useful, not very useful, or not at all useful?

VERY USEFUL 1
SOMEWHAT USEFUL 2
NOT VERY USEFUL (Please specify why: _____) 3
NOT AT ALL USEFUL (Please specify why: _____) 4
DON'T KNOW/NO PREFERENCE 5
REFUSE 6

Q9. In the Radford, Christiansburg, Blacksburg, Roanoke, Charlottesville, Richmond, and Fredericksburg areas, additional food establishments have been listed as a separate service category called full service food. Have you ever seen any of these signs for full service food establishments?

YES 1
NO [GO TO Q11] 2
DK/RF [GO TO Q11] 3

Q10. How useful were these signs to you?

VERY USEFUL 1
SOMEWHAT USEFUL 2
NOT VERY USEFUL (Please specify why: _____) 3
NOT AT ALL USEFUL (Please specify why: _____) 4
DON'T KNOW/NO PREFERENCE 5
REFUSE 6

GO TO Q12

Q11. How useful do you think it would be to you to have full service restaurants listed on their own full service food interstate signs? Would you say very useful, somewhat useful, not very useful, or not at all useful?

VERY USEFUL 1
SOMEWHAT USEFUL 2
NOT VERY USEFUL (Please specify why: _____) 3
NOT AT ALL USEFUL (Please specify why: _____) 4
DON'T KNOW/NO PREFERENCE 5
REFUSE 6

Q12. How useful do you think it would be to include full service restaurants on signs with other service types, such as camping, if there was free space on the camping sign? Would you say very useful, somewhat useful, not very useful, or not at all useful?

VERY USEFUL 1
SOMEWHAT USEFUL 2
NOT VERY USEFUL (Please specify why: _____) 3
NOT AT ALL USEFUL (Please specify why: _____) 4
DON'T KNOW/NO PREFERENCE 5
REFUSE 6

Q13. When thinking of the food establishments included on the blue interstate signs in Virginia, what do you consider to be the primary differences in the services provided by those establishments on the standard food signs and those establishments on the full service food sign?

RESPONSE PROVIDED: _____ 1
DON'T KNOW WHAT THE DIFFERENCES ARE 2
REFUSE 3

Q14. Thinking of restaurants that serve <u>breakfast</u>, please tell me your level of agreement that each of the items I mention should be served at breakfast.

Q14a. First, coffee? Do you…

strongly agree? 1
somewhat agree? 2
somewhat disagree? 3
or strongly disagree? 4
DON'T KNOW/NO PREFERENCE 5
REFUSE 6

Q14b. How about juice?

STRONGLY AGREE 1
SOMEWHAT AGREE 2
SOMEWHAT DISAGREE 3
STRONGLY DISAGREE 4
DON'T KNOW/NO PREFERENCE 5
REFUSE 6

Q14c. Eggs?

STRONGLY AGREE 1
SOMEWHAT AGREE 2
SOMEWHAT DISAGREE 3
STRONGLY DISAGREE 4
DON'T KNOW/NO PREFERENCE 5
REFUSE 6

Q14d. Breakfast meats such as bacon or sausage?

STRONGLY AGREE 1
SOMEWHAT AGREE 2
SOMEWHAT DISAGREE 3
STRONGLY DISAGREE 4
DON'T KNOW/NO PREFERENCE 5
REFUSE 6

Q14e. Breakfast grains such as biscuits, toast, pastries, or cereal?

STRONGLY AGREE 1
SOMEWHAT AGREE 2
SOMEWHAT DISAGREE 3
STRONGLY DISAGREE 4
DON'T KNOW/NO PREFERENCE 5
REFUSE 6

Q15. Now, Is there anything else you would like to tell me about interstate signs for food establishments that we have not already discussed?

YES (Please specify: _____) 1
NO 2
DK/RF 3

Q16. Would you say that your total combined household income before taxes last year was…

less than $20,000 1
at least $20,000 but less than $40,000 2
at least $40,000 but less than $60,000 3
at least $60,000 but less than $80,000 4
at least $80,000 but less than $100,000 5
at least $100,000 but less than $120,000 6
or $120,000 or more? 7
DK/RF 8

Q17. Counting yourself, how many people live in your household currently?

____
DK/RF 99

Q18. Counting yourself, how many of these people are 18 to 25 years of age?

____
DK/RF 99

IF Q18=Q17, GO TO Q22. IF Q18 > Q17, BEEP, REASK

Q19. How about 26 to 35?

____
DK/RF 99

IF Q18+Q19=Q17, GO TO Q22. IF Q19 > Q17, BEEP, REASK

Q20. 36 to 60?

DK/RF 99

IF Q18+Q19+Q20=Q17, GO TO Q22. IF Q20 > Q17, BEEP, REASK

Q21. Over 60 years of age?

DK/RF 99

Those are all of our questions. Thank you for your help with our study.
Have a nice [INSERT DAY/EVENING]!

Q22. GENDER

INTERVIEWER IF NECESSARY: "Our study requires that I ask if you are male or female."

MALE 1
FEMALE 2

INTERVIEWER IF ASKED: "This study is being conducted on behalf of the Virginia Department of Transportation in order to help shape policies regarding Interstate signs so that they will be most useful to citizens. If you have any specific questions about the study, please call Susan Willis-Walton at 800-488-8944."

APPENDIX B. SUMMARIES OF OPEN-ENDED RESPONSES TO TELEPHONE SURVEY

Q8. Historically, each service has been limited to one sign. If the same service were listed on multiple signs, would that be very useful, somewhat useful, not very useful, or not at all useful? Not very/Not at all useful responses summarized.

Response Type	Number of Respondents	Percent of Open-Ended Responses
Not necessary – will see the sign first time	59	32%
Multiple signs would be too confusing	34	19%
Other	30	16%
Multiple signs would be too much to read	24	13%
I like the signs the way they are	19	10%
Multiple signs would be too repetitive	16	9%

Q10. How useful were these signs to you? Not very/Not at all useful responses summarized.

Response Type	Number of Respondents	Percent of Open-Ended Responses
Don't eat at full-service while traveling	8	42%
Other	4	21%
Prefer fast food while traveling	2	11%
Already had stopping plans	2	11%
Didn't understand sign	2	11%
Already knew full-service	1	5%

Q11. How useful do you think it would be to you to have full service restaurants listed on their own full service food interstate signs? Not very/Not at all useful responses summarized.

Response Type	Number of Respondents	Percent of Open-Ended Responses
Prefer fast food while traveling	32	25%
Already understand the difference	24	19%
Don't stop to eat while traveling	23	18%
Don't care about difference	21	17%
Too many signs/waste/poor aesthetics	13	10%
Other	8	6%
Don't understand the difference	4	3%
Already planned all stops	2	2%

Q12. How useful do you think it would be to include full service restaurants on signs with other service types, such as camping, if there was free space on the camping sign? Not very/Not at all useful responses summarized.

Response Type	Number of Respondents	Percent of Open-Ended Responses
Too complicated/confusing	77	46%
Keep it simple/separate	34	20%
Other	21	12%
Don't eat on the road	13	8%
Keep the food signs already there	10	6%
Wouldn't look at Camping Sign	10	6%
Already planned stops	2	1%
Looking for fast food only	2	1%

Q13. When thinking of the food establishments included on the blue interstate signs in Virginia, what do you consider to be the primary differences in the services provided by those establishments on the standard food signs and those establishments on the full service food sign? Responses summarized.

Response Type	Number of Respondents	Percent of Open-Ended Responses
Standard: fast food, Full-service: sit-down	284	69%
Menu Variety/Quality/Service	36	9%
Gas/other services available at full service	27	7%
Time	26	6%
Other	23	6%
Price	9	2%
None	5	1%

Q15. Now, is there anything else you would like to tell me about interstate signs for food establishments that we have not already discussed? Responses summarized.

Type of Response	Number of Respondents	Percent of Open-Ended Responses
Put the distance/direction to the service on the interstate sign, not just the exit sign	59	37%
Make the signs easier to read (e.g. bigger, lights, clear trees, replace old signs)	20	12%
Include more restaurant information (e.g. hours, vegetarian options, pricing, showers, facilities for handicapped individuals)	16	10%
Update the signs more often/keep up with all the restaurants close to exit, including full-service	14	9%
Other	14	9%
Keep the signs the way they are	13	8%
Keep interstate signs to a minimum	9	6%
Limit the distance a service can be from the interstate to be on the sign	5	3%
Keep signs close to the exit/consider having two signs for each service	5	3%
Put more signs in urban areas	2	1%
Keep signs up in construction areas	1	1%
Have a separate service sign for car repair shops	1	1%
Place restaurant and gas station signs first	1	1%
Charge services to be listed on the sign	1	1%

APPENDIX C. COUNTY WHERE RESPONDENT CURRENTLY RESIDES

	Frequency	Percent	Valid Percent	Cumulative Percent
ACCOMACK	4	.5	.5	.5
ALBEMARLE	11	1.4	1.4	1.9
ALEXANDRIA	9	1.1	1.1	3.0
AMELIA	1	.1	.1	3.1
AMHERST	2	.2	.2	3.4
ARLINGTON	21	2.6	2.6	6.0
AUGUSTA	10	1.2	1.2	7.2
BEDFORD	13	1.6	1.6	8.8
BOTETOURT	6	.7	.7	9.6
BRISTOL	8	1.0	1.0	10.6
BRUNSWICK	1	.1	.1	10.7
BUENA VISTA	3	.4	.4	11.1
CAMPBELL	6	.7	.7	11.8
CARROLL	6	.7	.7	12.6
CHARLOTTE	1	.1	.1	12.7
CHARLOTTESVILLE	3	.4	.4	13.1
CHESAPEAKE	27	3.4	3.4	16.4
CHESTERFIELD	27	3.4	3.4	19.8
CLARKE	4	.5	.5	20.3
CULPEPER	5	.6	.6	20.9
CUMBERLAND	1	.1	.1	21.0
DANVILLE	6	.7	.7	21.8
DICKENSON	5	.6	.6	22.4
FAIRFAX	96	11.9	11.9	34.3
FAUQUIER	7	.9	.9	35.2
FLOYD	3	.4	.4	35.6
FLUVANNA	11	1.4	1.4	36.9
FRANKLIN	2	.2	.2	37.2
FRANKLIN CITY	1	.1	.1	37.3
FREDERICK	8	1.0	1.0	38.3
FREDERICKSBURG	3	.4	.4	38.7
GALAX	3	.4	.4	39.1
GILES	5	.6	.6	39.7
GLOUCESTER	7	.9	.9	40.5
GRAYSON	1	.1	.1	40.7
GREENE	7	.9	.9	41.5
GREENSVILLE	2	.2	.2	41.8
HALIFAX	2	.2	.2	42.0
HAMPTON	13	1.6	1.6	43.7
HANOVER	17	2.1	2.1	45.8
HARRISONBURG	1	.1	.1	45.9
HENRICO	23	2.9	2.9	48.8
HENRY	4	.5	.5	49.3
HIGHLAND	1	.1	.1	49.4
HOPEWELL	6	.7	.7	50.1
ISLE OF WIGHT	5	.6	.6	50.7
JAMES CITY	15	1.9	1.9	52.6
KING WILLIAM	3	.4	.4	53.0
LANCASTER	2	.2	.2	53.2
LEE	1	.1	.1	53.4
LOUDOUN	27	3.4	3.4	56.7

LOUISA	2	.2	.2	57.0
LUNENBURG	2	.2	.2	57.2
LYNCHBURG	6	.7	.7	58.0
MADISON	2	.2	.2	58.2
MECKLENBURG	2	.2	.2	58.5
MONTGOMERY	12	1.5	1.5	60.0
NELSON	5	.6	.6	60.6
NEW KENT	3	.4	.4	60.9
NEWPORT NEWS	12	1.5	1.5	62.4
NORFOLK	14	1.7	1.7	64.2
NORTHAMPTON	3	.4	.4	64.6
ORANGE	8	1.0	1.0	65.5
PAGE	5	.6	.6	66.2
PETERSBURG	2	.2	.2	66.4
PITTSYLVANIA	5	.6	.6	67.0
POQUOSON	2	.2	.2	67.3
PORTSMOUTH	15	1.9	1.9	69.2
POWHATAN	2	.2	.2	69.4
PRINCE EDWARD	1	.1	.1	69.5
PRINCE GEORGE	3	.4	.4	69.9
PRINCE WILLIAM	42	5.2	5.2	75.1
PULASKI	4	.5	.5	75.6
RADFORD	6	.7	.7	76.4
RAPPAHANNOCK	2	.2	.2	76.6
RICHMOND	1	.1	.1	76.7
RICHMOND CITY	15	1.9	1.9	78.6
ROANOKE	12	1.5	1.5	80.1
ROANOKE CITY	8	1.0	1.0	81.1
ROCKBRIDGE	2	.2	.2	81.3
ROCKINGHAM	13	1.6	1.6	83.0
RUSSELL	6	.7	.7	83.7
SALEM	7	.9	.9	84.6
SCOTT	2	.2	.2	84.8
SHENANDOAH	5	.6	.6	85.4
SMYTH	5	.6	.6	86.1
SPOTSYLVANIA	15	1.9	1.9	87.9
STAFFORD	15	1.9	1.9	89.8
STAUNTON	5	.6	.6	90.4
SUFFOLK	7	.9	.9	91.3
TAZEWELL	6	.7	.7	92.0
VIRGINIA BEACH	37	4.6	4.6	96.6
WARREN	1	.1	.1	96.8
WASHINGTON	12	1.5	1.5	98.3
WISE	5	.6	.6	98.9
WYTHE	2	.2	.2	99.1
YORK	7	.9	.9	100.0
Total	804	100.0	100.0	