TECHNICAL MEMORANDUM

DIAGNOSTIC STUDIES OF HIGHWAY VISUAL COMMUNICATION SYSTEMS

HPR-2(108)

PILOT SITE NUMBER 3

IH-5 (SANTA ANA FREEWAY) LOS ANGELES, CALIFORNIA

TM2(108)-3

INTRODUCTION

The "Diagnostic Studies of Highway Visual Communication Systems" research project has been designed to: (1) review the current practices in visual communications with the automobile driver using a multi-discipline team approach; (2) identify the deficiencies in these practices; and (3) recommend changes in the existing standards. Pilot studies were conducted in three states (Arkansas, California, and Maryland) in order to develop the diagnostic study techniques and to acquaint the members of the Project Policy Committee with these procedures. This memorandum is a detailed report on the results of the diagnostic team review of sites within these states. The opinions expressed are those of the diagnostic team and not the recommendations of the research staff. The results of pilot studies and the improvements recommended by the staff will be combined as an interim report to be published in the near future.

DESCRIPTION OF STUDY PROCEDURES

The diagnostic evaluation of the study site was conducted using both the driver interview and the open-end questionnaire techniques. Each member is asked to drive a route following the instructions of the interviewer. The route included short sections on adjacent facilities as illustrated in Figure 1. The driver was asked to comment on the roadway section as he drove, and these comments were recorded. The interviewer asked questions only as necessary to keep the conversation productive. At the conclusion of each driving phase (night and day), the subject was asked to complete a questionnaire. The interviews and the comments on the questionnaire are the basis of the material presented in this memorandum.

STUDY SITE CHARACTERISTICS

Pilot Site No. 3 is located in Los Angeles and Orange Counties, California and extends from Buena Park to Anaheim. The study section is a part of Interstate Highway 5 and is bounded by Disneyland on the south end. The study section is approximately seven miles in length.

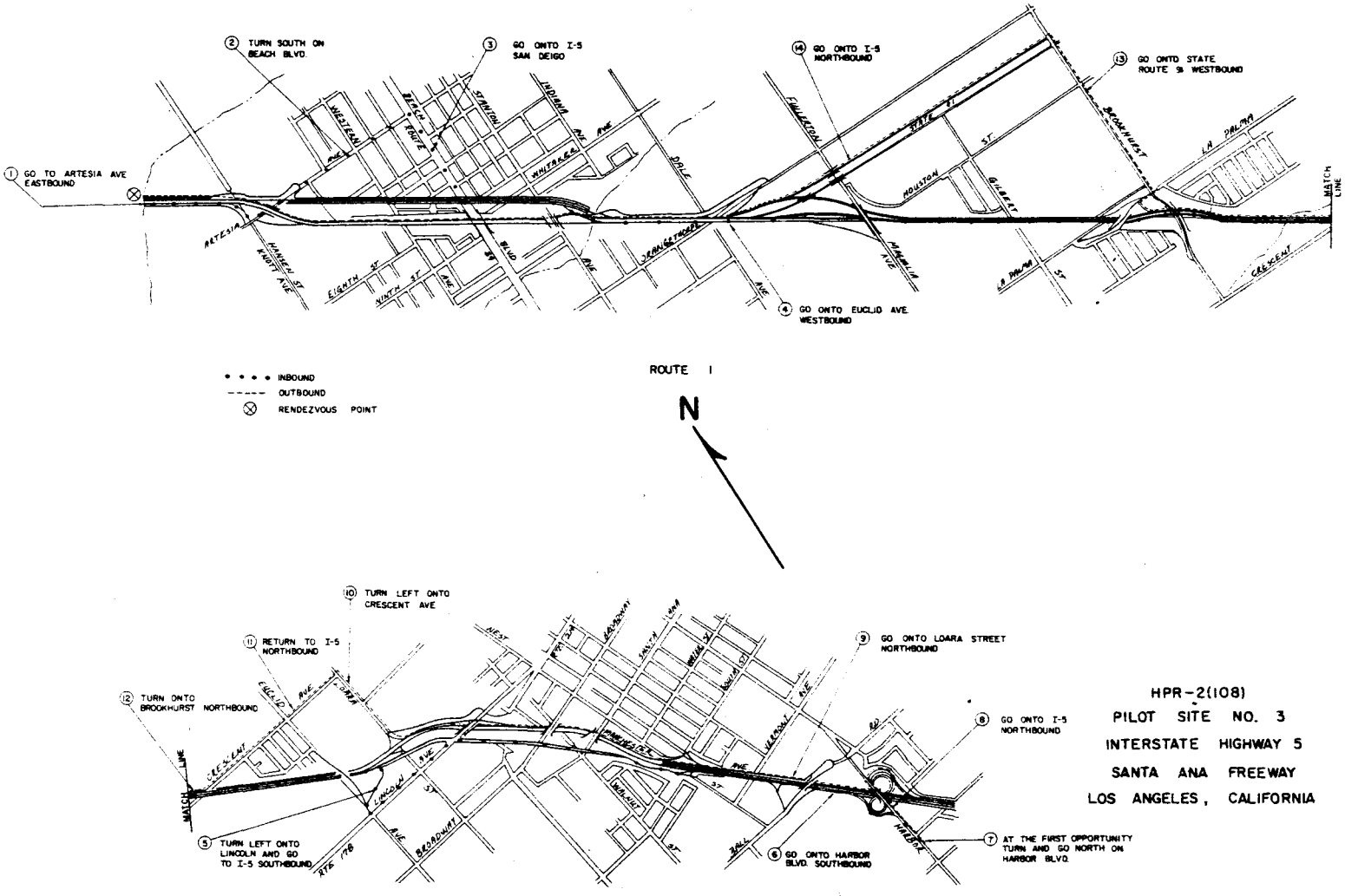
The basic roadbed consists of a six-lane divided, controlled access freeway with paved shoulders. Riverside Freeway originates at IH-5 between Buena Park and Anaheim and proceeds East to Riverside, California. Numerous interchanges of varying geometric designs are prevalent along the study section. The study section has both right and left exit and entrance ramps.

Directional signing is located both overhead and on the right.

The average daily traffic on the Santa Ana Freeway varies from 90,000 vehicles per day at Anaheim to 132,000 vehicles per day at Buena Park. The posted speed limit is 65 mph.

The 1967 accident record was a total of 432 accidents of which 172 resulted in personal injury. There were six fatal accidents. The predominate type of accident was the "rear end" type accident with the "hit object" type being the second most prevalent cause of accident. Most of the accidents occurred during hours of darkness. The apparent accident rate is 1.70 accidents per million vehicle miles with a fatality plus injury rate of 0.81 per million vehicle miles. These accident and fatality plus injury rates are slightly higher than what might be expected with the associated traffic volume.

A strip map of the study section is presented in Figures 1 and 2.

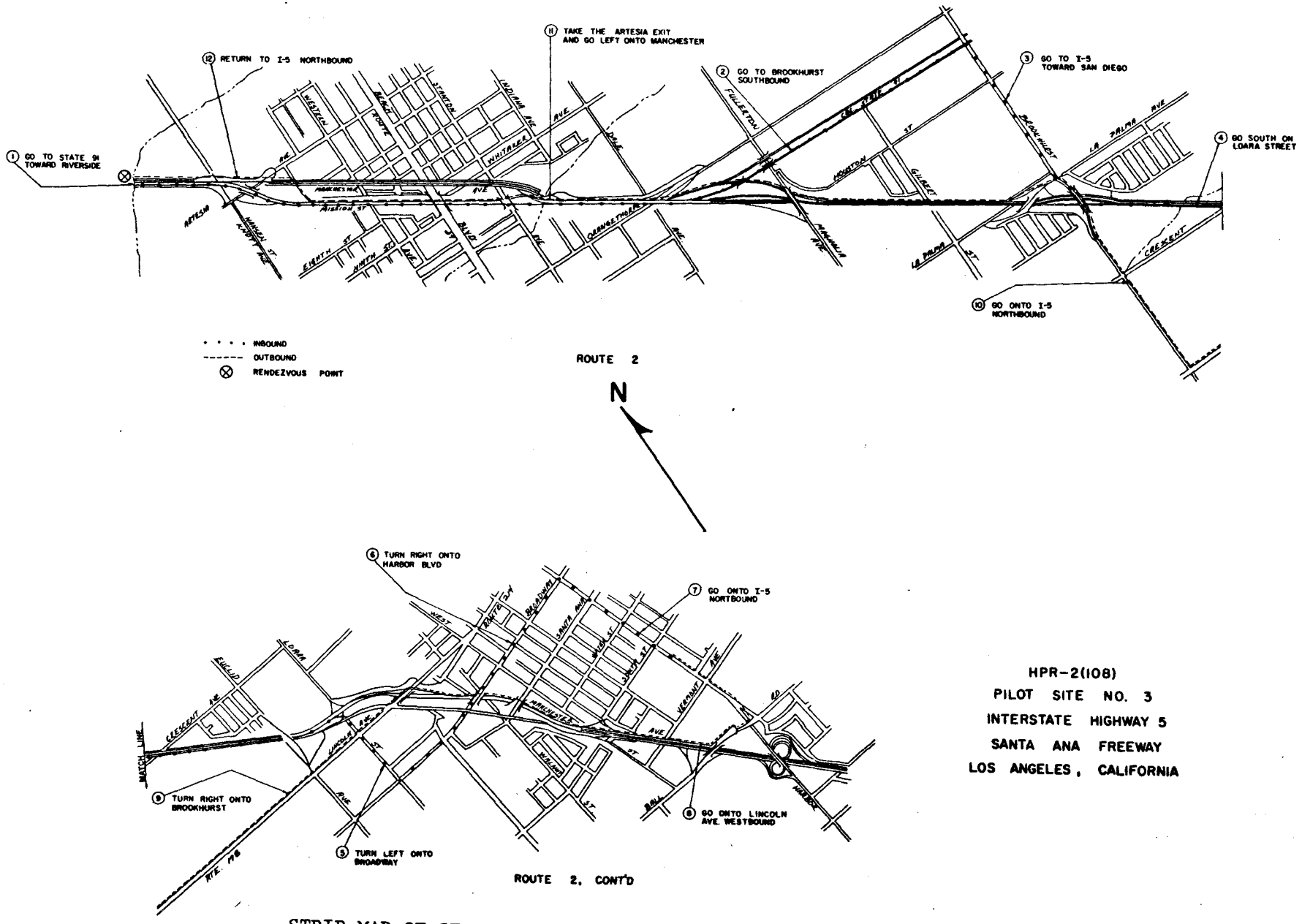


ROUTE 1

ROUTE 1, CONT'D

HPR-2(108)
PILOT SITE NO. 3
INTERSTATE HIGHWAY 5
SANTA ANA FREEWAY
LOS ANGELES, CALIFORNIA

STRIP MAP OF STUDY SITE 3 INDICATING DRIVING ROUTE 1
FIGURE 1



HPR-2(108)
PILOT SITE NO. 3
INTERSTATE HIGHWAY 5
SANTA ANA FREEWAY
LOS ANGELES, CALIFORNIA

STRIP MAP OF STUDY SITE 3 INDICATING DRIVING ROUTE 2
FIGURE 2

DIAGNOSTIC TEAM REVIEW

HPR-2(108)

PILOT SITE NO. 3 I-5 (SANTA ANA FREEWAY), LOS ANGELES, CALIFORNIA

GENERAL

The team review of Pilot Site No. 3 indicated that the roadway design is typical of the early stages of freeway development in this country. Narrow structures, ramps that are difficult to locate, and lack of contrast between the traveled-way and shoulder were the items most noted by the diagnostic team. The inconsistency in route designation and inadequacy in street name signing were also frequently mentioned by the team. Consideration should therefore be given to improving these items, where possible.

SUGGESTED DESIGN IMPROVEMENTS

The diagnostic team suggested several design improvements that would be possible without complete redesign of the facility.

Team members felt that the majority of the roadside signing could be changed to overhead signing. Also, some of the overhead signing could, perhaps, be placed on overpass structures and thus eliminate the hazard presented by the sign support.

Vegetation, especially along entrance and exit ramps, caused some concern on the part of team members. It was suggested that vegetation be removed in areas where visual contact with the roadway ahead is obscured by vegetation.

Several team members suggested the lengthening of deceleration lanes at exit ramps. Since most of the exit ramps were designed for low exit speeds, the longer deceleration lane would provide for a smoother transition from traveled-way speed to exit ramp speed.

Although the closeness of bridge piers to the main lanes and the vertical alignment of the main roadway were often mentioned by the team members, these items would involve major reconstruction and their improvement would not be feasible at this time.

SUGGESTED OPERATIONAL IMPROVEMENTS

Signing - the most critical problem of signing identified by the team was the inadequacy of local street name signing which is the responsibility of the individual city governments. However, this inadequacy did produce a breakdown in communication between the freeway and local street system.

Team members suggested some improvements in freeway signing. The use of arrows on directional signing caused some confusion; especially the use of slanted

arrows, up arrows and down arrows. It was suggested that the arrow designation on directional signing be reviewed for clarity and uniformity.

The diagnostic team also suggested that in the case where a single exit ramp served several local streets, the directional sign on the freeway indicate all of the local streets connected to the end of the ramp. The use of a directional sign near the ramps' end was suggested as a means of designating direction of travel from the ramp to the local streets. This type of signing could also be used to direct travel to a major street that parallels the freeway by using a "TO STREET" designation.

The lack of consistency in route designation was also noted by the team. The mixing of IH-5 route designation and Santa Ana Freeway signing have the interstate route shield placed adjacent to the name designation. The use of more route confirmation markers was also suggested by the diagnostic team.

Team members were concerned about the lack of an adequate "trail blazer" system on the major streets interchanging with the Santa Ana Freeway. The "trail blazer" system should be reviewed for its adequacy.

Pavement Markings - at night, contrast between main lanes and shoulder was practically non-existent. The use of an edge line is suggested as a means of providing positive separation of the main traveled-way from the paved shoulder. This edge line would also serve the purpose identification of the exit ramps.

Delineation - the exit ramps were difficult to identify at night. Team members felt that the use of an edge line and ramp delineation would aid the driver in identification of the exit ramps.

Illumination - the illumination provided by vehicle headlights was not sufficient for safe operation of the facility. The feasibility of continuous illumination or safety illumination should be investigated as a means of increasing nighttime safety on the facility.

GENERAL SUMMARY

The majority of the suggested design and operational improvements on the study section could be accomplished without major reconstruction. Since the study section was designed using early freeway design standards, good signing and delineation are necessary to compensate for inadequate design. The suggested improvements should be taken into consideration as a means of improving the operational characteristics of the study section.

LIST OF APPENDICES

APPENDIX "A"

DESCRIPTION OF THE STUDY PROCEDURES

The diagnostic evaluation of a study is conducted in four separate phases:

a. Preliminary session
b. Day driving phase
c. Night driving phase
d. Diagnostic team review

The preliminary session is designed to introduce the interdiscipline team to the objectives of the study and to explain the study procedures. The diagnostic questionnaire is presented to the team and discussed with them. The explanation of the questionnaire concentrates on the fact that it is not designed to obtain a particular response from them, but rather it is designed to direct their thinking into a particular area and thus elicit comments which the individual might care to make.

The day phase of the on-site review begins on the afternoon of the first day of the study. The diagnostic team members are transported to the rendezvous point at one end of the study section. Two cars are used in the driver interviews and, upon arrival at the study site, the number one drivers begin their driving runs with the other team members remaining in a car stationed at the rendezvous point. The driver is given instructions well in advance of the required maneuver, and his comments regarding the communication systems provided are recorded on a portable tape recorder. The comments are tied to the roadway through reference markers located at the roadside. The marker numbers are read and recorded on tape as each is passed. After completion of the driving run, the team member moves to an observer position, and the second driver begins his driving run. A different route is driven by the second driver. Errors made during the driving phase are corrected as soon as it is practical to do so. When both the driver and the observer runs are completed, the team member is asked to complete the diagnostic questionnaire on the daylight phase. The process is repeated until all team members have served as a driver and as an observer.

The night phase is conducted in the same manner as the day phase and is held on the evening of the first day of the study.

The morning of the second day of the study is devoted to a team review of the study site. Problem areas are identified, and suggestions regarding possible solutions are discussed. The team is not asked for a consensus of opinion on the improvements which should be made on the study site. Rather, all ideas are explored regardless of how many or how few of the team members might support them.

The comments made on the diagnostic questionnaire and the summaries of the driver interviews are the basis of the Technical Memorandum on the study site, which is the formal report of the opinions expressed by the team.

APPENDIX "B"

SUMMARY OF DIAGNOSTIC QUESTIONNAIRE

PILOT SITE NO. 3 - I5 (SANTA ANA FREEWAY) LOS ANGELES, CALIFORNIA

Question: Did you, as a driver, lose visual contact with the roadway at a distance less than your desired distance at any point along the vehicle's projected travel path?

Answer: Yes	No	Comments
x		Roadside development at Euclid. Roadside development at Harbor. Roadway vertical alignment at Artesia. Roadside shrubs and crest of vertical curve obstructs view of intersection geometrics. Cardinal direction not always apparent.
x		Highway structures and roadway vertical alignment.
x		Ramp on crest vertical and horizontal ramp curvature in Harbor.
	x	
x		Highway structures and roadway vertical alignment. Can't remember specific locations, however, the structure supports on the freeway and the poor sight distance to the interstate sign at the south end of the test section due to vertical alignment caused some problem.
x		Highway structures - most structures of the old type - no safe shoulders. Roadside development - dark area - foliage, etc., SR 91 - before I-5 merge off-ramp and bridge. Roadway vertical alignment - Lincoln Avenue. These comments could be said of most older interstate sections of highways everywhere in the U.S. We have surveillance teams in each state doing much the same work.
x		Some areas in vicinity of off-ramps. On-ramps - crest vertical.

Question: How would you evaluate the importance of the view of the road, or lack of it, in the driving task?

Answer: /_/ Of little importance /_/ Of some importance

/_/ Relatively important /_/ Critical problem

LI	SI	RI	C	Comment
			x	Critical problem - This is particularly so at the intersection of ramp and surface street, where proper lane selection is critical.
x			x	Of little importance - if I'm not near destination or decision point. Critical problem - if decision point is in close proximity.
		x		Relatively important - especially if in free flow, not important in stop-go.
			x	Critical problem - It is very difficult to overcome lack of good geometry with artificial delineation or direction.
			x	Critical problem - To drive properly and with any degree of confidence one must be able to see the complete roadway for a consideration distance ahead.
			x	Critical problem - particularly at speeds upwards of 70-75 mph.

Question: Do you, as a driver (observer), feel that the points of divergency from the traffic stream are obvious in time for the normally alert driver to make a smooth, natural transition to the diverging roadway?

Answer:	Yes	No	Comment
	x	x	Clear (5) on freeway, but not always so on ramps (2) and surface street.
		x	Having the exit ramp and decel lane as an extension of shoulder was confusing.
	x		On freeways
		x	On arterial Very confusing as to which street you enter from exit ramp and short storage for high volume turns.
	x		Except for one or two exceptions where gores are not plainly seen due to slight profile changes.

	Yes	No	Comment
		x	On the route driven, several manuevers were made in very short transition sections. If traffic had been heavier, this could not have been accomplished.
		x	Again, this is an old section of highway. New criteria would relieve some of these obvious geometric problems. Sight distance, gore area reconstruction.
		x	One or two off-ramps were not well enough signed; also speed change was too great - i.e., 65-15 in one instance.

Question: Does obscured visibility along the roadway create any noticeable degree of erratic behavior on the part of the driver?

Answer:	Yes	No	Comment
	x		A slowing - braking.
	x		On sharp turn of off-ramps, terminal intersections are often obscure, this was critical in a few cases where proper lane placement at intersection was necessary.
		x	
		x	Visibility is generally good on the freeway, but there are several deficiencies on ramps.
		x	The driver seemed to be very familiar with the area.
	x		Erratic movements such as double lane changes, Poor signing (overall) and not uniform - which necessitates quick sudden decisions for the motorist.
	x		On some off-streets signs were "hidden".

Question: Does the driver appear to have difficulty in maintaining the vehicle within the lane (i.e., does he tend to encroach an adjacent lanes)?

Answer:	Yes	No	Comment
		x	Except on surface street. Raised pavement markers helped considerably on freeway.
		x	

	Yes	No	Comment
		x	Lane width very adequate.
		x	Freeway alignment is generally good, however, many of the ramps have short radius curvature.
		x	Driver had good control of vehicle.
	x		Qualified yes - lane width O.K., however, as noted above, the foreign motorist has problems, (i.e., advance signing is not adequate.)
		x	

Question: Is the normal traveled-way clearly delineated from parking and emergency stopping areas?

Answer:	Yes	No	Comment
		x	Edge lines would have helped on freeways - particularly at off-ramps.
	x		
	x		Except no edge lines which would help on close bridges, gores, etc.
		x	
		x	
		x	Edge line striping poor, but better than not striped at all.
		x	

Question: Does there appear to be any substantial amount of vehicle encroachment on the parking areas?

Answer:	Yes	No	Comment
	x		Some on surface streets and on shoulders at beginning of off-ramps.
		x	
		x	
		x	Except in merging areas. Due to lack of right shoulder stripe and generally black color of pavement, drivers are forced to guide by lane lines

	Yes	No	Comment
		x	Did not observe any, however, I was not specifically looking for this type of encroachment.
	x		Trucks and other large vehicles encroach to a certain extent on the parking areas.
	x		Particularly in off-ramp areas.

Question: Are the roadside hazards (bridge abutments, piers, guardrails, sign supports, etc.) removed a sufficient distance from the traveled-way to insure reasonable safety?

Answer:	Yes	No	Comment
		x	
		x	
	x		
		x	
		x	
		x	
		x	

Question: If "NO", is the hazard visible for a sufficient distance to prevent the drivers being startled by it?

Answer:	Yes	No	Comment
	x		As the driver you know it's there, but does not affect your position within the lane. On surface streets there was some flaring away from power poles located two to three feet away from the traveled-way.
		x	Construction activity in study area was uncomfortably close in one area where lane was being added.
	x		Closed end bridge abutments are too close but generally clear at shoulder and visible during daylight.

Yes	No	Comment
x		Bridge abutments could be moved further away from the traveled-way. Overhead signs could be used to remove some of the existing sign hazards. Again (old road section status) bridge piers too close, foliage too close to traveled-way. The signing is not uniform. The night signing is not adequate; drainage curbing adjacent to the traveled-way.
x		Many bridge piers and abutments were not protected from the traffic, however, I did not think that it startled me.

Question: What do you feel is a minimum safe distance from the outside edge of the traveled-way to an obstruction?_____feet.

Answer: Distance (feet)	Comment
14'	
20 '	
	Depends on speed and degree of control needed plus break-away features. Going out of town a speed zone could be out 30' but entering it should be 5' outside the shoulder. Large destination mileage signs could go out 50'.
20+ Feet	
20 Feet	
30+ Feet	
	Depends on speed - amount of traffic as for us shy distance 10-15 feet is O.K. - but to an auto out of control 100 feet might not be enough.

Question: Does the horizontal alignment along the desired path of travel (particularly reverse curvature) require an excessive amount of driver concentration and thus increase the hazard of other roadway appurtenances?

Answer: Yes	No	Possibly	Comment
x			Only on ramps with view of roadway obstructed by shrubs.
		x	
	x		
		x	Exits are not readily visible and required some abrupt moves.
		x	In general, horizontal alignment did not present a problem. This does not imply that horizontal alignment could not be improved upon.
x			When driver's have a tendency to drive or exceed the speed limit, reverse curvature is a serious problem. They don't slow down enough on wet pavements. Result - spin-outs, overturning, loss of control, etc.

Question: Is there sufficient advance notification of diverging roadways or turn lanes under light to moderate traffic conditions?

Answer: Yes	No	Comment
		On freeways (5) yes, but not on surface street. Difficulty with street name (1) signs, also determining cardinal direction.
	x	Several locations on arterials caused some discomfort.
x		Average driver can get by with advance under those conditions.
x		
	x	Several places signing inadequate but manuever could be made as traffic was light.
	x	No, however, new highways with new criteria and uniform signing should solve some of these problems.
x		Generally - one or two exits, however, were questionable.

Question: Is there sufficient advance notification of diverging roadways or turn lanes under heavy traffic conditions (i.e., limited land change capability)?

Answer: Yes	No	Probably	Comment
x			Freeways (5) ramps and surface streets (1) no.
	x		
x			Qualified, however, two or even three advance signs would be a great help.
		x	Signs in median showing next three exits are easy to see from all lanes. Short freeway rides, however, can miss them.
	x		Left hand off-ramp manuever could not be made if vehicle located on the right lane and traffic heavy. This same problem applies at cross streets with left turn entrances to ramp.
	x		Again - daily commuter knows the road and he plans his lane change movements almost before he begins his trip - the foreign motorist is the dangerous motorist as he does not have enough advance and proper signing.
		x	Providing one was not a total stranger - one exit ramp in particular (sign) was not lighted and was very near the ramp.

Question: Where lane assignments are indicated, are the assignments clear and easily understood?

Answer: Yes	No	Comment
x		On freeway (5) but one location, I-5S to 91E, which had option caused unnecessary lane change. However, I feel this is not a great problem as local drivers know this when designated lane is filled under heavy traffic conditions.
x		
x	x	No - on Southbound lane. Yes - all down arrows worked well. Advance exit signs with 45° up arrows (might be better to say right lane.)
x		
x		

	Yes	No	Comment
		x	Again - old highway problems.
	x		On the freeway - however, on certain off-ramps and on-ramps there was confusion.

Question: Do the existing lane assignments result in an unnecessary lane change (i.e., indicate a change to another lane when both lanes continue in the desired direction)?

Answer:	Yes	No	Comment
	x		
		x	No noticeable problems.
		x	
	x		Branch connection to Route 91 indicates left lane only, but two-lane can also make this move.
		x	Not particularly a problem in this test site.
	x		There were some locations where lanes phased out and forced the motorist to change lanes. Geometric planning with access control would take care of most of these problems.
		x	

Question: Is the exit ramp, turning roadway or turn lane clearly identified and outlined?

Answer:	Yes	No	Comment
	x		Not always - edge lines on the approach to the exit should help if properly done.
		x	Not when exit ramp has appearance of continuation of shoulder.
		x	Needs edge line and move gore marking. Also commanding delineation.
		x	Several ramp exits are hard to pick out.
	x		For daytime driving generally adequate.

	Yes	No	Comment
		x	Again - old design - most deceleration lanes not properly striped - too small.
		x	Many cases - no lighting - delineation - off-ramps not striped - either turn lane or edge.

Question: When advisory speeds are posted, are they reasonable in light of the downstream geometric and traffic conditions?

Answer:	Yes	No	Comment
	x		On one of the exit ramps from Northbound I-5 exit speed of 15 mph you'd better believe it.
		x	They may have been reasonable but their position was generally not where driver would normally be looking - specifically exit ramp speed signs.
	x		Except exit speeds on curvalinear ramps - maybe there should be two recommended speeds rather than just one exit speed for entire ramp alignment.
	x		None on highway, but ramp exit speeds are O.K.
	x		I did not notice this problem here - however, this is a problem when ramps are connected to frontage roads - especially two-way frontage roads.
	x		For Los Angeles, yes - local motorists are oriented to this type of driving - a Nebraska farmer or a New Mexico rancher could have trouble.
	x		However, speed changes on the ramps were not clear until well into off-ramp in two or three instances.

Question: Are the directional sign messages clear and concise so as to minimize the possibility of driver confusion?

Answer:	Yes	No	Comment
			On the freeway, generally - except at a few locations (Brookhurst) where ramp entered another (La Palma) roadway.
		x	Not on-ramp approaches to arterials.

Yes	No	Comment
	x	Exits do not connect with main exit street (message) and too much use of "to" arrow signs directing to major arterials. Should be changed to trail blazer concept. (Also not enough street advance signing).
	x	Because of ramp geometry, it is very difficult to find streets.
x		On the freeway, the directional signs are adequate. On the cross streets, signs are not considered adequate. At times signs are lacking and messages not clear.
	x	Again - lack of conformity in signing - lack of advance signing causes confusion to the foreign motorists.

Question: In your opinion, is the sight distance to right-of-way control devices (signals, stop signs, etc.):

Answer: /_/ Adequate /_/ Questionable /_/ Inadequate /_/ Critical

A	Q	I	C	Comment
x				Generally adequate, except at a few locations where shrubs hid view of control device.
	x			Questionable. In a few cases, the sight distance was too short for comfortable reaction.
x	x			No adverse out of direction sight or blockage by other appert. Questionable - on curvalinear ramps too short of distance to determine correct turn with quick channelization.
x				Regulatory devices are easily seen -directional devices off the freeway are not, however.
x				Generally adequate but on several locations signs are hard to see and at times obstructed by poles and shrubs.
		x		Old geometric standards - poor signing.
	x			Many instances - where signs were on opposite side of facility - missing - hidden by traffic - too small - on crest Vertical Curve behind poles hidden in trees.

Question: Are the control devices located in positions where they are readily apparent to a normally alert driver?

Answer: /_/ Yes /_/ Possibly /_/ Poorly located

Yes	P	PL	Comment
x			Some exceptions - Artesia; location where lane use sign was located on curve and partially hidden by shrubs.
	x		
x			
x			
	x		Probably - alert drivers will generally see signs and signals placed on the right shoulder. However, if these items are placed over the appropriate lane they become much more effective. Some, yes - such as the newer lighted signs - No - again as far as the black or dark non-reflectorized signs.
		x	

Question: Is there sufficient advance warning of devices which are not readily apparent?

Answer: Yes	No	Comment
		Generally yes - except at certain locations where control devices were hidden by shrubs or vertical curve could use warning devices.
	x	
x		
x		
		Had not noticed any.
	x	Your method. Again - lay judgment possibly could do a better job.

Question: Are the required speed changes accomplished in a manner which minimizes driver alarm and discourages rapid deceleration?

Answer:	Yes	No	Comment
	x		Locations with exit speeds 20 and 15 felt a little uncomfortable. A longer decel lane would help greatly. 65 mph to 15 mph is a large drop in speed.
	x		When decel lane is part of shoulder and the fact is not readily discernible.
	x		
	x		
			Had not noticed any.
		x	Old highway design causes quick right or wrong.
		x	Geometry in some instances require rapid deceleration.

Question: Are adequate speed change areas provided so as to eliminate the need for a substantial speed reduction in the through traffic lanes?

Answer: /__/ Always /__/ Usually /__/ On occasion /__/ Seldom

A	U	O	S	Comment
	x			
		x		
	x			Original geometric design didn't always provide - could be helped with edge line even if shoulders needed for decel area.
	x			
	x			Entrance ramps had adequate distance to accelerate and merge. No truck climbing lanes seen in test section, possibly a result of good grade line selection.
	x			
	x			One or two on-ramps presented problems.

Question: Could sign and/or signal standards be relocated so as to reduce the associated accident potential and still retain an acceptable degree of effectiveness?

Answer: /_/ Yes /_/ Possibly /_/ Probably not

Y	P	PN	Comment
	x		Depending on location and type of device.
		x	
x			Some legends would have to be enlarged - especially on regulatory.
	x		More gore signs to right of ramp and cantilever over ramp.
x			Many signs and signals could be placed overhead and be much safer and effective. The cost to accomplish this may be prohibitive.
			Believe uniformity and conformity needed in signs.
		x	In some instances they should have been moved closer.

Question: Where hazard warnings are provided, can they easily be associated with the hazard involved?

Answer: /_/ Yes /_/ In some cases /_/ No

Y	ISC	N	Comment
x			
x			
	x		Seems like amber hazard marker used for almost everything - road closed, end lane, move over, tight curve (overusage).
x			Freeway hazards consist principally of sign supports and bridge piers and abutments - some open ditches with guardrail.
	x		
	x		
x			With exception of construction area.

Question: Are warnings provided for hazards which are obvious and for which little, if any, warning is actually required?

Answer: /_/ Yes /_/ In a few cases /_/ No

Y	IFC	N	Comment
			Not noticed.
			Didn't notice any.
		x	
	x		In a few cases. Construction area had warning signs. Maintenance crew at work in several areas with no signs or warning provided.
		x	
			No comment.

Question: In your opinion, is there a question as to which traffic stream a right-of-way control device applies?

Answer	Yes	No	Comment
	x		Left turn signal in median at Loara? There appeared to be some unreflectorized signs which were not visible at dusk or in the dark.
		x	
	x		Signal - three phase signal (bad geometrics), plates below. Stop signs - no three-way stop or four-way stop.
		x	
	x		Traffic signals at two intersections also together with traffic signalized for each.
	x		General - answer problems of this nature occur at the point where the ramps enter city streets.
	x		Signs on ramps. Signals on ramps.

Question: Does there appear to be an excessive amount of informational signing within the right-of-way?

Answer: /_/ Yes /_/ Possibly /_/ No

Y	P	N	Comment
		x	At some locations on the surface street more and larger signs could have been used. There seemed to be a need for more reassurance markers or trail blazers. One location (Harbor to I-5 North) at the top of vertical curve had several signs which could have been replaced with less and more effective signs.
		x	
		x	Could be even more advance for exits. Median signs could be utilized from both directions.
		x	
	x		Possibly. Depends upon the driver and what he is looking for - I generally disregard advertising signs along roadway unless I am looking for a specific item. (Gas, food, etc.)
		x	
x		x	There is considerable side attraction - yes, to a driver not familiar with area.

Question: Is the informational signing provided of real value to a majority of the traffic?

Answer: /__/ Yes /__/ Possibly /__/ No

Y	P	N	Comment
x			Definitely on freeway. Smaller (on surface streets). "To Santa Ana Freeway" signs should be replaced by trailblazers - since this would be more useful to the stranger and more consistent.
	x		
	x		Still sign major arterials at ramp termini. Doesn't seem like informational destination for major existing traffic.
	x		
	x		
			Old style and varied on freeways - not adequate on city streets - especially of the trailblazer variety.
x			

Question: In your opinion, the roadside advertising in this section competes with the traffic control devices for the driver's attention to:

Answer: (1) A marked degree, (2) Some degree, (3) A limited degree (4) A very limited degree, if at all

1	2	3	4	Comment
	x	x		Some degree - on surface streets. A limited degree - on freeway, but not very objectionable. "Freeway Entrance" signs proved very reassuring in most cases.
	x			Some degree. In a few cases commercial signs obstructed visibility of guide signs.
x				A marked degree. Disneyland area. However, I feel this is right for this area, since this is the major destination and generator.
	x			Some degree. There are some distractions such as the Japanese Gardens, Matterhorn and advertising signs particularly at north end of project.
	x			Some degree. The type of sign is of significant importance - flashing light - or red light signs are very distracting.
	x			Some degree.
	x			Some degree.

Question: Are the points of divergency from the traffic stream obvious to the normally alert driver a sufficient time in advance of the necessary maneuver such that a smooth, natural transition to the diverging roadway is possible?

Answer: Yes	No	Comment
		Not always - edge lines would be extremely helpful. Mountable curbs at beginning of Exit should be removed.
	x	Not always - several of the gores were obscured by slight grades.
	x	45^{o} arrow used two different ways, also edge lining would be great help as well as gore marking at night.

Yes	No	Comment
	x	Exit ramps are difficult to pick out for smooth exits.
	x	At ramps, one cannot see the gore striping until after the maneuver is made.
		Rate 2-3.
	x	Many off-ramps not well marked.

Question: Is the normal traveled-way clearly delineated from the parking and/or emergency stopping areas?

Answer: Yes	No	Comment
	x	On freeways - shoulder treatment has worn down so that differences in pave and shoulder is not always clear and edge line suggested. Parking stall markings should help on surface streets.
	x	Right edge of travel lane often not distinct.
	x	Not enough contrast under regular roadway headlamps, too much emphasis on total control by lane line.
	x	Little or no delineation of shoulder area, except where rolled gutters are used.
	x	Cars parked at the curb are not particularly distracting during daytime driving; however, at night they become much more important due to reduced visibility.
	x	Line striping poor or edge striping buttons good when and where used.
	x	No edge striping - and in some instances no difference in surface texture.

Question: Are the roadside hazards visible for a sufficient distance to prevent the driver's being startled by them?

Answer: Yes	No	Comment
x	x	Yes - on freeways No - on surface streets.

Yes	No	Comment
x		Generally they were.
	x	Loava Street Exit NBL and also sharp divergence of most exiting ramp abutments and guardrail.
x		Bridge abutments are hard to see, but clear of shoulder and not startling.
	x	At night it is very difficult to see roadside hazard due to reduced visibility.
	x	Younger eyes can see the bridge abutments, etc., early - at my age some delineation is necessary at the bridge piers - on 91 they were a grey area until 300' away.
x		However, not protected.

Question: Does the existing delineation provide a clear and distinct outline of the roadway ahead?

Answer: Yes	No	Comment
		Momentarily "lost" lane line at end of reflectorized pavement markers on I-5.
x		Better maintenance by frequent cleaning would be helpful.
	x	Lane lines good, raised delineation on road shoulder not really good. Median raised delineator might even help in guidance.
x		As far as lane delineation is concerned.
x		The Stimsonite lane markers are very helpful. Shoulder striping which was lacking this test site is also very helpful in night driving.
	x	Again a qualified no - only in areas where the buttons were used.
x		

Question: Is the illumination provided by the vehicle's headlights sufficient for safe operation on this facility?

Answer:	Yes	No	Comment
			Generally, but illumination of preceding vehicles is utilized on freeways. At freeway speeds, we are usually driving at speeds higher than the low beam of vehicle permits.
	x		Generally - except on arterials where need for low beam made signs more difficult to see.
	x	x	Yes, reasonably safe if other control devices upgraded signs - lighted or totally reflectorized edge lining accel decel.
	x		
		x	For the 50-60 mph the low beam lights are inadequate.
			In most cases yes - however, personally I still believe in lighting heavily traveled-routes and interchanges.
		x	At 65 mph a driver would be overdriving his lights.

Question: Does the glare from opposing headlights obscure the driver's view of the roadway ahead?

Answer: (1) Probably (2) Possibly (3) Not to any marked degree

(1)	(2)	(3)	Comment
x			High beam on approaching vehicles creates a problem. (Probably)
	x		On arterials it was quite noticeable. (Possibly)
	x		More safety might be realized if a screen could be erected, but no noticeable bad effect. (Possibly)
		x	Not to any marked degree.
x			Any oncoming night traffic with lights on tends to blind the driver in the opposing direction - wider medians tend to reduce this glare. (Probably)
			The glue screens were good. Oddly enough the barrier guardrail was almost enough. Low beams were in constant use.

	(1)	(2)	(3)	Comment
			x	Although the median barrier design was rather erratic - (not to any marked degree)

Question: Is there sufficient advance notification of diverging roadways or turn lanes?

Answer:	Yes	No	Comment
			On freeway - generally Yes.
	x	x	Generally O.K. on freeways but on arterials some left turn lanes were not well defined.
		x	Not at night.
	x		Median signs generally adequate - ground mounted not too good.
		x	On cross streets the notification is generally lacking or of such a nature that one cannot see it. On the freeway this situation is much better but could still be improved upon.
		x	Again - no unification of signing, too high a speed rate for the foreign driver, lack of proper lane delineation - very poor signing for major routing through city streets.
		x	

Question: Can the existing directional signs be easily read at a glance?

Answer:	Yes	No	Comment
	x	x	Yes - on freeway and No - on surface streets. Signs mounted near traffic signals not visible.
		x	Lighted overhead signs are O.K. but ground mount signs without reflectorized background were often hard to find. Legend size should be larger.
	x	x	No - especially on street entrances to freeways and on arterials by signal beads. Yes - on freeway especially lighted.
	x		Except for ground mounted signs which are not easily read.

	Yes	No	Comment
		x	One must pay particular attention and concentrate due to the reduced visibility at night.
	x	x	
		x	Many without light - not reflectorized.

Question: Is the existing lane delineation adequate?

Answer:	Yes	No	Comment
	x		On I-5. Generally, good on freeway except on right lane and shoulder and right lane and parking strip on surface street.
	x		
	x	x	Centerline yes - edge no.
	x		Markers are reasonably effective.
		x	On the cross streets it is not considered adequate. On the freeway it is satisfactory with Stimsonite markers and could be improved if shoulder stripe used.
		x	As I stated above.
	x		

Question: Does the glare from opposing headlights make it difficult to read roadside and/or overhead signs?

Answer:	Yes	No	Comment
		x	Not so with signs in median on surface street.
	x		On arterials.
		x	
		x	
		x	The answer is generally no unless side mount signs are placed in the median, then these signs would be harder to read due to opposing headlight glare.

Yes	No	Comment
	x	No great headlight problem.
	x	However, conflict with commercial establishments was quite noticeable, particularly at intersections.

Question: In your opinion, is the sight distance to right-of-way control devices at night:

Answer: (A) Adequate (B) Questionable (C) Inadequate (D) Critical

A	B	C	D	Comment
	x			Questionable - Some important signs not reflectorized or mounted too close to a light source as traffic signal.
		x		Inadequate - Bad at some ramp terminals where ramp has sharp turn.
x				Adequate - Poor placement and orientation of signal heads on three phase.
x				Adequate - Directional signs off freeway are very poor, however.
	x			The sight distance may be sufficient, however, many signs are not discernible due to inadequate reflection caused by vertical and horizontal alignment. (Questionable)
	x	x		
x				

Question: Where hazard warnings are provided, can they be easily associated with the hazard involved?

Answer:

Yes	No	Comment
x		Generally yes.
x		
	x	More than one usage of same warning device under different conditions.
x		Very limited number.
	x	

	Yes	No	Comment
	x	x	At the 65-70 mph of the average motorist at night the hazard warnings should be, I believe, more clearly and uniformly defined.
			No comment.

Question: Do signs and lights outside the right-of-way detract to a marked degree from the effectiveness of traffic control devices?

Answer:	Yes	No	Comment
		x	Generally no.
	x		Not bad for signals, but a couple of stop signs have some adverse back light.
		x	Except for large commercial signs on signing. Good back plate on signals.
	x		Particularly lighted facilities adjacent to freeway.
		x	The answer is generally no, however, strong lights like those of the ball park are very distracting. Flashing lights outside the right-of-way can also be distracting.
			Oddly enough the industrial lighting adjacent to the freeways helped. City advertising lighting did not.
	x		However, conflict with commercial establishments was quite noticeable particularly at intersection. (General Comment) The facility, although inadequate in many respects still carries 90,000-120,000 uph. To correct many problem areas would involve new construction, or proper signing would not overcome some of the geometrics of the system. There was a particular lack of uniformity in the use of the traffic control device - i.e., position - similar signs were overhead, right, left; various signs - some were not lighted.

APPENDIX "C"

SUMMARY OF TECHNICAL DRIVER INTERVIEWS

PILOT SITE 3 I-5 (SANTA ANA FREEWAY) LOS ANGELES, CALIFORNIA

FREEWAY DESIGN

DAY PHASE

Parking lane drop seems abrupt (EB on Artesia).
Shoulder should be different texture and should not appear as an additional driving lane - dash lines would help.
Left-turn lane backs up across ramp opening (at Euclid Exit).
Lane drop is too abrupt (on Harbor Freeway Bridge at I-5 NB entrance).
Loara exit is hard to find.
Bad to have to pull out on shoulder as part of the exit (exit to Fall Street).
Narrow lane (on Artesia).
Turn slot coming off of freeway was tricky (exit from I-5 Northbound to Brookhurst).
Dangerous to come onto bridge with two lanes transitioning into one.
Bridge with no shoulders is dangerous.
Left merge causes difficulties.
Entrance signs for I-5 are clear but merge onto I-5 is terrible (on Brookhurst).

NIGHT PHASE

A narrow bridge is dangerous at night time.
20 mph curve is very dangerous when coming off of I-5 (I-5 Northbound to Loara).
In some places the shoulder width is not sufficient.
I could not see the gore because of the bridge (I-5 Northbound to Brookhurst).
Need shoulders on the bridges.

SIGNING

DAY PHASE

Highway 39 sign is hard to see.
Keep right sign is not clear (Beach Boulevard at Commonwealth).
Santa Ana Freeway is not marked sufficiently. (Beach Boulevard at Manchester).
No directions on exit sign (Euclid exit).
Guide sign is not large enough and cannot be seen properly (Lincoln to I-5).
No confirmation signs.
Shortage of advance signing on freeways.

NIGHT PHASE

Street name signs on arterials are very difficult to locate and read. They should be lowered and reflectorized.
Merging traffic signs serve a useful purpose.
On a curved ramp, direction arrows should also be curved.
These street name signs are somewhat better (Lincoln at Brookhurst).
Confusing signs and no confirmation signs (on Lincoln).

Warning to I-5 entrance off Brookhurst is not sufficient.
Road signs are very poor and confusing.
Need identification signs for Santa Ana Freeway.
Overhead signs are needed at Artesia and Manchester.
Ramp signs are inadequate.
Need supplementary signs on Artesia.
Large name signs are of great help (street name signs at Crescent and Euclid).
Direction signs on streets leading onto I-5 are poor.

Signs are not clear enough (Manchester onto I-5 Southbound).
No direction signs (I-5 exit to Euclid). Ramps has no direction signs (Lincoln to I-5).
Bad to have two different signs both designating the same road.
Signs for exits are placed too close to exits and do not give driver sufficient warning.

ILLUMINATION AND SIGNALIZATION

DAY PHASE

Traffic signal covers up the street name sign (Broadway at West Street).

NIGHT PHASE

First part of luninaire on ramp is black (I-5 to Harbor).
Need left-turn signal (on Euclid at Lincoln).
Lighting is not uniform (on Lincoln).
Too dark for safety (I-5 at State Highway 91).
Insufficient lighting (on State Highway 91).
Direction signs on I-5 are not illuminated.
I-5 sign is not lighted sufficiently (Brookhurst to I-5 Northbound).

DELINEATION

DAY PHASE

NIGHT PHASE

Hard to find gore (I-5 exit to Lincoln).
Gore cannot be seen too well (I-5 exit to Crescent).
End of "on-ramp" is not very obvious.
The buttons seem fairly clear (I-5 Southbound 3/4 mile from Brookhurst.

PAVEMENT MARKINGS

DAY PHASE

NIGHT PHASE

Cannot distinguish shoulder from through lanes at night.
Edge line of no help at one point (State Highway 91 to Brookhurst Southbound).
Buttons look good (I-5 Southbound

MISCELLANEOUS COMMENTS

DAY PHASE	NIGHT PHASE
Tree is obstructing the guide sign (I-5 Northbound to Beach Boulevard). Vegetation should be held to a minimum.	