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16. Abstract <p>The principle objective of this study was to assess the effectiveness of the operational information currently being supplied to highway users in the larger urban areas of Texas. The effectiveness of such information was to be determined by the highway user in terms of relevance, clarity, accuracy, and timeliness. A second objective was to determine how to improve the operational information system if components are found to be ineffective.</p> <p>The scope of the project was limited to signing and associated guidance information on urban freeways in Texas. The ten subject cities with which the study is primarily concerned are: Abilene, Amarillo, Austin, Corpus Christi, Dallas, Ft. Worth, Houston, Lubbock, San Antonio, and Waco. Information was also collected concerning guide signing to commercial airports in the larger of these areas.</p> <p>In the process of determining the overall effectiveness of current urban signing, specific types of guide sign problems which are currently troubling Texas drivers were identified. A variety of approaches to data collection were studied. A series of interviews and surveys were conducted to identify urban locations where motorists had been lost or confused by signing (or its absence). Photographic and other data from problem locations were analyzed to diagnose information deficiencies. In addition a representative sample of drivers were asked questions that allowed an assessment of the magnitude of the problem of information deficiencies and to validate the diagnoses of the characteristics of those deficiencies.</p> <p>Guide sign deficiencies identified were related to lane assignment and lack of advanced information. However, it was suggested that the magnitude of the urban freeway guide signing problem was manageable. These efforts led to the development of recommendations for guidelines to be used to identify and remediate urban freeway guide signing problems.</p>					
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**HIGHWAY USER OPERATIONAL  
INFORMATION SURVEY**

by

Quinn Brackett, R.Dale Huchingson,  
Nada H. Trout, and Katie N. Womack

Research Report 957-1F  
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Sponsored by  
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College Station, TX 77843

February, 1991



# METRIC (SI\*) CONVERSION FACTORS

## APPROXIMATE CONVERSIONS TO SI UNITS

Symbol When You Know Multiply By To Find Symbol

### LENGTH

in	inches	2.54	centimetres	cm
ft	feet	0.3048	metres	m
yd	yards	0.914	metres	m
mi	miles	1.61	kilometres	km

### AREA

in <sup>2</sup>	square inches	645.2	centimetres squared	cm <sup>2</sup>
ft <sup>2</sup>	square feet	0.0929	metres squared	m <sup>2</sup>
yd <sup>2</sup>	square yards	0.836	metres squared	m <sup>2</sup>
mi <sup>2</sup>	square miles	2.59	kilometres squared	km <sup>2</sup>
ac	acres	0.396	hectares	ha

### MASS (weight)

oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg

### VOLUME

fl oz	fluid ounces	29.57	millilitres	mL
gal	gallons	3.785	litres	L
ft <sup>3</sup>	cubic feet	0.0328	metres cubed	m <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.765	metres cubed	m <sup>3</sup>

NOTE: Volumes greater than 1000 L shall be shown in m<sup>3</sup>.

### TEMPERATURE (exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
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## APPROXIMATE CONVERSIONS TO SI UNITS

Symbol When You Know Multiply By To Find Symbol

### LENGTH

mm	millimetres	0.039	inches	in
m	metres	3.28	feet	ft
m	metres	1.09	yards	yd
km	kilometres	0.621	miles	mi

### AREA

mm <sup>2</sup>	millimetres squared	0.0016	square inches	in <sup>2</sup>
m <sup>2</sup>	metres squared	10.764	square feet	ft <sup>2</sup>
km <sup>2</sup>	kilometres squared	0.39	square miles	mi <sup>2</sup>
ha	hectares (10 000 m <sup>2</sup> )	2.53	acres	ac

### MASS (weight)

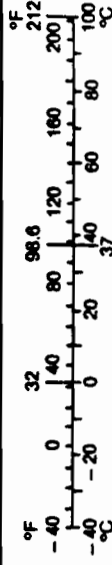
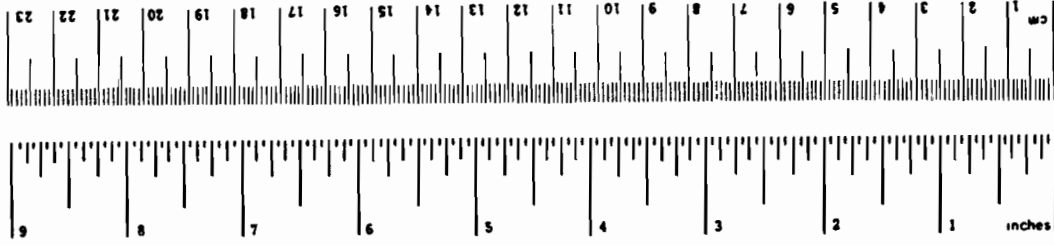
g	grams	0.0353	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams (1 000 kg)	1.103	short tons	T

### VOLUME

mL	millilitres	0.034	fluid ounces	fl oz
L	litres	0.264	gallons	gal
m <sup>3</sup>	metres cubed	35.315	cubic feet	ft <sup>3</sup>
m <sup>3</sup>	metres cubed	1.308	cubic yards	yd <sup>3</sup>

### TEMPERATURE (exact)

°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F
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These factors conform to the requirement of FHWA Order 5190.1A.

\* SI is the symbol for the International System of Measurements



## ABSTRACT

The principle objective of this study was to assess the effectiveness of the operational information currently being supplied to highway users in the larger urban areas of Texas. The effectiveness of such information was to be determined by the highway user in terms of relevance, clarity, accuracy, and timeliness. A second objective was to determine how to improve the operational information system if components are found to be ineffective.

The scope of the project was limited to signing and associated guidance information on urban freeways in Texas. The ten subject cities with which the study is primarily concerned are: Abilene, Amarillo, Austin, Corpus Christi, Dallas, Ft. Worth, Houston, Lubbock, San Antonio, and Waco. Information was also collected concerning guide signing to commercial airports in the larger of these areas.

In the process of determining the overall effectiveness of current urban signing, specific types of guide sign problems which are currently troubling Texas drivers were identified. A variety of approaches to data collection were studied. A series of interviews and surveys were conducted to identify urban locations where motorists had been lost or confused by signing (or its absence). Photographic and other data from problem locations were analyzed to diagnose information deficiencies. In addition a representative sample of drivers were asked questions that allowed an assessment of the magnitude of the problem of information deficiencies and to validate the diagnoses of the characteristics of those deficiencies.

Guide sign deficiencies identified were related to lane assignment and lack of advanced information. However, it was suggested that the magnitude of the urban freeway guide signing problem was manageable. These efforts led to the development of recommendations for guidelines to be used to identify and remediate urban freeway guide signing problems.

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## SECTION I. INTRODUCTION

The Texas Department of Highways and Public Transportation (SDHPT) wished to determine whether the current practices in providing guidance information on urban freeways are effective in satisfying the needs of highway users. Unsolicited public response has indicated that highway users are sometimes dissatisfied with the information furnished by the existing system. Complaints vary from lack of or ambiguous route information to lack of advance notice for proper lane occupancy. The Department sought, in general, to determine the scope and intensity of any deficiencies, and to determine what, if anything, might be done to improve such conditions. Of special concern to the Department was the adequacy of signing for route drivers to special locations; particularly commercial airports that have scheduled passenger operations.

The relationship between highway users and the Department is that of a client and a supplier of services. One of the services the Department supplies to the client is operational information. Whatever information the Department intends to convey, the final interpreter of such information is the client. The measure of effectiveness of the operational information system is how well the system is utilized by the highway user. The intent of the message to be conveyed to the user may be altered or obscured by many outside factors. For example, the information supplied may be changed during transmission because of lighting conditions or obscured by competition from other messages or supplied too soon to be relevant or conveyed too late to be effective or it may conflict with a user's expectations. Signing or delineation effectiveness may or may not be improved by changing the message if outside factors prevent or obscure the intended perception.

A highway user needs certain operational information at the proper time in order to use the highway system efficiently, comfortably, and safely. Such information comes from many sources such as highway signing, pavement markings (delineations), maps, the shape and texture of the roadway surface, the roadway configuration, the media (radio, television, newspaper references to weather, road conditions, traffic congestion, etc.), personal experience, ambient lighting, traffic conditions, environment, adjacent land use, commercial signing, roadway access facilities, traffic controls, etc. For the purposes of this study the needed operational information considered was principally that conveyed by guide signing, as affected by the roadway environment and traffic operational conditions present in the system.

It is a national policy that signing shall be uniform throughout the nation. Such general policy is set out in the Manual on Uniform Traffic Control Devices (MUTCD) which was adopted by all states and the federal government. This policy has been further refined, customized, and interpreted by the SDHPT for Texas in the Texas Manual on Uniform Traffic Control Devices (TMUTCD).

The Manual was issued under the authority of the "State of Texas Uniform Act Regulating Traffic on Highways." Motorist compliance to certain requirements set out in this manual are enforceable by law. Contrariwise, non-compliance with the MUTCD by the Department may be cause for a tort action against the Department by a highway user. Uniformity in signing and delineation is a desirable end. It is well accepted that deviations from uniformity are a kind of message to the highway user and subject to misinterpretation only because of deviation. Consequently, in the course of this study which concerns current practices in supplying operational information the necessity for change will have to be balanced against the desirability of uniformity and the possible ill consequences of change. However, the MUTCD does permit some latitude in practice and it is to be expected that improvements can be made within the scope of the manual. It is also possible for the Department to submit recommendations to the Federal Highway Administration (FHWA) for changes found to be needed as a result of the research project.

## REVIEW OF LITERATURE

Most often traffic control devices are the primary means of communicating with the driving public (1). Freeway guide signs, a component of traffic control devices, play a key role in maneuvering motorists through complex interchanges typical of urban freeways (2). National standards of signing are provided in the (MUTCD) (3) in order to create a sense of symmetry. Many states have adopted the MUTCD as their official model; however, some states have modified the MUTCD. These modifications must meet or exceed the minimum requirements in the MUTCD.

Guide signs must be used uniformly and effectively to insure correct driver interpretation and response. Much thought and time has been devoted toward finding a fail-proof method of signing at freeway interchanges. Dudek and Huchingson (4) conducted a study to determine the design criteria for route signs at major diversion points on freeways. The study was divided into two parts. The objective of the first part was to determine the importance and relative attraction of the interstate shield, destination designation, and cardinal direction in route choice decisions by unfamiliar drivers at major interchanges. The second part of the study was directed at determining driver understanding of the freeway loop numbering system used on static guide signs and investigating ways of designating loop freeways to achieve driver confidence at major interchanges.

The results revealed differences among drivers in smaller and larger cities. The sign containing the shield and destination influenced a greater percentage of through drivers from smaller cities to take the loop freeway. These results might be interpreted as meaning that drivers in smaller cities tend to be more destination oriented than drivers in larger cities. The sign containing only the destination had the highest percentage of



diversion by motorists in the larger cities. Hence, the results revealed that most unfamiliar motorists are destination oriented and are greatly influenced by destination names at major freeway interchanges (2). In order to catch the attention of a significant segment of unfamiliar drivers, it is vital that destination names be used on guide signs at major point diversions.

The second part of the study, directed at determining driver understanding of the third digit used in the freeway loop numbering system and ways of designating a freeway loop, revealed regional differences in driver reaction to the LOOP and BELTWAY descriptors. Also, drivers did not comprehend the three digit numbers as loop freeways in the interstate numbering system. Cardinal directions on freeway loops were found to cause some confusion. Because of the circular traits of a loop freeway, the cardinal direction on the sign conflicts with the direction of the destination city.

Four words designating loop freeways were studied in an effort to determine how best to achieve driver confidence at major point diversions. The descriptors BELTWAY and BELT were understood by less than 40 percent of the drivers studied. The use of the designators LOOP and CIRCLE greatly increased driver interpretation of the freeway route. More than 70 percent of the drivers correctly interpreted the message. However, since 30 percent of the drivers were confused, an adequate term for describing the characteristics of a loop freeway was not developed.

Another study conducted by Dudek and Huchingson (5) discussed guide signs (trailblazers) for arterial routes. Trailblazers are used for three specific intracity cases: routing to major generators, routing to a specific highway, and routing around incidents. Trailblazer signs should be as simple as possible to insure high target value and ease of recognition. In addition, they should confirm the destination, direction, and route.

Trailblazers to a major generator, such as a sporting event, include single destinations and multiple destinations. Single destinations can be depicted effectively by using the destination name, a logo, a symbol or silhouettes. Dudek and Huchingson suggested using the destination names in place of two or more abstract symbols as an effective method for directing traffic to multiple destinations.

A major event in an area usually generates a major amount of traffic. When drivers exit off of the freeway, they instantly begin looking for information about their destination, turning movements, and lane assignments. Because of the heavy driver work load, it is of utmost importance that the first trailblazer sign or sign assembly contain the destination name. The destination name must be identical to that used on the freeway changeable message sign.

Trailblazers should be located at every point where drivers may become confused. Drivers must be "pulled thru" the service

road/arterial street intersection with a trailblazer assembly that is easily recognized. Arrow assemblies can play an important part in guiding unfamiliar motorists to their destinations.

Several problems may arise when traffic is diverted to another major highway. A "forgiving sign system" is employed to return drivers traveling on a temporary bypass to the original route. Signing along the temporary route should consist of a route shield and distance generator (6). Some drivers like to know how far they have to travel and like to be reassured that they are on the correct route. Sometimes drivers fail to see a critical trailblazer at a turning point. It is suggested that the word "RETURN" be used rather than "TURN-AROUND". In addition, use an arrow which resembles a "U" turn arrow.

Another study conducted by Huchingson, Dudek, and others (4) is very similar to studies described previously. The purpose of the first segment of the study was to determine if unexplained pictorial coding techniques are as effective for providing route guidance to major generators as are verbal messages. The outcome of the study indicated a failure of over half of the subjects to exit appropriately and a long reaction time when a pictorial representation was used to guide unfamiliar motorists to a major generator. The conclusion was made that pictorial coding should be supplemented by verbal messages initially. In the absence of an explanation, it is better to use the verbal message. However, field studies indicated that motorists have little difficulty following a trailblazer code after the verbal message has been established.

The second segment of the study was concerned with determining word descriptors drivers in large cities use for certain types of facilities. This second segment had two individual studies. The purpose of Study 1 was to determine the word descriptors drivers use when referring to a frontage road. The results reveal that there are no clear cut descriptor names drivers use in referring to the frontage road. The terminology was found to differ from city to city.

The study was conducted in Houston, St. Paul, and Los Angeles. The majority of the respondents in Houston chose feeder road or feeder street. In St. Paul frontage road was the most common choice among the drivers. However, there was no clear cut choice among the Los Angeles drivers. In fact 15 percent did not respond. This is probably because drivers in Los Angeles are not as exposed to frontage roads as are drivers in Houston and St. Paul.

Part 1 of Study 2 was designed to determine the local use of highway numbers and local names when referring to a specific freeway. Differences were found in the terminology drivers from various cities use to refer to freeways and major highways. The use of local names in a city depends upon the particular road, and the use of names by news media, on road signs, and on maps.

Houston drivers tended to use interstate or highway numbers when referring to a freeway or major highway for an intercity trip. Houstonians used local names for the freeways when describing an intracity trip. However, St. Paul drivers used the route number when referring to freeways or major highways for both intercity and intracity trips. When referring to freeways for both intercity and intracity trips, Los Angeles motorists used their local names.

The objective of Part 2 of Study 2 was to determine whether descriptors for freeways that loop around a city or bypass a city are part of the drivers's everyday vocabulary. This study was conducted only in St. Paul and Los Angeles, since it was generated after the Houston studies.

There was no consistent response by the St. Paul drivers for a freeway that loops around a city. This finding was unexpected because there is an interstate freeway that loops almost completely around St. Paul. As was expected, the Los Angeles drivers did not have a common terminology either. The Los Angeles freeway system is much more complex. Drivers in both cities used bypass as the strongest descriptor for a freeway that goes around one side of a city.

Growth in traffic has put a greater demand on existing freeways. Exit ramps in many urban areas are no longer capable of handling the traffic for which they were designed. The demand today calls for two-lane exit ramps. However, signing for two-lane exits has not been established as a standard practice. Leisch (7) has been developing a standard format for signing at urban interchanges. He has suggested employing down-arrow arrangements exclusively for exits at system interchanges and using separated double up-arrows for two-lane exits at service interchanges. Using this standard pattern would establish a practice and eventually "educate" drivers.

It is apparent that much research has been conducted in an effort to establish a standard for signing on urban freeways. However, each unique interchange requires a unique system of signing. Many questions remain unanswered, and there is a need for further research in the area of urban freeway signing.

## **OBJECTIVES**

The principle objective of this study was to assess the effectiveness of the operational information currently being supplied to highway users in the larger urban areas of Texas. The effectiveness of such information was to be determined by the highway user in terms of relevance, clarity, accuracy, and timeliness. As a special case, one of the objectives was an assessment of the adequacy of the guide signing to commercial airports furnishing schedules passenger service.

A second objective was to determine how to improve the operational information system if components are found to be ineffective.

## **SCOPE**

The scope of the project was limited to signing and associated guidance information on urban freeways in Texas. The ten subject cities with which the study is primarily concerned are: Abilene, Amarillo, Austin, Corpus Christi, Dallas, Ft. Worth, Houston, Lubbock, San Antonio, and Waco. Information was also collected concerning guide signing to commercial airports in the larger of these areas.

A similar study was undertaken simultaneously at the Center for Transportation Research at the University of Texas. The results of that study are presented in a separate document.

## **APPROACH**

In the process of determining the overall effectiveness of current urban signing, specific types of guide sign problems which are currently troubling Texas drivers were identified. The unfamiliar driver visiting a major Texas city has specific needs in terms of guidance information. A major portion of the information needed is supplied by guide signs. When guide signs fail to provide the information in a form the driver needs, he or she may become confused or even lost attempting to negotiate a route. The cost of these delays in both time and public acceptance of the signing system is difficult to quantify but potentially extensive.

At the outset it was recognized that the task of attempting to evaluate all of the various guide signs in major Texas cities would be prohibitive. For example, having researchers observe hundreds of signs (designed according to MUTCD or TMUTCD standards) would not insure that whatever deficiencies were noted were, in fact, those of greatest importance to the drivers themselves. Therefore, a screening technique was proposed which would permit focusing on those problems which were deemed most important by the highway users.

The basic methodology selected for the initial study was patterned after the "critical incident technique," a technique widely used in industry and the military to determine those events which have made a difference between success or failure in any mission. The approach applied to traffic management basically involved asking drivers to recall recent instances in which they became confused or "lost" in trying to use guide signs to reach their destinations. They were asked to provide a narrative description of the event including their origin, destination, and the location where the problem occurred.

A variety of approaches to data collection were studied. A pilot study was to determine which method was most productive in terms of usable critical incident data. Also, district engineers and management personnel were questioned as to where they thought the problem locations were in their districts.

The exact location where problems occurred was critical because a clustering of reports of problems at a given interchange would suggest that the signing leading up to the interchange was deficient in some way. The drivers' analysis of the particular cause of becoming confused or lost was secondary. Although they might have difficulty verbalizing or correctly analyzing the situation, it was hoped that across a large number of complaints about the interchange a common thread of description would be evident. This information could then provide a place to start in evaluating the true cause of confusion.

Thus, the "critical incident" survey was a screening tool for establishing priorities for further in-depth diagnostic study. The data would lead to a plausible classification scheme for guide sign deficiencies and the relative frequency of occurrence of each type.

Armed with this priority information the research team then photographed the sequence of signs leading up to and through the interchange and after study developed hypotheses as to specifically what was deficient in the sign. The "critical incident" survey and the photographic documentation of problem locations permitted paring a host of potential problem interchanges into a limited few types of problems with the largest number of complaints and, hence, meriting further study.

Confirmation of the results of the diagnostic work was obtained from two sources. First, a statewide telephone survey of a representative sample of Texas drivers was conducted in order to assess the magnitude and nature of guide signing problems. A sample of this type was needed to determine the relevance of the generic problems identified since the previous surveys were not truly random in nature. The final source of confirmation was a limited study of various elements of one of the major guide sign problems identified. This study was an in-depth evaluation of the effectiveness of certain signing elements, but, because of its limited nature, left many, unanswered questions. It also demonstrated the efficacy of the study methodology.

## **OUTLINE OF REPORT**

The sections that follow describe the work performed to accomplish the project objectives. They are divided in a manner that approximates the sequence of major tasks. These sections are outlined below:

- Section II. Identification of Problem Locations - A series of interviews and surveys conducted to identify urban locations where motorists had been lost or confused by signing (or its absence).
- Section III. Problem Diagnosis - Collection and analysis of photographic and other data from problem locations to diagnose information deficiencies.
- Section IV. Statewide Telephone Survey of Drivers - A representative sample of drivers were asked questions that allowed an assessment of the magnitude of the problem of information deficiencies and to validate the diagnoses of the characteristics of those deficiencies.
- Section V. Pilot Survey of Understanding of Guidance Information - A limited test conducted to confirm the findings of the problem diagnosis and to assess some potential remedial measures.
- Section VI. Conclusions and Recommendations - A synthesis of the overall conclusions of the study and recommendations for future signing practice.

## SECTION II. IDENTIFICATION OF PROBLEM LOCATIONS

Several different sources and approaches were used to obtain information concerning the problems motorists might be having with urban guide signs. First, preliminary information was obtained from interviews conducted with SDHPT district traffic engineers, district traffic management teams, and the Travel and Information Division. Next, several methods were investigated to determine the best approach for obtaining information directly from the driving public. A description of these methods and the results of their evaluation is presented in the section entitled "Pilot Study". Finally, the optimum method from the pilot study was used to obtain information statewide about problem locations on urban freeways.

### PRELIMINARY DATA

Preliminary data to identify locations where problems exist was obtained first from SDHPT. Specifically, an Advisory Committee was established to assist in the data collection, analysis, and recommendation process. This committee was comprised of Department personnel from each of the Districts that included a study city, from the Travel and Information Division, and from the Safety and Traffic Operations Division. Structured interviews were conducted on an individual basis with each of the District representatives to identify problem locations based on reports, complaints, and professional knowledge or opinion. In many Districts, meetings were also held in conjunction with the Traffic Management Team. This preliminary data was brought to the Committee as a whole and discussed in detail.

Students of two Civil Engineering classes at Texas A&M University were asked just prior to the pilot study to list any problem locations on urban freeways where they had become lost or confused in the State of Texas. These students identified 18 potential problem locations. These locations were used as part of the preliminary data base, and as examples for respondents for the pilot study.

### PILOT STUDY

Input was elicited from the public to determine opinions about the roadway communications system on urban freeways and to locate guide sign problems in Texas. The information sought included locations where drivers became lost or confused on Texas freeways, the events immediately preceding and following the occurrence, and any comments or solutions related to the problem. In addition, specific responses were solicited regarding freeway and roadway access to major urban airports. It was essential that enough information be collected during the survey(s) so that specific guide sign problem locations could be identified.

A pilot study was conducted in order to find the most efficient and feasible method to use on a statewide basis for obtaining citizen input. The pilot study, for the most part, was conducted in the Bryan/College Station area in order to save time and expenses. The pilot study evaluated four survey methods: 1) a telephone elicitation, 2) face-to-face interviews, 3) group presentations, and 4) a mail survey.

**Telephone Elicitation.** The first survey method evaluated was a 24-hour telephone line, called the "SIGN LINE", which operated concurrently with an advertisement that was placed in the local newspaper for one week. The advertisement explained the purpose of the study, the information being requested, and a telephone number to call. A copy of the advertisement is shown in Appendix A. In order to provide for a 24-hour operation, an answering machine was used during non-working hours (5:00 p.m. to 8:00 a.m. and on weekends). When respondents telephoned the Sign Line after office hours, the answering machine greeted them in the following manner:

"Thank you for calling the Sign Line. No one is currently available in the office to answer the phones, but after the tone please leave a detailed description of the signing problem you encountered; or you can call back weekdays eight to five to talk to someone in person."

During regular business hours, a member of the research staff answered the phone, and manually recorded the information provided by the caller. To increase the effectiveness of the advertisement, a news story about the scope and nature of the research project was published on one of the days during which the advertisement appeared in the paper.

**Face-to-Face Field Interviews.** The second survey method evaluated was face-to-face personal interviews that were conducted in two shopping malls in the Bryan/College Station area. An interview area was provided in a central location for two days at each shopping mall. To get a better representation of responses at local malls in one of the ten subject cities, a two hour survey in one of Corpus Christi's malls was conducted in conjunction with the District meeting. A one-on-one interview was conducted with each motorist who stopped by the table. The scope of the study was explained, and the type of information needed identified. A research staff member completed the survey form as the respondent described a guide sign problem location.

The interview area consisted of a banner that read "BEEN LOST WHILE DRIVING IN TEXAS?", free incentives including "DON'T MESS WITH TEXAS" bumper stickers, Texas road maps, pamphlets from the Texas SDHPT, and a map of Texas on a poster board with the ten study cities printed in large bold letters. Maps were used during the interviews to assist motorists in identifying the guide sign problem locations.



**Group Presentations.** The third survey method evaluated was a group presentation administered by research staff members. This survey method consisted of presentations given to civic groups that explained the scope and nature of the problem, and the input needed from the members of the group. Immediately following the presentation, staff researchers distributed survey forms for the individuals to complete and return. The survey forms could either be returned at the end of the meeting or by mail. A stamped envelope was available for those who wished to return the form by mail. Two different approaches were used in this method. Approach 1 was presented at a business club meeting in a nearby small town, and Approach 2 was used at a local business club meeting.

Approach 1 - For the first approach, staff researchers made a presentation that constituted the program for the meeting. The presentation consisted of an introduction providing general background about the Texas SDHPT and a summary of the scope and nature of the study. The type of information being requested was explained, after which the meeting participants were encouraged to participate in a group discussion to recall certain situations where confusion may have occurred due to guide signing on urban freeways in Texas. After several comments and examples of specific problem locations, participants were asked to complete the survey forms and to return them before leaving. Self-addressed stamped return envelopes were available upon request. A section of the survey form provided the respondent with the option of giving their name and phone number for future contact, if necessary. The survey form used is shown in Appendix A.

Approach 2 - With the second approach used for this survey method, the study presentation was made after the regularly scheduled program for the members. This differed from Approach 1 in which the presentation was the substance of the meeting. With Approach 1, the presentation was approximately 30 minutes in length, compared to 5 minutes using Approach 2. Also, Approach 1 invited audience participation and discussion; Approach 2 did not. Further, the civic organization addressed using Approach 2 was twice the size of the organization addressed using Approach 1.

As in Approach 1, the research staff members presented a brief background of the project and explained the desired input. Texas road maps and self-addressed stamped return envelopes were distributed with the survey forms. The group was asked to complete the survey forms and return them by mail to the research staff.

**Mail Survey.** The fourth survey method evaluated was a direct mail survey. A total of 258 survey forms were mailed to out-of-state visitors. A Texas road map to assist in identifying problem guide signing locations and a self-addressed stamped return envelope were enclosed. Total preparation time for this survey was ten days. The names and addresses of out-of-state visitors were obtained from the Texas SDHPT Tourist Information Centers. These visitors had traveled in Texas within the previous three months,

and had completed a questionnaire about Texas that was distributed at the Information Centers.

The survey form was divided into two parts. The first part was similar to the form used in the previous pilot studies that asked general questions about how, when, and why the respondent had become lost or confused in the past. The second part included specific demographic questions.

**Results of Pilot Survey Methods.** Table 2.1 shows the results of the four pilot survey methods evaluated. A total of 71 potential problem locations were identified. The data indicated that the most effective survey method for obtaining information to identify specific guide sign problem locations on urban freeways was the use of face-to-face field interviews. The shopping malls generated a total of 41 specific problem locations. The two local malls yielded a total of 34 specific problem locations during a four day period, and a total of seven specific problem locations were identified at the Corpus Christi mall. The least effective survey method evaluated was the group presentation, which produced only five specific locations. (Approach 1 identified four specific locations, Approach 2 identified one).

**TABLE 2.1 PILOT STUDY-POTENTIAL PROBLEM LOCATIONS IDENTIFIED**

Survey Method	# Locations Identified	Duration (Days)
Telephone Elicitation	7	7
Face-to Face Interviews	41	5
Group Presentations	5	2
Direct Mail Survey	<u>18</u>	10
Total Locations Identified	71	

The telephone hot line yielded seven specific problem locations. A total of 19 individuals called in on the "SIGN LINE" during a seven day period, all of whom called during regular business hours. No messages were left on the answering machine. There was an average of two callers each day the advertisement was in the paper, except the day the news story appeared in the paper and eight calls were received.

A total of 18 specific problem locations were identified through the direct mail survey. There were 258 survey forms mailed out, and 17 were returned undeliverable, resulting in 241 forms that were assumed to have been delivered. A total of 177 completed survey forms were returned, giving a response rate of 73 percent. Of the 177 mail survey respondents, 111 (65 percent) reported they had never been lost or confused in the State of Texas.

Table 2.1 also shows the time invested conducting each survey method. Although the face-to-face field interviews and the direct mail survey methods identified a greater number of specific locations, the time invested in the face-to-face field interview method was more efficient than the mail survey (4 days as compared to 10 days).

**Summary of Pilot Survey Methods.** The face-to-face field interview technique proved to be the most effective in identifying specific problem locations, but it was evident that interviewers needed to be precise when asking questions about problem locations (i.e., what highway/freeway, what direction, destination) in order to obtain the information needed to identify a specific problem location. It should be noted that the results obtained at the mall in Corpus Christi were better than of the two local malls (seven responses in two hours compared to 34 in four days). This was possibly due to the fact that Corpus Christi was one of the study cities.

It should also be noted that the names and addresses of the respondents used in the mail survey were obtained from a list of out-of-state travelers that had previously (within 3 months) completed a questionnaire that was being distributed at the Texas Information Centers. The fact that the sample pool was predetermined to be "willing respondents" no doubt contributed to the high response rate.

The telephone elicitation method was not effective. One problem encountered with this type of survey method was that every type of complaint, from the need for a stop sign on a city street to problems with curb and gutter drainage was received. This could be due to the limitations of space and lack of precise information provided in a newspaper advertisement.

The results show that the group presentation method was the least effective. The poor response rate may be attributed to the fact that reflective thinking is required by motorists to elicit the information required in this study. Therefore, this approach was not as feasible for large groups.

## **STATEWIDE STUDY**

The results of the pilot study showed that the face-to-face field interviews and the direct mail survey were the more effective methods evaluated in identifying specific guide signing problem locations. Consequently, a large scale statewide study was conducted in the ten subject cities using these two methods. The fact that the field interviews were successful with shopping mall populations suggested that the same approach also be used at special events that generate large numbers of potential respondents.

**Face-to-Face Field Interviews.** Field interviews were conducted in the study cities at shopping malls and special events including the Houston Auto Show, the Fort Worth Southwest Exhibition and Livestock Show, and the Corpus Christi Winterfest.

Motorists were interviewed using the same procedure as in the pilot study. To enhance the interview area, a poster asking "Are Urban Freeway Guide Signs Confusing To You? The Texas Highway Department wants to Know" and an eight foot banner asking "Have you been lost or confused on Texas Highways?" were displayed. The interview area display used during face-to-face field interviews is shown in Appendix A.

Shopping Malls - Field interviews were conducted in a central location in shopping malls in seven of the ten study cities in Texas. A one-on-one interview was conducted with each motorist who stopped by the table. As in the pilot study, the scope of the study and the desired information was explained. A research staff member completed the survey form as the motorist described the guide sign problem location. Again, incentives were provided to the respondents. Motorists were interviewed at a total of ten shopping malls.

Houston Auto Show - The Houston Auto Show is one of the largest new car shows in the nation. The 1989 show attendance was over 300,000 during a 16-day period. The same procedure employed at the shopping malls was used at the auto show to interview motorists. An interview area was provided in the SDHPT Traffic Safety section of the show. This section included booths by local police agencies, The American Red Cross, and The Texas Department of Public Safety. Motorist interviews were conducted during the 16 days of the show. Due to the large number of people in attendance, it was necessary to limit the distribution of incentive material such as bumper stickers and Texas road maps to individuals that participated in the survey. It was discovered by using this method, individuals were more inclined to participate in the survey.

Fort Worth Southwest Exhibition and Livestock Show - The second special event where the face-to-face survey method was employed was the Fort Worth Southwest Exhibition and Livestock Show. Motorists were interviewed using the same procedure as in the previous statewide field interviews for two days of the show. An interview area was set up in a large warehouse room along with a number of other booths and tables representing other agencies. Due to space limitations, the banner stating "Have you ever been lost or confused on Texas highways" was not displayed as in previous surveys. The large amount of free material being distributed may have hindered getting individuals to participate in the study since the material was given to them whether they participated or not.

Corpus Christi Winterfest - The Corpus Christi Winterfest is an exhibition held annually for two days that is targeted toward out-of-state visitors who reside in the south Texas area during the winter months. The exhibitors fall into two categories, arts and crafts merchants and information distributors. The information distributor booths represented more than 35 states and Canada. The State of Texas had nine booths in its area including the table for this survey. The same procedure used in the shopping mall surveys was used to interview motorists at the Winterfest.

**Indirect Mail Survey.** The direct mail survey was effective in obtaining motorist response in the pilot study and, hence, a larger mail survey was conducted. However, this mail survey was an indirect mail survey (not mailed to specific individuals). A questionnaire was inserted in 5,000 issues of the March 1989 Texas Highways magazine to paid subscribers in Texas. It was placed in the middle of an article titled "TEXAS ROADS More than Meets the Eye." The nature of the article could be a factor in the success of the survey. The questionnaire was similar to the survey form used in the pilot study direct mail survey, and requested respondents to describe any problems they had encountered on freeways in the ten Texas cities due to guide signs. The questionnaire used is shown in Appendix A.

**Results of Statewide Survey.** Table 2.2 shows the results of the statewide surveys. There was a total of 563 potential specific problem locations identified, excluding the locations obtained in the pilot study. In 12 days, 105 specific locations were identified in 10 different shopping malls using the face-to-face field interview method. A total of 277 specific locations were identified in 16 days from the Houston Auto Show. The Fort Worth Southwest Exhibition and Livestock Show yielded a total of 25 specific locations in 2 days. There were 53 specific locations identified in the 2 days at the Corpus Christi Winterfest.

**TABLE 2.2 STATEWIDE STUDY-POTENTIAL PROBLEM LOCATIONS IDENTIFIED**

Survey Method	# Locations Identified	Duration (Days)
Shopping Malls	105	12
Houston Auto Show	277	16
Fort Worth Livestock Show	25	2
Corpus Christi Winterfest	53	2
Indirect Mail Survey	<u>103</u>	2
<b>Total Locations Identified</b>	<b>563</b>	

Of the 5,000 questionnaires inserted in the Texas Highways magazine, a total of 338 were returned, resulting in a response rate of 7 percent. As mentioned previously, this was an indirect

mail survey, consequently, the response rate would be expected to be less than for a direct mail survey. Of the 338 responses, 103 (30 percent) identified a specific location where the respondent became lost or confused.

**Summary of Statewide Survey.** The face-to-face field method was the most effective survey method evaluated to obtain specific problem locations on urban freeways. The Houston Auto Show produced the greatest number of usable responses because more time was allotted to this survey effort. The success of the Auto Show might also be attributed to the traffic related nature of this event.

One problem with the face-to-face interview method in shopping malls was the availability of mall space for survey use. It was discovered that some of the larger malls did not allow public service groups to use mall space on weekends and during certain times of the year (such as the weeks preceding Christmas). The larger malls were very effective in obtaining motorist response on weekends, but were of limited effectiveness during the week, due to the reduced number of shoppers. Furthermore, it was not surprising to discover that the smaller malls were not as productive as the larger malls during either time period.

The indirect mail survey did prove to be an effective method of obtaining motorists responses, even though it was not as successful as the direct mail survey. It should be noted that many times it was difficult to determine specific guide signing locations with self-reported written descriptions.

## **OVERALL RESULTS**

**Problem Locations.** A total of 654 potential problem locations were identified in the pilot and statewide study. There were 501 potential problem locations identified by using the face-to-face field interview method. This method was employed at various shopping malls, the Houston Auto show, the Fort Worth Southwest Exhibition an Livestock Show, and the Corpus Christi Winterfest. The two mail surveys generated a total of 121 problem locations. The telephone elicitation method in the pilot study generated 7 potential problem locations, while the group presentation resulted in identifying 5 potential problem locations. Eighteen potential problem locations were identified by two Civil Engineering classes at Texas A&M University which was part of the preliminary data base collected. The two remaining locations were received from the Travel and Information Division.

Table 2.3 illustrates the potential problem locations identified by district. District 12 had the most (273) potential problem locations identified. As previously explained, this was because more time was allotted to the survey in Houston. District 4 had the least reported problem locations with a total of 2.

**TABLE 2.3 POTENTIAL PROBLEM LOCATIONS IDENTIFIED BY DISTRICT**

Districts	# Locations Identified
2 (Fort Worth)	43
4 (Amarillo)	2
5 (Lubbock)	6
8 (Abilene)	3
9 (Waco)	29
12 (Houston)	273
14 (Austin)	53
15 (San Antonio)	89
16 (Corpus Christi)	17
18 (Dallas)	<u>139</u>
Total Locations Identified	654

Several locations were identified as problem locations by more than one participant. Eliminating these repeated locations left 393 potential problem locations. Each district was sent a list of motorists' comments pertaining to the five specific locations in their District which were identified most frequently by the motorists as problem areas.

Appendix A contains a complete inventory list of all the critical site locations identified by district. The first and second columns indicate whether the location was identified by the public surveys or the SDHPT preliminary data base. The number under the Public column indicates the number of times that particular location had been identified by the public as a problem location.

**Airport Problem Locations.** In addition to identifying potential problem locations, participants were asked if they ever had trouble locating an airport in urban areas. While several indicated that they had experienced some type of problem, only 23 could recall a specific problem location. Upon reviewing these 23 locations, 19 were found to be valid.

**Survey Comments.** In addition to the 657 potential problem locations identified, a total of 870 comments were collected during the public opinion surveys. The comments were taken either from individual survey forms, or from motorists that did not identify a specific problem location, but had a comment to contribute. A list of the types of comments is shown in Table 2.4. Table 2.5 shows the number of responses in each category by survey method used.

Category #1 (Positive Comments) contained the highest number of comments received. These comments were positive and sometimes general in nature, and not necessarily related specifically to guide signing. For example, comments were made

**TABLE 2.4 DISTRIBUTION OF COMMENTS BY SURVEY METHOD**

Category #	Comment Category
1	Positive Comments
2	Never Been Lost Or Confused (No Problem On Urban Freeways)
3	Inadequate Sign Placement
4	No Signs Or Not Enough Signs
5	Need More Advance Warning
6	Too Much Information/Wrong Information
7	Not Enough Information Given
8	Inadequate Lighting/Night Visibility
9	General Confusion In Certain Cities
10	Violation Of Driver Expectancy/Signs Not Clear
11	Airports
12	Destination Names vs. Route Numbers
13	Dislike Of Local Freeway Names
14	Suggested Arrow Usage On Guide Signs
15	Sign Maintenance
16	Confusion With Freeway vs. Frontage Road ROW Rule
17	Geometric Problems On Entrance And Exit Ramps
18	Negative Comments
19	Service/logo signing
20	Speed Limits
21	Construction
22	General comments/suggestions



**TABLE 2.5 COMMENT CATEGORIES RECEIVED FROM CITIZEN SURVEYS**

Category #	Pilot Survey	Information Center Survey	Mall Survey	Houston Auto Show	Rodeo	Winterfest	Total
1	7	59	23	68	7	19	183
2	11	87	24	28	14	14	178
3	2	-	5	2	1	1	11
4	5	-	6	21	-	4	36
5	8	-	13	36	6	6	69
6	-	-	6	3	1	1	11
7	6	-	-	4	-	-	10
8	1	-	2	7	-	3	13
9	3	-	16	28	12	11	70
10	6	-	7	4	-	4	21
11	1	-	-	5	-	-	6
12	1	-	5	8	-	2	16
13	1	-	8	9	-	-	18
14	1	-	1	1	-	-	3
15	1	-	-	1	-	-	2
16	1	-	2	-	-	-	3
17	-	1	8	14	1	2	26
18	1	2	9	10	1	4	27
19	3	-	12	10	3	3	31
20	2	2	1	-	-	-	5
21	1	2	5	19	-	-	27
22	8	8	30	25	16	17	104
TOTAL	70	161	183	303	62	91	870

regarding the quality of the roadways in general and the attractiveness of roadway landscapes. Additionally, respondents expressed their gratitude to the Department for taking an interest in public opinion on guide signing.

Category #2 (Never Been Lost or Confused - No Problem on Urban Freeways) had a total of 178 comments. Category #2 contained comments where motorist stated that they had never been lost or confused, or had any problem traveling in the state of Texas.

There was a variety of comments directly related to the guide sign system. A total of 315 (36%) comments were placed in 15 different guide sign related categories (Category 3 - Category 17).

Category #9 (General Confusion in Certain Cities) consisted of the most guide sign related comments with a total of 70. This category contained 58 motorists who stated that certain cities (Dallas, Houston, etc.), and types of freeways in certain cities such as loops, mixmaster, major interchanges) were confusing. However, the remaining 12 motorists did identify the sign system as the cause of their being lost or confused.

Category #5 (Need More Advance Information) contained 69 comments where motorist reported that there was a need for more advance notice on urban freeways. Forty-nine motorists stated there needed to be more advance warning at freeway exits. The other 21 focused on more advance signing on urban freeways in general.

Category #4 (No Signs or Not Enough Signs) included a total of 36 comments. Eight motorists stated that there were not any or enough guide signs to direct motorists to and from business districts. The remaining comments focused on signs needed to direct motorists to toll roads, around cities on bypasses, loop directions, and signing to inform motorists of continuous and non-continuous highways through business districts.

Category #10 (Violation of Driver Expectancy/Signs Not Clear) consisted of 21 comments. This category contained seven comments addressing the violation of driver expectancy with left exits. There were 14 comments that dealt with incorrect cardinal directions, the confusion of cardinal directions on loops, and conflicting directions when freeway routes overlap.

Category #12 (Destination Names vs Route Numbers) contained 16 comments. Five comments requested that more destination guide signs be used, while the remaining stated confusion when route numbers and name signs are used more than once (for example, SH-90 and Alternate 90, Pasadena Road and Pasadena City).

Category #13 (Dislike of Local Freeway Names) contained 18 negative comments about of the use of local freeway names (Katy Freeway) instead of freeway numbers (IH-10). There were also some

comments on the need for using the freeway numbers instead of the local names on local radio stations reporting freeway conditions.

Category #18 (Negative Comments) was not considered a guide sign related category since only three of the 27 comments indicated a complaint about the guide sign system. In general, the comments were about a particular city (for example, San Antonio is a joke; Fort Worth is a mess; Dallas in general is a problem; Houston is terrible, etc.), or a non-related topic (Loop 610 is dangerous, too many interchanges).

In addition, there was a total of 167 non-sign related comments that are included as Category #19 (Service/Logo Signing), Category #20 (Speed Limits), Category #21 (Construction), and Category #22 (General Comments/Suggestions).

## **SUMMARY OF RESULTS**

The pilot study showed that not only is the survey method important when attempting to obtain input from motorists, but several factors external to each technique need to be considered before larger scale implementation. The telephone elicitation did not prove to be successful due to the difficulty in obtaining desired information over the phone, and due to the difficulty of describing in a newspaper advertisement the information that is being requested.

The face-to-face field interviews at shopping malls during the pilot and statewide surveys were successful, but to a much greater degree in the larger malls and on the weekends when larger numbers of potential respondents were present. The face-to-face field interviews at special events proved to be the most successful way to obtain information useful for identifying guide sign problem locations.

The group presentation method was the least effective method evaluated. Although this method was evaluated using two small groups, it was concluded that the reflective thinking process required is unwieldy in a group setting. Therefore, this approach may not be feasible for large groups.

The mail surveys proved to be an effective means of obtaining the desired information, although many of the responses were comments only. Further, it was sometimes difficult to identify a specific location with the respondents' replies.

Using the techniques described above to identify critical incidents resulted in a total of 654 motorists' identification of potential problem locations. Several of these locations were given by more than one participant, and when duplicate locations were eliminated, the resulting number of problem locations was 393.

In addition to the identification of specific locations where motorists experienced a navigational problem, the pilot and statewide surveys provided for the elicitation of any related information in the way of comments. A total of 870 comments were received. These comments were categorized, and it was determined that 41% of all the comments were either favorable statements about Texas highways, or reports that the motorists had never been lost or confused in the State of Texas. Only 27 (3%) motorists made negative comments, and these were usually not guide sign related.

The comments did indicate that there is a need for more advance warning signing, primarily at freeway exits. In addition, some motorists seemed to be confused on urban freeways at interchanges, loops, mixmasters, etc.

It is interesting to note that of the 161 comments received from the Tourist Information Center Survey, 146 or 91% were positive comments about Texas. It is encouraging to have such a high percentage of approval of the state highway signing system from out-of-state visitors.

In summary, the comments illustrated that while there may be some problems in the guide sign system, such as the need for more advance warning, the majority of the public feels that the guide signs are adequate.

### SECTION III. PROBLEM DIAGNOSIS

Field studies were conducted at urban freeway locations identified by the public as potential guide signing problem locations. The sites that were selected were locations which had been identified most frequently by the motorists. The field inspections and inventories were to validate problem locations identified by the public, and to develop a visual record of the highway signing system, pavement markings, roadway configuration, etc. for use during diagnostic evaluations of the system. Once the field data collection was complete, the information collected was reviewed and analyzed using a case study, diagnostic approach. This approach entailed an evaluation of the signing and geometric characteristics of each site using criteria thought to be related to good information transmission. This diagnostic process was undertaken to determine if there were common, underlying causes for the complaints received.

#### FIELD DATA COLLECTION

**Data Collection Procedures.** Standard data collection procedures were established in an effort to ensure sufficient information was obtained to provide a comprehensive look at each of the problem sites. These procedures dealt with how, where and what data were collected and helped provide some uniformity in the data collected even though each problem site was different.

Photographic information was collected from a problem site well upstream before the first sign in the sequence that referred to the point that was complained about by motorists. A videocamera was used to photograph the first drive through each site. Lane position for the video filming was dependent on the number of freeway lanes. When there were three lanes or fewer one drive through was made. When there were four lanes or more two drive throughs were made - once in the far left lane and once in the far right lane. A VHS camcorder (1/2" format) was used with high-grade VHS tapes. The lens was focused in a wide angle mode to best approximate the view "as the driver sees it". The recording was begun at the first mile marker at least one full mile prior to the first sign or set of signs being filmed. A data generator was used to record the time and date on the film for documentation purposes.

Another drive through of the problem site allowed photographs to be taken of all signing pertaining to the problem site. A 35 mm camera was used with color print and slide film. An attempt was made to fill the camera field of view with the complete set of signs at a given location. The slides and photos were taken from the vehicle as it traveled through the site.

**Field Study Locations.** Field studies were conducted in seven of the ten study cities in Texas. The locations included urban freeway interchanges and access to and from commercial airports. Field studies were first conducted in Dallas. Data was collected at all of the sites where a complaint by motorists was received. It was later determined that it would not be necessary to collect field data at all of the sites where a complaint was received in the study cities. Only a sample of locations from each city would be required for a diagnostic evaluation of the system. In the remaining cities, field studies were conducted only at the sites that had a greater frequency of motorist complaints.

Field studies were conducted at a total of 96 sites. The number of sites in each city where field data was collected including access to commercial airports are as follows:

Amarillo (District 4)	7 sites (4 airports)
Lubbock (District 5)	8 sites (4 airports)
Abilene (District 8)	9 sites (5 airports)
Waco (District 9)	3 sites
Houston (District 12)	23 sites (1 airport)
Corpus Christi (District 16)	5 sites
Dallas (District 18)	41 sites

There were no public complaints for signing to the commercial airports in Amarillo, Lubbock, and Abilene but field studies were conducted at these locations to obtain a representative sample of airport signing.

## DIAGNOSTIC CRITERIA AND PROCEDURES

**Guide Sign Criteria.** One consideration in identifying and correcting problems with freeway guide signs is that of defining the criteria for good guide signs, or guide signing systems. If these criteria can be specified, then deficiencies in operational guide signs can be identified by comparison. Further, the enumeration of criteria for effective guides provides a basis for remediation of problems identified.

The criteria for effective freeway guide signs are, of necessity, general in nature. Certainly, desirable characteristics of good guide signs can be listed, but specification of precise values for each characteristic may not be practical or desirable. Many signs and signing environments are too idiosyncratic to permit the development of rigid specifications.

The criteria given in Table 3.1 is one set of several developed. They are presented as a point of reference for the subsequent development of a classification scheme for information transmission deficiencies for guide signs. In a sense, the criteria presented are not as important as the process of developing them. It is that process that led to the identification of ways in which guide signs could fail, which are described in the next section.

TABLE 3.1 CRITERIA FOR GUIDESIGNS ON URBAN FREEWAYS

**Attention Value** - Guide signs should have sufficient attention value to cause visual fixation in a motorist seeking information. Attention value is increased by the following factors:

- Size - large objects (up to a point) have higher value
- Shape - unique shapes stand out against a background
- Color - unique colors stand out against a background
- Location - of signs within the visual field (28 degree cone preferable) increases attention value
- Contrast - higher ratios of sign and background luminance enhance attention value.

**Information Content** - The information on the sign, once attended to, should provide needed guidance. Information is transmitted by the following sign characteristics:

- Shape - a rectangular panel indicates guide/information sign
- Color - coding by green background color on the panel indicates a freeway guide sign
- Location - sign placement itself carries some information (e.g. exit signs)
- Message - the combination of letter, numbers, symbols, and colors that are intended to convey information concerning destination, distance, direction, route type and number, and action necessary to reach a destination.

**Message Characteristics** - The message on the sign should have the following characteristics:

- Size - message should be large enough to be legible at speed, distance and available light
- Contrast - message should stand out against sign background, interrelated with color and illumination
- Accurate - message presented should be correct
- Comprehensible - symbols and text are readily understood (by at least 85% of the driving population)
- Redundant - message on sign should be presented in different ways (text and symbols)
- Expected - message should be presented in a form that is standardized with appropriate ordering and grouping of information.

**Spatial/Temporal Attributes** - Needed information should be presented at the appropriate time and place. Appropriateness is governed by the following characteristics:

- Location - sufficiently in advance to make a decision and the necessary maneuver
- Redundancy - presenting more than one sign in case one is missed
- Geometric - sign placement related to appropriate lane
- Expectancy - predisposition to look for guide signs in certain places
- Obscuration - reduce potential for sign blocking (see redundancy)
- Workload - avoid locations where work load is high (see redundancy)

**Classification of Guide Sign Deficiencies.** Several iterations of a classification scheme for signing problems have been used in the course of this study. Each had merits and limitations. The single drawback to most systems appeared to be that they attempted to be too specific. Specificity was, of course, desirable but only after a foundation of general information deficiencies was established. The scheme presented in Table 3.2 attempts to classify information transmission failures in a hierarchical fashion, beginning with four broad categories and ending with more detailed sub-categories with examples.

As can be seen in Table 3.2, there are only four general categories of information failures. The needed information may be unavailable, visually inadequate, temporally inadequate, or misleading. These categories and their accompanying sub-categories are not independent nor mutually exclusive. They serve only as a convenient means of grouping similar problems and narrowing the diagnostic focus.

The classification scheme presented in Table 3.2 was used in analyzing potential guide sign problem sites. This analysis included a review of the 219 comments taken from interviews with personnel from the various districts and from interviews with drivers who had experienced confusion at specific locations on the Houston freeway system. After reviewing these comments, the locations identified were classified according to the type(s) of information transmission failure thought to be present.

The classification effort was followed by a review of the photographic data collected at each problem location identified in the previously mentioned interviews. This review was undertaken to determine the accuracy of the classification scheme and to establish the relationship between the comments taken from the interviews and the problem diagnosed using the field data.

The results of this analytic process are presented in subsequent sections.

## **RESULTS OF DIAGNOSTIC EFFORTS**

**Driver Complaints.** As part of the developmental process for the information deficiency classification scheme, a sample of 219 driver complaints were examined. This sample was taken from the complaints elicited by interviews conducted in San Antonio, Austin, and Houston. One of the findings from this review was that most drivers had difficulty in explaining the nature of the problem they experienced. However, taken collectively, the comments provided insight about where to look for deficiencies and which types of signs were producing problems.

Another finding was that, generally, motorists were not lost in the classical sense. That is, they knew where they were, but had difficulty determining where to go, or where to be in order to follow a particular navigation sequence.



**TABLE 3.2 CLASSIFICATION OF INFORMATION TRANSMISSION FAILURES**

Category of Failure	Sub-Category of Failure	Class or Example	Behavioral Consequence
1. Information Unavailable	a. Absent	Sign does not exist or information not in recognized form.	Motorist continues or slows, eventually exits or stops for directions.
	b. Obscured	Sign hidden by permanent obstruction.	Same
2. Message Visually Inadequate	a. Size	Letters or symbols too small.	Motorist continues, slows, or makes sudden maneuver.
	b. Contrast	Sign cannot be located due to cluttered background, glare, or lack of reflectivity.	Same
3. Information Temporally Inadequate	a.1 Expectancy (form, format)	Information is not in expected form or format.	Motorist slows, or makes sudden maneuver for exit.
	a.2 Expectancy (location)	Sign not in expected location.	Same
	a.3 Expectancy (geometric violation)	Geometry of roadway not expected.	Same
	b.1 Inconsistency	Information is not presented in same manner within signs of the same type (internal), or from one sign to the next (external).	Same

Category of Failure	Sub-Category of Failure	Class or Example	Behavioral Consequence
3. Information Temporarily Inadequate (con'd)	b.2 Inconsistency	Route/place name different than expected.	Same
	c. Reinforcement	Pull through signs are not present after decision points to assure the correct choice was made.	Motorist slows, uncertain of correct road.
	d. Sign Overload	Sign information too complex to processed in time available.	Motorist slows in an attempt to read sign.
	e. State dependent/Temporary obstruction	Sign obscured by truck, or other obstacle temporarily. Vehicle handling or traffic requires attention.	Motorist continues, misses exit.
4. Information Misleading	a. Lane assignment	Lane designation does not match geometry.	Motorist fails to move to proper lane or moves when not required.

The most common complaints were (1) the driver could not find needed information; (2) the information came too close to the exit for the driver to change lanes; (3) the information was misleading regarding which lanes to be in; (4) that unexpected geometric configurations, such as left hand exits, required advanced signs and lane assignments; (5) that signs do not always explain when the facility changes names or route numbers which results in drivers thinking they are lost; and (6) that sign conventions, such as format or information layout, are sometimes inconsistent from one sign to the next.

The classified complaints are presented in Appendix B. Some general observations based on the review of a sample of driver comments are presented in the following paragraphs:

Unexpected Left Lane Exits. An exit on the left violates the driver's expectancy. Yet closer examination would suggest that this type of geometry could have been classified as either a "lane assignment" problem or "lack of advanced information" problem. Any unusual geometric requires advanced notice so that those exiting can be in the proper lane or lanes. It becomes a lane assignment problem when the overhead fails to make clear from which lane or lanes an exit is permitted.

Restricted Sight Distances, Visibility Issues. Comments which evaluated the conspicuousness or visibility of signs were rare. The category, "Missing Information," may actually include situations where the reason the sign was missed was visual occlusion by vertical curves, trucks, overhead bridges, etc. But seldom was the driver aware of the cause of the missing information.

Geometric Problems. Comments about geometry were very rare and limited to situations where drivers knew what they wanted to do, but traffic would not permit doing it due to geometrics. A requirement to make several lane changes from freeway entry to exit within a short distance is a classic example. Another is feeder road entry ramps too close to (upstream of) exits. No amount of signing would correct them. Other geometric problems such as bifurcation after an exit can be corrected by appropriate upstream signing for the two routes and lanes appropriate to each.

Lack of Information Continuity. Several classes of comments were grouped into this limited category. (a) Local boulevard names were familiar to the driver, but designations by route numbers were not. The signs did not mention the boulevard. (b) City destination names allegedly were given without mentioning the route number. (c) Use of the term "downtown" without specifying where in downtown. (d) Interstate routes turning into U.S. routes without notice they are the same route. (e) Map designation of route does not match the signed route number.

Lack of Advanced Information. Almost one-fourth of the drivers in the sample complained of not being given enough advanced warning of where to exit. Complaints were often in terms of

distances (signs too close to exit) or time (not enough time to change across several lanes).

Although the complaints dealt with advanced warning, many could be classified as lane assignment problems as well. Apparently, something about advanced signs misled the driver into being in the incorrect lane to exit. By the time another sign explained that the exit was upcoming, the driver lacked time to negotiate the lane changes.

Incomplete or Missing Information. This broad category encompassed many diverse driver's complaints. The complaint was the sign was "confusing" or "not clear," but did not describe specifically what the problem was.

Other complaints were more specific. For example, the driver was looking for an exit to a specific boulevard, which was not on any interstate sign. The signing required knowing to take one exit to another street which would lead to the boulevard of interest.

Another complaint was "I did not see a sign which directed me (somewhere)." Although it was missed, one does not know why. So missing something is largely an effect rather than a cause. One would need to check out the sign and verify that the needed information was actually missing from a sign at the site in question.

Lane Assignment. A very common complaint was that the signs did not tell the drivers which lane to be in to negotiate their exit. What they may have been trying to say was the sign elements were misleading. For example, several drivers complained the sign said to merge into one lane, but, in fact, exiting was feasible from an adjacent lane as well. An optional usage lane is not clear by traditional downward arrows (two on separate signs). Only one driver mentioned the arrow type as confusing, but not knowing which lane to be in was common. Several drivers wanted to stay on the interstate, but did not know how to do it. One said the exit sign was over the wrong lane.

Analysis of Field Data. An analysis of the 82 sites, for which both photographic and driver comments data were available, was made in order to determine what information deficiencies, if any, were present. This analysis was undertaken using the information deficiency categories presented in Table 3.2. Several individuals reviewed the data from each site and formed a consensus concerning the deficiency present. In many cases more than one problem was identified.

No discernible problems were found with eleven sites (13.4%). The remaining 71 sites (86.6%) had 93 deficiencies noted. The distribution of these deficiencies is presented in Table 3.3. Again, as with the driver complaints, lane assignment and lack of advanced information for lane assignment dominate the problems identified.

**TABLE 3.3 DISTRIBUTION OF INFORMATION DEFICIENCIES**

Category	Sub-Category	Frequency	Percent
Information Unavailable	Absent	13	14.0
Message Visually Inadequate	Size	2	2.2
Information Temporally Inadequate	Expectancy (format)	5	5.4
	Expectancy (location)	16	17.2
	Expectancy (geometry)	8	8.6
	Inconsistency	5	5.4
Information Misleading	Lane Assignment	30	32.2
	Incorrect	3	3.2
Geometrics	Sight Distance	11	11.8
		—	—
		93	100.0

General observations from this data suggest that the most frequently identified problem appeared to be associated with lane assignment. A related area of high incidence of signing deficiency was that of not providing information in the expected location; that is, the information was not presented soon enough to allow enough time for the selection of the appropriate lane. Still another portion of the deficiencies dealt with information that was absent. A number of these were related to the absence of lane assignment or advanced information.

Sight distance and odd or constraining geometrics were determined to be problems in eleven of the sites analyzed, while three had incorrect distance information. Detailed analyses of each site are presented in Appendix B.

**Geometry Associated with Problems.** An additional analytic task involved classifying each of the 82 sites by its geometric characteristics. The purpose was to identify the geometric features that may contribute to motorist confusion on urban freeways. It is difficult and sometimes impossible to adequately inform motorists of upstream decision points through guide signs when some of the geometric features identified exist near a freeway interchange. It is therefore important to be aware of the geometric features before any type of performance criteria or remedial solutions can be applied.

There are many geometric features that can be identified with the large number of sites being considered in this study. Only those features that have a direct and obvious impact on the motorist's navigational task through an interchange have been considered. The more common geometric features identified and their frequency of occurrence are shown in Table 3.4.

The majority of sites include an optional exit lane where the motorist can continue on the through route or exit from the same lane. Only 23 of the 82 sites are left hand exits. Field data has been collected at several airport signing locations that have not been identified as potential problem areas and are not included in this analysis.

## **SUMMARY**

Examination of the comments of drivers concerning problems they had experienced did not pin-point the specific design element deficiency because the driver often did not know exactly why the sign was confusing or failing to provide needed information. However, it is recognized that when many drivers complain about the same sign design (albeit using different words) there is some deficiency in the sign communications process. Further analysis is required to determine why the sign is confusing. It may be necessary to test other drivers in laboratory situations to pinpoint the deficiency. If the problem is confirmed, it is then possible to apply remedial treatment and retest to see if the deficiency has been corrected.

**TABLE 3.4 FREQUENCY OF GEOMETRIC CATEGORIES**

Geometric Category	Frequency
A. Left Lane Exit	23
B. Optional Lane Exit, Single	32
C. Optional Lane Exit, Double	28
D. Ramp Split After Exiting	10
E. Separate Exits for Cardinal Directions of Crossing Route from Left & Right Lanes	9
F. Tangential Off-Ramp From Curved Mainlanes	5
G. Multiple Exits in a Short Distance	9
H. Lane(s) Added Near Exit	11
I. Left Lane Exit for Destination to the Right	5
J. Restricted Sight Distance	7

While the survey of driver complaints did not pinpoint the design problems, the data served as a screening tool to suggest which of the many types of possible problems warranted further study. Among these were lack of advanced information, misleading information, and lane assignment.

Some deficiencies were readily recognized once the complaints were examined in context supplied by the photographs and videotapes of the site locations. This analysis showed lane assignment and related deficiencies to be predominant.

Geometric features associated with problem locations indicated that again lane assignment was deficient. Conveying lane assignments where optional exit lanes are present were most frequently represented followed by left hand exits.



## SECTION IV. STATEWIDE TELEPHONE SURVEY OF DRIVERS

### DESCRIPTION OF APPROACH

After information from motorists had been acquired using the critical incident approach by way of interviews, mail questionnaires, and other solicitations described previously, a statewide telephone survey of motorists was undertaken. This random survey of motorists within telephone households throughout Texas was conducted to yield a more representative overview of motorists' opinions of freeway guide signs in urban areas. Once specific problem areas had been identified and diagnosed, the remaining task was to find out how widespread similar problems are among the motoring public, and to distinguish the variation of opinion, if any, among various segments of the motoring public. The primary objective of the statewide telephone survey was to assess driver opinion of the freeway guide sign system, in general, and to determine the magnitude of specific problems previously identified. A secondary objective of the telephone survey was to elicit information from the Hispanic population of Texas in sufficient number to identify any guide sign problems unique to this group.

The survey was conducted by the Public Policy Resources Laboratory at Texas A&M University from May 25, 1990, through June 18, 1990. Respondents were selected using randomly generated telephone numbers from selected exchanges throughout the State. Further randomization was exercised at the household level by screening for drivers over 18 years of age with the most recent birthday. Shortly after the telephone interviews were underway, it was evident that a significant percentage of drivers selected for the sample had little or no experience with freeway driving or the freeway guide sign system. Therefore, an additional screening question was included to select freeway drivers.

A copy of the survey instrument is included in Appendix C, with response percentages provided for each question. The interview instrument was constructed such that an introductory question was followed by questions designed to determine if, where, how often, and under what conditions respondents had been lost, confused, or misdirected. The next set of questions used a Likert Scale format (five point scale of agree/disagree) to measure opinions about guide sign characteristics. Respondents were then asked several multiple choice questions about their preferences for numbers of signs and amount of information on signs. Several questions addressed directions to urban airports. The topical portion of the interview concluded with an open-ended question that allowed the respondent to comment freely on freeway signs in Texas. Six questions were included at the end of the interview to obtain demographic data as well as a small amount of driving history.

The interviews were conducted using a CATI (computer assisted telephone interview) format, so that each response prompted the next appropriate question. The responses were entered on screen as the interview progressed, and responses to open-ended questions were recorded verbatim.

A total of 1047 households were contacted that agreed to be interviewed and met the selection criteria. There were 349 refusals, for a cooperation rate of 75 percent. Forty-nine interviews (4.7 percent) were conducted in Spanish.

A description of the survey sample is provided in Table 4.1. The sample size was determined to be sufficient to produce a sampling error of plus or minus three percent with a confidence interval of 95 percent. In other words, in 95 out of 100 such samples, the results should differ by no more than three percent in either direction from what would have been obtained if every telephone household in the State had been surveyed.

Table 4.1 indicates that the sample is slightly over-represented by females and Anglos. Despite the over-sampling of Hispanics, the sample is slightly under-represented by Hispanics as well as Blacks and other minorities, in comparison with the race/ethnicity composition of the State. The age breakdown of the survey sample corresponds fairly well with the age composition of the State. No single age group was skewed in this sample. The sample is somewhat more educated than the Texas population as a whole.

The respondents were experienced drivers for the most part, with over 92 percent having had more than five years of driving experience. However, the self-reported number of miles driven in a year was somewhat less than average. These estimates are probably low, as it is more common to under-estimate than over-estimate mileage.

**TABLE 4.1 TELEPHONE SURVEY SAMPLE CHARACTERISTICS**

	Number	Percent
<b>Gender</b>		
Males	479	45.8
Females	568	54.3
<b>Age</b>		
<25	128	12.2
25 to 35	304	29.0
36 to 45	238	22.7
46 to 55	145	13.8
>55	230	22.0
<b>Race/Ethnicity</b>		
Anglo	725	69.2
Black	82	7.8
Hispanic	199	19.0
Other	35	3.3
<b>Education</b>		
<High School	137	13.1
High School or Equivalent	344	32.9
Some College	257	24.5
College Degree(s)	304	29.0
<b>City Population</b>		
Rural (Less than 5,000)	132	14.4
Small Urban (5,001-49,999)	202	22.0
Urban (50,000-100,000)	107	11.7
Large Urban (100,000+)	477	52.0
<b>Years Experience Driving</b>		
Less than 1	5	.5
1 to 5	75	7.2
More than 5	966	92.3
<b>Miles Driven in Avg. Year</b>		
<10,000	190	18.1
10,000-15,000	383	36.6
15,000-20,000	206	19.7
20,000-30,000	122	11.7
>30,000	111	10.6

## RESULTS

**General Opinions of Sign Performance.** Guide signs, in general, were evaluated by Texas motorists as clear and understandable. In response to the opening question designed to introduce the topic of freeway guide signing, over 90 percent of the respondents in the statewide survey answered that guide signs usually provide clear and adequate information. Later in the interview, drivers were again asked to indicate, on a five-point scale of agreement, if they thought information given on guide signs is clear and understandable. While very few people strongly agreed (3.7 percent) with the statement, the vast majority (73.4 percent) said they agreed. Less than one percent of those surveyed strongly disagreed, and 11.8 percent simply disagreed that information on guide signs is clear and understandable. Approximately 10 percent of the survey respondents had a neutral response to the question.

While the guide signs in Texas may be described by drivers as clear and understandable, and provides adequate information in general, over half (55 percent) of those surveyed reported they had been lost, confused, or misdirected in at least one city in the State. Another 23 percent named two cities in which they had been lost, and eight percent named at least three cities in which they had been lost.

The city most frequently given for those who had been lost, confused, or misdirected was Dallas. Houston and San Antonio were named second and third, respectively. The table below lists the 10 study cities and corresponding frequencies with which they were given as locations where respondents had been lost, confused, or misdirected.

**TABLE 4.2 CITIES WHERE SURVEY RESPONDENTS WERE LOST, CONFUSED, OR MISDIRECTED**

City	Frequency
Dallas	267
Houston	252
San Antonio	138
Ft. Worth	71
Austin	53
Corpus Christi	9
Lubbock	5
Abilene	4
Amarillo	3
Waco	2

Drivers were asked how often they experienced being lost confused or misdirected in the cities they named. The following responses were given:

**TABLE 4.3 FREQUENCY WITH WHICH SURVEY RESPONDENTS WERE LOST, CONFUSED, OR MISDIRECTED**

Percent	Response
15.2	Has only happened once
24.5	Happens rarely
5.9	Happens when I travel to a city first time
23.0	Happens occasionally
12.4	Happens frequently
18.9	Happens every time I go to _____

Those who said they had been lost, confused, or misdirected only once mentioned Dallas as the site of their mishap more than any other city (named 32.7 percent of the time). Conversely, Houston was the city most often named by those who said they had been lost, confused, or misdirected every time they visited a city (named 34.3 percent of the time).

Table 4.4 describes how often each of the most often named cities was traveled to or through by those who said they had been lost, confused, or misdirected there. Note that in most cases the respondent had driven to or through the city in which they reported having a confusing experience more than ten times in the past two years.

**TABLE 4.4 EXPOSURE IN CITIES WHERE SURVEY RESPONDENTS WERE LOST, CONFUSED, OR MISDIRECTED**

City (N)	None in past 2 years					
	once	twice	3-5 times	5-10 times	>10 times	
a. Dallas (259)	10.8	7.3	10.4	22.0	16.2	33.2
b. Houston (248)	10.5	6.5	13.3	19.3	15.7	34.7
c. San Antonio (134)	9.0	14.2	13.4	22.4	16.4	24.6
d. Ft. Worth (66)	7.6	10.6	7.6	19.7	9.1	45.5
e. Austin (52)	1.9	19.2	13.5	26.9	13.5	25.0
f. Corpus (9)	0	0	44.4	44.4	0	11.1

When motorists did have a problem of some kind with freeway guide signs, it was not uncommon for the freeway to be under construction. Fifty percent of those who reported a problem said the freeway was frequently or usually under construction at the time of their mishap(s). An additional 19 percent said the freeway was occasionally under construction.

Respondents were asked to agree or disagree or state if they had a neutral opinion about a list of statements regarding freeway guide signs in Texas. The table on the following page (Table 4.5) gives the results of this set of questions in descending order of agreement by the respondents.

Most drivers (86 percent) agreed that the information on guide signs is correct. They also agreed that guide signs are easy to read as well as easy to see (83.5 and 82 percent, respectively). Over three-fourths (77 percent) of the survey respondents agreed that the information given on guide signs is clear and understandable.

The statement that elicited the strongest agreement was that directions are not given early enough (18 percent of the respondents strongly agreed with this statement). This statement was further clarified in the interview with the example, "too late to get in the correct lane."

Most drivers (73.5 percent) disagreed that there are too many arrows on guide signs. They also did not think that the letters on signs are too small (72.5 percent), or that the overhead signs are above the wrong lanes on the freeway (65.8 percent), or that the arrows on guide signs are confusing (63.4 percent).

Drivers were asked if they thought there are too many, too few, or the right number of guide signs on city freeways. While over half (53.4 percent) said there are the right number, those who disagreed were much more likely to say that there are too few (35.3 percent) than too many (5.9 percent) signs on city freeways.

When asked if there is too much, too little, or the appropriate amount of information on overhead signs on the freeways, 72.5 percent of those surveyed said the amount of information is appropriate. "Too little information" was given more often (22.2 percent) than "too much information" (3.1 percent) as a response choice.

With regard to sign content, the question was posed: "Do you prefer that freeway numbers, freeways names, or both freeway numbers and names be used on freeway guide signs?" The majority of the respondents (73.7 percent) preferred that both freeway numbers and names be used on the guide signs. Of those that did not prefer both, twice as many drivers preferred numbers only (16 percent) to names only (eight percent).

TABLE 4.5 OPINIONS REGARDING GUIDE SIGNS

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The information on guide signs is correct.	4.7	81.5	6.9	5.5	.5
Guide signs are easy to read.	5.7	77.8	6.3	8.9	.7
Guide signs are easy to see.	5.5	76.1	7.3	9.4	.7
The information given on guide signs is clear and understandable.	3.7	73.4	9.8	11.8	.8
Directions are not given early enough.	18.1	41.0	7.6	31.0	1.2
Destinations are not given on enough signs.	6.4	45.7	9.8	34.2	1.6
The arrows on guide signs are confusing.	1.8	23.9	9.8	61.0	2.4
The overhead signs are above the wrong lanes on the freeway.	2.5	21.5	7.7	61.9	3.9
The letters on the signs are too small.	1.9	20.0	5.1	68.9	3.6
There are too many arrows on guide signs.	1.2	14.3	9.0	69.9	3.6

The identification of problems associated with locating airports was of special interest in this survey. Drivers were asked if they had ever had trouble locating an airport in Texas, in what city, and by what means were they trying to find the airport. Twenty percent of the survey sample had experienced some difficulty locating an airport in Texas. The airport cities named most frequently were Dallas/Fort Worth (given by 115 respondents) and Houston (given by 79 respondents). Frequencies for the top five cities named are provided below:

**TABLE 4.6 CITIES WHERE SURVEY RESPONDENTS HAD DIFFICULTY LOCATING AN AIRPORT**

City	Frequency
Dallas/Ft. Worth	115
Houston	79
San Antonio	16
Austin	12
Harlingen/Brownsville	5

The most frequent method used to locate an urban airport was road signs. This method was used in 133 instances. The use of verbal directions was relied upon in 76 instances. A map was used in 50 cases, and previous experience was relied upon 31 times.

**Characteristics of Lost or Confused Respondents.** Analysis was performed comparing those respondents who said "yes" they had been lost, confused, or misdirected on freeways in Texas with those who reported they had not. Using Chi-square tests of significance, it was found that those who said they had never been lost or confused on Texas freeways were more likely to be college educated and to be Anglo or classified as "Other" race/ethnicity. Being lost or confused was not associated with gender, age, or driving experience.

Those who said they had been lost differed significantly in opinion from those who had not on all of the agree/disagree statements with one exception. There was no difference in opinion regarding the number of arrows on guide signs. Otherwise, as shown in Table 4.7, those who had been lost were more apt to agree that destinations are not given on enough signs, that directions are not given early enough, that the letters on signs are too small, that the overhead signs are above the wrong lanes on the freeway, and that there are too many arrows on guide signs. They were also more apt to disagree that the information on guide signs is clear and understandable, that the information is correct, and that guide signs are easy to read and to see.

Those who had been lost were also more likely to say there are too few signs, and that there is too little information on the



TABLE 4.7 OPINIONS REGARDING GUIDE SIGNS: LOST DRIVERS COMPARED TO NEVER LOST

	Agree		Neutral		Disagree	
	Lost	Not Lost	Lost	Not Lost	Lost	Not Lost
The information on guide signs is correct.	82.4	92.6	9.3	4.2	8.4	3.3
Guide signs are easy to read.	77.4	92.1	8.1	4.2	14.4	3.7
Guide signs are easy to see.	77.7	89.0	9.1	4.9	13.2	6.1
The information given on guide signs is clear and understandable.	67.5	90.7	12.5	5.8	20.0	3.5
Directions are not given early enough.	70.8	45.1	8.7	6.1	20.5	48.8
Destinations are not given on enough signs.	60.0	44.2	10.3	10.0	29.7	45.8
The arrows on guide signs are confusing.	33.2	16.4	12.5	6.8	54.3	76.8
The overhead signs are above the wrong lanes on the freeway.	28.3	19.9	9.7	5.5	61.9	74.6
The letters on the signs are too small.	27.1	16.0	4.7	5.3	68.2	78.7
There are too many arrows on guide signs.	17.5	14.0	10.9	7.1	71.5	78.9

signs. There was no difference in those who said they had been lost and those who said they had not with regard to a preference for names or numbers as destinations on the signs.

#### **Evaluation of Guide Signs By Demographic Characteristics.**

Each respondent was asked to give their opinions of guide signs, regardless of whether or not they reported any prior difficulty with guide signs. There were some differences in these opinions based on the demographic characteristics of the respondents.

The statement, "the information on guide signs is correct" was agreed with by a large majority of the respondents. However, those that disagreed with this statement were more often college educated. College educated respondents were also more likely to agree that directions are not given early enough, or are given too late for proper lane assignment. Respondents with less than college education (high school or less) were more likely to say there are too many arrows on signs.

Number of years of driving experience was significantly associated with several opinion statements. Those with more than five years experience were more likely to think directions are not given early enough, and that there are too few signs. However, these more experienced drivers were more likely to believe that the amount of information on signs that are provided is adequate. The respondents with the least amount of driving experience (0 to 5 years) were most likely to say there are too many arrows on guide signs.

Number of miles driven per year was also significantly associated with several opinion statements. Respondents who drove the most miles per year most strongly agreed that destinations are not given on enough signs. This group also showed a significant preference for numbers on guide signs rather than names.

Age proved to be a factor for six of the opinion and preference statements. There was a direct relationship between age and the opinion that directions are not given early enough to get in correct lanes. In other words, the older the respondent the more likely they were to believe that directions are not given early enough. Older drivers also agreed that destinations are not given on enough signs, and to disagree that guide signs are clear and understandable. On the more positive side, older drivers (55 years or over) were more likely than younger drivers to say there are the right number of guide signs and the amount of information on guide signs is appropriate. The over 55 age group had a significant preference for names on guide signs rather than numbers. Drivers under 25 years of age had a significant preference for both names and numbers on guide signs. The age of the driver was not significantly associated with any of the opinions indicating that the guide signs are difficult to see, read, or that the letters are too small.

While gender was not significantly associated with reports of being lost or confused in Texas' cities, there were differences among males and females on five of the opinion items. Females were more inclined than males to say that the letters on guide signs are too small. The arrows on guide signs were more confusing to females than males, while males disagreed more often that there are too many arrows on the guide signs. However, males were more likely to say there are too many guide signs in general, females were more likely to say there are too few. Finally, males showed a preference for numbers on guide signs while females showed a preference for either names or a combination of names and numbers, but not numbers alone.

The relationship between race/ethnicity and opinions regarding guide signs can be reported, but with some caution in making inferences based on these relationships. There is a tendency among Hispanics to give "desirable" responses in interview situations where opinions are elicited. Therefore, as expected, Hispanics were least likely to report ever being lost or confused on Texas highways. The chi-square tests showed that Hispanics were significantly more likely to agree with each of the positive statements about guide signs and to disagree with the negative statements. While this may appear to be a significant finding, the consistency with which the responses were significantly "desirable" indicates that the results may be an artifact of the survey technique.

With respect to measures of differences among other race/ethnic groups, a significant association was found between Blacks and the opinion that 1) destinations are not given on enough signs; 2) the letters on guide signs are too small; 3) arrows on guide signs are confusing; and 4) names instead of numbers should be used on guide signs.

Those that classified themselves as in the Other race/ethnic group had a tendency, in general, to give lower intensity responses to the opinion questions (i.e., very few "Strongly Agree" or "Strongly Disagree" responses were given by this group). Two notable exceptions were: the Other group strongly agreed that the letters on guide signs are too small, and strongly preferred numbers to names on guide signs.

There were no significant differences for any of the demographic characteristics for the three statements: 1) The overhead signs are above the wrong lanes on the freeway; 2) Guide signs are easy to see; and 3) Guide signs are easy to read.

**Supplemental Survey of Spanish Speaking Drivers.** A supplemental sample of 30 Spanish speaking drivers was interviewed in Spanish, and combined in the analysis with the 19 interviews conducted in Spanish in the course of the statewide sampling process. The resulting 49 interviews in Spanish represented five percent of the total interviews and 25 percent of the Hispanic sample. As stated in the objectives, the purpose of the

supplemental sample was to elicit information from the Hispanic population of Texas in sufficient number to identify any guide sign problems unique to this group.

The response percentages for the Spanish supplement are provided in Appendix C. As mentioned previously, the Spanish-speaking subsample reported very little difficulty with freeway guide signs; no problems unique to this group were identified. An analysis comparing the responses of Hispanic drivers who were interviewed in English with Hispanic drivers interviewed in Spanish revealed no differences between the two groups.

**Open-ended Comments.** Respondents were asked the open-ended question, "Is there anything you would like to add about freeway signs in Texas?" Responses to questions posed such as this are sometimes difficult to interpret due to the wide range of possible comments. Given that such a wide range of comments could be made, it is useful to note which issues are raised with this format. In this way, a sense of the relative importance of the topics covered in the questionnaire, as well as those not addressed with the questionnaire can be assessed.

Each of the comments given for the 414 respondents who made any type of comment is provided in Appendix C. The comments are grouped according to topic and arranged alphabetically. The most frequent comment was classified as an "approving comment," given by 25 percent of those who had a comment. Approving comments ran from general comments about the Highway Department or highways in general to specific comments regarding freeway or other signs.

The second most frequent comment (and the most frequent comment of a specific nature) was related to requirements for advance information. Twenty percent of all comments addressed this issue. Examples of these comments are: "Not notified soon enough to change lanes;" "Need more advance notice of exits;" "Need to start telling people earlier as to when to get over to exit...You need at least a mile before you exit;" "Should give three miles notice to change lanes."

Other comments and the frequency with which they were made concerned the following topics:

	<u>Percent of Comments</u>
Lighting/Night Visibility	6
Construction	5
Miscellaneous	5
Sign Frequency/Amount of Information	4
Specific Examples	4
General Confusion/Clarity/Ability to Read	3
Multiple Comments on Multiple Topics	3
Names and Numbers	3
Yield	3
Color of Signs	2
Distance Between Cities	2

Exits	2
Hospital/Service Signs	2
Inaccuracies	2
Larger Letters/Larger Signs	2
Placement	2
Sign Maintenance	2
Airports	1
General Negative	1
Service/Logo Signing	1
Speed Limit	1
Arrows	0.7

### **SUMMARY OF STATEWIDE TELEPHONE SURVEY**

The statewide telephone survey indicated that the guide sign system in Texas is effective as far as most drivers are concerned. When asked, the majority of drivers will express a sense of confidence in the overall system. However, 55 percent admitted that they had had at least one experience in which they had been lost, confused, or misdirected in a Texas city. These experiences occurred most often in Dallas and Houston, although each of the 10 study cities were named at least once. A large proportion of the time, a lost or confusing experience happened to respondents who were frequent drivers in the cities in which they were lost.

One limitation of the telephone survey approach is that specifics are difficult to address, and in-depth questions would be more effectively studied using another approach (such as with personal interviews or an experimental design). However, the results of the telephone survey indicated (via the scaled response questions and the open-ended comments) that: 1) lane assignment/advance information is a problem; 2) motorists do not perceive arrows on guide signs as a problem; and 3) some aspects of the guide sign system are more problematic for certain population groups than for others, based on differences in demographic characteristics.



## SECTION V. LIMITED SURVEY OF UNDERSTANDING OF GUIDANCE INFORMATION

A survey was conducted to gain more information about the primary guide sign deficiency identified in the analysis of the driver complaints and field data. It was intended that this survey also compare alternative methods for providing lane assignment information on guide signs. Data was collected during the Houston Auto Show held March 24 through April 1, 1990.

### SURVEY DESCRIPTION

Each survey consisted of an individual presentation of eight figures of guide signs and associated questions. The questions were in the form of statements. Respondents were to indicate agreement or disagreement with statements regarding which lane or lanes could be used to exit or to continue on the interstate. The signs are presented in the Results section together with the percentage answering each question correctly. Details of administration are presented in the Procedure section.

On each computer-generated sign the route numbers and destination cities were fictional to prevent respondents from recognizing a specific sign.

There were two different sets of surveys, Set A and B, each administered to approximately half of the respondents. The two sets were further divided into four subsets each. The sets and subsets differed only in the order of questions. This procedure was to insure that there were no carry-over effects influencing results. Otherwise, the figures and associated questions were identical.

**Topics Investigated.** Figures A, B, and C were used to compare understanding of signing elements and overhead lane positions on two-lane exiting guide signs. Of specific interest was the white down-arrow for optional lane usage, the black down-arrow in the "Exit Only" lane, organization of route numbers and destinations, and overhead lane position.

Figures D and E compared understanding of the MUTCD diagrammatic guide sign and the modified diagrammatic with separate arrows for each lane. Figure F dealt primarily with understanding of "Next Left" on conventional guide signs. Figures G and H dealt with understanding the modified diagrammatic when the number of arrow shafts exceeded the number of lanes shown. Also of interest were the detail designs of signing elements affecting understanding of a single-lane, optional left exit guide sign and two-lane "pull-through" arrowheads.

Figures G and H tested the effect of a right-hand guide sign sharing the sign bridge with a four-lane modified diagrammatic. Specific interest was the understanding of "Next Right" in conjunction with the fourth arrow.

Since the modified diagrammatic is less common, another objective was to test the effect of a prior explanation of how to interpret its meaning. It was predicted a brief explanation would greatly enhance the understanding of lane usage. Five figures (D, G, H, I, and J) included the modified diagrammatic. Half of the respondents were termed "the informed group." They were shown a sample diagrammatic, not used in the survey, and a printed explanation of how to read and interpret it. (See Appendix D for the Instructions.) The other half of the participants, termed "the uninformed group," received no explanation. Each group was given the same figures and questions. Problems associated with administration to the informed group are discussed in Problems in Administration.

**Procedure.** Two staff members were present to administer the survey. One person was in charge of administering Set A, while the other administered Set B. Informed and uninformed surveys were given in sets of fours. Hence, four uninformed surveys were followed by four informed surveys. The participants were told that there were no right or wrong answers, and that their responses would be confidential. They were then shown the figures of guide signs and asked to check each statement they deemed true based on their understanding of the sign. It was explained that there could be more than one true statement for a set of statements relating to a given figure. A total of 662 surveys were completed.

**Problems in Administration.** Several problems were encountered during the survey. One major problem was the noise that was generated from the surrounding booths. The "Traffic Safety Section" consisted of 18 different booths, including two seat belt convincers, an air compressor to refill air bags, and a singing puppet show. This made it hard to hear, and it may have affected the respondent's ability to concentrate while completing the survey. It should be noted that the noise factor may have also affected the comparison results of the uninformed and informed participants. Originally the staff members were going to read aloud the paragraph informing the motorist how to properly read a diagrammatic sign. Due to the loud noise from the surrounding booths, it was impossible to do so. Since motorists have various literacy skills, this may be a factor to consider in the analysis.

It should be noted that several of the participants did not understand the meaning of "urban," and "downstream." Urban was used in the second question in the demographic section. The question was "How often do you travel on urban freeways?" The word "downstream" was used for Figure G only, and the question was: "What do you think happens downstream that made this difference possible?" (See attached questionnaire.)



**Data Analysis.** The data collected at the Auto Show was placed into a database file and later converted into SAS format for further analysis. The SAS program converted frequencies into percentages and determined if there was a significant difference between groups in answering the same question.

## RESULTS OF SURVEY

**Description of Respondents.** In all, 662 visitors to the Auto Show volunteered to participate. Demographic data was collected, but was not employed as a basis for selection other than to insure that all were frequent travelers on urban freeways. The characteristics of the sample are presented in Table 5.1.

TABLE 5.1 DESCRIPTION OF RESPONDENTS

How many years have you been driving?

4.70 less than 1 year    16.00 1-5 years  
79.30 more than 5 years

How often do you travel on urban freeways?

17.30 occasionally                      82.70 often

Into which ethnic group do you classify yourself?

76.60 Anglo                      5.30 Black  
9.60 Hispanic                      8.50 Other

What is the highest level of education you have completed?

5.50 less than high school    19.20 high school or equivalent  
30.90 some college                      44.40 college degree(s)

What is your approximate age?

28.30 less than 25    65.70 25 to 55    6.10 over 55

What is your gender?

69.90 male                      30.10 female

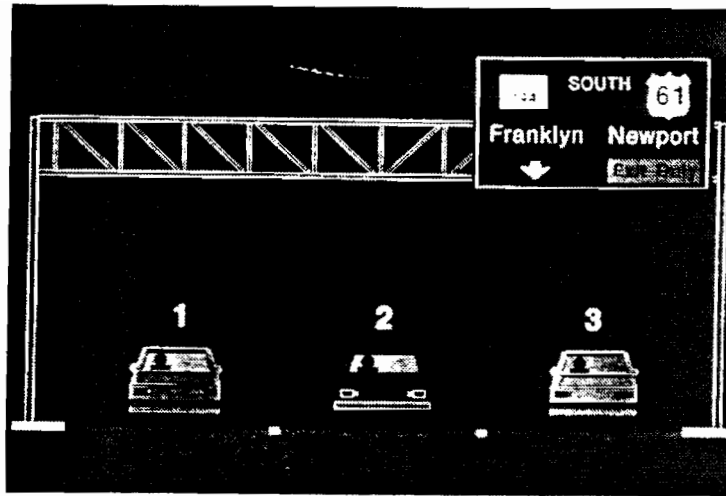


Figure A

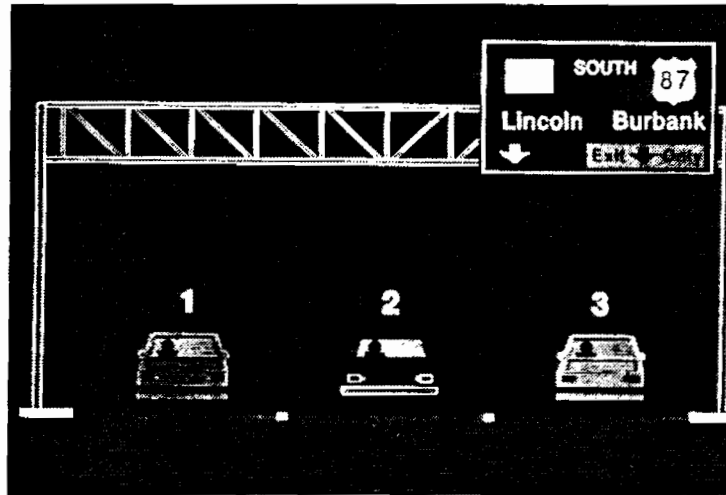


Figure B

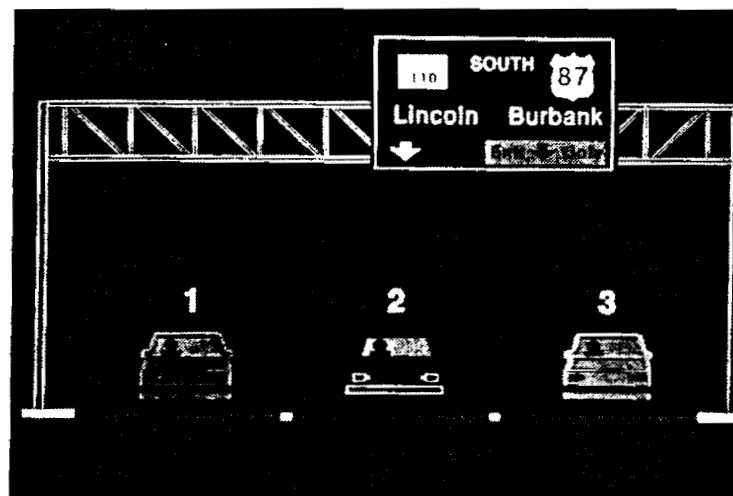


Figure C

## DISCUSSION OF FIGURES A, B, AND C

### OBJECTIVES:

The objectives of this comparison were as follows:

- (1) To determine driver's understanding of the downward white arrow on the left as an indicator of optional usage of Lane 2.
- (2) To determine if the black down-arrow embedded in the "Exit Only" message aided in clarifying the optional usage of Lane 2 (by emphasizing Lane 3 is for exit).
- (3) To determine if the position of the overhead sign was a factor in understanding.
- (4) To determine if the side-by-side array of route numbers and destinations led to the assumption that Lane 2 and 3 led to different routes.

### QUESTIONS PERTAINING TO FIGURES A, B, & C:

- (1) Lane 2 may be used to exit to Texas 144 to Franklyn (Texas 110 to Lincoln), but not to US-61 to Newport (US-87 Burbank).

Fig.	True	False	Sample Size	p < .05
A	<u>51.60</u>	<u>48.40</u>	<u>651</u>	
B	<u>64.35</u>	<u>35.65</u>	<u>331</u>	
C	<u>68.62</u>	<u>31.38</u>	<u>325</u>	

- (2) Either lane 2 or 3 may be used to exit to US-61 South (US-87 South).

Fig.	True	False	Sample Size	p < .02
A	<u>12.90</u>	<u>87.10</u>	<u>651</u>	
B	<u>18.13</u>	<u>81.87</u>	<u>331</u>	
C	<u>11.08</u>	<u>88.92</u>	<u>325</u>	

- (3) If you are in lane 3 you must take the next exit.

Fig.	True	False	Sample Size
A	<u>90.00</u>	<u>10.00</u>	<u>651</u>
B	<u>91.24</u>	<u>8.76</u>	<u>331</u>
C	<u>90.15</u>	<u>9.85</u>	<u>325</u>

- (4) Lane 2 may be used to continue on IH-47 South.\*

Fig.	True	False	Sample Size	p < .001
A	<u>75.50</u>	<u>24.50</u>	<u>649</u>	
B	<u>74.85</u>	<u>25.15</u>	<u>330</u>	
C	<u>62.15</u>	<u>37.85</u>	<u>325</u>	

\*Respondents instructed that they were driving south on IH-47.

## RESULTS AND DISCUSSION:

Question 1 addressed the fourth objective, to determine if a side-by-side array of route numbers and destination lead to the assumption of route separation. A majority of drivers believed that Lane 2 led only to Franklin (Texas 144). When the downward black arrow appeared (Figures B and C) this seemed to increase confusion as if Lane 3 was reserved for U.S. 87 to Burbank. This result may be due to some drivers spatially clustering information with each arrow. Thus, the information on the left side of the sign is associated with the left arrow, while the information on the right side of the sign is associated with the "exit only" or "exit only" with an arrow.

Question 2 addressed the first objective. Over 80 percent did not understand that the white down arrow meant Lane 2 could be used as an exit. Moving the sign such that the white arrow was over Lane 2 (Figure C) did not improve understanding. In fact, there was significantly poorer understanding of Figure C than B.

For question 3, 90 percent understood that Lane 3 traffic must exit. For question 4, 75 percent agreed that Lane 2 traffic could continue when the sign was over Lane 3, but only 62 percent agreed when the sign was over Lane 2. Changing the sign position had a negative impact on understanding.

In summary, the data suggest that the white arrow does not connote optional usage. The black arrow did not aid in connoting optional usage. Positioning the sign over Lane 2 led to more misunderstanding than when it was over Lane 3. A side-by-side array of route numbers and destinations may be confusing when the down-arrow appears directly under one or both routes.

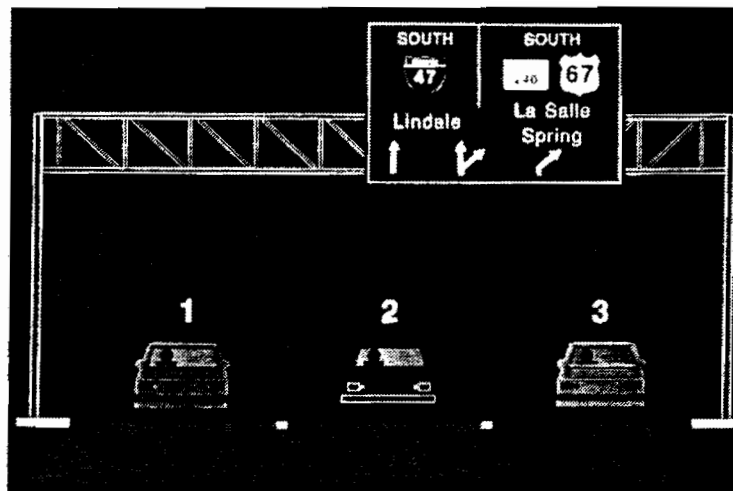


Figure D

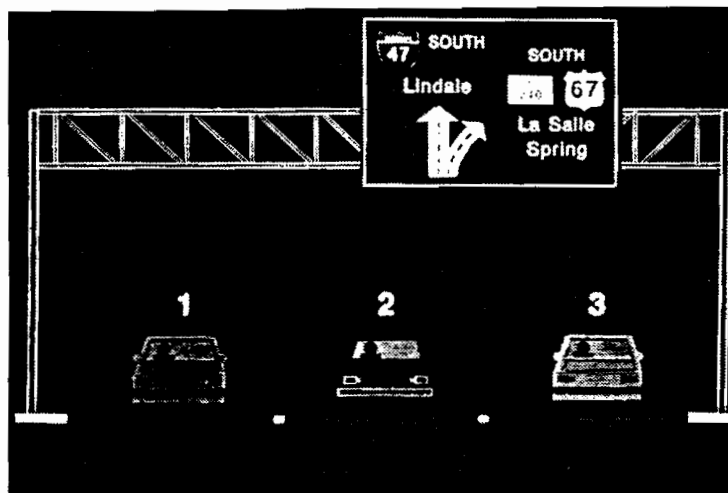


Figure E

## DISCUSSION OF FIGURES D AND E

### OBJECTIVES:

The objectives of this set of questions were as follows:

- (1) To compare the effectiveness of the conventional diagrammatic (Figure E) and the modified diagrammatic (Figure D)
- (2) To determine the degree to which instructions on how to read diagrammatic signs improved performance.

### QUESTIONS PERTAINING TO FIGURES D & E:

- (1) If you are in lane 3 you must take the next exit.

Fig.	True	False	Sample Size	p = .001
D	<u>82.07</u>	<u>17.93</u>	<u>329</u>	
E	<u>71.43</u>	<u>28.57</u>	<u>322</u>	

- (2) Lane 2 may be used to exit to Texas 240 to LaSalle, but not to US-67 to Spring.

Fig.	True	False	Sample Size
D	<u>14.59</u>	<u>85.41</u>	<u>329</u>
E	<u>11.15</u>	<u>88.85</u>	<u>323</u>

- (3) Either lane 2 or 3 may be used to exit to US-67 South.

Fig.	True	False	Sample Size	p < .001
D	<u>88.75</u>	<u>11.25</u>	<u>329</u>	
E	<u>75.85</u>	<u>24.15</u>	<u>323</u>	

- (4) Lane 2 may be used to continue on IH-47 South.

Fig.	True	False	Sample Size
D	<u>92.71</u>	<u>7.29</u>	<u>329</u>
E	<u>90.09</u>	<u>9.91</u>	<u>323</u>

### RESULTS AND DISCUSSION:

Question 1 asked if Lane 3 traffic must exit. Significantly more respondents understood the modified diagrammatic for this application. Training had no effect on the percentages. Thus, the separate, modified up-arrow over Lane 3 better communicated that Lane 3 must exit. However, the level of understanding was below that reported in Figures A, B, and C where "Exit Only" appeared over Lane 3.

Question 2 was analogous to Question 1 in the previous set of figures. Over 85 percent understood that Lane 2 applied to both routes (Texas 240 and US 67). Note that here destinations are arrayed one above the other. There was no difference between the modified and conventional diagrammatic for this application.

Question 3 tested whether respondents thought Lane 2 could be used to exit to US 67. With the modified diagrammatic, significantly more respondents (13 percent) were correct than with the conventional diagrammatic. Again, training did not significantly improve the performance with the modified diagrammatic sign.

Question 4 asked if Lane 2 could be used to continue on the interstate. Ninety percent of both groups agreed. Training had no effect. It is interesting to note that these signs had "pull through" route designations unlike those in Figures A, B, and C. This information coupled with the modified diagrammatic arrows increased the correct responses by at least 17 percent.

In summary, the modified diagrammatic, with separate arrows for each lane, resulted in better performance when applied to whether Lane 3 must exit or whether Lane 2 may be used to exit. When the two exit destinations were not side-by-side and did not have down-arrows, as in Figures A, B, and C, drivers were less likely to assume that Lane 2 led to one route and Lane 3 to another.

Training on how to read diagrammatic signs was predicted to increase understanding. However, instruction appeared to have little or no effect. One possible explanation for this finding could be the conditions of administration, which required the respondent to read the explanation and not orally demonstrate understanding. The exercise failed to teach many drivers the basic principles.

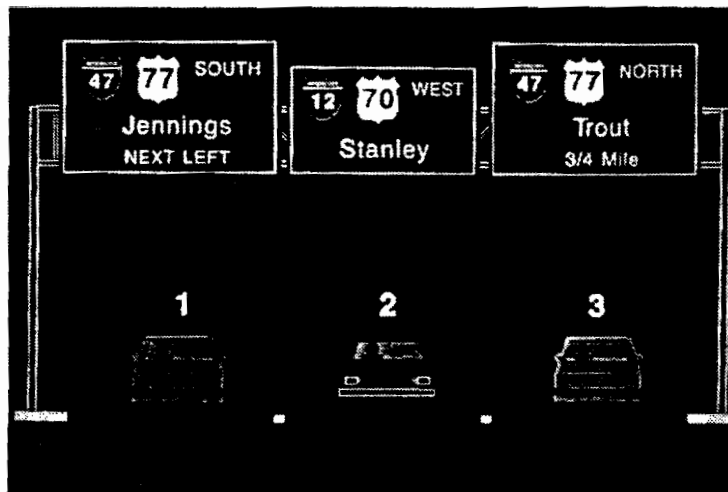


Figure F



## DISCUSSION OF FIGURE F DATA

### OBJECTIVE:

The objective of this set of questions was to determine if a sign over Lane 1 which displayed "Next Left" would imply that exiting was optional or mandatory.

### QUESTIONS PERTAINING TO FIGURE F:

- (1) Lane 1 traffic must exit to IH-47 South.

Fig.	True	False	Sample Size
F	<u>29.30</u>	<u>70.70</u>	<u>651</u>

- (2) Lane 2 traffic may continue on IH-12 West.

Fig.	True	False	Sample Size
F	<u>86.80</u>	<u>13.20</u>	<u>651</u>

- (3) Lane 1 traffic may exit to IH-47 South or may continue on IH-12 West.

Fig.	True	False	Sample Size
F	<u>64.50</u>	<u>35.50</u>	<u>651</u>

### RESULTS AND DISCUSSION:

In answer to Question 1, 70.7 percent understood that exiting was not required, but a surprising 29.3 percent thought Lane 1 was for exiting only. Question 3 was essentially the same question restated in a different form. Here 64.5 percent understood that Lane 1 exiting was optional.

Question 2 asked if Lane 2 traffic could continue on the interstate. Although 86.8 percent were correct, one might have expected near perfect performance.

In summary, "Next Left" over Lane 1 was misinterpreted by almost a third of the drivers as being mandatory.

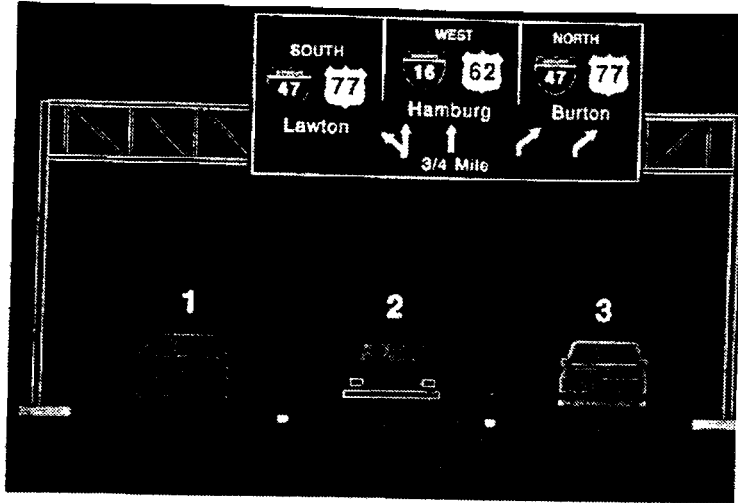


Figure G

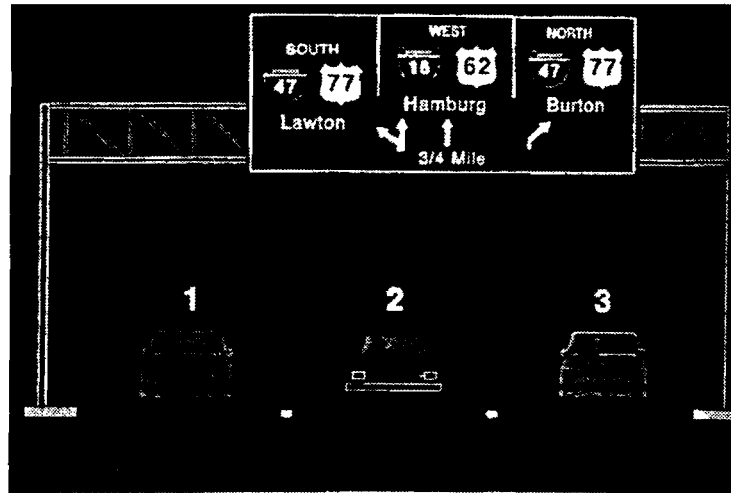


Figure H

## DISCUSSION OF FIGURES G AND H

### OBJECTIVES:

The objectives of this set of questions were as follows:

- (1) To determine the effects of displaying modified diagrammatic arrows when there are more arrows than lanes shown. The actual situation was one of an added right-hand lane downstream of the overhead sign. The drivers were not told this but were asked to speculate on why there were more arrows than lanes.
- (2) To determine the extent to which poor formatting of information and overhead placement of information in the wrong lane affects interpretation of a left, optional usage exit shown by a modified diagrammatic.

### QUESTIONS PERTAINING TO FIGURES G & H:

- (1) Lane 2 traffic may exit to IH-47 North.

Fig.	True	False	Sample Size	p = .0001
G	<u>42.86</u>	<u>57.14</u>	<u>329</u>	
H	<u>14.51</u>	<u>85.49</u>	<u>324</u>	

- (2) Lane 1 traffic may continue on IH-16 West.

Fig.	True	False	Sample Size
G	<u>56.10</u>	<u>43.90</u>	<u>328</u>
H	<u>54.01</u>	<u>45.99</u>	<u>324</u>

- (3) Lane 1 traffic may exit to IH-47 South.

Fig.	True	False	Sample Size
G	<u>77.81</u>	<u>22.19</u>	<u>329</u>
H	<u>79.63</u>	<u>20.37</u>	<u>324</u>

- (4) Lane 1 traffic must exit to IH-47 South.

Fig.	True	False	Sample Size
G	<u>25.84</u>	<u>74.16</u>	<u>329</u>
H	<u>24.07</u>	<u>75.93</u>	<u>324</u>

- (5) Lane 2 traffic must continue on IH-16 West.

Fig.	True	False	Sample Size	p = .001
G	<u>44.07</u>	<u>55.93</u>	<u>329</u>	
H	<u>57.10</u>	<u>42.90</u>	<u>324</u>	

- (6) Lane 3 traffic must exit to IH-47 North.

Fig.	True	False	Sample Size
G	<u>85.41</u>	<u>14.59</u>	<u>329</u>
H	<u>84.57</u>	<u>15.43</u>	<u>324</u>

## RESULTS AND DISCUSSION:

Question 1 addressed the first objective. With only one up-arrow over Lane 3 (Figure H), 85.5 percent understood that the middle arrow referred to Lane 2 and that Lane 2 could not exit to IH-47 North. However, with two up-arrows (Figure G) 42.9 percent thought that Lane 2 traffic could exit. It is surmised that counting from the right, they assumed the second arrow referred to Lane 2.

Skipping to Question 5, drivers were asked if Lane 2 traffic must continue on the interstate. Only 57 percent of the responses to the Figure H group were the correct answer and even less (44 percent) of the responses to the Figure G group were correct.

Examining the elements of the sign provides several possible explanations for the poor performance. For the four arrow group (Figure G), respondents may have assumed that both the second and third arrow referred to Lane 2. If so, traffic would have had an option to exit or continue and "must" continue was incorrect. This explanation would not apply to the three-arrow group (Figure H). The elements of both the sign and the question need be considered. The question gave only the route number (IH-16) and not the destination, "Hamburg", so the driver had to locate the small IH-16 shield. Another possibility is consistent with the findings of the first set of questions (Figures A, B, and C) where a majority of drivers thought that the two routes displayed had separate exit lanes and the arrows accentuated this misinterpretation. Generalizing, some may have assumed that the second arrow referred to US-62 and the first arrow referred to IH-16. Regardless of the reason, performance was unexpectedly poor for both groups.

Questions 2, 3, and 4 all address the second objective. As expected, there was no significant difference in responses between the Figure G and H data because the issue of one or two right exit arrows did not apply to questions related to Lane 1.

When asked if Lane 1 traffic may continue on the interstate, over 40 percent answered negatively (Question 2). Evidently, respondents were not counting lanes from the left and identifying this as an optional usage lane. For questions 3 and 4 understanding was much improved. Over 75 percent grasped the idea that Lane 1 had the option of exiting, but was not required to do so. It is somewhat paradoxical that they believe Lane 1 did not have to exit yet 40 percent did not believe that Lane 1 traffic could continue either. Without fully answering this paradox, it is important to note the many misleading and confusing elements in this sign. First, the vertical lines suggest that the information in the middle part refers to Lane 2 only. Second, the optional usage arrow is over lane 2 only. Third, the amount of information displayed is overloading. One must search to locate the small IH-16 interstate shield and read it. Also, single lane, left-side, optional exits may be less familiar to many drivers.

In summary, there was a better understanding that exiting was optional than that continuing was optional, suggesting many drivers may have been overwhelmed and confused by the formatting of the information.

The last question asked if Lane 3 traffic must exit to IH-47 North. About 85 percent of both groups answered correctly. Note that whether Group G thought the third or fourth arrow applied to Lane 3, they would answer correctly.

Two concluding questions were asked. One question was: "Note that there are more arrows than lanes. Do you find this confusing? The second question asked: "What do you think happened downstream that made this difference possible?"

Of 333 Set A respondents, 198 (60 percent) reported the four-arrow sign was confusing. To the write-in question of what was happening downstream, the responses were highly variable. 137 (41.1 percent) gave no answer. Other responses were classified into three categories in the data analysis. The associated frequencies and percentages are as follows:

- (1) partially correct - 80 (24.0 percent)
- (2) exactly correct - 15 (4.5 percent)
- (3) ambiguous, irrelevant, or incorrect - 101 (30.3 percent)

A partially correct tally was assigned if it was stated "a lane was added on the right", "lane 3 split into 2 lanes", "the road widens on the right", or words to this effect. Respondents grasped the notion of another lane, but did not state that this lane had incoming traffic.

An exactly correct answer used verbs such as "merging, feeding in, or entering" to describe the new lane. A few stated there was a ramp or feeder road. Ambiguous responses were ones which indicated a possible lack of understanding. Irrelevant or incorrect comments included: "missed an exit", "it feeds to another road", "several forks leading to different highway", "road narrows" or mention of Lane 1 and 2. Some incorrectly said there was another exit upstream of the routes on the sign given; a few even mentioned a narrowing of the highway.

Less than 30 percent understood the meaning that four arrows indicated an added exit lane upstream on the right. And only 4.5 percent recognized that the lane would have traffic on it entering from a ramp, rather than just another exit lane. A majority felt it was confusing. Even those who did not report confusion were largely incorrect.

The display of more arrows than lanes in Figure G was confusing in terms of whether Lane 2 traffic could exit. Twenty-eight percent more were incorrect with four arrows as when there was one arrow per lane. An optional usage, modified diagrammatic referring to Lane 1 failed to communicate that traffic in that lane could continue. Several explanations were offered. Failure to understand that Lane 2 could continue with the three-arrow group was unexpected and may relate both to the question and the signing elements.

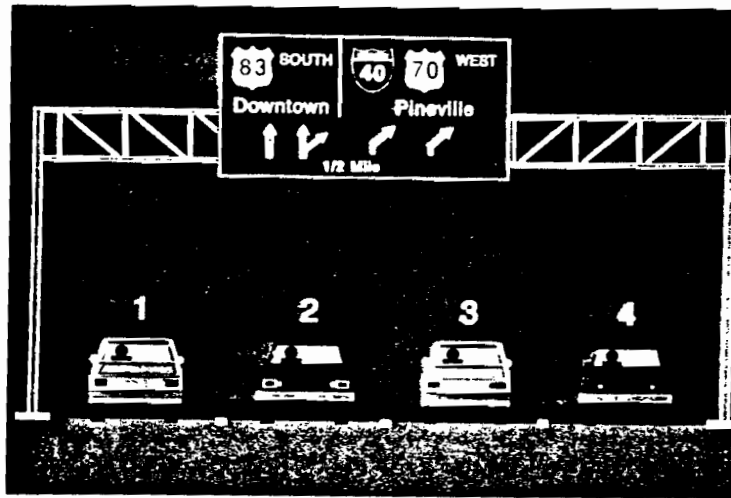


Figure I

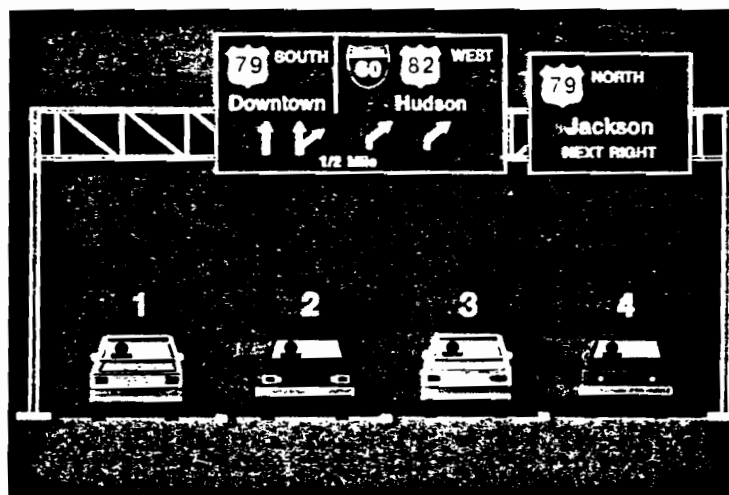


Figure J

## DISCUSSION OF FIGURES I AND J

### OBJECTIVES:

The objectives of this comparison were as follows:

- (1) To determine if adding a guide sign over the fourth lane affected driver understanding of the Lane 3 and 4 exiting requirement. Figure I is the control group for Figure J in this comparison.
- (2) To determine the degree to which drivers misinterpreted "Next Right" as referring to a mandatory exit.

### QUESTIONS PERTAINING TO FIGURES I AND J:

- (1) Lane 1 traffic must continue on US-83 South (US-79 South).

Fig.	True	False	Sample Size	p < .001
I	<u>90.90</u>	<u>9.10</u>	<u>651</u>	
J	<u>84.80</u>	<u>15.20</u>	<u>652</u>	

- (2) Lane 1 traffic may continue on US-83 South (US-79 South) or exit to IH-40 West (IH-60 West).

Fig.	True	False	Sample Size	p < .001
I	<u>11.80</u>	<u>88.20</u>	<u>651</u>	
J	<u>18.90</u>	<u>81.10</u>	<u>652</u>	

- (3) Lane 2 traffic must continue on US-83 South (US-79 South).

Fig.	True	False	Sample Size
I	<u>5.40</u>	<u>94.60</u>	<u>651</u>
J	<u>4.40</u>	<u>95.60</u>	<u>652</u>

- (4) Lane 2 traffic may continue on US-83 South (US-79 South) or exit to IH-40 West (IH-60 West).

Fig.	True	False	Sample Size
I	<u>93.10</u>	<u>6.90</u>	<u>651</u>
J	<u>94.00</u>	<u>6.00</u>	<u>652</u>

- (5) Lane 3 traffic must exit to IH-40 West (IH-60 West).

Fig.	True	False	Sample Size	p = .001
I	<u>87.40</u>	<u>12.60</u>	<u>650</u>	
J	<u>80.70</u>	<u>19.30</u>	<u>652</u>	

- (6) Lane 3 traffic may continue on US-83 South (US-79 North) or exit to IH-40 West (IH-60 West).

Fig.	True	False	Sample Size	p < .001
I	<u>8.30</u>	<u>91.70</u>	<u>651</u>	
J	<u>21.00</u>	<u>79.00</u>	<u>652</u>	

(7) Lane 4 traffic must continue on US-79 North.

Fig.	True	False	Sample Size
J	<u>50.00</u>	<u>50.00</u>	<u>652</u>

(8) Lane 4 traffic may exit to US-79 North or may continue on IH-60 West.

Fig.	True	False	Sample Size
J	<u>44.40</u>	<u>55.60</u>	<u>651</u>

#### RESULTS AND DISCUSSION:

The first two questions referred to Lane 1. Correct responses were high for both groups, but significantly higher for Figure I than Figure H. Regarding the optional usage lane, correct responses of both groups (trained and untrained) were in excess of 80 percent.

Regarding Lane 3, correct responses varied significantly (6.7 percent) between Figures I and H as to whether this lane must exit (Question 5). The guide sign in the right lane appeared to be exerting some effect on distinguishing lanes.

Due to editing errors it is not possible to compare the corollary question of whether or not Lane 3 is optional. For Figure I, 92 percent said that it was (Question 6). However, Question 6 of Figure J listed the options as IH-60 West and US-79 North (rather than US-79 South). Thus, the correct response called for knowing a vehicle could negotiate into Lane 4 from Lane 3 and exit. The 79 percent correct is high, but it is not the same issue addressed in Question 6 for Figure I.

Questions 7 and 8 were asked for Figure J only and addressed Objective 2, understanding "Next Right". Question 8 data is usable but Question 7 data is not because it used the word "continue" rather than "exit" for the exit to US-79 North. Compounding this problem, in the previous questions US-79 South was the continuing "downtown" route. Thus, if the reader did not see the cardinal direction (US-79 North) and translate "continue" to "exit", the question would be missed.

However, Question 8 was stated correctly, and 56 percent did not interpret "Next Right" as being optional. Recall that there was a similar although less pronounced misinterpretation of "Next Left" for Figure F, Question 1.

In summary, a large percentage of drivers misinterpreted "Next Right" as implying that Lane 4 must exit. The guide sign over Lane 4, particularly if it is viewed as an exit lane, may be exerting some influence over interpretation of the Lane 3 arrow, but had no impact on the Lane 1 and 2 arrows. The modified diagrammatic over Lanes 1 and 2 performed very well, possibly because they were simpler than those investigated in the previous study.



## **SUMMARY AND CONCLUSIONS FROM PILOT SURVEY**

A questionnaire, administered individually to a sample of volunteers at the Houston Auto Show, was an attempt to address several variables identified previously as being major sources of confusion in overhead guide signs. The lane assignment issues related to various signing elements, formatting of information, and overhead placement.

Previous survey research had identified high frequency problem areas. This research attempted to isolate the elements as potential contributors to misunderstanding and to measure understanding by a series of true-false questions. The questions systematically addressed each interstate lane and asked if traffic could exit from the lane, was required to exit, was required to continue on the freeway, or had a choice.

In general, the level of understanding was not as high as anticipated particularly for signs that had been in use in Texas for many years, e.g. the white down arrow for optional usage and "Next Left" or "Next Right" messages. The large sample size and the demographics of the sample suggest that the findings are reliable. The volunteers were younger, better educated, and more experienced in freeway driving than the driving public in general. So if there was a measurement error, it would be in the direction of underestimating the true extent of misunderstanding.

One of the major findings of the study related to the conventional diagrammatic sign. Although previously suspected of having a shorter legibility distance compared to the modified separated lane arrows, the present study demonstrated that the conventional diagrammatic was not communicating lane assignment information as well, even when legibility was not an issue.

Other major findings were presented at the end of the Results and Discussion sections above but are reiterated below.

1. The downward white arrow on the left side of an exit sign was misinterpreted by 80 percent as an indicator that a lane has optional usage. A black down-arrow embedded in the "Exit Only" message did not improve understanding.
2. Moving the sign so that the downward white and black arrows are over the appropriate lanes did not improve understanding of the optional usage and, in fact, increased misunderstanding.
3. Two common routes appearing side-by-side on an exit guide sign misled many drivers to think that they referred to different routes, accessed by different lanes. Adding the second black, down-arrow accentuated this confusion more so than the one white down-arrow. Arraying destinations under one another in another set of questions (Figure D) resulted in 85 percent thinking they were a common route.

4. The modified diagrammatic was 10 percent better than the conventional diagrammatic in indicating whether the third (right-hand) lane must exit, and was 13 percent better regarding whether a lane had optional usage. The two were equally effective in connoting that the optional lane could continue.
5. A "Next Left" sign over a lane was misinterpreted by 30 percent as indicating a mandatory, single-lane exit.
6. When the number of arrowshafts on a modified diagrammatic exceeded the number of lanes displayed, drivers were confused about optional usage. When the number of arrowshafts equaled the number of lanes (Figure H) performance was 28.5 percent superior regarding exiting from an optional usage lane. This suggests that the added lane downstream should not have been displayed on the advance sign.
7. When a modified diagrammatic was used to indicate an optional usage left-lane exit and when the arrow and other information was clustered over Lane 2, about 20 percent did not understand that Lane 1 traffic could exit and 25 percent thought that traffic must exit. However, 45 percent thought traffic could continue. It is speculated that the location of the information overhead was misleading and that vertical lines accentuated the conclusion the information did not apply to Lane 1. Too many secondary routes were displayed forcing the reader to extract the small relevant route number from a mass of information. There is a need to simplify diagrammatic signs to display only the primary routes.
8. On this same sign, misinterpretation that Lane 2 could continue on the interstate was unexpected and one explanation is in terms of the problem identified in Item 3 above. The high degree of understanding of modified diagrammatic in Figures H and J, suggests that it is not the diagrammatic itself but the array of information on the sign that may be leading to some confusion.
9. "Next Right" signs were misinterpreted by 56 percent of the respondents as a mandatory exit. An improved message is required.
10. Although some data was lost due to a miswording of two questions, there is some evidence supporting the position that guide signs should not appear on the same bridge with a diagrammatic.
11. The effects of an educational paragraph on interpreting modified diagrammatics was not assessed due to poor conditions of administration. This issue remains unanswered.

## SECTION VI. CONCLUSIONS AND RECOMMENDATIONS

### CONCLUSIONS

**Guide Sign Deficiencies.** The results of the driver interviews, the analyses of field data, and the statewide telephone survey suggest there are deficiencies in the guidance information system present on urban freeways in Texas. Although many types of deficiencies were identified through the various study procedures, most were related to specific locations rather than the system as a whole. The exceptions to this finding were the related deficiencies of inadequate lane assignment and lack of advanced information. These two areas were far and away the most significant and frequently encountered. Inadequate lane assignment is the term that has been used to describe those situations where motorists missed an exit or were forced to leave the freeway because they were confused about the lane they needed to be in to make the desired maneuver. Lack of advanced information implies that motorists are not receiving information soon enough to make an appropriate decision or maneuver. These two deficiencies are related in the sense that if adequate lane assignment is made, by definition, it will be in advance of the decision point. The problem then is not that the information is not there, rather it is not presented soon enough or in a form that drivers can readily use. Hence, drivers are not reporting that they are lost in the classical sense of not knowing where they are; their complaint is that they are inconvenienced by not having enough information to make the right move at the right time. They are forced, by traffic conditions, to continue straight as they watch their exit go by, or find themselves in an exit only lane wishing to go straight, but unable to do so. In the best of circumstances this results in delay and inconvenience to the driver and adds to the congestion on the side roads and freeway as the driver is forced to circle. In the worst of circumstances, the situation may increase accidents as drivers slow in confusion or drive erratically across several lanes of traffic in panic.

Philosophically, it could be said that all roadway navigation problems can be reduced to those of lane assignment. If adequate lane assignment is made, then drivers would all arrive efficiently at their destinations. In reality, it is neither possible, nor desirable to assign lanes for all destinations. To attempt to do so would force freeways into rail lines and eliminate the flexibility motorists have to select different lanes and routes. It would also severely restrict the ability of traffic engineers to manage traffic and drivers to respond to changes in traffic patterns. Obviously, since freeways generally function well, not all individuals, nor all decision points on freeways have lane assignment problems. Consequently, the philosophical argument that all navigation problems are lane assignment problems is somewhat specious and serves little useful purpose. However, there are specific locations and specific types of information displays that pose special lane assignment problems. Referenced here are not lane assignment problems which are state dependent; that is, ones

where there is adequate lane assignment information but it is not received by the driver because of distraction or blockage by traffic. The lane assignment problems referred to are those that are associated with particular geometric features (left hand exits, bifurcations, optional exit lanes) and with particular display features (arrow, colors, etc.).

Geometric features such as bifurcations are complex and require more information processing time for the driver. The same is true of optional exit lanes. Both require advance notice in a form that can be easily understood. Left hand exits may not be complex, but do increase processing time because they are not expected.

Adequate processing time means that lane assignment information must be conveyed early and in a form easily interpreted by drivers. Despite the fact that most motorists surveyed do not feel that lane assignment arrows are a problem, experimental evidence and evidence from the analyses of problem locations would suggest otherwise. The color of arrows, their background, their orientation, spatial relationships, and intended meaning varies considerably. This variety has undoubtedly produced confusion.

The solution to the lane assignment problem is not simply a matter of placing additional signs upstream of the decision point (although in many specific cases this is indeed the solution) but more of developing a standardized, coding system that is easily comprehended. Preliminary investigations of diagrammatic and modified diagrammatic signs show promise in improving comprehension. However, many questions regarding these signs and their use remain to be resolved.

**Magnitude of the Problem.** The fortunate aspect of the urban freeway information deficiency problem is that it is manageable in size. A good portion of the driving population contacted in the course of the study indicated that they had experienced no significant problem (telephone survey 45%, direct interviews 36 - 63%). When asked to recall a location where a problem had been experienced, most drivers were able to do so, however, they also felt the urban freeway signing system generally works well. There were numerous, unsolicited comments that were favorable and complimentary. On the other hand, it was quite remarkable that many individuals were able to identify the same locations as problem areas. While the system as a whole is functioning well, these locations can be improved. If, in the course of their improvement, signing techniques are developed that can be used in other parts of the systems, then general improvement will result as well.

## RECOMMENDATIONS

A logical progression as a result of this project was to develop a set of recommendations or guidelines for diagnosing and remediating problems with urban freeway guide signs that might cause motorists to become lost or confused. The results of the various studies conducted suggest that, by and large, the system is functioning as it is intended. That is not to say, however, that motorists were not able to identify locations where they had experienced some difficulty or inconvenience. Some causes of the problems at the locations identified were endemic, that is, peculiar to specific locations or to specific sequences of signs. Other causes of problems were pandemic, that is, found to exist system wide. Guidelines have been developed to assist in the diagnosis of both endemic and pandemic problems. These diagnostic guidelines are intended to provide a frame of reference, or an indication of problems that may be created by guide signs. They are, of necessity, general in nature.

Recommendations for remediation of problems identified are even more general and in some cases incomplete. They are incomplete because, for some problems diagnosed, there are no, currently recognized, corrective action. For example, the complex geometric configurations of some roadway sections do not afford an opportunity to provide adequate distances for lane assignments or for the timely presentation of other information. These situations defy remediation with signing given the current state of the art. In the future, with some innovative intelligent vehicle/highway technology, solutions may be forthcoming.

In summary, there are recommendations that can be made for identifying and remediating some of the signing problems encountered. However, other problems require remediation techniques that are still in the developmental stage, and as such beyond the scope of this effort.

The following sections present recommendations for:

1. Guidelines for identifying potential or possible urban freeway guide sign problem locations.
2. Guidelines for diagnosing the causes of the problems.
3. Guidelines for general remediation procedures.

In addition, recommendations are made for future signing studies that might lead to better remedial treatment for some of the problems of guide signs.

**Identifying Problem Locations.** Problem locations can be called to attention or discovered. It is a matter of knowing when and where to look.

When to Look - Locations with possible guide signing problems can be identified in several ways. One way is through reports by

citizen, department personnel, police, or others. A more proactive method would be through a periodic review of the signing system. Certainly, an appropriate time for identification of potential guide signing problems would be when there has been a major construction or reconstruction project or during routine sign maintenance activities.

Where to Look - Locations that have had a number of complaints warrant investigation for potential signing problems. A complaint log should be kept, recording the nature of complaint by location. It should be noted that it may take several years before a significant number of complaints accumulate because few individuals who experience a problem will take the time to report. It also should be understood that complaints received may not mention signing at all. The individual reporting may not truly understand the nature of the problem experienced and complain about something else. That is why it is important to log reports by location.

Incident or accident reports also can provide an indication of a signing problem. Although freeway accidents typically involve some form of sideswipe or rear-end collision, a concentration of such occurrences in a location may indicate a signing problem, particularly if there is a concomitantly high incidence of crash attenuator maintenance.

Without relying on reported problems it is possible to examine certain geometric features present on the freeway system to determine if guide signing problems might exist. These features are those used infrequently in design practice, and may not be familiar to some motorists. Two examples of these geometries are left hand exits and major freeway divisions or forks.

Another feature that apparently causes some motorist problems is the optional exit lane. The problem involves faulty understanding of the optional lane and occurs at both single and multi-lane exits.

Complex geometries where multiple exits occur in a short distance are also potential problem areas. This is particularly true when the sight distance to the exits is obscured by vertical curves or overhead structures (overpasses, sign bridges, etc.).

**Problem Diagnosis.** Freeway guide signs can fail to communicate because the information sought by a motorist is not available, is present but either the sign or sign message is visually inadequate, is present but temporally inadequate, or because the information presented is misleading.

Information Unavailable - Information can be unavailable because it is absent or because it is obscured. Information can be considered absent if a sign or sign message does not exist or if the motorist does not recognize it in the form presented. Information may be obscured if it is hidden from view by a permanent obstruction. The obscuration may occur for only one lane, or for all lanes.

Message Visually Inadequate - The letters and symbols of a sign message may be too small to be seen from the available viewing distance, or they may not have sufficient contrast to be easily read at night. The sign itself might not have sufficient contrast to be located in a cluttered visual environment or in the presence of glare.

Information Temporally Inadequate - Temporal inadequacy results when the information is present and visually adequate but for some reason is not received in time for appropriate action to be taken. One reason for inadequacy might be because a critical sign is physically located too close to the necessary decision point. Another might be because some characteristic of the sign requires more processing time than is available for a decision. Excessive processing time can be caused by an unexpected message, message format, or sign location. It can also be caused by information overload, or too many signs. There also exists a state dependent problem caused by temporary obscuration of a sign by traffic (large trucks), or other obstacles.

Inconsistencies in the use and placement of route, placement, and directional information can increase processing time.

A subtle form of temporal inadequacy exists when there is a lack of confirmation of a correct choice after a decision point. Reinforcing or pull through signing can reduce uncertainty about choices that have already been made.

Misleading Information - Guide signs can present information that is misinterpreted by the motorist. The process of lane assignment is one that can cause such misinterpretation. If lane designation does not match the geometry of the roadway, incorrect driver action can result. The designation of optional through and exit lanes also lends itself to misinterpretation.

**Remediation.** Remedial techniques follow directly from the problems diagnosed, that is to say, guide signs should be present and provide information, the information presented should be visually and temporally adequate and should not mislead. Indeed, for some failures no additional criteria are needed. If, for example, a sign or sign message is not present in the system, then the solution is to install a sign or present a message. This solution, of course, must be tempered with reason and should be consistent with policy. It is neither necessary nor desirable to sign for every destination or attraction.

Failures that involve visually inadequate messages should also be easily remedied. If the useful life of the reflective sheeting has been exceeded, it should be replaced. If the alpha numeric characters of the sign are too small then their size should be brought into compliance with the manual (MUTCD). If there is a glare or visual clutter problem, the sign can be reoriented, or the size of the sign background can be increased.

Remediation techniques for guide signs that do not provide information at the right time or that mislead may be as subtle as the failures themselves and, consequently, require more detailed discussion.

If needed information is available and visually adequate, then it must be received at the right time and not mislead the motorist. If the needed information is received in a timely fashion, and correctly interpreted, the motorist will be in the appropriate lane at the decision point. Consequently, lane assignment is a characteristic of guide signs that is salient.

Lane Assignment - Lane assignment information is presently being conveyed using a variety of techniques, symbols, and colors. Lane assignment is currently made using white down arrows, black down arrows with a written message on a yellow panel, a written message on a yellow panel, and various combinations of these techniques. It is also made using white on green written messages such as, "next right" and can be implied by using no written or symbolic message at all. Although there is movement underway to standardize the presentation of this information, it is still not clear what the motorists' interpretations will be. By way of general guidance the following suggestions are made.

Lane assignment arrows on signs should be equal to the number of lanes on the freeway. This problem usually occurs at bifurcations or forks where one lane is used as an optional lane for either leg. The difficulty arises from signing for the lane geometry after the fork using a sign located at or before the fork. One solution might be to move the lane assignment information to a position in advance of the fork. This solution does not allow for designation of an optional lane. An alternative that holds some promise is the use of a supplemental diagrammatic or modified diagrammatic sign at the choice point because it describes the appropriate number of lanes and the option as well.

Lane assignments should be made as soon as possible prior to the decision point and assignment arrows should be on all signs referring to the same exit. Spatial separation and proper clustering of information should be maintained on signs that assign lanes for complex or unusual route divisions. Spatial association between path arrows and geometry should also be maintained.

**Considerations for Future Research.** The limited study of alternative methods for conveying lane assignment undertaken as part of this study provided useful insight about the problems drivers were having with this type of information. It also generated a number of questions that should be addressed in future studies. A few of these questions are presented below:

1. What is the legibility distance of conventional, diagrammatic and modified diagrammatic lane assignment displays?



2. Will sign placement over the freeway travel lanes affect the understanding of diagrammatic type signs?
3. What method of grouping information on diagrammatic signs produces maximum understanding and minimum comprehension time?
4. Can verbal messages be used to enhance understanding of lane assignment?
5. How much advance warning is needed for left hand exits, complex geometric situations, bifurcations, etc.?



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## APPENDICES



**APPENDIX A**

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NEWSPAPER ADVERTISEMENT



***Having trouble  
reading our signs?***

We try our best to inform motorists through our sign system, but sometimes it just doesn't work. What seems perfectly logical on the drafting table may be confusing to the person behind the wheel.

If you've experienced such a problem, we'd like to know. We're currently conducting a study to locate such problem areas, but we need your input. Give us a call at 409/845-9902. You don't even need to give your name.



**State Department of Highways and Public Transportation.**

APPENDIX A.2

GROUP PRESENTATION SURVEY FORM

Date: \_\_\_\_\_ Location Opinion Taken: \_\_\_\_\_ Recorder: \_\_\_\_\_

**HAVING TROUBLE READING OUR SIGNS?** The Highway Department tries their best to inform motorists through their sign system, but sometimes it just doesn't work. What seems perfectly logical on the drafting table may be confusing to the person behind the wheel. If you've experienced such a problem, we'd like to know. Please describe in detail where you've experienced such a problem.

City where you became lost or confused: \_\_\_\_\_ Time of day: \_\_\_\_\_

Highway/Freeway: \_\_\_\_\_ Direction traveling: \_\_\_\_\_

Where you were coming from: \_\_\_\_\_ Destination: \_\_\_\_\_

Narrative description of problem area: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Was there construction in the area that contributed to the problem?  
\_\_\_\_\_ yes \_\_\_\_\_ no \_\_\_\_\_ not sure

What happened at this problem area? For example, did you get lost or confused? Did you have to turn around or ask for directions, etc.? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

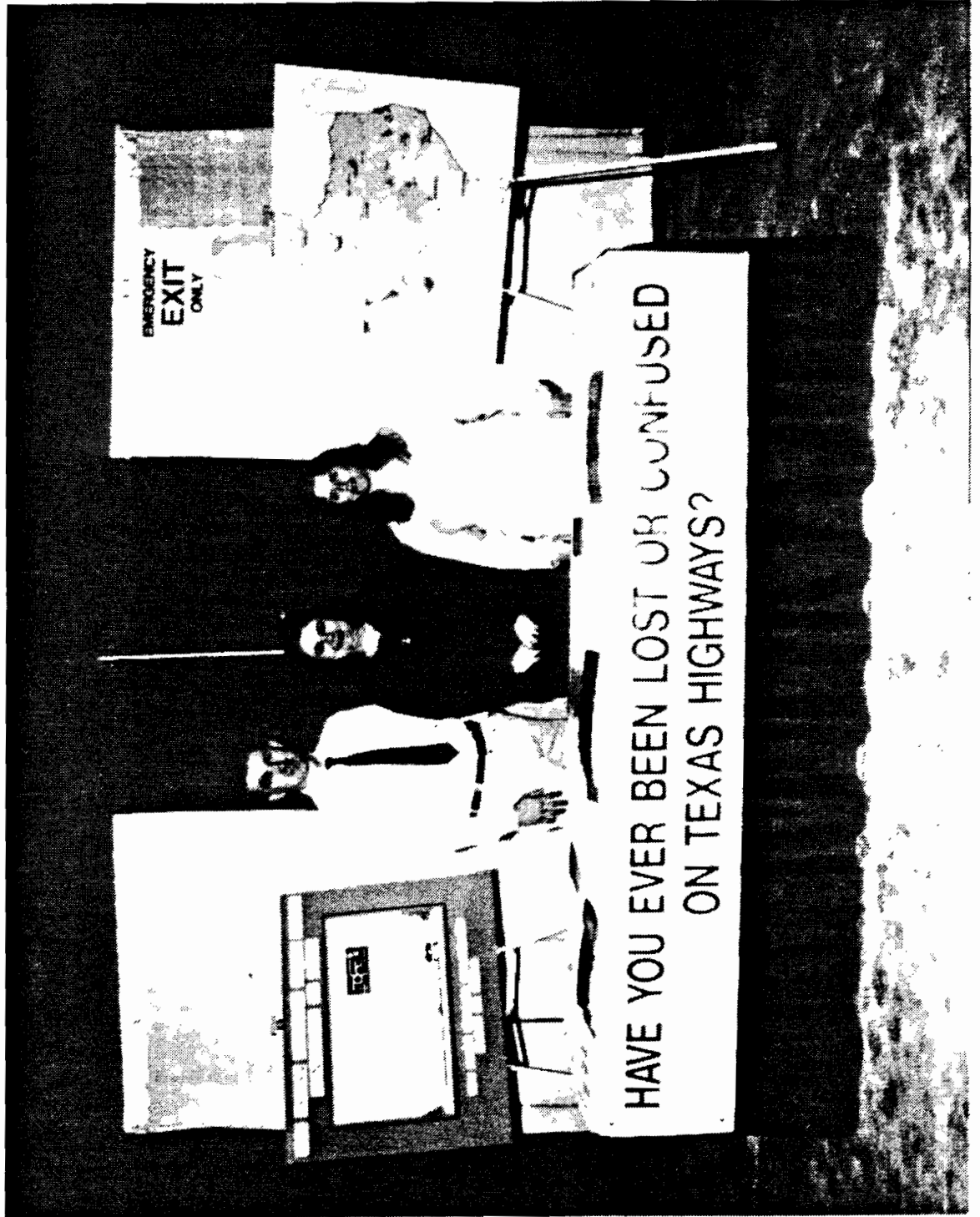
Suggestions that could help alleviate this problem area: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

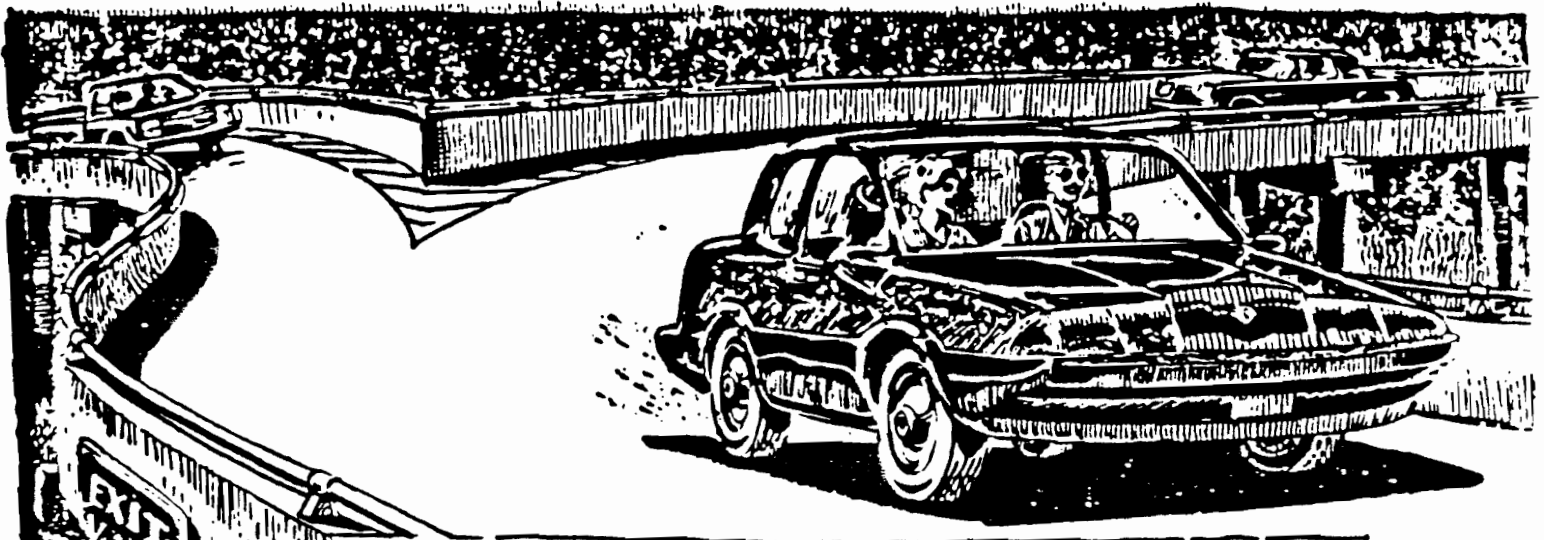
May we call you if we have any questions? No \_\_\_\_\_ Yes \_\_\_\_\_  
If yes, Name: \_\_\_\_\_ Phone: \_\_\_\_\_

APPENDIX A.3

INTERVIEW DISPLAY AREA



TEXAS HIGHWAYS MAGAZINE SURVEY FORM



Dear TEXAS HIGHWAYS Subscriber . . .

Because you are known to travel more than most people, you have been selected to provide your valuable opinion about driving on urban freeways in Texas.

Have you ever missed a freeway exit because a sign was not clear or because you were in the wrong lane? Ever wondered whether you were on the right freeway after a fork in the road? Ever become hopelessly lost in a maze of unfamiliar freeways?

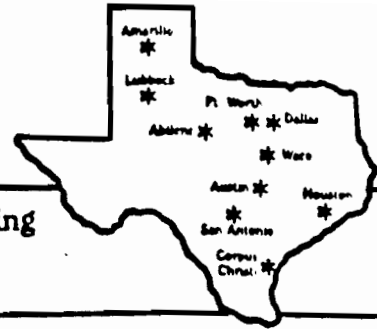
These, and other troublesome things have happened to us all.

Your answers to a few questions on the next two pages will be used by decision makers in the highway department. They want to make it easier for you to get where you're going on urban freeways. YOUR answers are important, especially since only a few select TEXAS HIGHWAYS subscribers are being asked to respond to these questions.

Your response will be completely anonymous—so don't include your name. You can sound off all your frustrations about urban freeways at the highway department!

Just fill out your answers on the next two pages, fold this up, and seal it so that the postage-free address shows on the outside.

**PART I**



If you have been lost, confused, or inconvenienced by misleading guide signs in any of these cities, please continue.

If you have never been lost, confused, inconvenienced, or had any problems with guide signs in any of the above cities, check here, \_\_\_\_\_ and continue to PART II.

In which city were you lost, confused, or inconvenienced? \_\_\_\_\_  
(Note: If more than one problem occurred, describe the most recent occurrence and feel free to enclose an additional sheet to describe others.)

Highway/Freeway you were traveling on: \_\_\_\_\_ Destination: \_\_\_\_\_

Direction you were traveling: \_\_\_\_\_

Describe in as much detail as possible where and how you got lost or confused. Use highway numbers where they apply.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

What happened after you got lost or confused at this location? For example, did you have to turn around, ask for directions, stop and consult a map, etc.?

\_\_\_\_\_  
\_\_\_\_\_

Was there construction in the area that contributed to the problem?

\_\_\_ yes    \_\_\_ no    \_\_\_ not sure

How often have you traveled in the city where you were lost?

\_\_\_ once  
\_\_\_ occasionally  
\_\_\_ often  
\_\_\_ city where I live

What suggestions would you make that might solve this problem?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## PART II

For comparison purposes, we would like to know something about you and your driving experience. Your answers will be kept confidential.

<p><b>How many years have you been driving?</b></p> <p><input type="checkbox"/> less than 1 year</p> <p><input type="checkbox"/> 1-5 years</p> <p><input type="checkbox"/> more than 5 years</p> <hr/> <p><b>Into which ethnic group do you classify yourself?</b></p> <p><input type="checkbox"/> Anglo</p> <p><input type="checkbox"/> Black</p> <p><input type="checkbox"/> Hispanic</p> <p><input type="checkbox"/> Other</p> <hr/> <p><b>What is the highest level of education you completed?</b></p> <p><input type="checkbox"/> less than high school</p> <p><input type="checkbox"/> high school or equivalent</p> <p><input type="checkbox"/> some college</p> <p><input type="checkbox"/> college degree(s)</p> <hr/> <p><b>What is your age?</b></p> <p><input type="checkbox"/> less than 25</p> <p><input type="checkbox"/> 25 to 55</p> <p><input type="checkbox"/> over 55</p> <hr/> <p><b>Are you:</b></p> <p><input type="checkbox"/> male</p> <p><input type="checkbox"/> female</p>	<p><b>Do you have any other comments about Texas' freeways or highways?</b></p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>
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Thank you for participating in this project.

**APPENDIX A.5**

**DISTRICT 2 (FT. WORTH) CRITICAL SITE LOCATIONS**

<u>PUBLIC</u>	<u>SDHPT</u>	<u>LOCATION</u>
4		IH-35 W NB to US-287 NB
3		IH-35 W SB to IH-30 EB
2		IH-35 W SB to US-287 SB
2		IH-35 W NB to IH-20 WB
2		IH-35 W NB to IH-30 EB
1		IH-20 EB to IH-35 W NB
1		IH-20 EB to IH-820 (SL) EB
1		IH-20 EB to SH-183 NB
1		IH-20 WB to IH-35 W NB
1		IH-20 WB to IH-820 (EL) NB
1		IH-20 WB to SH-183
1		IH-30 EB to Camp Bowie NB
1		IH-30 EB to University
1		IH-30 WB to IH-35W NB
1		IH-30 WB to IH-820 (EL) NB
1		IH-30 WB to Lamar Blvd.
1		IH-30 WB to Mix-master WB
1		IH-30 WB to University
1		IH-30 (Cont) EB @ IH-35 W
1		IH-30 (Cont) WB @ IH-35 W
1		IH-30 WB to IH-820 NB
1		IH-35 W NB to IH-820 (NL) EB
1		IH-35 W SB to Berry Street
1		IH-35 W SB to IH-30 WB
1		IH-35 W SB to IH-820 (NL) EB
1		IH-35 W SB to IH-820 (NL) WB
1		IH-35 W SB to IH-820 (SL) WB
1		IH-35 W (Cont) SB @ IH-30
1		IH-35 W (Cont) SB @ IH-820 (NL)
1		IH-820 (EL) NB to SH-26 EB
1		IH-820 (EL) SB to IH-30 WB
1		IH-820/20 EB to IH-820 (EL) NB
1		SH-121 SB to IH-35 W SB
1		US-287 (Cont) SB @ IH-30
1		University SB to IH-30 EB
	D	IH-20 EB to SH-157 SB
	D	IH-35W NB to IH-820 (NL) WB
	D	IH-35W NB to IH-30 WB
	D	IH-35W NB to SH-121
	D	IH-35W SB to SH-121

## DISTRICT 4 (AMARILLO) CRITICAL SITE LOCATIONS

<u>PUBLIC</u>	<u>SDHPT</u>	<u>LOCATION</u>
1		IH-40 WB to IH-27 SB
1		IH-40 WB (Cont) at IH-27 SB
	D	IH-40 EB to IH-27 SB
	D	US-87 SB to IH-40 WB
	D	US-87 SB to IH-40 EB
		IH-40 EB to Airport
		IH-40 WB to Airport
		US-60 EB to Airport
		US-60 WB to Airport



## DISTRICT 5 (LUBBOCK) CRITICAL SITE LOCATIONS

<u>PUBLIC</u>	<u>SDHPT</u>	<u>LOCATION</u>
1		US-82 NB to US-84 SB
1		US-82 NB to IH-27 NB
1		Spur 331 NB to Loop 289 (EL) NB
1		US-84 WB to Loop 289 (SL) WB
1		IH-27 SB to Loop 289 EB
1		US-84 NB (Cont) at Traffic Circle
	D	Loop 289 (WL) NB to 19th ST.WB
		Loop 289 (NL) EB to Airport
		Loop 289 (NL) WB to Airport
		IH-27 SB to Airport
		IH-27 NB to Airport

## DISTRICT 8 (ABILENE) CRITICAL SITE LOCATIONS

<u>PUBLIC</u>	<u>SDHPT</u>	<u>LOCATION</u>
1		US-83/84 NB to Loop 322 EB
1		US-83/84 NB to IH-20
1		IH-20 EB to SH-36 SB
		US-83/84 NB to Airport
		SH-36 NB to Airport
		IH-20 WB to Airport
		IH-20 EB to Airport
		S-83/84 SB to Airport

## DISTRICT 9 (WACO) CRITICAL SITE LOCATIONS

<u>PUBLIC</u>	<u>SDHPT</u>	<u>LOCATION</u>
4		SH-6 (NL) NB to IH-35 NB
3		IH-35 SB to SH-6 (NL) SB
3		IH-35 SB to US-77 (circle) SB
2		IH-35 SB to SH-6 EB
1		IH-35 NB to Loop 340 (SL) WB
1		IH-35 NB to Loop 340 (SL) EB
1		IH-35 NB to SH-31 EB
1		IH-35 NB to SH-31 NB
1		IH-35 NB to SH-6 (NL) EB
1		IH-35 NB to US-77 EB
1		IH-35 SB to Loop 340 (SL) WB
1		Loop 340 (NL) NB to SH-31/US-84 NB
1		SH-6 (NL) NB to BR-77 NB
1		SH-6 (NL) NB to Loop 340 (EL) SB
1		SH-6 (SL) NB to US-84 NB
1		SH-6 NB to IH-35 NB
1		SH-6 WB to IH-35 NB
1		US-77 NB to IH-35 NB
1		US-77 SB to Loop 340 (SL) NB
1		US-84 NB to SH-31 NB
1		US-84 SB to SH-6 (SL) EB

## DISTRICT 12 (HOUSTON) CRITICAL SITE LOCATIONS

<u>PUBLIC</u>	<u>SDHPT</u>	<u>LOCATION</u>
12	D	IH-10 EB to IH-45 SB
12		US-59 NB (Cont) at IH-45 NB
11		IH-45 SB to IH-610 (SL) WB
7	D	US-290 SB to IH-610 (WL) SB
7	D	SH-288 NB to US-59 NB
7	D	IH-45 NB to IH-610 (SL) WB
6		IH-10 WB to IH-45 NB
6		IH-10 WB to US-59 SB
5		IH-45 SB to IH-610 (NL) WB
4		IH-610 (WL) SB to US-59 NB
4		US-290 SB to IH-610 (NL) EB
4		IH-10 WB to IH-45 SB
4		IH-45 NB to Belt 8 (NB) EB
4		IH-45 NB to Belt 8 (NB) WB
4		IH-610 (WL) SB to US-59 SB
4		US-59 NB (Cont) at IH-10 WB
3		IH-45 SB to US-59 SB
3		IH-10 EB (Cont) at IH-45
3	D	IH-10 EB to IH-610 (WL) SB
3		IH-610 (NL) EB to IH-45 NB
3		IH-10 WB to IH-610 (EL) NB
3		IH-10 WB to IH-610 (EL) SB
3		IH-45 SB (Cont) at IH-10 EB
3		US-59 NB to IH-10 EB
3		US-59 SB to IH-610 (NL) EB
3		US-59 SB to IH-610 (NL) WB
3		US-59 SB to IH-610 (WL) SB
2		IH-45 SB to Belt 8 (NB) EB
2		IH-45 SB to SH-288 SB
2	D	IH-45 SB to US-59 NB
2		IH-45 SB (Cont) at US-59 SB
2		IH-610 (EL) SB to SH-225 EB
2	D	US-59 NB to IH-610 (WL) NB
2		IH-45 NB to IH-10 WB
2		IH-45 NB (Cont) at IH-10 WB
2	D	IH-10 EB to US-59 NB
2		IH-10 EB to US-59 SB
2		IH-10 WB to Belt 8 (WB)
2		IH-10 WB to IH-610 (WL) SB
2		IH-10 WB to SH-6
2		IH-45 NB to Greens Road
2		IH-45 SB to Hobby Airport
2		IH-45 SB to NASA Rd. 1 EB

## DISTRICT 12 (HOUSTON) CRITICAL SITE LOCATIONS

<u>PUBLIC</u>	<u>SDHPT</u>	<u>LOCATION</u>
2		IH-610 (WL) SB to IH-10 WB
2		US-59 SB to Belford NB
2		US-59 SB to SH-288 SB
2		IH-610 WB (Cont) at IH-45
2		SH-225 WB to IH-610 (EL) NB
2		SH-288 NB to IH-610 (SL) EB
1		SH-6 WB to US-290 WB
1		IH-45 NB to US-59 NB
1		IH-45 SB to IH-610 (SL) WB
1		IH-45 NB (Cont) at US-59 NB
1	D	IH-45 NB to IH-610 (NL) WB
1		IH-45 NB to US-59 SB
1		IH-45 SB (Cont) at SH-288 SB
1		IH-610 SB (Cont) at SH-225 EB
1	D	IH-10 EB to IH-45 NB
1	D	US-59 NB to IH-610 (WL) SB
1		US-59 NB (Cont) at IH-610 (WL) SB
1	D	IH-610 SB (Cont) at S.Post Oak SB
1	D	IH-610 (SL) WB to Post Oak SB
1		IH-45 NB (Cont) at IH-610 (SL) WB
1		IH-45 NB to Airline
1	D	SH-288 NB to US-59 SB
1	D	US-59 NB to IH-45 NB
1		IH-10 EB (Cont) at US-59 NB
1	D	IH-610 (NL) WB to US-290 WB
1		IH-610 WB (Cont) to US-290 WB
1	D	IH-610 (EL) NB to SH-225 EB
1		Allen Pkwy. EB to IH-45 NB
1		Belt 8 (NB) EB to IH-45 NB
1		Belt 8 (NB) WB to Hardy Toll R SB
1		FM-1960 EB to Hardy Toll R SB
1		FM-1960 WB to FM-149, 249 NB
1		Hardy Toll R NB to Belt 8 (NB)
1		Hardy Toll R SB to IH-610 (NL) WB
1		Holcombe WB to SH-288 NB
1		IH-10 EB to Belt 8 (WB)
1		IH-10 EB to SH-6 NB
1		IH-10 WB to Belt 8 (EB) NB
1		IH-10 WB to IH-610 (WL) NB
1		IH-10 WB to US-59 NB

## DISTRICT 12 (HOUSTON) CRITICAL SITE LOCATIONS

<u>PUBLIC</u>	<u>SDHPT</u>	<u>LOCATION</u>
1		IH-10 WB (Cont) at IH-610(WL)NB
1		IH-10 WB (Cont) at US-59 NB
1		IH-10 WB (Cont) at US-59 SB
1		IH-45 NB to Airport Int.
1		IH-45 NB to Alameda-G.ex WB
1		IH-45 NB to Aldine-Bende WB
1		IH-45 NB to Allen Pkwy
1		IH-45 NB to Scott Street
1		IH-45 NB to Tidwell
1		IH-45 NB to US-90 WB
1		IH-45 SB to Allen Pkwy.
1		IH-45 SB to Hardy Toll R
1		IH-45 SB to IH-10 EB
1		IH-45 SB to IH-610 (SL) EB
1		IH-45 SB to Main Street
1		IH-45 SB to Milam Stree
1		IH-45 SB to SH-35 SB
1		IH-45 SB to U of H exit UH
1		IH-610 (EL) NB to IH-10 EB
1		IH-610 (NL) EB to Steller Link SB
1		IH-610 (NL) WB to Hardy Toll R NB
1		IH-610 (NL) WB to IH-45 NB
1		IH-610 (NL) WB to IH-45 SB
1		IH-610 (SL) EB to IH-45 SB
1		IH-610 (SL) WB to Alt-90 SB
1		IH-610 (SL) WB to Broadway Blv
1		IH-610 (SL) WB to SH-288 SB
1		IH-610 (WL) NB to Beachnut
1		IH-610 (WL) NB to Bellaire Blv
1		IH-610 (WL) NB to IH-10 EB
1		IH-610 (WL) NB to IH-10 WB
1		IH-610 (WL) SB to Braeswood
1		IH-610 (WL) SB to IH-10 EB
1		IH-610 NB (Cont) at US-290 NB
1		JF Kennedy Bl SB to Belt 8 (NB) WB
1		Roosevelt St to IH-10 EB
1		S.Post Oak SB to W.Bellfort WB
1		SH-288 NB to Old Spanish
1		SH-521 NB to IH-610 (SL) EB
1		SH-6 NB to FM-1960 NB
1		SH-6 NB to US-290 NB
1		San Jacinto SB to US-59 SB
1		Shepard St. WB to IH-45 NB

## DISTRICT 12 (HOUSTON) CRITICAL SITE LOCATIONS

<u>PUBLIC</u>	<u>SDHPT</u>	<u>LOCATION</u>
1		US-290 NB to Antoine Dr.
1		US-290 SB to SH-6 SB
1		US-59 NB to Airport
1		US-59 NB to Hardy Toll R NB
1		US-59 NB to IH-610 (NL) EB
1		US-59 NB to IH-610 (NL) WB
1		US-59 NB to Main Street
1		US-59 NB to Richman Exit
1		US-59 NB to SH-288 SB
1		US-59 SB to Chimney Rock
1		US-59 SB to IH-10 WB
1		US-59 SB to IH-45 SB
1		US-59 SB to IH-610 (WL) NB
1		US-59 SB to Wilcrest
1		US-59 SB (Cont) at SH-288 SB
		IH-45 SB (Cont) at US-59 SB
	D	IH-610 (NL) EB to IH-45 SB
	D	IH-45 NB to IH-610 (SL) EB

## DISTRICT 14 (AUSTIN) CRITICAL SITE LOCATIONS

<u>PUBLIC</u>	<u>SDHPT</u>	<u>LOCATION</u>
8		IH-35 SB @level split SB
5		US-290 WB to IH-35 SB
2		IH-35 NB to AIRPORT
2		IH-35 NB @level split NB
2		IH-35 NB to 26th Street WB
2		IH-35 SB to Riverside Dr EB
1		Airport Blvd SB to Austin airport
1		Austin Airport to Airport Blvd NB
1		IH-35 NB to Yager Lane
1		IH-35 NB to 6th Street WB
1		IH-35 SB to 11th Street
1		IH-35 SB to Airport Blvd
1		IH-35 SB to SH-71 EB
1		IH-35 SB to US-290 EB
1		IH-35 SB to US-183 WB
1		Loop 1 Mopac NB to Anderson Blv
1	D	Loop 1 Mopac SB to Bull Creek WB
1		Loop 360 NB to RM-2222
1		Loop 360 SB to US-290 EB
1		Loop 360 SB to Lamar Blvd. NB
1		Loop 360 SB to Loop 1 Mopac SB
1		Loop 360 SB to SH-71 WB
1		SH-71 WB to Loop 1 Mopac NB
1		SH-71 WB to IH-35 SB
1		SH-71 (Cont) EB @ Loop 360 EB
1		Spur 343 SB to SH-71 WB
1		US-183 NB to Anderson Ln.
1		US-183 NB to IH-35 NB
1		US-183 NB to US-290 NB
1		US-183 NB to Loop 1 Mopac SB
1		US-290 EB to IH-35 SB
1		US-290 WB to Airport Blvd
1		US-290 WB to IH-35 NB
1		US-290 WB to Loop 1 Mopac NB
1		US-290 WB to SH-71 NB
1		US-290 WB to SH-360 WB
1		US-290 (Cont) WB @ IH-35 SB
1		US-290/SH-71 WB to US-290 WB



## DISTRICT 15 (SAN ANTONIO) CRITICAL SITE LOCATIONS

<u>PUBLIC</u>	<u>SDHPT</u>	<u>LOCATION</u>
7		IH-10 (Cont) WB @ US-90 WB
5		IH-35 SB to IH-410 (NL) WB
3		IH-10 EB to IH-37 SB
3		IH-37 NB to IH-410 (SL) EB
2		Downtown to IH-10 WB
2		IH-10 WB to IH-35 SB
2		IH-10 WB to IH-410 (EL) NB
2		IH-35 SB to IH-37 SB
2		IH-37 NB to IH-10 WB
2		IH-37 NB to IH-410 (EL) NB
2		IH-410 (EL) NB to IH-35 NB
2		IH-410 (EL) SB to IH-10 EB
2		US-281 NB to IH-410 (NL) WB
2		US-90 EB to IH-35 NB
1		US-281 SB to US-81 SB
1		IH-10 (Cont) WB @ IH-35 NB
1		IH-10 (Cont) WB @ IH-35/37
1		IH-10 EB to Holiday Inn
1		Downtown to IH-10 EB
1		FM-151 WB to Sea World
1		FM-471 WB to Loop 1604 NB
1		IH-10 WB to IH-35 NB
1		IH-10 WB to IH-35/37 NB
1		IH-10 WB to IH-37 SB
1		IH-10 WB to IH-410 (EL) SB
1		IH-10 WB to IH-410 (NL) WB
1		IH-10 WB to US-90 WB
1		IH-10 WB to Wurzbach Rd.
1		IH-10 (Cont) EB @ IH-35 SB
1		IH-10 (Cont) EB @ US-90 EB
1		IH-10 (Cont) WB @ IH-35 SB
1		IH-10 (Cont) WB @ IH-35/US-90
1		IH-10 (Cont) WB @ Loop 536
1		IH-35 NB to Commerce
1		IH-35 NB to IH-410 (SL) EB
1		IH-35 NB to US-87/IH-10 NB
1		IH-35 SB to IH-10 EB
1		IH-35 SB to Loop 1604 WB
1		IH-35 SB to US-90 WB
1		IH-35 (Cont) WB @ IH-37 SB
1		IH-35/410 SB to IH-410 (EL) SB
1		IH-37 NB to IH-35 NB
1		IH-37 NB to Old Austin R

**DISTRICT 15 (SAN ANTONIO) CRITICAL SITE LOCATIONS**

<u>PUBLIC</u>	<u>SDHPT</u>	<u>LOCATION</u>
1		IH-37 NB TO San Pedro
1		IH-37 SB TO IH-410 (SL) EB
1		IH-410 NB to Wurzbach Rd.
1		IH-410 WB to Seaworld
1		IH-410 (EL) NB TO IH-410 (NL) WB
1	D	IH-410 (EL) SB to IH-37 SB
1		IH-410 (NL) EB to US-281 SB
1		IH-410 (NL) EB to Whitmore
1		IH-410 (NL) WB to Cullaghan
1		IH-410 (NL) WB to SH-16 NB
1		IH-410 (NL) WB to Sea World
1		IH-410 (NL) WB to US-281 SB
1		IH-410 (SL) WB to IH-35 SB
1		IH-410 (WL) NB to US-90 EB
1		IH-410 (Cont) NB @ Austin Hwy SB
1		IH-410 (Cont) NB @ IH-35 (NL) NB
1		IH-410 (Cont) WB @ Austin Hwy SB
1		US-281 NB to IH-410 (SL) EB
1		US-281 SB to IH-410 (NL)
1		US-81 WB to IH-35/37 SB
1		US-90 EB to IH-410 (WL) NB
	D	IH-410 (EL) SB to IH-37 NB
	D	IH-410 (SL) EB to IH-37 SB
	D	IH-410 (SL) EB to IH-37 NB

**DISTRICT 16 (CORPUS CHRISTI) CRITICAL SITE LOCATIONS**

<u>PUBLIC</u>	<u>SDHPT</u>	<u>LOCATION</u>
4		SH-286 NB to US-181/SH-35 NB
2	D	IH-37 SB to Shoreline SB
1		US-181 SB to IH-37 NB
1		SH-286 NB to IH-37 NB
1		SH-286 NB to Shoreline SB
1		SH-358 WB to SH-286 SB
1		US-77 SB to IH-37 SB
1		IH-37 NB to US-77 NB
1		IH-37 NB to US-77 SB
1		IH-37 SB to US-77 SB
1		IH-37 (Cont) SB @ US-77 SB
1		SH-358 NB to FM-44(Agnes) WB
1		SH-44 WB to Airport
	D	US-181 SB to Shoreline SB
	D	IH-37 SB to SH-286 SB

## DISTRICT 18 (DALLAS) CRITICAL SITE LOCATIONS

<u>PUBLIC</u>	<u>SDHPT</u>	<u>LOCATION</u>
9		IH-35E NB to US-75 NB
9		IH-45 NB to US-75 NB
7		IH-35E SB (Cont) at IH-30
6		IH-45 NB to IH-635 (SL) WB
6	D	IH-45 NB to IH-35E NB
5		IH-35E SB to IH-45 SB
5		IH-30 EB to IH-45 SB
4	D	IH-35E NB to IH-30 EB
4		IH-35E NB (Cont) at IH-30
4		US-75 SB to IH-45 SB
4		US-75 SB to IH-35E SB
4		IH-45 NB (Cont) at Business-75
3		IH-30 WB to IH-45 SB
3	D	IH-30 WB to IH-35E NB
3		IH-45 NB to IH-30 WB
2		IH-35E SB to IH-30 WB
2		IH-30 EB to US-75 NB
2		IH-635 (NL) WB to IH-35E NB
2	D	IH-635 (NL) EB to US-75 NB
2	D	IH-20 WB to US-80 WB
2	D	IH-35E SB to IH-30 EB
2		IH-45 NB (Cont) at IH-635 (SL) EB + WB
2		IH-35E NB to IH-635 (SL) EB
2		IH-20 WB to IH-35E NB
1		IH-20 WB to IH-35E SB
1		IH-635 (NL) WB to SH-121 SB
1	D	IH-35E NB to IH-635 (NL) WB
1		IH-635 (NL) EB to US-75 SB
1	D	IH-30 WB to US-75 NB
1		IH-30 WB (Cont) at IH-35E SB
1		IH-35E NB (Cont) at US-80 EB
1		IH-635 (EL) SB to US-80 WB
1		IH-20 WB to IH-635 (EL) NB
1		IH-35E SB to Reunion Exit
1		IH-30 WB to IH-35E SB
1		Spur-366 WB to IH-35E SB
1		IH-35E NB to Loop 12 (SL) EB
1		IH-45 NB to IH-635 (SL) EB
1		IH-635 WB (Cont) at US-75 NB
1		US-75 SB (Cont) at IH-635 (NL)
1	D	IH-30 EB to IH-35E SB

## DISTRICT 18 (DALLAS) CRITICAL SITE LOCATIONS

<u>PUBLIC</u>	<u>SDHPT</u>	<u>LOCATION</u>
1		IH-30 EB (Cont) at IH-35E
1	D	IH-35E NB to IH-30 WB
1		IH-35E NB to Commerce St.
1		IH-35E NB to NorthTollway NB
1		Haskell Ave. SB to IH-30 WB
1		IH-20 WB to IH-45 SB
1		IH-20 WB to SH-408 NB
1		IH-20 EB to IH-635 (EL) NB
1		IH-30 EB to US-175 SB
1		IH-30 WB to US-175 SB
1		IH-30 WB (Cont) at Loop 260 WB
1		IH-30 EB to Loop 12 SB
1		IH-35E NB to Mockingbird EB
1		IH-35E NB to SH-356 WB
1		IH-35E NB to IH-30 WB
1		IH-45 NB to IH-30 EB
1		IH-45 SB to IH-30 WB
1		IH-45 SB to US-175 SB
1		IH-45 NB to IH-20 WB
1		IH-635 (EL) NB to IH-20 EB
1		IH-635 (NL) EB to Coit Road NB
1		IH-635 (NL) EB to Forest Lane
1		IH-635 (NL) EB to N. Tollway SB
1		IH-635 (NL) WB to N. Tollway NB
1		IH-635 EB to Dal. Tollway NB
1		IH-635 WB to SH-121 SB
1		IH-635 (SL) WB to IH-35 E SB
1		SH-183 EB to Belt Line Rd
1		SH-183 EB to SH-114 WB
1		US-75 NB to IH-635 (NL) WB
	D	IH-35E NB to SH-183 WB
	D	IH-635 (NL) WB to US-75 SB
	D	IH-635 (NL) WB to IH-35E SB
	D	IH-635 (NL) EB to IH-35E NB
	D	IH-35E NB to CADIZ ST.
	D	IH-30 EB to US-80 WB
	D	IH-30 WB to ERVAY ST.
	D	IH-30 EB to LAMAR ST.
	D	SPUR-366 WB to IH-35E NB



**APPENDIX B**

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## APPENDIX B.1

### CATEGORIES OF DRIVER COMPLAINTS

#### 1. Unexpected Left Lane Exits

- 12 An unexpected left lane entrance before the loop
- 44 Unexpected left lane exit and missed it
- 69 Unexpected lefthand exit
- 70 Left lane exit at a right curve in the road
- 111 Unexpected left lane exit (4 occurrences)
- 147 AIRPORT - need notification of a left lane exit
- 190 There were not enough signs informing the motorist of the left lane exit
- 203 A single lane, left lane exit with not enough advanced warning
- 210 An unexpected left lane exit with a queue of traffic
- 211 Not enough warning for the left lane exit

#### 2. Restricted Sight Distances, Visibility Issues

- 21 Circular intersection is confusing and difficult to see signs
- 51 The exit sign is not distinct enough to notice
- 103 Vertical curves obstruct view of sign (Likely a traffic engineering comment) (3)
- 109 Overhead signs too high to see
- 165 The exit sign was hidden from view

#### 3. Geometric Problems

- 81 Cannot get over in time because the feeder road merges too close to the exit.
- 95 Wanted to stay on I-60 (SL) but ended up on Post Oak because the road narrows and the right side must exit.
- 99 Going from I-610 WB to S. Post Oak SB (left lane exit) to W. Bellfort WB (right lane exit). You must cross two lanes of traffic of Post Oak to exit.
- 167 You have to go north before you are able to turn around and go south on US-281 in San Antonio.

#### 4. Lack of Information Continuity

- 72 The sign at the exit says "Victoria" and nothing about US-59 SB (3 occur)
- 138 Map says "Research Blvd."; sign only say US-183; driver missed it.
- 144 Not enough signs that tell you that Lamar Blvd. turns into SH-71
- 141 Driver did not know that Ben White Blvd. was also US-290. He thought he had gotten off US-290.
- 207 (Regarding I-45 and US-75) Signing does not explain that the two roads are the same (4 occur)

- 218 No sign stating US-75 (Same as 207 in the opposite direction)
- 91 Exit is labeled "downtown." This is confusing.
- 19 Exit sign states the cities but not the road name (Should give both)

**5. Lack of Advanced Information**

- 1 Entering Fort Worth from west on I-20. Many exits do not have enough warning (Specifically, SH-183).
- 2 Exit is too soon after the sign
- 16 Not enough advanced warning
- 30 Same
- 36 Not enough time to get in proper lane to exit.
- 38 Same
- 41,42 (4 occur) After exiting I-10, I-610 splits immediately to N and S. Not enough signing to tell you which lane goes N or S. Ended up in wrong direction. (Advanced signing cries for diagrammatics).
- 45 Not enough advanced warning to react
- 50 AIRPORT - not enough warning to make the exit to the airport.
- 48 Wanted to stay on I-10WB but ended up on US-59 NB because not enough warning of the exit only lanes (Note: This could also be in lane assignments).
- 56 Sign was too close to the interchange to get in proper lane.
- 58 Exit sign too close to the split to get in the proper lane.
- 59 Exit near previous exit. Difficult to get in proper lane.
- 63 Not enough time to get into proper lane to exit.
- 79 Not enough advance warning to exit.
- 83 Missed the exit because not enough advanced warning
- 92 Not enough time to cross several lanes of traffic to exit.
- 94 Missed the exit because could not get in the proper lane.
- 118 Not enough time to make lane changes.
- 120 No advanced warning for exits
- 121 No advanced warning of the West Park/Chimney Rock exit
- 125 Not enough advance notice of exits
- 127 Wanted to stay on US-59; not enough advanced warning of the I-45 split. (3 occur)
- 131 Need more warning for the exit before the frontage road merges.
- 133 As the express and under lanes merge there is not enough advanced warning & for the 11th street exit.
- 134 Unaware that I-35 splits into two levels and merges back again.
- 146 Sign not observed far enough prior to the exit
- 169 After exiting I-35 and you are on Loop 410, no warning that US-81 is ahead and you are forced to take US-81.
- 171, 172, 173, 175 (2) - No advance signing to exit.
- 177 No advance signing that US-77 and I-37 split

182 Driver saw no advance warning signs (Vague)  
186 Exit sign was seen too late to react  
191 Signs are at an angle and come up very quickly  
192 No advance notice. Missed exit because could not get in  
the proper lane  
195 No advance warning prior to exit  
194 Missed I-635 exit from I-35E several times. Not enough  
signs.  
196 Exit sign too small and not enough advance notice to get  
over  
199 Sign too close to the exit  
206 Not enough advanced warning in the south loop  
interchange.

#### 6. Incomplete or Missing Information

3 Two exits for I-30, but you don't know which goes east  
and which west.  
4 Not enough signing to inform motorists that US-287  
splits.  
11 Wanted to stay on I-40W to Denver, but got confused and  
ended up on I-27 SB.  
13 Wanted to circle around the city, but ended up in  
downtown.  
14 Signs and directions confusing  
15 Going north on US-84 looking for intersection with I-20.  
Could not find it.  
17 Exit is confusing and driver is not sure which way to go.  
18 Signs are confusing in this area  
20 Missed exit from I-35 to SH-6 several times because did  
not see any signs. (3 occurrences)  
22 No signs indicating where to turn  
23 Looking for SH-6 WB, but sign did not indicate any  
direction.  
25 Signs not clear (4 occurrences) (SH-6 to I-35 NB)  
26 Signs not clear. Exited too soon.  
27 Could not find I-35 exit.  
28 Can turn right or left at interchange and signs do no  
tell which way to go.  
31 Could not find access to I-45  
33 Never saw a sign for Beltway 8.  
53 Two ramps exist, but are not marked well. One goes east;  
the other west.  
60 No airport exit sign was seen at the interchange.  
62 No airport exit sign was seen at the interchange.  
65 Exit is poorly marked and confusing on the frontage road.  
88 The sign on Beechnut overpass does not include Bissonnet  
on the list of streets for the next exit.  
89 Must use Bissonnet exit to get to Bellaire Blvd. and  
Evergreen, but signs do not include the latter.  
126 Signs do not tell you to exit at Bissonnet for Wilcrest  
129 Signs not clear which way to airport at first signal  
after US-290.

- 130 On leaving Austin airport, no direction on how to get to US-183.
- 132 Exits to airport on different levels of I-35N are not clear.
- 135 After exiting to Airport Blvd. signs don't tell you which way to go.
- 137 No signs on I-35 giving an exit for SH-71 East.
- 145 Lack of signs for exit (US-183 to Anderson Lane)
- 148 Airport signs unclear as to which exit to take.
- 149 Same as above (3 above)
- 150 Missed Loop 1 from US-290 west.
- 154 No signs tell you that US-90 goes straight and I-10 exits to the north.
- 163 No exit sign seen from I-410 to Wurzbach Rd.
- 174 Difficulty finding the right exit
- 180 Signs did not say how to stay on I-37 SB at interchange with US 77
- 182 Exit is not signed well. Missed it.
- 184 Ended up going south instead of north on I-635 from I-20. Lanes misleading
- 187 Never saw an exit sign for US 75 from I-30
- 188 Too many signs to read; could not find right exit.
- 198 Saw no exit sign from I-35E to I-30
- 213 Ended up on I-35 NB. Wanted westbound. Signs gave cities.
- 214 Wanted to stay on I-35E NB but ended up on US-75. Did not know the rightlane was exit only!
- 216 Did not see any sign for exit from I-45 to SB I-30

## 7. Lane Assignments

- 179 At split, signs say to merge into one lane when two lanes exist.
- 8 Not enough signs to tell you which lane to get into to exit on SH 121.
- 9 Wanted to stay on US 287 SB but signs do not tell you which lane to be in
- 35 Signs do not tell which lane to be in to go from I-10 to I-45 EB. (8 occur)
- 37 They do not tell which lane to be in (I-10 to SH-6 EB)
- 39 Not enough signs to tell which lane to be in to exit (I-10 to I-45 WB) (3 occur)
- 40 The arrow type sign is confusing as to which lane to be in (I-45 from I-10)
- 43 The signs are not clear that 2 lanes go to I-610 NB.
- 55 Not enough warning of which lane to be in (I-45 to I-610 NB) (2 occur)
- 57 The lane assignments are not soon enough (I-45 to US-59)
- 64 The signs are there but they do not give lane assignments (I-45 to I-610)
- 78 Signs do not tell which lane to be in (I-610 to SH-225)
- 84 Signs do not tell you which side of the road the exit is (I-610 to I-45 W)
- 87 The exit sign is over the wrong lane (I-610)
- 93 Could not tell which lane to be in to exit to US-59

96 Wanted to stay on I-610 WB but the lane was not marked as exit only.  
104 Signs for lane assignment are not clear (SH-288 to US-59)  
106 Was not in the correct lane to exit to US-59 and could not get over.  
116 Not sure which lane goes where (US-59 to I-45)  
123 Same as above  
157 Was not able to follow I-10 at US-90 split  
164 Signs not clear as to which lane to be in to exit (I-410 to I-10)  
168 Wanted to continue on I-410 WB but signs do not tell you which lane to be in. Ended up on I-35 NB.  
193 Lane assignments need to be improved (I-35 to I-30)  
204 Not enough signing to direct motorists to the exit (I-45 to I-30)  
155 Wanted to stay on I-10 at the US-90/I-35 intersection but there was not enough signing.  
156 Wanted to stay on I-10W but was confused  
46 Wanted to stay on I-10 but the signing at the intersection was confusing.

## APPENDIX B.2

### SITE ANALYSIS FROM FIELD DATA

#### WACO (DISTRICT 9)

##### SITE 1: SH-6 WB to IH-35 NB

**Problem:** Several complaints indicating unclear signs to IH-35. The exit is a single exit only lane on the right that takes you underneath an elevated freeway interchange. SH-6 WB splits off prior to the first sign indicating IH-35. Once under the freeway, pull thru shields are used to guide motorists to IH-35. The shields may be difficult to see but the driving speeds are low.

**Solution:** The IH-35 shield should be shown on an overhead sign prior to the SH-6 split. It would be difficult to sign any differently under the interchange because of several turns required and the fact that several different routes are being shown.

**Classification:**

##### SITE 2: IH-35 SB to SH-6 EB

**Problem:** Several complaints including unclear signs on IH-35 and lack of guidance after exiting IH-35. The exit is a single, optional right lane exit from three lanes on IH-35. There are three signs on IH-35. The first and third have three route shields and a street name. With this much information, it would be difficult to include a destination city because this exit leads to several different destinations. The second sign is ground mounted and says "Marlin Bryan Next Right". After exiting, the motorist must follow route shields underneath the interstate. The route shields are difficult to spot because several different routes are being signed.

**Solution:**

**Classification:** Missing information (destinations are not given when SH-6 is presented)

##### SITE 3: IH-35 SB to US-77 SB

**Problem:** One complaint for signing on IH-35 and two complaints about the traffic circle after exiting from IH-35. The exit is a single, optional right lane exit from IH-35. The motorist must then follow a city street with trailblazers to a traffic circle. There are three signs on IH-35 for the exit and there does not appear to be any problem. The traffic circle is very confusing. Many route shields, destinations, and directional arrows are presented. Full attention must be given to merging vehicles which makes it impossible to read the signs.

**Solution:** Remove the traffic circle.

**Classification:** Geometric (attention demanding traffic circle)

HOUSTON (DISTRICT 12)

Site P1: IH-45 NB to US-59 NB/SB

**Problem:** Several complaints for exiting and one to continue on IH-45. Complaints include not enough advance warning and advance lane assignment. IH-45 NB is a 4 lane freeway section. US-59 exits from the left with 2 exit only lanes. US-59 NB exits from the right with an optional exit lane. There are three advance signs (the first at 1 1/4 miles) and one exit directional sign.

**Solution:** There is no apparent problem other than lack of lane assignment arrows on the first sign for the left exit. A bridge restricts the sight distance to the third sign.

**Classification:** Geometric - restricted sight distance

Site P2: IH-45 SB to US-59 NB/SB

**Problem:** Several complaints for exiting and continuing on IH-45. IH-45 is a 3 lane freeway section. US-59 NB exits from the left with an optional exit lane. A bridge makes it impossible to have an exit directional sign at the left exit. There currently is only a small route shield with an arrow under the bridge. US-59 exits from the right with 2 lanes; one being an optional exit lane. The advance signs do not indicate this properly.

**Solution:** The geometry is the problem for the left hand exit and signing can definitely be improved for the right exit.

**Classification:**

Geometric - no place to install a sign at the exit  
Lane assignment - inconsistent use of lane assignment arrows  
Misleading information - lane assignment arrows incorrectly used

Site P3 - IH-610 (EL) SB to SH-225 EB

**Problem:** 2 complaints to the exit about lack of advance notice. 1 complaint to continue because the driver was "in the wrong lane". IH-610 is a 5 lane freeway section. SH-225 WB is a right exit with 2 lanes; one being an optional exit lane. There are only two advance signs and one exit directional sign. The first advance sign is ground mounted on the right.

**Solution:** The first advance sign may violate expectancy because of its location on the side of the road.

**Classification:**

Information temporally inadequate-expectancy of sign location

**Site P4 - IH-10 WB to IH-45 NB/SB**

**Problem:** Several complaints with a variety of problems identified. IH-45 NB exits from the left with an exit only lane and a short distance later IH-45 SB exits from the left with an exit only lane. The advance lane assignment arrows do not appear to be centered over the proper lane. The exit direction sign for IH-45 NB is ground mounted on the right. Some of the signs have a sight distance problem.

**Solution:** Several small problems combined appear to cause much confusion.

**Classification:**

Geometric - restricted sight distance

Information temporally inadequate - expectancy of location of sign

Information misleading - down arrows not centered over lane.

**Site 1 - US-290 EB to IH-610 (WL) SB**

**Problem:** Interchange geometry is incompatible with driver expectations. The problem is that the left lanes are for going right (West Loop) and the right lanes are for going left to IH-610 EB. Instead of the expected fork there is a "criss-cross" pattern. The result is that visiting drivers are in the wrong lanes and must make a series of late lane changes.

**Solutions:** The ideal solution is a diagrammatic at least one mile in advance of the interchange with arrows showing the interchange in planned view. Both the route numbers and distant destinations should be given. An interim solution would be at least two advanced overhead signs (one at one mile and another at one-half mile) indicating the appropriate lanes.

**Classification:**

3.a.3 - Geometric expectancy violation

**Site 2 - IH-10 EB to IH-610 (WL) NB**

**Problem:** Misleading arrows for IH-610 and not enough time to change lanes. The left lanes are appropriately signed for IH-10, but the right lanes do not inform the driver as to which lane to be in to take IH-610 North or South once the exit has been made. Within a short distance there is a fork with IH-610 North assigned to the left lane and IH-610 South, the right lane. (However, the driver might expect a "criss-cross" such as Site 1.) From the point where the second sign appears indicating the appropriate lane to be in, the traffic volume may prevent the driver from changing lanes.

**Solution:** The exit sign on IH-10 should indicate not only the IH-610 exit but should also indicate "North" for the left lane and



"South" for the right lane. In addition, another sign a half mile upstream should provide the lane assignments for IH-610 after exiting. Again, the ideal solution would be a diagrammatic depicting the split immediately after the exit. Given this information the NB driver would not likely be in the extreme right lane.

**Classification:**

- 3.a.2 - Sign location expectancy
- 4.a - Misleading information, lane assignment

**Site 3 - US-59 NB to IH-610 (WL) NB**

No information. Problem and solution may have been the same as Site 2.

**Site 4 - IH-610 (WL) SB to South Post Oak exit**

**Problem:** Lane assignment arrows are misleading and exceed the actual number of lanes. The geometry is that IH-610 turns sharply to the left with the exit to South Post Oak designated for the right two lanes. The problem is that three upward arrows arc to the left for IH-610 and two separate downward arrows mark Post Oak. The expectation is for five lanes, but there are actually only four. The second lane from the right actually divides permitting either a left movement for IH-610 or a continuing movement to Post Oak.

**Solution:** The arrows should be reformatted such that only four lanes are depicted. All arrows should point upward. The arrow second from the right should have two "heads" correctly showing that the driver may either exit or stay on 610 from this lane.

**Classification:**

- 4.a - Information misleading, lane assignment

**Site 5 - IH-610 (WL) SB to South Post Oak exit**

**Problem:** Second lane from left splits immediately before the exit thereby permitting two left lanes to exit to South Post Oak. The existing sign shows only the extreme left lane as exiting.

**Solution:** To correctly depict the situation the sign should also show that the second lane from the left divides (with two-headed arrow). Otherwise, all of the drivers will merge into the left lane to exit to South Post Oak.

**Classification:**

- 4.a - Information misleading, lane assignment
- 3.a.3 - geometric violation

**Site 6 - IH-45 NB to IH-610 (SL) WB**

**Problem:** Left hand exit to a major arterial and only one exit lane. Drivers apparently did not expect a left hand exit or one lane exit and were not given enough advanced warning to be in the extreme left lane.

**Solution:** Lane assignment arrows should match the number of lanes. The overhead should clearly show there are two right exiting lanes to Pasadena (IH-610, East Loop), one continuing pull-thru lane for IH-45 NB and one "exit only" lane for IH-610 NB. Otherwise the expectation is that the second lane from the left would also permit a left hand exit.

**Classification:**

- 3.a.3 - geometric violation
- 4.a - information misleading, lane assignment

**Site 7 - IH-45 NB to IH-10 WB**

**Problem:** This left hand exit differs from Site 6 in that two lanes exit to IH-10 WB but the arrows do not make it clear that one may continue on IH-45 SB from the second lane from the left.

**Solution:** The current sign at the interchange is misleading because it has two upward arrows showing an exit to San Antonio with two yellow inserts (one showing "exit" and, after the first arrow, another showing "only"; then another arrow). This should be changed to two arrows with the words "exit only" under the left hand arrow. This implies that either lane may be used to exit but the second lane from the left is not committed to an exit. Also, the advance sign should display "Dallas" with two downward arrows so the driver recognizes that there are two acceptable lanes for continuing on IH-45 NB.

**Classification:**

- 4.a - Information misleading, lane assignment

**Site 8 - IH-45 SB to IH-610 (NL) at Airline exit**

**Problem:** Advance sign displays "West - East IH-610, 1 mile" but fails to tell drivers specific lane assignments for these exits. The second sign displays lane assignments but there is insufficient time for the drivers to get into the appropriate lanes to make the exit desired.

Another problem is that the overhead signs after exiting to IH-610 require that the driver read and distinguish the small words "East" and "West" (only two letters differing).

**Solution:** Regarding the first problem, the advance sign should be modified to present specific lane assignments for IH-610 East and IH-610 West. Downward "exit" arrows under each route message would

tell the driver he should begin immediately to get into the correct lane.

Regarding the overhead signs after the IH-610 exit but before they divide, major destinations should be placed above the route numbers. These should be major cities known to be to the left (East) and right (West).

**Classification:**

3.a.2 - Violation of sign expectancy

**Site 9 - SH-288 NB to IH-45 and US-59 NB**

**Problem:** The signing appears to be adequate for the site. Driver comments are diverse and focus on no single problem that appears to be a problem.

**Site 10 - US-59 NB to IH-45 NB**

**Problem:** Information on the "modified diagrammatic" sign showing downtown exits from US-59 South is not well formatted. Another sign depicting exits to IH-45 and to SH-288 has a similar problem. The overhead word messages on each sign seem to "run together".

**Solution:** On the diagrammatic sign the word "Downtown" should be perceptibly lower than "US-59 North". On the other sign the word "to" could be placed above IH-45 and above SH-288 rather than to the left of each. This would provide more spacing between the various messages without loss of meaning.

**Classification:**

3.a.1 - Format of message inadequate

**Site 11 - IH-10 EB to US-59 NB**

**Problem:** Not sure there is one. There is an excellent diagrammatic sign that shows a succession of four upcoming exits to various destinations and one arrow shows an unexpected left exit to go right. The diagrammatic in conjunction with a subsequent overhead of lane assignments is excellent. The only problem is that the diagrammatic is mounted on the last of four bridges over the interstate and sight distance is somewhat limited.

**Solution:** Move the diagrammatic to the first bridge where there is a longer sight distance and more time to absorb the message. If wind gusts from trucks preclude this solution the overhead diagrammatic should be mounted on an overhead structure slightly upstream of the bridges. I see no problem with the sign itself being "busy" because drivers will scan only for their particular destination.

**Classification:**

**Site 12 - IH-610 (NL) WB to US-290 NB**

**Problem:** No problem. The sign is not confusing and taking the left lane to IH-610 and right lane to US-290 is as expected although differing from the situation in the opposing direction (Site 1). Cardinal directions are omitted but this presents no problem here since US-290 begins at this point and IH-610 South is the only option.

**Site 13 - IH-610 (NL) EB to IH-45 NB**

**Problem:** 3 complaints for not enough warning and lane assignment. IH-45 NB exits from the left with 2 lanes; one being an optional exit lane. IH-45 SB exits from the right with 2 lanes; one being an optional exit lane. Two of the sign bridges have 5 signs on them which may overload the motorist. The exit signs with lane assignment arrows do not accurately depict the geometry of the exits. There is one ground mounted sign on the left prior to the exit with "up arrows" that does pictorially describe the geometry of the exits.

**Solution:** The lane assignment arrows on the conventional signs could be revised to better indicate which lanes exit.

**Classification:**

Information misleading - lane designation does not match geometry

**Site 14 - IH-610 (EL) NB to SH-225 EB**

**Problem:** One lane assignment complaint. No apparent problem except that the exit ramp expands to 3 lanes and splits immediately after the exit.

**Solution:** Geometric problem

**Classification:**

Geometric - ramp split after exiting

**Site 15 - IH-10 WB to IH-45 NB/SB**

**Problem:** There are several complaints to US-59 NB and SB inferring too much information, unclear signs, and confusion about which lane to be in. IH-10 is a 3 lane freeway section that increases to 4 lanes within 1/2 mile of the exit. IH-45 SB exits from the left with an optional exit lane. There is no sign at the exit. The last sign prior to the exit is a very large diagrammatic. Lane assignment is not given prior to the US-59 NB exit.

**Solution:** An exit directional sign needs to be installed at the IH-45 SB exit.

**Classification:**

Geometric - lane added immediately prior to the exit  
Missing information - there is no sign at the IH-45 SB exit  
and no lane advance lane is given

**Site 16 - US-59 NB to IH-10 EB**

**Problem:** Several complaints including signs over the wrong lanes, being forced to exit and not enough notice of the exit only lanes. IH-10 WB is a two lane exit with one being an optional lane. Lane assignment arrows are not used. A lane is added prior to the exit and there are several horizontal and vertical curves prior to the interchange which reduces sight distance to the signs and the exits. The first sign for IH-10 is over the far left lane but the exit is on the right. There is no indication of how many lanes exit.

**Solution:** The geometry of the roadway makes it difficult to adequately sign for the exit.

**Classification:**

Geometric - lane added immediately prior to the exit  
- restricted sight distance  
Information temporally inadequate - sign location expectancy  
Information inadequate - lack of lane assignment

**Site 17 - IH-10 WB to US-59 NB/SB**

**Problem:** Several complaints including not enough advance warning, confusing and unclear signs, and insufficient lane assignment. US-59 NB exits from the right with an optional exit lane and US-59 SB exits from the left with two lanes (one optional lane). There are three advance signs (the first at 2 1/2 miles) with a message only and no lane assignment. When lane assignment is given, there is no indication of two lanes exiting. There is one large diagrammatic sign but it, also, does not make it clear how many lanes exit.

**Solution:** The lanes that exit should be communicated to the motorist.

**Classification:**

Information misleading - lane designation does not match geometry

**Site 18 - IH-45 SB to IH-610 (SL) EB/WB**

**Problem:** Several complaints including signs misleading and exit not clearly marked. There is one exit for IH-610 and the ramp splits after exiting. The exit is two lanes with one an exit only lane and the other an optional exit lane. The advance signs are wider than the lane width because of the large amount of

information on them and therefore the signs are not positioned over the appropriate lane. There is no advance lane assignment. There are separate signs for EB and WB but it is not clear that there is one exit.

**Solution:** The signs need to better communicate which lanes exit.

**Classification:**

Information misleading - signs too large to be positioned over the appropriate lane.

Lack of advance lane assignment

**CORPUS CHRISTI (DISTRICT 16)**

**SITE 1: US-181 SB to Shoreline Blvd.**

**PROBLEM:** No public complaints. The site was identified by the Highway Department. There are three signs for the exit. The first at 1 3/4 miles with no lane assignments. The second two set of signs have four down arrows and only three lanes. The bifurcation is a dual left lane exit with one optional lane. No destinations are given but the exit is a city street to downtown Corpus. US-181 apparently terminates at the bifurcation and splits into Shoreline Blvd. and SH-286/IH-37.

**SOLUTION:** There may not be a problem because of no public complaints. The second two signs may need to be changed to show the correct number of lanes.

**CLASSIFICATION:**

Geometry (Route terminates at bifurcation)

Down arrows do not match number of lanes (4 arrows and 3 lanes)

**SITE 2: US-181 SB to IH-37 NB**

**PROBLEM:** One complaint stating did not know which lane to be in. The first half of this site is the same as site 1. The motorist must go through two bifurcations. The first is when US-181 terminates and IH-37/SH-286 and Shoreline Blvd. split. The second is when IH-37 and SH-286 split. In both cases there are three lanes and two lanes go to each destination with the center lane optional. Also, the signs have four down arrows with only three lanes. Cardinal directions are never given and destination cities are given only on the signs for the second bifurcation.

**SOLUTION:** Same as site 1.

Cardinal directions and destinations could be included on the signs.

**CLASSIFICATION:**

Missing information (missing cardinal directions and destinations)  
Down arrows do not match number of lanes (4 arrows and 3 lanes)

**SITE 3: SH-286 NB to IH-37 NB and US-181 NB**

**PROBLEM:** Several complaints including not enough advance warning and the signs not visible because of an overpass. SH-286 terminates at a bifurcation where IH-37 and US-181 split. There are three lanes on SH-286 and the center lane disappears prior to the bifurcation. There are several exits within a mile of the bifurcation. No lane assignment arrows are given until within 1/4 mile of the bifurcation. Cardinal directions are not given. A fourth lane is added and then dropped as an exit only lane within 1/4 mile of the bifurcation. All signs have restricted site distance due to overpasses.

**SOLUTION:** Mostly a geometric problem.

**CLASSIFICATION:**

Geometry (Route terminates at bifurcation)  
(Center lane disappears prior to bifurcation)  
(Other exits close to the bifurcation)  
Missing information (No cardinal directions)  
(No advance lane assignments)  
Restricted sight distance to signs

**SITE 4: IH-37 SB to Shoreline Blvd.**

**PROBLEM:** Two complaints indicating there is not enough signing to the exit. IH-37 SB terminates into Shoreline Blvd. There are only two signs indicating Shoreline Blvd. There is restricted sight distance to the signs. The first sign has four down arrows and only three lanes. An exit prior to the termination of IH-37 has a center optional exit lane.

**SOLUTION:** The signing could be revised so that the down arrows equal the number of lanes.

**CLASSIFICATION:**

Down arrows do not equal the number of lanes  
Restricted sight distance to the signs

**SITE 5: SH-358 WB to SH-286**

The complaint was intersection not well marked due to construction.

DALLAS (DISTRICT 18)

Site 1: IH-35E NB to SH-183/SH-114 WB

**Problem:** No public complaints but department personnel suggest it may cause problems because it is a left hand, multi-lane exit. Lane assignment arrows are misleading and do not equal the number of lanes. Two advance exit signs have lane assignment arrows but there are 5 lanes and only 4 arrows shown on the signs. The exit directional sign has 6 down arrows but only 5 lanes with the center lane being optional.

**Solution:** The advance exit signs will work as they are if the pull through sign for IH-35E NB did not include lane assignment arrows or a diagrammatic sign could be used. Also, the exit directional sign could be improved by using a diagrammatic or "up" arrows.

Site 2: IH-35E NB to IH-635(NL) WB

**Problem:** There is a single, optional lane exit for IH-635 immediately after a horizontal curve and bridge overpass. The exit directional sign is visible but the exit itself is not. There is not consistent use of lane assignment arrows. The first sign has no assignment arrows, the second sign has 3 arrows with 4 lanes, the third sign has 4 arrows with 4 lanes and the fourth sign has 6 arrows with 5 lanes. An additional lane is picked up between the last advance sign and the exit directional sign.

**Solution:** The complaint was confusion on which lane to be in but the signs appear to clearly state which lane to be in for this particular exit with 1 mile advance lane assignment warning. There does appear to be some potential problems because of geometrics. This problem could be resolved by using a diagrammatic sign.

Site 3: IH-635(NL) WB to US-75 SB

**Problem:** No public complaints but department personnel suggest it may cause problems because it is a single, left hand, exit only lane. The first advance exit sign (1 1/2 mi.) gives no indication of lane assignment and no distinction between US-75 NB & SB but the next 2 do. There could be a sight distance problem from an overpass prior to the last advance exit sign. The exit ramp expands to two lanes after exiting from the main lanes and splits with no advance warning of the split. This definitely could be a problem for a motorist unfamiliar with the area.

**Solution:** The first advance sign could give some indication that it is a left lane exit by adding "left exit" or a lane assignment arrow to the sign but an additional sign would be required to distinguish it from US-75 NB. There should be an advance sign for the exit ramp split.



**Site 4: IH-635(NL) WB to IH-35E SB**

**Problem:** No public complaints but it is a triple left lane exit with one option lane. The first two signs (2 1/2 and 1 1/2 mi.) give no lane assignment and no distinction between IH-35E NB & SB. The third sign which gives lane assignments may have restricted sight distance because of a crest vertical curve. The third, fourth, and fifth signs are consistent with each other (4 arrows and 4 lanes). The signs indicate only two lanes exiting when in fact three lanes can exit.

**Solution:** There is no apparent problem except that you can exit from the third lane and the signs do not tell you this. The only possible way to correct this is to use "up" arrows or a diagrammatic sign.

**Site 5: IH-635(NL) EB to IH-35E NB**

**Problem:** No public complaints and it is a single, right hand, optional lane exit. The first sign (2 mi.) gives no lane assignment and no distinction between IH-35E NB & SB. The second sign (1 mi.) gives no lane assignment but there is a separate sign for NB & SB. The third sign is the exit directional sign. There is no prior lane assignment but it should not violate driver expectancy because it is a typical rural right lane exit.

**Solution:** Because this is a major interstate exit, drivers may be expecting a more elaborate interchange. The only apparent improvement could be the addition of "next exit" or "right lane" to the second advance exit sign.

**Site 6: IH-635(NL) EB to US-75 NB**

**Problem:** The exit is a single lane, left hand, optional exit lane immediately beyond a bridge overpass. The complaints were unexpected left lane exit and overhead arrow sign not above the appropriate lane. The first advance sign (1 3/4 mi.) gives no lane assignments and no distinction between US-75 NB & SB and the sign is over the center of 4 lanes. There is not consistency of signs on the same sign bridge. The signs for this exit say "left lane" but there are arrows on the signs for other exits on the same sign bridge. There is not consistent use of information on the signs. The first three overhead advance signs say "Sherman" and the fourth sign (ground mounted) says "Richardson Plano Next Left". The exit directional sign says "Sherman". This may cause confusion for a driver looking for Sherman.

**Solution:** The first advance sign should give some indication that it is a left lane exit but it would require an additional sign to distinguish between US-75 NB & SB. The ground mounted sign should either be removed or add "Sherman" to the sign.

**Site 7: IH-635(NL) EB to US-75 SB**

**Problem:** The exit is a single, right hand, exit only lane. This is the same location as site 6. The first advance sign (1 3/4 mi.) gives no lane assignments. The second sign which does give a lane assignment is only 1/2 mile from the exit.

**Solution:** The first advance sign should give lane assignment.

**Site 8: IH-30 WB to US-75 NB**

**Problem:** The complaint is that signs are at an angle and they come up very quickly. The exit is dual right hand exit with one lane optional. The first advance sign (1 1/4 mi.) gives no lane assignment and it is over the center of 4 lanes. The second sign (1/2 mi.) indicates to be in the right lane (arrow and "exit only") but it has restricted sight distance because of a horizontal and vertical curve. There is a third sign which only gives the city destination. It is ground mounted, small, and easy to miss. Also, just after exiting, the ramp splits which may violate driver expectancy.

**Solution:** Geometrics make the exit confusing. A diagrammatic sign could tend to cause more confusion.

**Site 9: IH-30 WB to IH-35E NB**

**Problem:** There are several complaints for this exit including too many signs, not enough warning, and lack of lane assignment. All of these complaints are apparent from the video. The exit involves several lane splits, lane merges, and lane changing. The first sign (1/2 mi.) has lane assignment, destination, and route number but the next two signs only give city destination and lane assignment. A driver expecting to see the route number will become confused. The exit ramp splits and merges with another highway. It is a confusing area with a sign bridge containing too many signs and too much information. Two more sign bridges are currently being installed at the time of the filming but it will not solve all the problems.

**Solution:** A redesign of the entire sign system with a more detailed evaluation of all the intersecting routes is required.

**Site 10: IH-35E NB to Cadiz Street**

**Problem:** No public complaints but the department suggests problems because of lack of lane assignment. The exit is a single, right hand, optional lane exit. There are only two signs for the exit. The first (1/2 mi.) is on a sign bridge with two other signs. There is a lot of information of the signs and all four lanes are indicated with arrows for other routes. The Cadiz sign is over the right shoulder.

**Solution:** The first sign could include "next exit" and should somehow indicate the right lane is also for this exit.

**Site 11: IH-45 NB to IH-35E NB (via Spur 366)**

**Problem:** The exit is a single, right hand, exit only lane. There are a total of four lanes at the exit with one being dropped for the exit. Spur 366 connects the two roads. Complaints include lack of advance signing and unclear signs. There are only two signs for the exit. The first sign may have a sight distance problem due to a horizontal curve and it says "Exit Only" with no indication of how far the exit is. Both signs do not give any cardinal directions, only a destination city (Denton). Also, there is no signing for Spur 366.

**Solution:** Because this is an exit to a major interstate, at least two advance signs should be used. Also, a cardinal direction should be included on the signs.

**Classification:**

Lack of advance information (no sign)  
Information unavailable (no cardinal direction and no signing for Spur 366)

**Site 12: IH-35E NB to IH-30 EB**

**Problem:** The exit is a two lane, right hand, exit only bifurcation. Complaints include not enough advance warning for lane assignment. The first and second advance signs have 4 arrows with four lanes. One of the signs (for a different exit) is over the shoulder on both sign bridges and the signs are after a horizontal curve which may cause lane assignment confusion in addition to limited sight distance. The exit directional sign is after a horizontal curve which again may cause lane assignment problems.

**Solution:** Using "up" arrows may not be appropriate because of several close exits in the vicinity of the bifurcation. The signs over the shoulders could be moved to a different location.

**Classification:**

Inadequate association between path and arrows (because of horizontal curve)  
Sign placement (signs over the shoulder)

**Site 13: IH-635(EL) SB to US-80 WB**

**Problem:** The exit is a single, right hand, optional exit. The complaint was the exit is not clearly marked. The first two signs (2 & 1 mi.) do not distinguish between US-80 NB & SB which are two separate exits 1/4 mi. apart.

**Solution:** The advance signs could indicate that there are two exits for US-80.

**Classification:**

Lack of information (distinguishing between US-80 NB & SB)

**Site 14: IH-20 WB to US-80 WB**

**Problem:** The complaint was missed the exit for US-80. IH-20 and US-80 are the same road and IH-20 splits off. The first sign indicates that the roads are the same but then there is a split with signing for IH-20 only. Nothing is said about US-80 until after the split. A person could easily assume that US-80 continues to follow IH-20 at the split.

**Solution:** A sign could be included on the sign bridge at the split to indicate US-80 continues straight.

**Classification:**

Lack of information consistency (no US-80 signing at the split)

**Site 15: IH-30 EB to US-80 EB**

**Problem:** No public complaints but the exit is a three lane, right hand exit with one lane optional. There are three signs for the exit and the first two have restricted sight distance due to bridge overpasses. The exit directional sign has four down arrows with five lanes.

**Solution:** The exit directional sign could use "up" arrows to better indicate the destination of each lane.

**Classification:**

Restricted sight distance  
Lane assignment arrows do not equal the number of lanes

**Site 16: IH-45 NB to US-75 NB**

**Problem:** Several complaints indicating no warning of IH-45 ending. No exiting is required to stay on US-75. There is only one sign that says "IH-45 USE US-75" which not clear as to what happens. Also, there are no signs indication US-75 is also North Central Expressway.

**Solution:** The signs could say "IH-45 ENDS USE US-75" and use this sign at least twice.

**Classification:**

Lack of route numbering continuity  
Misleading information (nothing about IH-45 ending)

**Site 17: IH-30 WB to Ervay Street**

**Problem:** No public complaints but it is a single, left hand, optional lane exit. There is only one sign for the exit but a sign bridge is currently being installed 1/2 mile prior to the exit.

**Site 18: IH-35E NB to US-75 NB (via Spur 366)**

**Problem:** Complaints include not enough warning of which lane to be in. The exit is a single, right hand, optional lane exit. There is only one sign and it is at the exit. No advance information is given and there is no signing indicating the road is Spur 366.

**Solution:** An advance warning sign could be added at the Reunion exit sign bridge.

**Classification:**

Lack of advance information (no advance signing)  
Missing information (no signing for Spur 366)

**Site 19: IH-35E SB to Reunion Exit**

**Problem:** The complaint was the sign is too close to the exit. There are five total lanes on the freeway. The exit is a single, right hand, optional lane exit. There are two advance signs (1/2 & 1/4 mi.) without lane assignments.

**Solution:** The second sign could include the words "Next Exit".

**Classification:** ?

**Site 20: IH-35E SB to IH-30 EB**

**Problem:** Complaints include not enough and confusing signs. The exit is a two lane, left hand, exit only bifurcation. The first advance sign has three down arrows with five lanes. The last two

exit signs have four arrows with four lanes but there is restricted sight distance due to the geometry of the road.

**Solution:** There should be more advance information about the exit only lanes. The fourth sign could easily include this.

**Classification:**

Not enough advance information for exit only lanes.

**Site 21: IH-30 EB to IH-45 SB and  
IH-30 EB to US-75 NB**

**Problem:** Complaints include not enough advance warning and lane assignment. The exit is a two lane, right hand, exit with one optional lane. There is restricted sight distance to all signs. The exit ramp splits to IH-45 and US-75 after exiting with little advance warning of the split. An advance sign has IH-45 on the left side but IH-45 splits to the right after exiting. Also, there is a diagrammatic sign with flashing lights along with down arrows on the sign bridge.

**Solution:** The second sign could have "up" arrows instead of the luminated diagrammatic sign and the information of the exit directional sign should be reversed.

**Classification:**

Manner which information is displayed  
Misleading information  
Lack of lane assignment  
Route inconsistency

**Site 22: IH-30 WB to IH-35E SB**

This site is the same as Site 9.

**Site 23: US-75 SB to IH-45 SB**

**Problem:** Complaints agree with the apparent problem of no signs informing the motorist of the route number change. The first two signs have IH-45 and US-75 on the same sign. The third sign has Business 75 exiting and nothing about IH-45. The rest of the signs only have IH-45 on them.

**Solution:** The third sign should indicate that US-75 ends and IH-45 continues.

**Classification:**

Inadequate information  
Not enough information

**Site 24: US-75 SB to IH-35E SB (via Spur 366)**

**Problem:** There are essentially two separate exits. The first is from US-75 SB to Spur 366 and the second is Spur 366 to IH-35E SB. A sign bridge is currently being installed for the second exit which will require a reevaluation.

The first exit is a two lane, right hand exit with one optional lane. Sequence series signs are used in this section of freeway with the message being "TO IH-35E WACO". The sequence signs are in the center median at distances of 3/4, 1/2, and 1/4 mile. An overhead sign is above the right lane at 1/4 mi. but no arrows or indication of an exit only lane. The placement of the signs from the left to the right and back may confuse motorists. In addition the fifth sign with arrows is not consistent with the sixth sign. No cardinal direction is given on the signs.

**Solution:** The IH-35E message on the fourth sign could be deleted and the fifth and sixth signs should better represent the road path.

**Classification:**

Sign placement inconsistency (left to right and back)  
Lack of information (no cardinal direction)  
Inconsistency of assignment arrows with optional exit lane

**Site 25: IH-35E NB to Loop 12(SL) EB**

**Problem:** The complaint is did not see the sign in time to exit. The exit is a single, right hand exit only lane which is also the acceleration lane for the previous entrance ramp. Only two signs exist for the exit, the first at 3/4 mile. The second sign does not indicate an exit only lane.

**Solution:** The first sign bridge could include a sign for Loop 12 WB and the second sign bridge sign could say "Exit Only".

**Classification:**

Lack of advance information

**Site 26: IH-20 WB to IH-35E SB**

**Problem:** The complaint was simply missed the exit. The exit is a single, right hand optional exit lane. There are four total lanes. There are two advance signs (2 1/2 & 1 mi.) which do not distinguish between IH-35E NB & SB. They are two separate exits 1/4 mi. apart. There is also no lane assignments given in advance. The first sign indicating two exits is at the first exit.

**Solution:** There could be advance warning to two separate exits which would require an additional sign.

**Classification:**

Not enough advance information of two exits  
No lane assignments (Note: may not be required)

**Site 27: IH-45 NB to IH-20 WB**

**Site 28: IH-45 NB to IH-20 EB**

**Problem:** The complaint is not enough warning for the exit. Both exits are single, right hand, optional lane exits. The first sign (1 1/4 mi.) does not distinguish between IH-20 EB & WB. The second sign does but it is 1/4 mi. from the EB exit. No lane assignment is given but it is a typical rural right lane exit.

**Solution:** No major problem observed but the second sign could say "Next Exit" instead of "1/4 Mile".

**Classification:** ?

**Site 29: IH-635(NL) WB to US-75 NB**

Complaint does not match actual conditions.

**Site 30: US-75 SB to IH-635(NL) WB**

**Problem:** The complaint was the motorist wanted to continue on US-75 but was forced to exit. There are four lanes with two exiting to the right (one optional lane) to IH-635. Sequence series signs are used with the message "JCT IH 635" at distances of 2, 1 1/4, and 1/2 miles. The first warning of lane assignment and exit only lanes is only about 1/4 mile from the exit. Also, at the exit the arrows do not equal the number of lanes.

**Solution:** There could be more advance warning of lane assignments and better representation of path destination.

**Classification:**

Lane assignment not enough in advance  
Lane assignment arrows do not equal the number of lanes

**Site 31: IH-30 EB to IH-35E SB**

**Problem:** The exit is a single, right hand, optional exit lane. The complaint is not enough advance warning. The first sign is at 3/4 mile and the lane assignment arrows do not equal the number of lanes. The second sign is simply a route shield side mounted on a light pole which could be easily over looked. The third sign is at the exit and again the arrows do not equal the number of lanes. Once exiting, the driver must follow trailblazers through city streets to get to IH-35E. The trailblazers are small and difficult to see.



**Solution:** A diagrammatic sign or "up" arrows could be used to indicate the number of lanes. Also trailblazers could be larger and more visible.

**Classification:**

Lane assignment (arrows not equal to number of lanes)  
Inadequate message visibility (second sign and trailblazers)

**Site 32: IH-35E NB to IH-30 WB**

This exit is the same as site 10 except that the driver must follow trailblazers through city streets after exiting. The trailblazers are small and difficult to see.

**Site 33: Thru Downtown Dallas on IH-35E SB**

This site is the same as site 20.

**Site 34: IH-35E NB to Commerce Street**

**Problem:** The exit is a single, right hand, optional exit lane. The complaints were not enough advance information. There are only two signs for the exit with the first being at 1/2 mile. The exit numbers are not consistent. The first sign says "Exit 428D" and the second sign says "Exit 428C".

**Solution:** The first could include the words "Next Exit" and the exit numbering needs to be corrected.

**Classification:**

Conflicting information (exit number incorrectly marked)

**Site 35: IH-35E NB to Dallas Tollway**

**Problem:** The exit is a single, right hand, optional exit lane. There are five total lanes on IH-35E. The complaint was not enough advance notice and the exit sign is too small. There are only two signs for this exit with the first being at 1/4 mile. The exit is marked as "Tollway". If Tollway is the name of the road then there is no apparent problem other than lack of advance signing.

**Solution:** More advance information may be required but this may not be possible due to geometrics and existing signs.

**Classification:**

Lack of advance information

**Site 36: IH-30 EB to Lamar Street**

This site is the same as site 21. There is a bifurcation with a lighted diagrammatic sign. There is restricted sight distance to the exit directional sign due to geometrics.

**Site 37: IH-35E NB to IH-20 WB**

**Site 38: IH-35E NB to IH-20 EB**

**Problem:** The exits are 1/4 mile apart and both are single, right hand, optional exit lanes. The complaints are not enough signs and did not know how far the exit was. There are three signs for the WB exit and four signs for the EB exit. The distances on the first sign say "2 miles" for both exits when they are 1/4 mile apart. There is no apparent problem with the exit signing.

**Solution:** The last advance sign for each exit could say "Next Exit" instead of 1/4 mile.

**Classification:**

Inconsistent information (distances to the exits)

**Site 39: IH-20 WB to IH-35E NB**

This site is the same as site 26.

**Site 40: Haskell Avenue to IH-30 WB**

**Problem:** Haskell Ave. is a one way three lane city street with trailblazers used to direct traffic to IH-30. The trailblazers are small and difficult to see. The first two trailblazers are on the right side of the street when you need to turn left.

**Solution:** Trailblazers need to be more visible and they should be on the same side of the street that you are required to turn on one way streets.

**Classification:**

**Site 41: Spur 366 to IH-35E NB**

**Problem:** There are no public complaints but the department indicates that there is a lack of lane assignment arrows because of geometrics. The exit is a single, right hand, exit only lane from the four lane freeway section. There are three signs for the exit and the first at 1 mile gives no lane assignment or distinction between NB and SB. The third sign has restricted sight distance due to a bridge overpass and indicates an exit only lane. There may not be enough advance notice of the exit only lane.

**Solution:** Additional signing may not be possible because of the geometrics and existing signs.

**Classification:**

Lack of advance information



**APPENDIX C**

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APPENDIX C.1

FREEWAY GUIDE SIGN QUESTIONNAIRE

INTRODUCTION: Hello, this is \_\_\_\_\_ calling from the Public Policy Resources Lab at Texas A&M University. We're conducting a statewide survey about road signs in Texas. This confidential survey will take only a few minutes of your time, and we'd really appreciate your participation.

[RANDOM SELECTION WITHIN HOUSEHOLD PROCESS, SELECTING DRIVERS OVER 18 YEARS OLD]

This is a survey about guide signs on urban freeways. The Texas Highway Department is interested in finding out if the signs that give directions on city freeways are giving motorists the information they need in order to find their way in Texas' cities.

1. First, it has been suggested that the green guide signs on city freeways are sometimes confusing. What is your opinion of the information provided on the guide signs on city freeways? Would you say it is:

<u>47.0</u>	Clear and adequate information
<u>43.5</u>	Usually, but not always clear and adequate
<u>7.4</u>	Often is not clear and adequate information
<u>2.2</u>	DK/NA

2a. Have you ever been lost, confused, or misdirected on the freeways in the Texas cities you've driven to or through?

<u>54.6</u>	Yes
<u>42.7</u>	No
<u>1.0</u>	Not Sure
<u>1.7</u>	Don't drive on freeways in cities
<u>0.1</u>	DK/NA

[If no, skip to Question 3]

[If Don't drive on freeways in cities, skip to Question 18]

[If yes]

2b. In which city or cities have you ever been lost, confused, or misdirected on the freeways? [List all cities named.]

Dallas (267)	Corpus Christi (9)
Houston (252)	Lubbock (5)
San Antonio (138)	Abilene (4)
Ft. Worth (71)	Amarillo (3)
Austin (53)	Waco (2)

2c. How often has this happened to you? [Don't read responses.]

[If a city or cities is named in conjunction with the frequency, list here]

<u>15.2</u>	Has only happened once	Dallas--32.7%
<u>24.5</u>	Happens rarely	Dallas--44.3%
<u>5.9</u>	Happens when I travel to a city first time	Dallas--57.9%
<u>23.0</u>	Happens occasionally	Dallas--35.1%
<u>12.4</u>	Happens frequently	Houston/Dallas--30%
<u>18.9</u>	Happens every time I go to	Houston--34.3%

2d. When you have had a problem with freeway guide signs, how often would you say the freeway was under construction?

<u>29.1</u>	Rarely
<u>18.7</u>	Occasionally
<u>18.5</u>	Frequently, or
<u>31.3</u>	Usually
<u>2.3</u>	DK/NA

2e. How often have you driven to or through (name each city given in 2b) in the past 2 years?

City	None in past 2 years	once	twice	3-5 times	5-10 times	> 10 times
a. Dallas	10.8	7.3	10.4	22.0	16.2	33.2
b. Houston	10.5	6.5	13.3	19.3	15.7	34.7
c. San Antonio	9.0	14.2	13.4	22.4	16.4	24.6
d. Ft. Worth	7.6	10.6	7.6	19.7	9.1	45.5
e. Austin	1.9	19.2	13.5	26.9	13.5	25.0
f. Corpus	0	0	44.4	44.4	0	11.1



Next, I'd like to read a list of statements about the green freeway guide signs on city roads that are not under construction, and I'd like you to tell me if you Strongly Agree, Agree, Disagree, Strongly Disagree, or feel Neutral about them.

	Percent					
	SA	A	N	D	SD	DK/NA
3. The information given on guide signs is clear and understandable.	3.7	73.4	9.8	11.8	0.8	0.5
4. The information on guide signs is correct.	4.7	81.5	6.9	5.5	0.5	0.9
5. Destinations are not given on enough signs.	6.4	45.7	9.8	34.2	1.6	2.3
6. Directions are not given early enough. (too late to get in correct lane)	18.1	41.0	7.6	31.0	1.2	1.1
7. The letters on the signs are too small.	1.9	20.0	5.1	68.9	3.6	0.5
8. The overhead signs are above the wrong lanes on the freeway.	2.5	21.5	7.7	61.9	3.9	2.5
9. The arrows on guide signs are confusing.	1.8	23.9	9.8	61.0	2.4	1.1
10. There are too many arrows on guide signs.	1.2	14.3	9.0	69.9	3.6	2.0
11. Guide signs are easy to see.	5.5	76.1	7.3	9.4	0.7	1.0
12. Guide signs are easy to read.	5.7	77.8	6.3	8.9	0.7	0.6

13. In general, do you think that there are too many, too few, or the right number of guide signs on city freeways?

<u>5.9</u>	Too many
<u>35.3</u>	Too few
<u>53.4</u>	Right number
<u>5.4</u>	Not Sure

14. Do you think that there is too much, too little, or the appropriate amount of information on overhead signs on the freeways?

<u>3.1</u>	Too much
<u>22.2</u>	Too little
<u>72.5</u>	Appropriate amount
<u>2.2</u>	Not Sure

15. Do you prefer that freeway numbers, freeway names, or both freeway numbers and names be used on freeway guide signs?

<u>7.5</u>	Names
<u>15.7</u>	Numbers
<u>73.7</u>	Both
<u>3.0</u>	Not Sure
<u>0.1</u>	Ref/NA

16a. Have you ever been lost, confused, or had trouble finding an airport in Texas?

<u>19.7</u>	Yes, [go to 17b]
<u>79.5</u>	No [skip to 18]
<u>0.5</u>	Not Sure [skip to 18]
<u>0.3</u>	DK/NA

16b. Where? (City(ies) : Dallas/Ft. Worth--115  
Houston--79  
San Antonio--16

16c. How were you trying to find the airport--were you using  
(Check all that apply)

<u>133</u>	Road signs
<u>50</u>	A map
<u>76</u>	Verbal directions
<u>31</u>	Relying on previous experience, or
<u>4</u>	Using some other method?

(What: \_\_\_\_\_)

17. Is there anything you would like to add about freeway signs in Texas? [Record response verbatim.]

\_\_\_\_\_  
(See Appendix C.3)  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

For comparison purposes, we would like to know something about you and your driving experience.

18. How many years have you been driving?

<u>0.4</u>	Less than 1 year
<u>7.3</u>	1 - 5 years
<u>92.2</u>	more than 5 years

19. Approximately how many miles do you drive during an average year?

<u>17.4</u>	Less than 10,000
<u>36.7</u>	10,001 - 15,000 (This is average)
<u>19.9</u>	15,001 - 20,000
<u>11.7</u>	20,001 - 30,000
<u>10.9</u>	over 30,000
<u>3.4</u>	Don't know/No answer

20. In what city do you live?

\_\_\_\_\_ Don't live in a city (Rural)

City: \_\_\_\_\_

21. What was the last grade in school you completed?

<u>12.7</u>	less than high school
<u>33.3</u>	high school or equivalent
<u>24.6</u>	some college
<u>28.9</u>	college degree(s)
<u>0.5</u>	DK/RF/NA

22. What is your current age? Are you:

<u>12.0</u>	younger than 25 years old
<u>29.7</u>	25 to 35,
<u>22.6</u>	36 to 45,
<u>13.7</u>	46 to 55. or
<u>21.8</u>	over 55 years old
<u>0.2</u>	DK/RF/NA

23. Which of the following best describes your racial or ethnic group?  
Are you:

<u>70.8</u>	Anglo
<u>8.1</u>	Black
<u>17.1</u>	Hispanic, or
<u>3.4</u>	something else
<u>0.6</u>	DK/RF/NA

24. [Without asking, enter gender of respondent.]

<u>45.2</u>	male	<u>54.8</u>	female
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APPENDIX C.2

FREEWAY GUIDE SIGN QUESTIONNAIRE  
(SPANISH LANGUAGE: N=49)

INTRODUCTION: Hello, this is \_\_\_\_\_ calling from the Public Policy Resources Lab at Texas A&M University. We're conducting a statewide survey about road signs in Texas. This confidential survey will take only a few minutes of your time, and we'd really appreciate your participation.

[RANDOM SELECTION WITHIN HOUSEHOLD PROCESS, SELECTING DRIVERS OVER 18 YEARS OLD]

This is a survey about guide signs on urban freeways. The Texas Highway Department is interested in finding out if the signs that give directions on city freeways are giving motorists the information they need in order to find their way in Texas' cities.

1. First, it has been suggested that the green guide signs on city freeways are sometimes confusing. What is your opinion of the information provided on the guide signs on city freeways? Would you say it is:

<u>79.6</u>	Clear and adequate information
<u>12.2</u>	Usually, but not always clear and adequate
<u>6.1</u>	Often is not clear and adequate information
<u>0</u>	DK/NA

2a. Have you ever been lost, confused, or misdirected on the freeways in the Texas cities you've driven to or through?

<u>24.5</u>	Yes
<u>75.5</u>	No
<u>0</u>	Not Sure
<u>0</u>	Don't drive on freeways in cities
<u>0</u>	DK/NA

[If no, skip to Question 3]

[If Don't drive on freeways in cities, skip to Question 18]

[If yes]

2b. In which city or cities have you ever been lost, confused, or misdirected on the freeways? [List all cities named.]

Houston (5)  
Dallas (4)  
San Antonio (2)  
Waco (1)  
Harlingen (1)

2c. How often has this happened to you? [Don't read responses.]

[If a city or cities is named in conjunction with the frequency, list here]

<u>50.0</u>	Has only happened once	Houston-100%
<u>50.0</u>	Happens rarely	Houston-100%
<u>0</u>	Happens when I travel to a city first time	
<u>0</u>	Happens occasionally	
<u>0</u>	Happens frequently	
<u>0</u>	Happens every time I go to	

2d. When you have had a problem with freeway guide signs, how often would you say the freeway was under construction?

<u>66.7</u>	Rarely
<u>8.3</u>	Occasionally
<u>0</u>	Frequently, or
<u>25.0</u>	Usually

2e. How often have you driven to or through (name each city given in 2b) in the past 2 years?

City	None in past 2 years	once	twice	3-5 times	5-10 times	> 10 times
a. Dallas	33.3	0	33.3	0	0	33.3
b. Houston	14.3	14.3	14.3	42.9	0	14.3
c. San Antonio	60.0	0	0	20.0	0	20.0
d. Waco	0	0	0	0	0	100.0
e.						
f.						

Next, I'd like to read a list of statements about the green freeway guide signs on city roads that are not under construction, and I'd like you to tell me if you Strongly Agree, Agree, Disagree, Strongly Disagree, or feel Neutral about them.

	Percent					
	SA	A	N	D	SD	DK/NA
3. The information given on guide signs is clear and understandable.	2.0	93.9	4.1	0	0	0
4. The information on guide signs is correct.	2.0	93.9	2.0	2.0	0	2.0
5. Destinations are not given on enough signs.	0	38.8	8.2	51.0	0	2.0
6. Directions are not given early enough. (too late to get in correct lane)	0	20.4	12.2	65.3	0	2.0
7. The letters on the signs are too small.	0	20.4	2.0	77.6	0	0
8. The overhead signs are above the wrong lanes on the freeway.	0	16.3	0	79.6	2.0	2.0
9. The arrows on guide signs are confusing.	0	16.3	4.1	79.6	0	0
10. There are too many arrows on guide signs.	0	28.6	8.2	63.3	0	0
11. Guide signs are easy to see.	0	93.9	2.0	4.1	0	0
12. Guide signs are easy to read.	0	98.0	2.0	0	0	0

13. In general, do you think that there are too many, too few, or the right number of guide signs on city freeways?

<u>4.1</u>	Too many
<u>10.2</u>	Too few
<u>83.7</u>	Right number
<u>2.0</u>	Not Sure

14. Do you think that there is too much, too little, or the appropriate amount of information on overhead signs on the freeways?

<u>2.0</u>	Too much
<u>10.2</u>	Too little
<u>85.7</u>	Appropriate amount
<u>2.0</u>	Not Sure

15. Do you prefer that freeway numbers, freeway names, or both freeway numbers and names be used on freeway guide signs?

18.4 Names  
22.4 Numbers  
55.1 Both  
4.1 Not Sure

16A. Have you ever been lost, confused, or had trouble finding an airport in Texas?

10.2 Yes, [go to 17b]  
89.8 No [skip to 18]  
0 Not Sure [skip to 18]  
0 DK/NA

16b. Where? (City(ies) : Dallas/Ft. Worth--3  
Houston--1  
Harlingen--1

16C. How were you trying to find the airport--were you using (Check all that apply)

1 Road signs  
1 A map  
3 Verbal directions  
0 Relying on previous experience, or  
0 Using some other method?  
(What: \_\_\_\_\_)

17. Is there anything you would like to add about freeway signs in Texas? [Record response verbatim.]

\_\_\_\_\_  
(See Appendix C.3)  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_





### APPENDIX C.3

#### COMMENTS FROM STATEWIDE SURVEY (N=414)

##### ADVANCE INFORMATION (N=82)

4. Have basically good road signs but information on signs sometimes is not given early enough.
18. Put signs further in advance to make decisions to exit--give more time.
19. We need them early at major intersections.
25. They need to have more of them to give you more notice.
45. Give more information before you get to a place, not just one time.
50. Post the sign far enough away in order to get in proper lane.
52. Just that sometimes you don't see the signs soon enough and don't have time to change lanes.
54. I think that we have pretty well covered that there needs some improvements. The signs need to say such and such next exit. We need 2 warnings on them.
58. Put them further away from exits so you know what exit to take.
59. Either more signs or have them sooner.
63. It is usually just the placement of the signs that is the problem. If they would give you more warning.
68. Ought to have more advanced warning before you have to turn. Overhead signs hard to tell at a distance if you're in the lane or not. More overhead signs earlier on.
69. Just that they give us more time.
71. Put them before the exit, long before the exit so you can get in the right lane.  
Have signs more frequently. More signs before the exit. Especially more signs before the mix masters and all major passways. More signs on the passways where there are many together.
73. The only thing I would say is you need to be warned sooner, before you get down the road.
74. Need to start telling people earlier as to when to get over to exit. You need at least a mile before you exit. Overhead signs need to be higher up, so people can see them farther away.
77. Not given enough time before an exit.
90. Should give 3 miles notice to change lanes.
97. Do not tell you soon enough as to when to exit. Not enough time to get in right lane to exit.
101. The worse thing is there is no consistency. When you enter, you don't know how to exit or enter. Texas signs are better than other States though. The signs aren't early enough to get off in time.
112. Not notified soon enough to change lanes.
121. Need more advanced notice of exits.
124. They should warn, or post signs for exits much earlier so people on the far left lanes can take the exit. Also, some

- exits don't have ways to get back on the highways, which is dumb.
131. No, I think we have some of the best in the United States. They just aren't placed soon enough. If you miss one you are right on top of it.
  133. When you're traveling, the information will appear just when you need to make the turn, which doesn't give the driver enough time.
  134. Spread them out more so you can get in the right lanes. The distance is too short.
  135. Early enough detection of exits left or right as to which lane I should be in to make the exit. Would like to see it overhead instead of on the side of the road in case I'm behind a truck.
  146. There needs to be information sooner so you can change lanes.
  148. Need to tell way in advance of where to exit for Tollroad. Lack of signs main concern.
  162. They need to make them give you plenty of time to see what's coming.
  175. It would help if the signs were back far enough to be able to turn.
  178. Especially in Texas, need to tell you which lane to get in half a mile before.
  180. Just that they need to plan ahead, post sooner, and list all the things that are coming up. Southern California lists exits three or four exits in advance so we have plenty of time to get in the right lane.
  185. Well, like I said, they should tell people more ahead of time before they need to turn.
  186. If they put signs for exit signs in lanes sooner, it would help.  
It would be nice if they would replace them a little quicker when they got knocked down on the North Freeway.
  188. They don't give the signs soon enough or far enough in front of the lanes before you have to switch lanes. Need more notice. In some cities they have exit numbers and street names for exits. The above would help give people, newcomers, and easier way to find directions.
  207. Before mix master, 2 miles ahead, need to notify driver of which lanes go where. Need highway numbers and street names for the exits 2 miles ahead. Lanes need to be notified about 2 miles ahead in mix master. Hard to find way in downtown Houston because of the way streets are changed to one way.
  209. In northern cities they have a list of roads that are farther ahead that give you plenty of warning ahead of time--road or exit preview.
  216. More time to get into the right lane when traffic is heavy.
  219. No. The only thing is put the sign far enough back so you can get over in time.
  229. Sometimes they're placed just after or right on top of exit ramp.
  231. They could give you the exit sign before you get up to the exit.

232. They don't tell you early enough to exit. Construction lighted arrows are too bright at night.
234. No, other than give signs earlier. Give more warning.
244. If approaching something like Dallas/Ft. Worth in heavy traffic, they need to give you signs sooner so you can digest what the sign is saying and get in the lane sooner, not having to rush it.  
Texas needs nicer, bigger rest stops!
250. Not really. Need more signs further down the road.
254. I'd like the signs to be in a place to give adequate time for the driver to get in the correct lane when the freeways splice or merge. Should give adequate information to get in the right lane.
255. My problem is when you reach an exit off the freeway, the roads are not marked to confirm the exit, the road isn't properly identified. The roads should be identified clearly so the driver doesn't slow down to ponder and harm traffic flow.
256. Not enough signs, especially for major exits.
260. Sometimes the information is given too late for the driver to react. There should not be exits on the left lane.
265. In Dallas it seemed like you were there and without any warning you were fixing to get off.
278. No. I usually like for them to give information earlier so I can get into the right lane earlier.
285. Don't give lane indications quick enough.
288. I think that the signs don't give information soon enough to exit, especially in cities.
291. There should be ample warning in big cities when lanes end or on exits.
299. I just think they should put the exit signs a little bit further away from the exits.
301. No, I think you pretty well covered all the problems. My main thing is seeing the signs too late.
316. Sometimes the directions should be given sooner.
317. Need to move them farther away and give you more warning. By the time you read it, it's too late to get into the other lane.
323. No. The only thing I would say is they need to have more signs for more warning.
331. Sometimes they don't come early enough. Generally they are very good.
332. Sometimes when you begin to enter a exit to a town, they need to be specific as to what part of town it will lead to--"the next 3 exits go to \_\_\_\_\_."
338. Merging lanes happen without any notice at times and it is very dangerous.
342. I guess more. If they could give more notice before you have to exit.
343. Confusing in San Antonio--not given enough warning or destinations, mostly in downtown San Antonio.
345. The reason you usually get lost is because you overshoot the exit signs and the signs are not given early enough, such as on LBJ in Dallas.

- 349. Not located soon enough to change lanes. Can't move over in time.
- 354. Problems arise when you can't find out directions early enough.
- 360. The signs should be further away from where you have to turn.
- 361. It would be a good idea if the signs for exiting the highway for destinations were more numerous to prepare the driver for the exit. Nothing else.
- 362. It would be helpful sometimes if you'd know the streets coming up before you get to it.
- 364. I would like to see more signs farther away from the exit so you can get in the right lane.
- 375. No, most of the time they are clear and marked pretty well, but sometimes where there is lots of traffic, the signs should be marked far enough ahead to allow ample time for the driver to switch lanes and take the exit.
- 377. Without giving too much information for the sake of brevity, put more signs up to warn the drivers of future exits and stops.
- 386. Sometimes very fast in showing the exit signs.
- 390. They should warn us a little ahead of time so we can get in the right lane.
- 391. The lane end signs come up at the last moment.
- 394. Like to see them give me the right lane in time to get in it.
- 395. Should give you enough time to be able to get into the correct lane.
- 396. They don't give you information early enough to react quick enough. Tell sooner.
- 400. Wish they'd all be early enough for your exit. There is one exit off LBJ in Dallas that takes you to the toll road and also to Mumford that is very confusing.
- 403. I would like to see signs placed soon enough to give people time to get into the appropriate lane in order to exit.

**AIRPORTS (N=5)**

- 93. On I-35 North or South, there is no exit for an airport in Austin. There should be, but there isn't. There is Airport Blvd.
- 236. No. I just think airports are never marked on time, and recreational signs are never marked, and it's hard to figure out where you are going.
- 275. No. Unless on the way to airports, there should be larger signs. Like going to Hobby, it's not on a major highway. The signs get lost in advertisement signs. They may have already taken care of this.
- 409. Well, I can't think of anything except that the signs going into the Dallas/Ft. Worth airport are too confusing. There is far too much information on them.
- 412. No. As far as I'm concerned they are really doing a good job. But I think we should probably have a few more, like around the airport.

APPROVING COMMENTS (N=104)

3. No problems.
16. We have real good road systems.
21. I find them very good.
24. No, not really. Everything is there on the signs.
26. I'm satisfied with them. I didn't know there was a problem.
27. Some of the questions are a little misleading. Neutral was the chosen answer because there were two possibilities. Texas is one of the better States for road sign quality if you have the time to read them.
34. Here in the valley, they're fine.
35. They're fine, most of them.
37. Pretty pleased. Depends on the area as far as signs and how adequate they are.
40. Texas is easier than other States.
43. It's OK.
47. Seem alright to me.
48. Think they're fine.
51. They're better than most States. Need to be clearly marked.
53. They're fine.
56. Alright with me.
60. Actually, Texas does a pretty good job of it. The cities do a poor job.
70. Just be sure you get them up. The ones that are up are great. Just be sure that they are there.
78. Yeah, it seems some other States don't have good signs. I like the signs here.
83. We have the best highway system in the nation.
84. Overall, they're pretty good. Should give mileage and advance warnings. They're pretty good.
104. State signs on highways (major and interstate) keep the driver better aware of the road and where it's headed than city highways.
110. They are fine.
111. Don't do anything with them. I'm used to these.
122. They are a lot better than most States.
123. Do a lot of traveling, have no trouble getting around.
126. Overall, pretty good.
128. They're adequate and that's it.
136. Everything is fine.
137. Never had any real problems.
139. I think they're fine, no problems at all.
158. The places I've been, I've had no trouble.
159. No, not anything. Fine with me.
160. No, I think everything is okay.
161. I think they are fine. No problems.
163. No, they are fine.
167. Not offhand. Pretty fair all around.
169. Pretty well marked if people will pay attention to it.
171. No, I think they are fine.
173. I drive for a living and I think they are fine.
174. They are adequate as a whole in Texas.

182. No, as a general rule I think Texas does real well with their information.
190. I thought they were better than other States.
191. No. Everything is OK.
192. No, can't think of anything. I think they are fine. They do a very good job.
196. Not really. I hope they get their act together. Sometimes are confusing.
197. No, I guess not--never been lost.
203. Basically, they're OK but we need to fine tune them a little bit.
210. Pretty good compared to other States. Probably spend enough money on the signs already.
212. I'm very satisfied with the freeway signs.
213. The system is pretty good.
218. Texas signs are great. I've driven from the west coast to the east coast and Texas signs are the best.
221. I think they are very good.
222. I think they are good, especially for tourists.
224. No. I'm pretty happy with it. We're doing pretty good compared to other States.
230. They are generally acceptable.
233. Have no problem with freeways.
241. No. I think they are pretty good.
245. I think that every sign is fine for me.
246. Never been lost--everything is fine.
247. No, I really don't have any problem with signs.
253. Everything is fine.
257. Is pretty good.
261. They're fine. I wish they'd clean up some of their other signs.
263. I've never had any trouble.
269. I appreciate the fact that they keep them updated.
270. No. I think Texas has the best roads in the State.
271. No. They are fine.
277. I think they're great.
279. No, Texas has the better signs and freeways.
281. I am satisfied with the signs.
282. For me they are OK.
283. No. Everything is pretty much active.
290. I'm pretty satisfied. We do drive on the Houston freeways a lot.
292. Everything is fine.
294. No trouble.
297. They're doing a great job.
298. No. I think they are very adequate.
302. They are pretty good and shine in their light.
304. No, I,m happy with the system.
307. No, I think the Highway Department is pretty good.
313. No. If people ever drive in Louisiana, they would thank God for Texas signs. Our signs are big and adequate.
318. I like the way they are doing it.
324. Doing a good job.
326. Not really because everything is there.

- 328. Our signs are pretty good.
- 329. They're fine.
- 334. No, they know more about it than I do so why should I open my big mouth at all.
- 336. No, they're pretty good.
- 337. They do a good job.
- 346. Everything is clear for me.
- 350. Everything is fine.
- 365. Improve them a little bit, please. Happy they are inquiring.
- 367. Everything is OK.
- 368. All the signs I see are perfect.
- 369. Everything is fine.
- 378. It's good the hazardous cargo signs went up. New signs should be adequate.
- 382. Satisfied with freeways. #2787--Spanish?
- 384. No. They are adequate.
- 385. He knows all the highways of Texas and likes them. #2792--Spanish?
- 392. I think they are doing the best they can.
- 393. They all suit me.
- 411. Well, they are positive. I haven't had any bad experiences.
- 413. No. It's a good thing we've got them.

**ARROWS (N=3)**

- 49. Arrows are hard to see from a distance for the correct lanes.
- 127. I guess in Houston you have four lanes and all the arrows and signs. We need to have one arrow for one lane instead of eight arrows for four lanes.  
Need more reflectors for the arrows.
- 239. Arrows are sometimes leading you in the wrong directions.

**COLOR OF SIGNS (N=8)**

- 6. Color code multiple directions on signs.  
Map of freeway system at city limits.
- 44. Change to black and white. Green blends in.
- 120. Maybe they could change the color to blue.
- 199. Yeah, they should change the color to blue.
- 249. Each direction--north, south, east, and west--should all be a different color statewide.
- 251. Don't change the color green.
- 280. How about another color--orange or yellow.
- 399. Need to change color to a darker color like brown or gray because it's hard to see them in the day.

**CONSTRUCTION (N=21)**

- 5. Work on signs at night instead of holding up traffic during rush hour.
- 13. Only that they should be further away from lanes during construction. They take the signs down and they should immediately put them back up when they finish.

- 29. Give motorists plenty of time to change lanes for construction. Use overhead signs for changing lanes. Easier to read.
- 87. A few more during times of construction.
- 103. Too much construction during business hours.
- 118. Does not give adequate warning, to slow people down in major construction. States need to have a program that a courteous driver is a safe driver.
- 154. Don't know of anything. Problem is all the construction.
- 156. In construction, they don't give you enough warning. Signs are placed too close to the exit signs.
- 177. The construction is always going on in San Antonio. Too much construction. The construction is frustrating.
- 181. Repairs are done too slow. They go on for years. Texas highways have main arteries torn up at the same time, which makes it hard to find alternate routes.
- 184. Sometimes whenever there is construction work, they need to have a brighter color around it, so that people can see it.
- 194. During the construction give ample caution signs.
- 201. Construction signs are not given soon enough, need earlier warning.
- 202. No, just when it is under construction is the only confusing time, and that is a lot. That's it.
- 214. No. There's just too darn much work going on. It's hard to get around most of the time.
- 217. No. The construction streets that are closed should be posted early.
- 266. Too much construction on the highways ties up traffic at the wrong time of day.
- 267. I-35 in Ft. Worth, under construction. They are putting up overhead signs letting you know if its blocked or closed--a good thing.
- 295. Sometimes during construction, they don't put in enough signs far enough ahead of time telling them where to go.
- 341. The construction, especially in El Paso, takes a long time.
- 405. Main freeways posting off signs while under construction. The main problem I have is like with lane changes, you don't have enough time. When a road is under construction, the road level is not the same like when the shoulder drops off. It would be nice if they could minimize that somehow. Should not allow roadways off the highway on curves.

**DISTANCE BETWEEN CITIES (N=10)**

- 10. There isn't enough information about distances between cities on signs.
- 23. More distance signs, next 3 or 4 towns listed.
- 30. Put signs on the side of the road of mileage like Louisiana has, so you know how many miles you have driven in the State.
- 32. We need more signs that indicate the miles between the towns.
- 89. More destinations (how many miles left) put on signs.
- 96. Change destination signs to show intermediate cities.
- 107. Need more distance between place signs.
- 130. More mileage signs, especially between Austin and Dallas.



- 204. Too long in between mileage signs between cities.
- 268. Generally, distances to the next two or three cities would be more helpful instead of the signs that just give distances to the upcoming city.  
When highway numbers change, they should have more signs that educate the driver of the change and don't assume that he knows it.

**EXITS (N=7)**

- 28. They should have more wider exits.
- 39. Longer entrance and exit lanes.
- 100. The exit markers are terribly inconsistent.
- 165. Would like to see mile markers coincide with exits.
- 296. The main problem is exit signs--need to be consistent in placing them.
- 322. The only complaint is that the enter and exits are too close together.
- 351. Exits need to come off the same side of the freeway.

**GENERAL CONFUSION/CLARITY/ABILITY TO READ (N=11)**

- 1. They don't clarify the directions enough.
- 2. Sometimes the exits resemble highways, which can confuse the driver.
- 11. They wouldn't be as confusing if it weren't for the lack of billboard regulations.
- 79. I would say change the design (lettering and colors). Hard to distinguish all of the signs.
- 179. Need to make things clearer for tourists who are not familiar with Texas freeways.
- 273. They're not uniform throughout the State. Need to be clearer, positioned higher.
- 289. They are confusing. That's it.
- 321. Traffic is congested so it's hard to read the signs.
- 357. Has trouble reading, too far away. #2814--Spanish?
- 383. He is from south Texas, close to Laredo, and they have not internationalized enough of the highways. Not adequate enough. Hard for a foreigner to find his way, especially if he does not read or speak English. And does not have signs in kilometers, which is important. #2790--Spanish
- 397. Need better directions.

**GENERAL NEGATIVE (N=4)**

- 310. Some of them are stupid.
- 356. Worse than most third world countries. Potholes are terrible. Worst roads in the country.
- 221. I better not comment. I've seen a few other States that have better signs.
- 109. Signs like "Don't Mess With Texas" are a waste of money and a good useful road sign should be in it's place.

**HOSPITAL/SERVICE SIGNS (N=7)**

- 15. Hospital signs should be larger and better notated.
- 31. I guess more signs directing to hospitals.
- 94. Hospital signs are inadequate, and don't give proper direction on how to find the hospitals.
- 235. Special signs like airports and hospitals should be more visible.
- 272. The only thing I know is there should be more hospital direction signs.
- 274. Need to be more signs to hospitals.
- 340. Put hospital signs and the name of the hospital up on signs.

**INACCURACIES (N=7)**

- 42. Need to get it straight. Sometimes when freeway branches off, incorrect information on direction.
- 81. Well, I think they have enough signs but they don't put the proper directions on them. Incorrect and inaccurate information sometimes.
- 82. East and West is sometimes really North and South.
- 105. Exit signs are sometimes wrong.
- 113. Need to be more accurate. More detail.
- 125. They don't have any mile markers and the ones that they do have are not accurate.
- 311. Sometimes things are misspelled on them.

**LARGER LETTERS/LARGER SIGNS (N=7)**

- 41. Make them larger. You can not see them if you are behind an 18-wheeler.
- 170. Enlarge the letters so you can read them at a greater distance.
- 227. No. They might be bigger for people who can't read them.
- 259. The print could be larger.
- 320. No. Make the letters bigger.
- 348. Need to make the lettering bigger on the signs.
- 380. Letters on the signs should be larger. Nothing else.

**LIGHTING/NIGHT VISIBILTIIY (N=25)**

- 61. They need to be better lit at night.
- 62. A little more reflective at night.
- 66. Put lights on the freeway so the signs are easier to see, especially I-35.
- 98. Some places need more light on the guide signs. More light on the freeways.
- 102. Signs aren't as visible at night.
- 106. Need to be little easier to read at night. Need more lighting on signs at night. Possible more signs--let you know ahead of time.
- 118. Need to put lights over signs so you can see them.
- 138. During the nightttime the green guide signs are very difficult to read, by the time you see the sign it's often too late.

- 143. Sometimes they get faded out and they are hard to read at night.
- 150. Need more visible markers that glow on the lanes--bump markers.
- 193. I wish more of them were lit at night, particularly in bad weather.
- 225. I think they should be lighted more at night.
- 262. Hard to see at night.
- 276. Need to do something for night drivers, need to be more luminous, hard to see at night, especially far away. Need to be brighter.
- 284. Can't see them real good at night.
- 293. Better lighting at night. Use more of the reflective materials in darker areas.
- 300. Well, not really. I think the way it is now, if you plan ahead you will always be OK. I usually have problems with the lights of freeways.
- 305. Maybe a little better lighted.
- 309. I wish they would put the glitter things on all of them so we can see them all at night, especially exit signs.
- 325. Hard to see at night.
- 366. Need more light on signs during the night.
- 370. In the dark, I can't see the signs until the reflective lights hit them.
- 372. To me, I think they should have more lights at night. That's it.
- 381. I think that signs should be florescent so it would be easier to notice during the nighttime.
- 406. Some are hard to read at night.

**MISCELLANEOUS (N=20)**

- 7. Sign telling slow drivers to use right lane.
- 9. Too many highway patrolmen, and they're not doing a good job.
- 57. Miles by the tenths of miles is a good idea.
- 64. I think the main reason I got lost was because of fatigue.
- 65. The cops that mess with the dump trucks should mess with the people in cars. I drive a dump truck.
- 67. Make freeways bigger so traffic loads go down.
- 72. We should do a survey regarding suburban signs.
- 116. Well, some way you could be warned of an accident ahead with flashing lights or something.
- 164. Don't mess with Texas.
- 168. I think they were designed for military purposes. They don't go very straight. Don't think all were designed properly, especially US-59.
- 176. Nothing, except the need to get a person who is not from that city to check their signs.
- 223. I don't think the problem's the signs. It's the roads, the way they're planned.
- 237. Really nothing. More changeable ones.
- 242. Show if there is more than one lane. Show that there are two lanes instead of one lane because you could kill yourself trying to get there--especially the ones that are turning.

- 308. The cost is way too much.
- 355. Pictures are great, especially for small children and the less educated. Need more visual aids.
- 359. Nothing, other than the traffic lights in many places take too long to switch, and causes more congestion and traffic problems on the Farm to Market roads. Nothing else.
- 371. The roads that have the red light to one side and the yellow to the other--the older people don't know which light pertains to them. It is very dangerous.
- 388. The only problem is the maps of Texas need to have directions (North, South, East, and West) on them.
- 404. I just don't know my directions. I don't think it's the signs.

**MULTIPLE COMMENTS ON MULTIPLE TOPICS (N=11)**

- 14. On certain roads, on long stretches of isolated country with no towns, there should be phones every mile or 2 miles in case of emergency breakdown. Also, there should be vegetation control so the signs can be read easier. There should not be any trees or tree limbs or underbrush blocking the signs.
- 76. Repair on the freeways should be done at night when traffic is light.  
Entering and exiting ramps should be made safer--no curbs or gutters.  
Warn motorists sooner with overhead warnings, especially for RV's  
More overhead signs further down the freeway, graduated warnings.  
Roadside signs are more dangerous than overhead signs.
- 92. More than one route isn't shown.  
Need more warning for an exit off of freeways.
- 119. Be uniform--exiting right or left. Previous warning with light.  
Ft. Worth--East side needs better markings and instructions.  
Need clarification for multiple exits for same town or city.  
Spring/Stuebner Exit--have to get on freeway to cross railroad track.  
Put road signs on overpasses and bridges.  
Large block number signs on Greenville.
- 144. They need to put the names on the freeway signs.  
They need to upkeep the freeways. The elements have affected the highways and they need to fix them.
- 145. More information sooner.  
Airports--maps help. There are no appropriate signs for airports.  
Cleveland exit going North in Houston should say North Houston. Cleveland is a small town.
- 151. Texas has the best highway signs.  
Need to have more of the destination signs closer together.  
Also, the highway number signs--more and closer together.
- 312. Do they have to be green? The signs aren't repeated enough and they should be far enough in advance so that you can get in the right lane, especially where there is heavy traffic.

- There also needs to be someone who travels on the freeways to help people who are stranded, especially where there are no service stations around.
327. They ought to put more signs that say "no more littering," and maybe a phone on the road in case people get stuck and need to call someone. Get the construction done quicker. That's it.
  339. I am for progress but there is still a lot to be desired as far as the freeways go. With the taxes we pay we could have far more information than we do. Signs should be closer together than they are. And use both names and numbers.
  402. For one thing, night speed limit signs are in black. They need to be in a different color to stand out. In Dallas they need to tell the motorist whether the exit is on the right or left, because usually they are one the right, but some are on the left.

#### **NAMES AND NUMBERS (N=12)**

55. No--just I feel real strong about the part where you use both names and numbers on freeways.
75. The only part I have any trouble with is the names and the numbers not coinciding. They should use the name and number.
166. The names and the numbers need to be labelled together, correctly.
172. The only time they become confusing is when they have several different numbers.
195. They need to continue to keep numbers and names on the freeway signs, the same the whole way through the freeway.
198. They should take the names of streets off the signs.
205. No, they need to put the number and name on the freeway.
252. Need to put the common names on the freeway signs, such as Stemmons Freeway in Dallas.
286. The Highway Department needs more funds. Too many names for the same freeway.
287. Need to go by numbers in the city and on the freeway for the same street.
333. It's very confusing that freeways have two to three names.
376. It's a real help for the signs to carry both the name and the number of the freeway. It's a big help for the freeways to be named after the cities they will eventually lead to, an example of which would be California.

#### **PLACEMENT (N=9)**

80. Some signs are too high and on a sunny day the glare prohibits you from seeing the signs.
86. The problem is that the signs are there when you come into town, but then they are not there when you need to exit. Lanes disappear with no notice. People who make up signs don't travel.
152. Better than some of the other States. Can't see some signs through the traffic because they are too low. Trucks cover the signs until it's too late to get there.

- 155. Sometimes they lead you in the right direction but there will be a sign or two missing or you can't see them.
- 157. Sometimes they are placed weird, or in the wrong place, causing confusion when you have to exit or change lanes. Mostly Dallas seems to misdirect you.
- 189. I wonder why they don't use the overhead bridges to indicate lane choice where they're available. Why don't they continue the interstate number so that the out of state driver knows they're going in the right direction. Indicate the right side of the freeway.
- 208. I'd like to recommend single poles with signs that have some kind of spring loading system at the base so that when they are run over then they'll pop back up so that they don't become a hazard for other motorists at night.
- 398. I like the overhead sign better than the ones on the side of the road.
- 407. Sign placement isn't consistent. They are sometimes overhead and sometimes on the side of the road. They all need to be in the same place.

**SERVICE/LOGO SIGNING (N=5)**

- 95. Should show what services are available in next exit (food, hotel, gas) on exit signs.
- 206. They just aren't thorough enough in some instances as they are in other States. Some States give company names of gas stations or motels and sometimes restaurants.
- 211. I question advertising McDonald's. If you put one restaurant you should put them all.
- 220. Appreciate signs for campers, where the camper parks are. In other States they have signs close to town that say which stations they have, has logo and the turnoff, same with restaurants on the outskirts of town.
- 315. I like how some States put what services are available at the next exit.

**SIGN FREQUENCY/AMOUNT OF INFORMATION (N=16)**

- 38. Need to be more detailed.
- 99. Signs need to give more instruction, especially around the new toll road in Texas. Need more signs, not just more information on one sign.
- 114. The only thing I can say is to add more. Texas has fantastic highways.
- 117. No, just have more of them. Heavy traffic makes it hard to get over. Numbers and names would be good on exits.
- 142. You caught me off guard. In some places there's enough signs, in some not enough. Well, I think my suggestion is there should be more signs so that people can get off in time.
- 149. Need to have better indicators of destinations. Need to have more destination signs for major cities.
- 226. Not that I can think of. Sometimes in cities it's confusing because there are so many signs.
- 228. The infrequency of signs is more of a problem than anything.

- 243. No. Maybe just more sometimes. No, nothing.
- 248. On some signs there is too much information, and it's hard to watch your speed, other cars, and read the information on the signs.
- 258. They need to improve the guide signs, need more signs.
- 330. No. Well, I think they need to have more towns listed on the signs.
- 335. I think there should be better directions from central downtown areas to freeways (on ramps) at least from major locations in the city, i.e., stadiums.
- 344. Basically, I think they're doing a good effort as far as keeping them clean and understandable. I just think they don't have enough information, like whether you are going east or west.
- 363. Well, add more information in the rural towns.
- 401. In some instances there is too much information, the reason being people are driving 60mph and are trying to read a paragraph. Basing my opinion on being in France for 6 weeks and not speaking French, I could read road signs. They seem to put one thing on them at a time.

**SIGN MAINTENANCE (N=8)**

- 36. Some of the signs need to have the brush removed around them. They are hard to see.
- 215. They should keep them cleaner. People write on them.
- 240. It would be nice if they would keep the interstate the same. Need to replace the ones that are fading.
- 319. Some of them are so out of date, they need to be replaced or made brighter.
- 347. Some of the signs look very oily and the signs need to be updated because of the heavy traffic. Maybe maps should be updated.
- 353. Some signs are destroyed or not in good condition.
- 373. Put signs back up that have been knocked down.
- 387. Sometimes you can't see the signs because there is something hiding it.

**SPECIFIC EXAMPLES (15)**

- 12. In Arlington the on and off of freeways are ridiculous.
- 17. Houston was very confusing (many years ago).
- 22. Noticed that in San Antonio the signs were not clear enough on the North or South directions.
- 33. Houston is the only city with major interstate problems in Texas out of all the major cities.
- 85. They don't tell you in Dallas that Loop 12 and Northwest Highway are the same road. I-35 and LBJ are the same road. Everything is double named and you don't know what to look for.
- 88. The European method is better. They have signs everywhere.
- 108. The road signs in Dallas don't make any sense.
- 115. I-37 going South from San Antonio, there are no marked exits for the Rio Grande Valley. It's very ambiguous as to where the driver should exit. Very confusing.

- 132. San Antonio is the easiest place to get around in. There are not enough signs during road construction. We have pretty good roads in Texas.
- 140. No, I can't say that there is. The freeway signs in Houston are good except when they are not lighted as when there is construction. Temporary construction freeway signs on the southwest side on Houston were very confusing and are not soon enough. Signs were not visible for the Freeport exit.
- 147. Hardy Tollroad in Houston--hard to find.
- 153. In Houston, on Loop 610 on the southwest side, sometimes it is very confusing. Don't know if you're on the west or on the south.
- 306. Yeah. I'm a construction worker and I travel all over the country, and Texas has the best information on the signs. My only gripe is the Loops. They need a better system on giving directions on that.
- 314. No. Most of the time I can read them but Ft. Worth signs are very confusing.
- 408. No. The only place I ever have trouble is Dallas.

**SPEED (N=6)**

- 20. The speed limit signs change and you aren't given any warning. They are hidden.
- 183. I think the speed limit should be faster than 55 and shoulders should be wider, and more lights like out in the country.
- 187. Raise the speed limit.
- 200. Eighteen wheelers should have 45mph and stay to the right lane within the city limits. Would save a lot of problems.
- 303. Not really. As far as I'm concerned they are adequate. Only that they would make it 55 during the day and 65 at night.
- 410. No. Let it ride. I think they should either raise or enforce the speed limit.

**YIELD (N=11)**

- 8. The people entering the highways from the service roads should be required to yield for the cars on the highway.
- 46. Need more advance notice for yield signs coming off the freeway.
- 91. Yield signs are a problem. When you have to yield in the middle of a street for the off coming traffic, it is ridiculous. There is a long enough feeder road.
- 129. No, the only thing that is confusing is the yield signs on service roads and people coming off of the freeway have the right of way.
- 141. Yeah, I took my driver's lessons. I'm from Chicago and no one knows what Yield is, either Stop or Yield. We have merge up North to slow down.
- 238. The feeder exits and entries are sometimes hard to use. The yield signs aren't being used by the cars on the feeder road. This should be considered.



352. The on ramp where people enter the freeway refuse to slow down and yield to the cars already proceeding on the highway-- there should be a yield sign to slow down the incoming traffic, and to lessen near accidents.
358. Sometimes the yield signs are missing on the access roads off of freeways.
374. No--well, I don't like the access to the freeway. The system of yielding to enter the freeway is very dangerous on a two-way access road.
379. Yield signs are ineffective. The people who are required to give the right of way refuse to do so, just making it hazardous for the driver who has the right of way. Everything else is OK.
389. Yield signs are really bad off of the freeways. Many people don't realize that you need to yield on access roads. They need a blinking light. No one realizes you need to yield.



**APPENDIX D**

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## APPENDIX D

### INSTRUCTIONS FOR INFORMED SURVEY

#### Use Informed Sample Sign

In a moment I am going to show you a series of diagrammatic signs. You may not have seen these types of signs before, so I will explain what they mean (display informed sample sign). Notice that some arrows have two heads. This means that the driver has an option of either continuing or exiting from the lane indicated (may illustrate from the informed sample sign). Notice also that the number of arrow shafts equals the number of lane on the highway at the place of exit. The first arrow stands for the first lane on the left; the second arrow stands for the second lane from the left, and so forth.

Now on rare occasions you will find more arrow shafts than lanes on the highway, at the place you see the sign. This means that another lane will emerge on the right very shortly, but before the interchange the sign is trying to show. There should not be another sign on the same sign bridge as the diagrammatic sign. However, if you do see one in the extreme right or left lane, simple ignore it in associating arrows with lanes.

Okay, now that you know about the diagrammatic sign, I am going to show you a few more diagrammatic signs. You will be given a series of questions about which lane or lanes t be in to take an exit to a certain route or to continue on the route you are presently on. Remember what I told you about counting arrow shafts and about two arrow heads meaning you can go either way.

Let us see how you do.

