DRIVER ATTITUDES TOWARD AN EXPERIMENTAL FREEWAY CORRIDOR INFORMATION AND CONTROL SYSTEM

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OPTIMIZING FREEWAY CORRIDOR OPERATIONS
THROUGH TRAFFIC SURVEILLANCE,
COMMUNICATION AND CONTROL

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Following operation of a ramp-metering control system for more than three years and a dynamic Freeway Corridor Route guidance system for one year, 2,824 responses to a questionnaire handed out at metered ramps were analyzed for comprehension, behavior and attitudes toward the systems. A similar questionnaire study had been made during 1969 shortly after the installation of the first stage of the dynamic route guidance system. Although there were a number of problems associated with the experiment, notably hardware reliability difficulties, it is believed that the lack of a strong positive response by motorists is a poor omen for operational systems in daily use. There was no indication that the various types of signs used elicited a differential response by the cooperating motorists. As would be expected analysis has shown a strong relationship between trip length and system responses and attitudes. After one year's operation 80% of the respondents recalled seeing a Ramp Information Sign (RIS). About half the drivers seeing RIS's used them as an aid in route selection. Only three quarters of the users used the signs on their trip the day of the study, however, the relationship among frequency of Freeway use, trip length and RIS use was quite complex. Sign use was greater for those on shorter trips and much greater for infrequent users than for daily users, with this effect being particularly strong for short trip makers. It is concluded that many of the drivers who did not use the system did so because they found it unsatisfactory, not because they were indifferent to it. The main effect of the system was to help drivers enter the Freeway sooner. A study of significant changes in origin-destination patterns indicated a tendency for origins to be upstream rather than at the ramp previously used and it is believed that this effect is due to the information system, not the ramp metering system. There has been a significant increase in trip length over the years. For every one of the eight on-ramps the fraction of drivers going beyond 8 Mile Road was greater in 1970 than it was in 1965 or 1967 and greater than 1969 at the four main on-ramps. There were great differences in most variables by ramp of entry, reflecting the many different characteristics of users of the various ramps.

ACKNOWLEDGEMENTS

The authors of this report wish to express their appreciation to the many individuals who have given their full support to this phase of the project. Their valuable cooperation has contributed much toward accomplishing this research.

The Michigan Department of State Highways, the City of Detroit, and the Wayne County Road Commission have shown an active interest in all phases of the work through monetary and personnel assistance. Special appreciation is extended to the Detroit Department of Streets and Traffic for the loan of personnel and equipment to aid in the distribution of the questionnaires; the Detroit Police Department for assigning officers to the ramps where distribution took place to assure smooth traffic operations; and the Wayne County Road Commission and the City of Ann Arbor for the loan of equipment.

Much additional support was received during the initial phases of questionnaire planning and design. The Human Factors Section of the Highway Safety Research Institute provided the support of a psychologist to refine the wording of the questionnaire to make it as easily understood and succinct as possible. Mr. H. Cox of the Traffic Safety Association of Detroit provided his technical knowledge of the printing process and assisted in a final review of the design of the questionnaire.

Project staff members deserving special recognition are Mr. Lars Pedersen for his work in the design and content of the questionnaire and Mr. Scott Grannan for his diligence in reading and analyzing all the comments given on the returned questionnaires and his participation in other phases of analysis.

The Highway Safety Research Institute and Dr. Robert L. Hess, Director, merit special thanks for the financial and administrative support they provided as well as their encouragement to undertake this project.

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DISCLAIMER

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SUMMARY OF FINDINGS

A questionnaire was distributed to more than 12,000 motorists entering the northbound John C. Lodge Freeway on a weekday afternoon peak period during the month of August, 1970. Although responses were received from 28% (more than 3,400) of the motorists, completely consistent responses were obtained from 2,824 cooperative Freeway users. This represents a substantial increase in the returns compared to the number of questionnaires returned from a similar study conducted one year earlier.

The purpose of the study was to determine the effects over a one-year period of a dynamic route guidance information system operating in the Lodge Corridor in conjunction with a ramp metering system which had been operating for more than three years. The effects were measured in terms of motorist behavior, comprehension and attitudes toward the system. Different characteristics of the motorists by ramp of entry associated with their place of employment were explored.

Although there were a number of problems associated with the experiment, notably hardware reliability difficulties, it is believed that the lack of a strong positive response by the motorists who cooperated by participating

in this study is a poor omen for operational systems in daily use. It is believed that the habits and patterns of years of driving experience will be difficult to overcome and that an inadequate fraction of the motorists will respond voluntarily to efforts to control their routes in conjunction with a ramp metered system.

There was no indication that the various types of signs used, Ramp Information, Variable Message, Trailblazer and Blank-out, elicited a differential response by the cooperating motorists. However, it is believed that evidence from other studies in this research program supports the accomplishment of the Ramp Information Sign function by a Trailblazer or a simple Blank-out Sign providing information for only the decision point at hand.

As would be expected, this analysis has shown the strong relationship between trip length and system responses and attitudes.

After one year's operation, 80% of the respondents recalled seeing a Ramp Information Sign (RIS). About half of the drivers seeing RIS's used them as an aid in route selection. Only three-quarters of those users used the signs on their trip the day of the study.

When faced with an hypothetical RIS with all the ramps displaying red and the system recommending traveling on to the fourth or farther ramp downstream, almost as many respondents indicated a willingness to follow the recommendation as to enter at one of the red indications. Long trip regular Freeway users recorded a more negative response to the recommendations. Almost one-quarter of the motorists indicated that they would not use the Freeway at all that trip.

The relationship among frequency of Freeway use, trip length and RIS use was quite complex. Sign use is greater for those on shorter trips and much greater for infrequent users than for daily users, with this effect being particularly strong for short trip makers.

It is concluded that many of the drivers who did not use the FCDRICS did so because they found it unsatisfactory, not because they were indifferent to it.

The main effect of the Freeway Corridor Dynamic Route and Control System (FCDRICS) was to help drivers enter the Freeway sooner since they attempted to enter at their most convenient ramp after the system was in operation, while before that they may have diverted downstream on a regular basis.

A study of significant changes in origin-destination patterns indicated a tendency for origins upstream from the first controlled ramp to enter upstream rather than at that ramp and it is believed that this effect is due to the information system, not the ramp metering system. Drivers from the New Center area developed a reluctance to use more than the natural first two ramps in the system, although some took advantage of the relaxed metering strategy employed at the Davison Expressway ramp.

There has been a significant increase in trip length over the years. For every one of the eight on-ramps, the fraction of drivers going beyond 8 Mile Road was greater in 1970 than it was in 1965 or 1967 and greater than 1969 at the four main on-ramps.

There were great differences in most variables by ramp of entry, reflecting the many different characteristics of users of the various ramps.

PART ONE

CHAPTER ONE

INTRODUCTION AND RESEARCH APPROACH

INTRODUCTION

The John C. Lodge Freeway and its paralleling corridor have been the site of innovative formal experimentation in almost all aspects of freeway operations, information, and control research since 1961. During the five-year period ending in December 1966, a closed circuit television surveillance system and an on-freeway speed and lane control system were implemented and operated by the Michigan Department of State Highways and the National Proving Ground for Freeway Surveillance Control and Electronic Traffic Aids with the aid of national and local agencies (3)*.

In the Spring of 1967, the Texas Transportation Institute (TTI) installed a ramp metering system on the eight ramps north from West Grand Boulevard to Livernois Avenue as shown in Figure 1 (31). In 1968 the motorists approaching the Lodge Freeway in the New Center area were presented Ramp Information Signs developed by TTI which indicated the state of congestion at the four southernmost of the metered ramps and these signs were later replaced

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*Numbers in parentheses refer to references following Chapter Four.

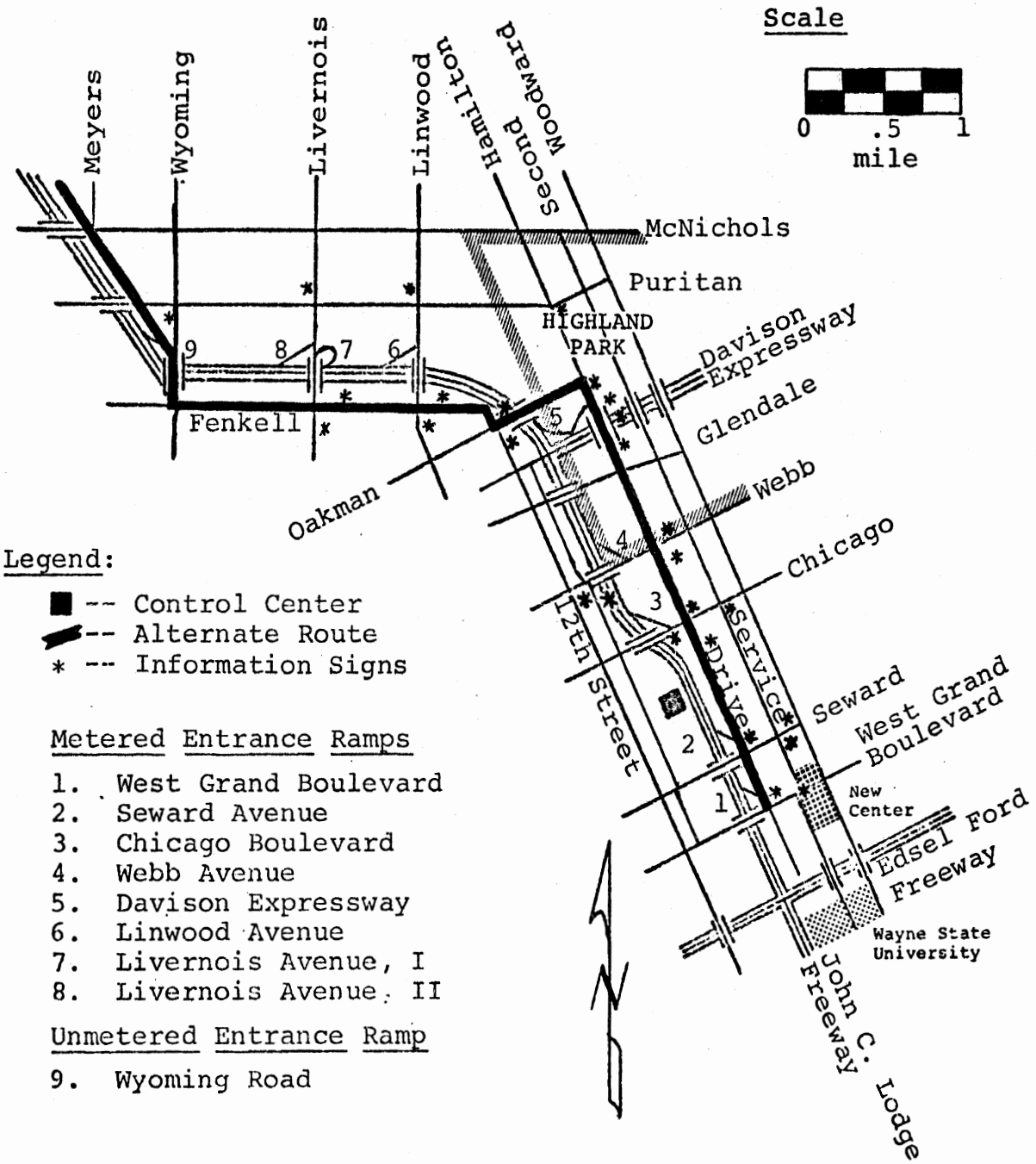


FIGURE 1

JOHN C. LODGE FREEWAY CORRIDOR DYNAMIC INFORMATION AND CONTROL SYSTEM

and augmented by The University of Michigan so that by mid-1969 a Principal Alternate Route generally paralleling the Freeway north to Wyoming Road had been identified (6, 26). In late 1969, this display system was extended to the Corridor when an additional 19 dynamic route guidance information signs were installed in the Corridor identifying an Alternate Route Network (27). The ramp metering system and ramp and Corridor information system were operated until December 1970. A number of strategic operational changes, not necessarily apparent to Corridor users, were made in 1969 and 1970 (5, 28). The operation of this dynamic information system for more than one year provided an opportunity to both observe and ask motorists for their response and attitudes toward the display and control system several months before the experiment terminated.

The research described in this report is based on a self-administered questionnaire received from more than 3,400 of the 12,000 users of the Lodge Freeway on a summer weekday afternoon.

OTHER STUDIES

The current widespread interest in Freeway Corridor Dynamic Route and Control Systems (FCDRICS) has served as a basis for research on driver behavior and attitudes toward these systems and several investigators have recently reported on their findings using several study approaches (7, 10, 12, 15, 17, 18, 20, 30). Their studies are being utilized as an aid in the planning, design and operation of this FCDRICS and there are a number of factors for which the attitudes of motorists in the Lodge Freeway system toward their experiences over a one-year period would assist in the development of this type of system. It is believed that the results of this study, in addition to three other reports of this research effort, will provide assistance in these engineering efforts (26, 27, 28). Many of the points of interest are described below.

Heathington's study of the allocation of an hypothetical budget to a variety of roadway improvements indicated that drivers strongly preferred smooth-riding pavements (15). Information on traffic conditions seemed to be relatively important while driving on an expressway, but unimportant while driving on a city street. The provision of real-time traffic information on freeways received a very large mean expenditure (15). Dudek similarly found that 500 drivers

in Dallas and Houston indicated a desire for additional traffic information currently not provided by static signing (10). They pointed out a need for real-time freeway traffic information which they said they would frequently utilize. There was a preference for receiving information about freeway traffic conditions before entering the freeway (10). The sequencing of preferences were on a major street, at the entrance ramp, at the beginning of the trip and on the freeway, respectively.

Hoff's Chicago and other studies indicated that the response of motorists to the dynamic displays was such that the maximum diversion attributable to the signs would constitute only about one-fourth of the total traffic (18, 19). However, Courage concluded that the operation of four internally illuminated signs and six Blank-out signs in the Lodge Freeway Corridor resulted in travel time savings of approximately 41,000 vehicle-hours per year and that the cost of this system was approximately ten cents per vehicle-hour saved (6). However, he expressed concern with the interaction between permanent changes in patterns of ramp usage and pointed out that the savings from the display system are likely to be reduced under a fully operational ramp metering system after queueing patterns have completely stabilized.

Benshoof concluded that a traffic information system designed to relieve day-to-day congestion by directing motorists to less heavily traveled routes would probably provide little value (2). The primary reasons for this conclusion were that most motorists considered only two or three routes and, furthermore, selected a specific route before beginning a trip. Secondly, the established criterion for route choice, minimum travel time, was shown to be deficient because most motorists expressed several reasons for their route choice, and because several other reasons were nearly as popular as minimum travel time. In this study, the minimization of expected travel time for those using the northbound Lodge Freeway beyond McNichols Road was the criterion used in the design and operation of the information and control system.

It has been shown by Potts that the selfish driver who does not select the minimum time route available to him in a congested network is antisocial and overall travel time in the network for all users is increased (25). Wachs found that drivers' attitudes toward route choice for the trip to work appear to be strongly influenced by the length of the trip (30).

There are two types of guidance information possible. One can provide simple data at each decision point, in which case it is only necessary to give detailed information at

each road junction. If the road user is interested in the general direction of his goal, as suggested by Gordon, overall information should be provided (14). As a part of the display system developed for this project, consideration was given to various possibilities in the hope that differential responses to the different types of displays could be identified that would be useful in final designs (26, 27). Among the displays used were:

1. A simple binary display using an arrow indicating which of two directions should be used.
2. Map type presentations giving information on which ramp to use.
   a. Showing one ramp
   b. Showing two ramps
   c. Showing three ramps
3. A complex word display including the term "delay" and providing information on more than one decision point.

Most motorists passing signs in Chicago similar to the Ramp Information Signs used in Detroit understood the purpose of map dynamic signs (19). Eberhart's study showed that 75% of his subjects preferred a symbol display showing both correct and incorrect paths for turning information using green for correct paths and red for incorrect paths (12).

Several investigators have concluded that a variable message matrix sign would be preferred to other types of displays (10, 19).

Heathington has suggested the selection and marking of only one alternate route (15).

The presence of the old Davison Expressway in the Lodge Freeway Corridor created an interesting challenge in this study. It provided an opportunity to explore diversion from a freeway to a major street and back to the interchanging freeway rather than using the ramp directly.

Courage also pointed out that the Lodge Service Drive Alternate Route that he studied is a well-defined portion of the Corridor and that in other areas the probability of success is likely to be much lower where the alternate surface route is not as clearly established (6).

Mackie's English studies show that drivers can learn new signs, but this is a slow process and he concluded that there is a need for much publicity to achieve desired limits of comprehension (23).

Moskowitz recommended studying the rerouting and informing of drivers (24). He believed that problems associated with this are familiarity with route, familiarity with the travel time on the alternate route, the possibility

of too much diversion and that the information provided to the motorists will not be timely and relevant to their needs.

The overall record of dynamic traffic sign displays in the U.S. is less than satisfactory. For example, the overhead lane speed signs used on the John C. Lodge Freeway were found to have little effect on the actual speed driven (31). Attitudes expressed in this study should assist in determining steps to be taken to encourage better conformance to such displays.

RESEARCH APPROACH

Ideally, the population toward which a user survey should be directed would include all motorists in the John C. Lodge Freeway Corridor during the control period. No feasible way was found by which this population could be identified and sampled at a reasonable cost. Hence, it was determined that, following past practices in the Corridor, a mail return questionnaire would be handed to each motorist entering the Freeway itself at one of the eight metered entrance ramps (26). It was recognized that those motorists in the Corridor who did not use the Freeway at that time or who had previously used it but stopped doing so as a result of the system would not be sampled.

PURPOSE OF THE QUESTIONNAIRE STUDY

The purpose of the 1969 questionnaire, administered slightly more than one month following the installation of the Principal Alternate Route dynamic information system, were several (26). Driver understanding of the Ramp Information Signs used to implement the Principal Alternate Route was explored. Data on origin and destination of traffic in conjunction with the actual ramp used to enter and exit from the Freeway were obtained to provide a basis for the investigation of ramp selection practices as well as driver response to the innovative system.

The purpose of the 1970 study was to determine the long-term motorist response to the Freeway Corridor Dynamic Route Information and Control System (FCDRICS) which successively included frontage road Ramp Information Signs, the guidance sign (Variable Message, Trailblazer and Blank-out) system installed on nearby streets in the Corridor and, finally, dynamic control of selected traffic signal installations. It was desired to compare these findings with the results from the questionnaire issued in 1969, particularly with respect to the sightings of the sign, the understanding and response of the motorists, and the possible changes in origins and destinations of traffic. The 1970 analysis concentrated on the changes in ramp use for the same origins. There was a particular concern with the general overall response to the Freeway control system and the understanding of new devices. Changes in observation, understanding and sign obedience were also tested.

THE QUESTIONNAIRE AND ITS DESIGN

Plate 1 presents the four-page questionnaire developed for this study. During the 1969-1970 year, Trailblazer, Variable Message and Blank-out route guidance signs were installed to support the expanded system of alternate routes in the northbound John C. Lodge Freeway Corridor shown in Figure 1. These signs differed from the Ramp Information Signs, installed in 1969 and it was necessary to depict them

PLATE 1 (Opposite Page)
1970 QUESTIONNAIRE

HIGHWAY SAFETY RESEARCH INSTITUTE
Institute of Science and Technology
Huron Parkway and Baxter Road
Ann Arbor, Michigan 48105

THE UNIVERSITY OF MICHIGAN

YOUR COOPERATION IS REQUESTED

The Highway Safety Research Institute (HSRI) of the University of Michigan is currently trying to find ways of reducing congestion in freeway corridors to help motorists make afternoon rush hour trips with less delay. The City of Detroit, the Wayne County Road Commission, the Michigan Department of State Highways, and the Highway Research Board of the National Academy of Sciences, which is providing financial support, are actively cooperating with HSRI in local efforts to help you save time.

The John C. Lodge Freeway Corridor is the site of a research project in which many new techniques of providing you with information on the best route to your destination are being tested. The latest of these innovations is a series of ramp information and route guidance signs installed in the Northbound Lodge Freeway Corridor in 1969.

Your answers to the attached questionnaire (page 3) will help us to evaluate these signs and to determine what additional improvements are needed. Any other comments you wish to add will be appreciated.

Please check the appropriate answers, detach page 3 and mail the questionnaire as soon as possible (the postage has already been paid). You need not sign the questionnaire.

Thank you for your assistance and cooperation.

Donald E. Cleveland

Donald E. Cleveland
Principal Investigator

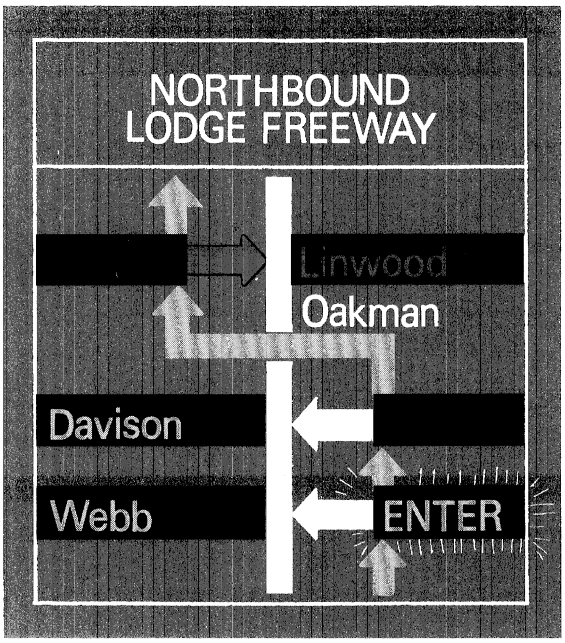


FIGURE 1A
Ramp Information Sign

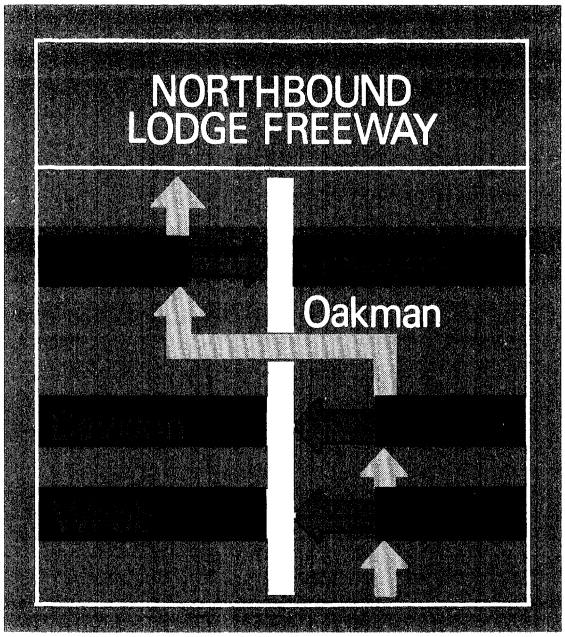


FIGURE 1B
Ramp Information Sign

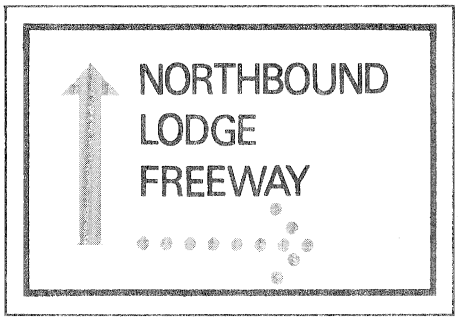


FIGURE 2A
Route Guidance Sign

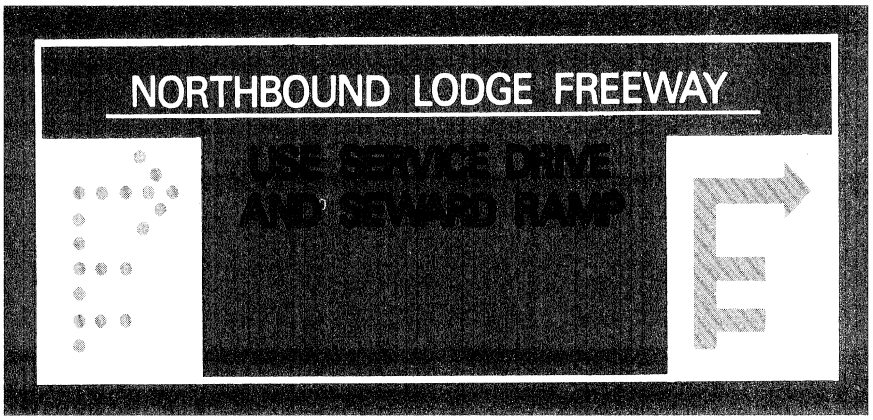


FIGURE 2B
Route Guidance Sign

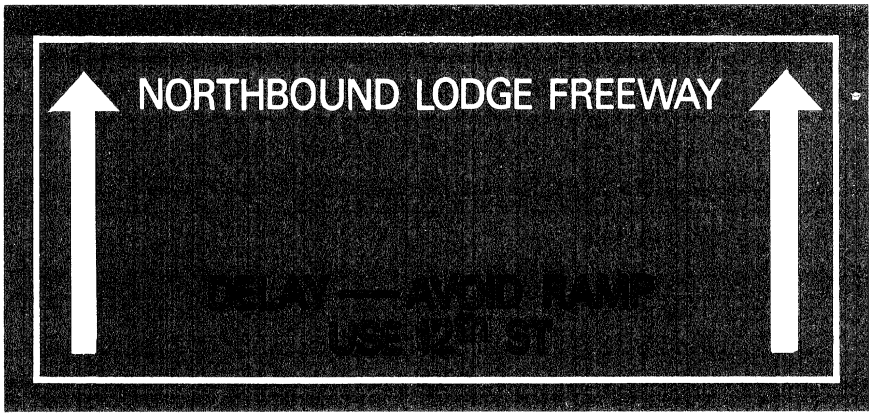


FIGURE 2C
Route Guidance Sign

IN ANSWERING *QUESTION 9* ON THE ATTACHED SHEET (PAGE 3), USE ONE OF THE FOLLOWING (NUMBERS):

0. South of West Grand Blvd.
1. West Grand Blvd.
2. Seward
3. Chicago
4. Webb
5. Davison
6. Linwood
7. Livernois
8. Wyoming
9. North of Wyoming

YOU WERE GIVEN THIS QUESTIONNAIRE AS YOU ENTERED THE LODGE FREEWAY AT THE **SEWARD RAMP**

1. WHERE DID YOU BEGIN THIS TRIP? _____
(street and nearest cross street)

2. WHERE DID YOU END THIS TRIP? _____
(street and nearest cross street)

3. WHICH RAMP DID YOU USE TO EXIT FROM THE FREEWAY ON THIS TRIP? CHECK ONE:

Clairmount Ave. . ☐	Davison West . . . . ☐	7 Mile Rd. . . . . ☐
Chicago Blvd. . . . ☐	Linwood Ave . . . . ☐	8 Mile Rd. . . . . ☐
Webb Ave. . . . . ☐	Livernois Ave. . . . . ☐	9 Mile Rd. . . . . ☐
Glendale Ave. . . ☐	Wyoming Rd. . . . . ☐	Other (Please specify) . . ☐
Davison East . . . ☐	Meyers Rd. . . . . ☐	_____

4. HOW OFTEN BETWEEN 2:30 P.M. AND 6:30 P.M. DO YOU USE OR WANT TO USE THIS FREEWAY?

Never or seldom ☐ Once or twice a week ☐ Almost every day ☐

5. a. HAVE YOU EVER SEEN A SIGN SIMILAR TO FIGURE 1(A or B) ON THE ATTACHED SHEET? . . . . . YES ☐ NO ☐

b. DO YOU USE THESE SIGNS TO HELP YOU DECIDE WHERE TO ENTER THE FREEWAY? . . . . . YES ☐ NO ☐

6. a. DID YOU SEE ANY SIGNS SIMILAR TO FIGURE 1(A or B) ON THIS TRIP? . . . . . YES ☐ NO ☐

b. DID YOU USE THESE SIGNS TO HELP YOU DECIDE WHERE TO ENTER THE FREEWAY ON THIS TRIP? . . . . . YES ☐ NO ☐

7. IF YOU HAD SEEN A SIGN SIMILAR TO FIGURE 1B ON THIS TRIP, WHAT WOULD YOU HAVE DONE? CHECK ONE:

Disregarded the sign and entered the Freeway at a ramp shown in red . . . . . ☐
Continued on the recommended path and entered at a ramp shown in green . . . . . ☐
Decided not to use the Freeway at all . . . . . ☐

8. a. DID YOU SEE ANY SIGNS SIMILAR TO FIGURE 2(A, B or C) ON THIS TRIP? . . . . . YES ☐ NO ☐

b. DID YOU USE THESE SIGNS TO HELP YOU DECIDE WHERE TO ENTER THE FREEWAY ON THIS TRIP? . . . . . YES ☐ NO ☐

9. IF THE SIGNS HAD NOT BEEN IN OPERATION TODAY, AT WHICH RAMP WOULD YOU HAVE ENTERED? . . . . . ☐
(refer to attached sheet, page 2, and choose one of the answer-numbers given)

COMMENTS:

Please detach this sheet, fold, seal and mail

FIRST CLASS
PERMIT NO. 1597
ANN ARBOR, MICH.

BUSINESS REPLY MAIL

NO RETURN STAMP NECESSARY IF MAILED IN THE UNITED STATES.

POSTAGE WILL BE PAID BY

THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
ROOM 319 HIGHWAY SAFETY RESEARCH INSTITUTE BLDG.
HURON PARKWAY AND BAXTER ROAD
ANN ARBOR, MICHIGAN 48105

Please fold along this line.

in the 1970 questionnaire. It was then realized that a one-sheet questionnaire would not have sufficient space for the required figures. Therefore, the four-page format with a separation to be made by the recipient was considered necessary.

On the front page, there was a request to the motorist for cooperation. This request was slightly changed from the 1969 plea to fit the new format and to include the whole sign system. On the second page, there were five figures, two showing the Ramp Information Sign (1A, 1B) and three showing the different route guidance signs (2A, Trailblazer; 2B, Variable Message; 2C, Blank-out). The questionnaire itself was printed on page 3. The final page was the standard postage form. The last two pages were detached, folded, sealed (page 3 was gummed) and mailed. For comparison, a copy of the 1969 Ramp Information Sign questionnaire is presented as Plate 2. The complete report on the results of the study, based on returns of the 1969 questionnaire, is presented in another of the publications of this research (26). In this section details of the design of the 1970 questionnaire are given.

In the design of the 1970 questionnaire, all phases of the conduct of the 1969 questionnaire study were thoroughly reviewed with the further assistance of experts in survey research techniques.

PLATE 2 (Opposite Page)
1969 QUESTIONNAIRE

YOU WERE GIVEN THIS QUESTIONNAIRE AS YOU ENTERED THE JOHN C. LODGE FREEWAY BY THE

W. GRAND BLVD.

_____ RAMP.

1. WHERE DID YOU BEGIN THIS TRIP ? _____
(STREET AND NEAREST CROSS STREET)

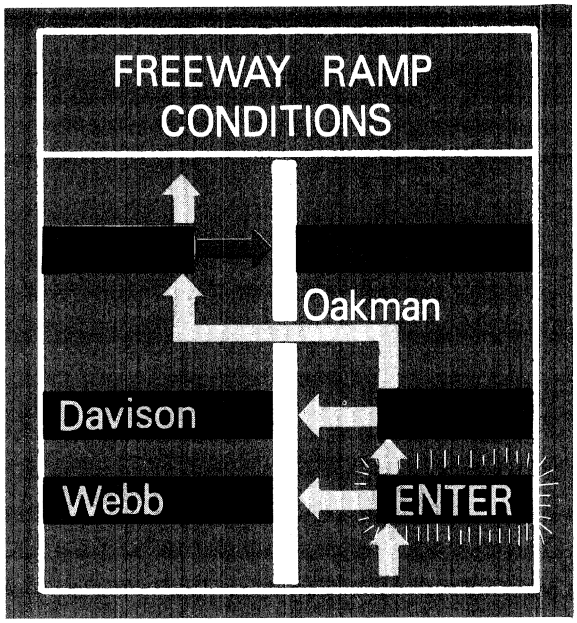
2. WHERE DID YOU END THIS TRIP ? _____
(STREET AND NEAREST CROSS STREET)

3. WHICH RAMP DID YOU USE TO EXIT FROM THE FREEWAY ? CHECK ONE:

CLAIRMOUNT AVE . . . . . ☐	DAVISON WEST ☐	WYOMING RD . . . . . ☐
HAMILTON AVE, CHICAGO BLVD ☐	DAVISON EAST ☐	MEYERS RD, McNICHOLS RD . ☐
WEBB AVE . . . . . ☐	LINWOOD AVE ☐	7 MILE RD . . . . . ☐
GLENDALE AVE . . . . . ☐	LIVERNOIS AVE ☐	8 MILE RD, GREENFIELD AVE ☐
OTHER . . . . . ☐	(PLEASE SPECIFY) _____	

4. HOW OFTEN BETWEEN 2:30 P.M. AND 6:30 P.M. DO YOU ENTER THE RAMP WHERE YOU RECEIVED THIS QUESTIONNAIRE ? CHECK ONE:

NEVER BEFORE ☐ ABOUT ONCE A WEEK ☐ ALMOST EVERY DAY ☐
SELDOM ☐ ABOUT TWICE A WEEK ☐



5. HAVE YOU EVER SEEN A SIGN SIMILAR TO THE EXAMPLE SHOWN ? YES ☐ NO ☐

6. DO YOU USE THESE SIGNS TO HELP YOU DECIDE WHERE TO ENTER THE FREEWAY ? YES ☐ NO ☐

7. ACCORDING TO THE EXAMPLE:

IS THE WEBB RAMP CONGESTED ? . . . . . YES ☐ NO ☐
IS THE DAVISON RAMP CONGESTED ? . . . YES ☐ NO ☐
IS THE LINWOOD RAMP CONGESTED ? . . . YES ☐ NO ☐

8. AT WHICH RAMP ARE YOU ADVISED TO ENTER THE FREEWAY ?

WEBB ☐ DAVISON ☐ LINWOOD ☐

9. IF ALL THREE RAMPS SHOWN ON ANY SIGN ARE CONGESTED, THE ARROW AT THE TOP OF THE SIGN FLASHES IN GREEN. WHAT WOULD YOU DO IN THIS CASE ? CHECK ONE:

ENTER AT THE FIRST RAMP (EVEN IF SHOWN IN RED) . . . . . ☐
GUESS THE LEAST CONGESTED RAMP AND ENTER THERE . . . . . ☐
CONTINUE ON THE TRAIL OF SIGNS UNTIL AN UNCONGESTED RAMP IS FOUND . . . . . ☐
DECIDE NOT TO ENTER THE FREEWAY AT ALL . . . . . ☐

10. HAVE YOU PREVIOUSLY RECEIVED ANY INFORMATION ABOUT THESE SIGNS ? YES ☐ NO ☐
FROM WHICH SOURCES ?
TV ☐ RADIO ☐ NEWSPAPER ☐ LEAFLET ☐ OTHER ☐

REMARKS:

Prepared By The Traffic Safety Association Of Detroit For The University of Michigan Highway Safety Research Institute

YOUR CO-OPERATION IS REQUESTED

The Highway Safety Research Institute of The University of Michigan and several city, state, and federal agencies are co-operating in an attempt to find ways of reducing congestion on freeways so you can get home quicker.

The John C. Lodge Freeway Corridor is currently the site of a research project testing many new techniques of providing the individual motorist with information on the best route to his destination. The latest of these innovations is a series of ramp condition information signs recently installed on the northbound Lodge Freeway.

Your answers to the questionnaire on the other side of this page will be an important contribution in helping us to evaluate these signs to determine what improvements are needed. Any other comments you wish to add are also welcome.

Please check the appropriate answers and mail the questionnaire as soon as possible (the postage has already been paid). You need not sign the questionnaire.

Thank you for your assistance and co-operation.

Question Development

In the 1969 study, the motorists were asked to indicate their origins (Question One) and destinations (Question Two) by naming the nearest intersection for the beginning and end of that trip. The coder then located these intersections on coded maps or from a dictionary. This was a very time-consuming activity. An alternative would have been to supply each of the motorists with a printed zoned map, asking them to indicate their zones of origin and destination. There was not space on the questionnaire and it would have required that two additional maps be distributed. Therefore, it was decided that Questions One and Two would be unaltered from 1969.

Question Three, the exit-ramp used, was of particular value for comparison with the same question used in 1969. Unfortunately, the 1969 printing format had a weakness because some of the check-boxes were close to two columns of possible answers. Additional coding efforts were necessary to check for and overcome this problem. A format change was made. The 9 Mile Road exit was added because of its heavy use in the 1969 study and an interest in determining the proportion of motorists staying on Northwestern Highway beyond the city limits of Detroit who used the 9 Mile Road exit. Trips terminating beyond 9 Mile Road were long enough to make it unnecessary to have more detailed information on off-ramps farther downstream.

Question number Four, dealing with frequency of Lodge Freeway use, referred to the one particular ramp in 1969. Since motorists obeying the signs were not always advised to enter at their desired ramp, the 1970 question referred to frequency of use or general desire to use the Freeway. Also, in the analysis of the 1969 questionnaire, it was found that the five categories of response were unnecessary and these were combined to give a total of three categories.

For comparison with the 1969 study, the questions referring to the Ramp Information Signs: "Have you ever seen?" (Number 5a) and "Do you use?" (Number 5b) were again included. Questions 6a and 6b also referred to the Ramp Information Signs and were concerned with their sighting and use on this trip. In a large sample this should give reliable information on usage. Even with the augmented sign system, it was possible to enter the Freeway without passing a dynamic sign. Therefore, the question (Number 6a) of whether or not the motorist saw a sign on this trip was needed.

If the motorist did not understand the signs, the information would not be of value to him. In the 1969 study, two questions were designed to test drivers' understanding of the Ramp Information Signs (Plate 2, Questions Seven and Eight). As many as 95% answered these questions completely correctly. These signs were in operation another year and direct questions about driver understanding were not included in the 1970 questionnaire.

Question Seven (1969 Question Nine) was also included again, although it was changed slightly. The 1970 questionnaire had an additional drawing of the Ramp Information Sign with congestion shown at all ramps (Figure 1B). Also, the emphasis in the question was on "today's trip." The responses made it possible to study the relative importance of reasonable answers, continuing on the alternate route or abandoning the Freeway, for different trip lengths. There were two other small changes in this question. First, the hypothetical case referred to was shown in Figure 1B on page 2 instead of in a sentence. Second, the first two possible answers from last year were combined based on the similarity of 1969 responses.

Question Eight was similar to Question Six, only dealing with the route guidance signs.

Question Nine was developed to determine the first ramp motorists considered entering. Since the ramp they actually used (the point of distribution) was preprinted on the questionnaire, the diversion because of the signs could be determined for those who used the signs on this trip. For those who did not use the signs, the answer to Question Nine would be expected to be the same as the on-ramp used.

In 1969, there had been extensive publicity about the sign system in the television, radio and newspaper media at the time of introduction of the system. Since there had been no comparable effort during much of 1970, 1969 Question Ten, dealing with sources of information, was not repeated.

Three other questions which were considered but not included are listed below.

1. What is the purpose of this trip?
2. Which ramp do you normally use to enter the Northbound Lodge Freeway between 2:30 and 6:30 p.m.?
3. If this ramp were closed to traffic, how would you get to your destination?
   a. Attempt to enter the Freeway at another ramp
   b. Use some alternate surface street route

In an attempt to keep response effort to a minimum, the answers to these questions were not considered to be of enough significance and the questions were not used.

QUESTIONNAIRE PREPARATION, DISTRIBUTION AND RETURNS

Since records of traffic volume entering at each ramp were known, it was easy to estimate the number of preprinted questionnaires needed for distribution at each ramp. This value was increased by from 250 to 500 for each ramp. A total of 15,000 questionnaires were printed.

It had been planned to issue the questionnaire in mid-July, exactly one year following the 1969 distribution. However, printing delays prevented the distribution of the questionnaire at that time. It was instead distributed on Tuesday, August 11th. The later distribution date was more satisfactory since some of the ramp signals were temporarily out of service during July and it was believed that driver response should be tested on a system that had been in good working order for some weeks. There is no evidence that there was a different traffic pattern on August 11th from the originally planned distribution day of July 16th. All local schools and colleges were either in recess or had summer programs in session on both days. Tuesday and Thursday did not usually exhibit different patterns as days of the week during 1969 and 1970, and there were no public holidays close to either date.

Extensive publicity on the questionnaire was obtained both before and shortly after distribution. A joint press conference was held with Inspector Ricard of the Detroit Police Department, Motor Traffic Bureau, to announce and explain the purpose of the questionnaire distribution. This conference was widely reported on local television and radio news programs and in the Detroit newspapers (see Appendix A for information on public relations and information). On the day of the distribution, television news interviews

were filmed at the West Grand Boulevard on-ramp distribution point. The films of the distribution were shown the same evening on local television news programs.

The questionnaires were distributed from 2:30 p.m. to 6:30 p.m. at the same eight metered on-ramps as in 1969. The actual distribution process caused little delay to motorists as they were handed a questionnaire while stopped for the ramp metering process. A police officer from the Motor Traffic Bureau was present at each ramp to insure the smooth flow of traffic. Almost all motorists accepted the questionnaire.

Experience in 1969 indicated that questionnaires would be mailed as late as one year following the date of issuance. It was believed desirable that, since information on a specific trip was requested, a date beyond which no further questionnaires would be analyzed be established. This date was set at one month. Table 1 shows the log of questionnaires received by date of reception. More than half of the questionnaires had been delivered by the Monday following the distribution (5th day) and almost 85% of those returned within 30 days had been received after one week.

TABLE 1

QUESTIONNAIRE RETURNS

NUMBER OF DAYS AFTER QUESTIONNAIRE DISTRIBUTED	CUMULATIVE NUMBER OF QUESTIONNAIRES RECEIVED
1	1
2	341
5	1,731
6	2,332
7	2,910
14	3,294
21	3,377
30	3,437

Table 2 shows both 1969 and 1970 information on traffic entering at each distribution point ramp, the number of questionnaires issued, the percent receiving questionnaires, and the number and percent of questionnaires returned. More than 12,000 questionnaires were issued and 3,437 were returned, a return rate of 28.3%, a substantial increase from the 2,419 or 22.3% returned in 1969. The difference was due to a larger fraction of motorists receiving questionnaires in 1970 as well as a better return rate for which no explanation is apparent.

TABLE 2

QUESTIONNAIRE DISTRIBUTION, RESPONSE AND RAMP TRAFFIC
(1969 FIGURES ARE GIVEN IN PARENTHESES)

	VOLUME ENTERING RAMP	NUMBER DISTRIBUTED AT RAMP	PERCENT RECEIVING	NUMBER RETURNED	PERCENT RETURNED
West Grand Boulevard	2777 (3007)	2735 (2438)	98.3 (80.4)	909 (665)	33.3 (27.2)
Seward	1380 (907)	1410 (819)	97.8 (90.2)	488 (237)	34.6 (28.9)
Chicago	1025 (1226)	930 (1067)	90.7 (86.9)	192 (218)	20.6 (20.4)
Webb	849 (892)	819 (804)	96.4 (98.2)	175 (169)	21.4 (21.0)
Davison	3079 (3262)	2410 (2473)	78.2 (76.2)	695 (537)	28.8 (21.7)
Linwood	1426 (1491)	1262 (1000)	88.5 (67.1)	363 (191)	28.8 (19.1)
Livernois	1400 (1146)	1235 (1000)	88.2 (87.3)	269 (175)	21.8 (17.5)
Wyoming	1435 (1452)	1329 (1000)	92.5 (68.9)	346 (227)	26.0 (22.7)
TOTAL		12130 (10601)		3437 (2419)	

Overall percentage returned: 28.3 (22.8)

It is evident that the overall percentage returned and the percentage returned for each ramp was much higher than in 1969, as was the percentage of motorists entering at each distribution point who received questionnaires. Considerable improvements in the return rate at the Davison and Linwood ramps were most notable.

It is also noted that the return rate varied widely among the ramps with more than one-third of the questionnaires returned by those receiving them at the West Grand Boulevard and Seward ramps. The Davison Expressway, Linwood and Wyoming Road ramp users returned more than 25% of the questionnaires. The Chicago, Webb and Livernois returns remained near a disappointing 20% level. These differences are statistically significant (Chi-square; $\alpha = .001$).

QUESTIONNAIRE CODING AND RESPONSE CHECKING

As shown in Table 1 returned questionnaires began arriving on August 12, 1970, the day after distribution. The bulk of the questionnaires were returned within two weeks of the distribution date and a cut-off date of September 11, 1970 was established for processing. Those questionnaires received after that date were read, responses to the respondent's comments made when appropriate (all respondents providing their name and address were thanked for their participation) and any unusual comments noted. Otherwise, the more than 100 questionnaires received well into 1971 were neither coded nor processed with the bulk of the questionnaires.

Coding for later machine processing was accomplished directly on the questionnaire form, although the form had not been specifically designed for easy keypunch operator processing. Each of the eight ramps was assigned a one-digit number (see Table B-1 in Appendix B for code dictionary). The ramp name was pre-printed on the questionnaires to insure quick and accurate identification of their place of entry to the Freeway. Each questionnaire received was assigned a four-digit serial number commencing with 0001 for the first received, 0002 for the second, etc., for each ramp. Thus, the first questionnaire returned that had been distributed at the Seward ramp (Entry No. 2) became 20001, the second 20002, etc. A log was kept showing the questionnaires received daily and the serial number assigned to each questionnaire. This log was used for various administrative functions in the coding and processing activity.

The coding was done by one of three individuals, checked by one of the others and discussed with the Principal Investigator as needed. A notebook was maintained to achieve uniform treatment of data by all coders. The coding was done one question at a time to maximize consistent treatment.

In Question One, the motorist was asked to give the nearest major street intersection to where he began his trip. This data had to be transformed to a zone of origin

as shown in Figure 4 on page 91. Generally, the coder located the origin on a map that was divided into number zones and recorded the appropriate zone number on the questionnaire. The zones were generally the same as those used in 1969 with some grouping of zones with low samples (Table B-3, Appendix B). If the given origin occurred on a line bounding zones, the zone to the south or east of the line was coded as the origin. If the origin given was outside of the zones on the map, "01" or "07" was coded, depending on whether the origin was east or west of a line drawn parallel to Woodward Avenue through the center of Detroit. An American Automobile Association (AAA) map of Detroit and Southeastern Michigan (1969) and a Detroit Edison Corporation map of Detroit and the Detroit Metropolitan Area (1970) were used to locate origins.

An alphabetical dictionary of the origins was sequentially developed to facilitate the coding process. The street and nearest cross-street were entered in the log under the first alphabetic letter of the intersection (numbers followed letters). As the dictionary grew, this speeded coding by making it possible to look up an intersection in the log and record the zone rather than go through the more lengthy procedure of locating the intersection and zone on the map.

The Keystone Street Guide and Map of Detroit and Vicinity and the Detroit Telephone Directory were also used to locate addresses, buildings and hospitals when these were given instead of intersection names. Such specific traffic generators as the General Motors Building, Wayne State University, etc., were added to the dictionary. The "Street Guide" also helped to locate minor streets and intersections.

It was decided not to code the destinations (Question Two). The 1969 returns showed that this was not a particularly important question since destinations were generally evenly distributed about the most convenient off-ramp.

The Freeway exit ramp responses to Question Three were numbered and coded "01-13", respectively (Table B-2 in Appendix B). All exit ramps beyond Southfield were coded "14." Most of these exit ramps were located on Westbound I-696. Other coding practices are shown in Tables B-3 through B-11 in Appendix B.

The respondent's comments were also coded. Coders looked for five basic themes: the Lodge Freeway in general; the Ramp Metering system; the Ramp Information Signs; the Route Guidance Signs (the Trailblazers, Variable Message Sign and Blank-out Sign system); and the Alternate Routes. Comments concerning the Freeway and ramp metering were coded "1" for favorable comments and "2" for negative comments. A "0" was entered for no response.

Comments on the Ramp Information signs (Figures 1A and 1B on the questionnaire) and Route Guidance signs (Figures 2A, 2B, 2C on the questionnaire) were coded in more detail. The same coding system was used for both types of signs. A "0" signified that a respondent had not commented on the signs. A "1" indicated a generally favorable response and "2" a generally unfavorable response. If the respondent commented that the idea behind the signs was good, the response was coded "3." If the respondent felt the basic idea of the signs was bad, the code was "4." Favorable comments on the sign design were coded "5" and statements that the sign design was bad were coded "6." If the respondent felt the signs were operating well, the code was "7." If the respondent commented that the signs were operating poorly, the code was "8." Comments which mentioned the signs but were neither favorable nor unfavorable were coded with a "9."

In coding comments on the alternate route, two basic comments, referring either to the slowness of the route or the neighborhood traveled through, were looked for. A "0" signified either "no response" or comments which stated that the alternate route was neither slower nor faster than the normal route taken by the particular respondent. Generally favorable comments were coded "1" and comments that stated alternate routes are always or almost always slower were coded "2." A "3" signified that the respondent

got lost or feared getting lost in following the alternate route, and "4" signified an objection to the neighborhoods passed through by the alternate route. General objections to alternate routes where the respondent listed no specific problems were coded "5." Increase in travel time due to the fact that the alternate route was slower as a result of the ramp metering were coded "6." A response which included objections to both the slowness of the alternate routes and the neighborhood they traversed was coded "7."

Coding Problems

Problems occurred with the origin coding when the respondent listed an incomplete origin (no cross street given) or the origin made no sense as in the instance where the streets named did not intersect. In these cases, "00" was recorded for no response. A few origin answers were very inconsistent with the ramp entered. These were coded "00." Occasionally, the respondent viewed a round trip as having both its origin and destination at home.

Sometimes the respondents would check two boxes for Question Three, the exit ramp. In most cases, they were indicating the ramps they used for both entrance and exits. The exit ramp was, of course, coded as the answer. Replies that were inconsistent with a reasonable on-ramp for the trip origin were coded "no response."

The respondents sometimes had trouble defining the difference between "once or twice a week" and "almost everyday" when answering how often they used the Freeway (Question Four). If it was noted that the Freeway was used three times a week, a "2" was entered. If they used the Freeway four or five times a week, a "3" was entered.

Questions Five and Six were so similar that the same types of problems arose in coding responses. If both boxes were checked in Question 5a or b, or if "sometimes" was given for an answer, yes "1" was coded as the reply. If both boxes or "sometimes" were the reply in Question 6a or b, no response was coded. Similar problems arose with Question Eight and were handled in the same manner.

In many instances, respondents replied to Question Seven by writing their own answer or by checking two or all of the boxes. In these cases, no response was coded.

In Question Nine, the coder was to have referred to Page Two of the questionnaire for a list of numbered ramps. Sometimes the respondent would get his answer from the figures on page two and would answer 1A, 2B, etc. These answers were deciphered and the proper answer coded.

ADDITIONAL VARIABLES

In the analysis of the questionnaire results, initially it was determined desirable to create a number of variables beyond those directly printed on the questionnaire itself. A total of 18 variables were defined from the questionnaire. It was also deemed important to develop a number of spatially related variables concerned with the ramp deemed most likely to be used for traffic moving during uncongested periods and various characteristics of the trip itself.

These additional variables are listed in Table 3.

TABLE 3

ADDITIONAL VARIABLES

Most Convenient Ramp (MCR) (See Table B-1, Appendix B)
Origin to MCR Distance (Miles)
MCR to Exit Ramp Distance (Miles)
Freeway Distance (Miles)
MCR to On-Ramp Distance (Miles)
Excess Distance (Miles)
Minimum Trip Length (Miles)
Fraction of Trip on Street System

The Most Convenient Ramp (MCR) was defined as the on-ramp which would most logically be used by a motorist from a zone of origin using major streets during typical

uncongested conditions. The MCR for each of the 32 zones of origin is given in Table B-17 in Appendix B.

The other variables are based on major street and Lodge Freeway distances measured from large scale maps between centroids of zones, on-ramps and off-ramps. These variables are self-explanatory, except the Excess Distance variable is the additional travel in miles on the route actually used over that of the minimum distance route passing through the MCR.

In order to construct these distance-related variables, matrices of distances from Zones of Origin to all ramps, between Freeway on- and off-ramps and between Freeway on-ramps were developed. These are presented as Tables B-18 through B-20 in Appendix B.

FINAL SAMPLE

It was believed highly desirable to be able to conduct an orthogonal analysis of the results of the questionnaire study. Therefore, a review of the completeness of responses to important questions was made and it was determined that it would be possible to retain more than 80% of the 3,427 questionnaires by using only those which had responses to all of those questions deemed to be important.

A total of 613 questionnaires were eliminated because of inconsistent or non-response to questions believed to be highly significant in the analysis. Almost 30% of these had a defective origin. Almost 10% failed to give their off-ramp or identified an impossible off-ramp upstream from their on-ramp. Almost 70% of the defective questionnaires did not select a response to the hypothetical behavioral response to the important Ramp Information Sign display (Question Seven). Almost 20% of these questionnaires had inconsistent responses to the various parts of Questions Five and Six dealing with Ramp Information Sign sighting and use.

Appendix B, Table B-1, contains a key and a listing of the data for each of the 2,824 questionnaires in the final analysis group.

In making the analysis, consideration was given to treating the returned acceptable questionnaires as if they were from a sample stratified by ramp and weighted accordingly to express an estimate of the population of users of the eight ramps. For example, each of the 772 West Grand Boulevard questionnaires would have a weight of almost 4 since the volume entering that ramp was 2,777. At the Chicago Boulevard entrance ramp the weight would be almost 7 since there were only 149 satisfactory interviews of the 1,025 vehicles entering at that ramp the day of the survey. It was believed that the inherent bias in a post-card return questionnaire and the lack of need for a precise

population value supported the decision not to weight each questionnaire but to report the results as those obtained from 2,834 cooperating motorists from among 12,130 receiving them of a total of 13,370 vehicles entering the ramps during the study period.

ANALYSIS

It was believed that the most important findings of this research would be obtained by considering not only the relative frequency of the question responses and values of the variables themselves, but also the many interactions of a joint distribution of two or more variables.

After developing univariate distributions for each of the 26 variables (Figure 2 shows questionnaire return frequency by ramp of entry), more than 100 possibly important multivariate distributions were identified. Each of these distributions was developed and analyzed as appropriate. As the detailed analysis proceeded, it was found that several additional distributions had to be enumerated.

Many of the final variables used were numerical and standard statistical tests of means and dispersions could have been used. However, it was found that satisfactory results could be obtained by classifying each of the variables, and when statistical tests were necessary, using the Chi-square test on the contingency tables resulting from the classifications.

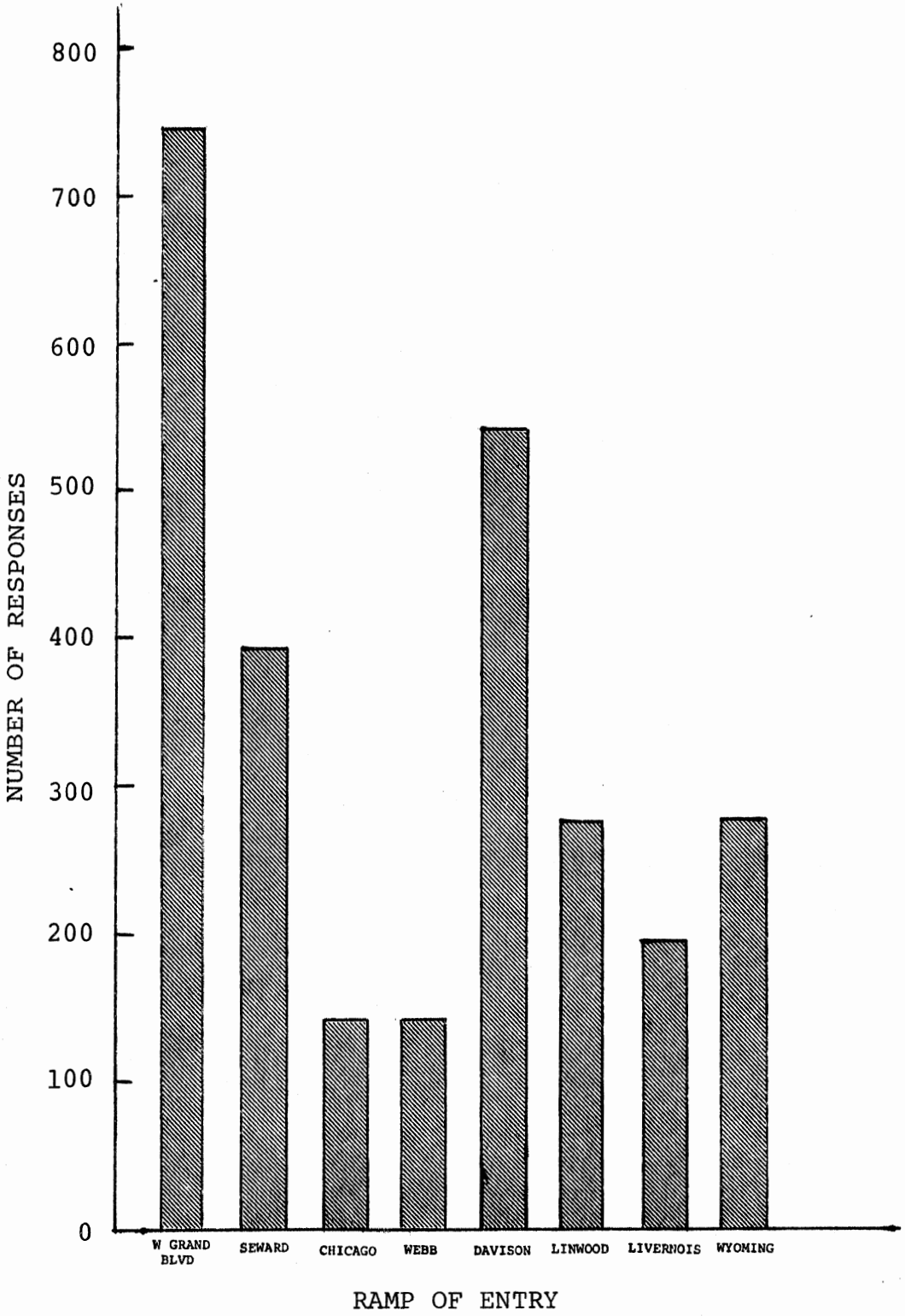


FIGURE 2

QUESTIONNAIRE RETURNS BY RAMP ISSUED

A risk of identifying a difference when in fact one does not exist (the alpha risk) of one percent was selected. For purposes of studying the results, however, the actual value of Chi-square and its associated probability level are presented, or the fact that the Chi-square values are such that probabilities of errors of the first type of less than .001 are identified.

The results of the analysis are presented in Chapter Two.

CHAPTER TWO

RESEARCH FINDINGS

As described in Chapter One, a final set of 2,824 questionnaires complete in all significant respects and with internally consistent answers were obtained. Distributions of responses to each question and derived variable were obtained as well as many joint distributions of two or more variables. In this chapter, successive consideration is given to seven topics listed below.

1. Sighting and Usage of the Dynamic Sign System
2. Sighting and Usage Determinants and Attitudes Toward the Ramp Information System
3. Specific Comments
4. Ramp Usage Dispersion
5. Trip Origins and Destinations
6. Ramp Differences
7. Comments

This structuring attempts to develop both the simple and complex relationships among the attitudes, knowledge and behavior of almost 3000 users of this important freeway corridor.

SIGHTING AND USAGE OF THE DYNAMIC SIGN SYSTEM

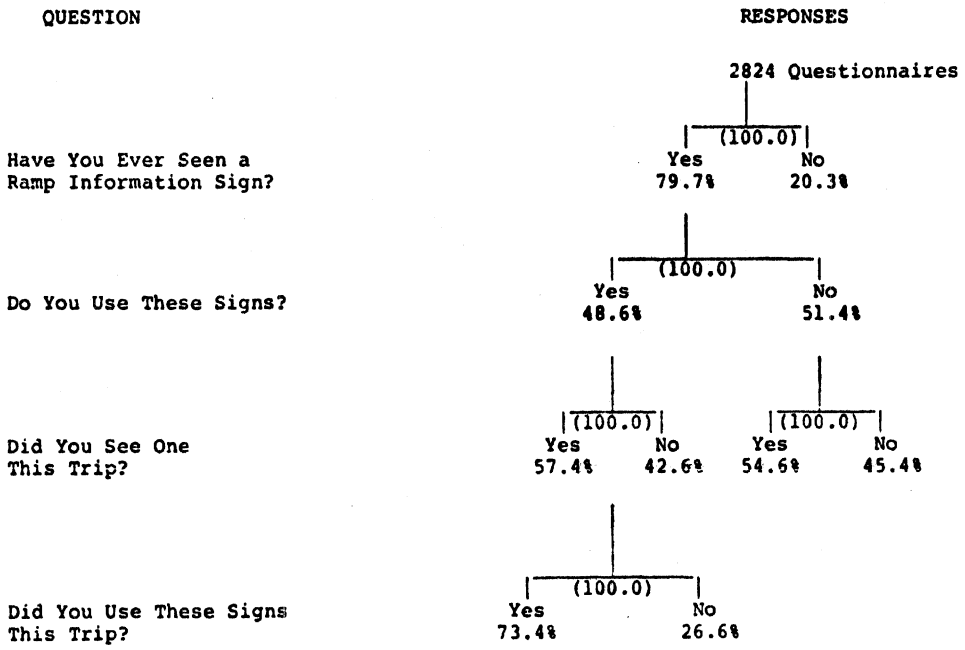
Driver responses to the four questions on seeing and using the Ramp Information Signs (Questions Five and Six) are presented in Table 4. Even after a year's operation 20.3% of the motorists had not seen these signs. Of those who had seen them, 48.6% used them as an aid in route selection. Even among this group of users only 73.4% of those who saw the signs on this trip used the signs on this trip.

It would be expected that drivers who used the signs would be more likely to see them this trip since they presumably found the information advantageous and should have been familiar with the locations of the signs. Surprisingly, a comparison of drivers who did and did not use the signs shows that very nearly the same percent of each group saw the Ramp Information Signs this trip. (A χ^2 analysis gives a value of 1.59; $\chi^2_{1,.10} = 2.71$; so there is no statistically significant difference between these two groups.) This indicates an awareness of the signs by those who did not choose to use them.

Table 4 also points out that 26.6% of the drivers who said they used the signs and saw them this trip did not use the signs this trip. One possible explanation for this is that drivers may have varied their use of the signs according to the information presented. For example, a driver may

TABLE 4

RESPONDENTS SIGHTING AND USING RAMP INFORMATION SIGNS



have been willing to divert to the next one or two ramps downstream but if faced with an all red display he would have disregarded the sign and thus respond that he did not use the signs this trip. There is no data to test this hypothesis, but it is consistent with the response to Question Seven (explored later) which asked what the driver would do when faced with an all red display.

Table 5 gives the percent of drivers who saw either, both, or neither or the two types of information signs this trip and Table 6 is a comparable table for use of the signs this trip. From Table 5 it can be seen that while 62.4% of all drivers saw one or the other of the signs, only 10.2% of all drivers saw both the Ramp Information and Route Guidance (referred to as Trailblazers) signs this trip. Table 6 shows that only 23.7% of all drivers used one or the other or both of the sign types this trip and only 3.9% of all drivers used both.

Since the trailblazers were placed farther from the Freeway than the Ramp Information signs, it might be expected that drivers who saw or used the trailblazers were more likely to see and use the Ramp Information signs than the converse. The tables illustrate that this is true as 36.4% of the drivers who saw a trailblazer this trip also saw a Ramp Information sign this trip, but only 22.9% of the drivers who saw a Ramp Information sign this trip also saw a

TABLE 5

COMPARISON OF SIGHTING EACH TYPE
OF SIGN THIS TRIP

		Did You See a Route Guidance Sign This Trip?		
		YES	NO	
Did You See A Ramp Information Sign This Trip?	YES	10.2%	34.4%	44.6%
	NO	17.8%	37.6%	55.4%
		28.0%	72.0%	100%=2824

TABLE 6

COMPARISON OF USING EACH TYPE
OF SIGN THIS TRIP

		Did You Use a Route Guidance Sign This Trip?		
		YES	NO	
Did You Use A Ramp Information Sign This Trip?	YES	3.9%	13.0%	16.9%
	NO	6.8%	76.3%	83.1%
		10.7%	89.3%	100%=2824

trailblazer this trip. A comparison between users of both signs is much the same, as 36.4% of the drivers who used the trailblazers also used the Ramp Information signs this trip and only 23.1% of the Ramp Information sign users also used a trailblazer this trip.

Even more interesting is the fact that 76.2% of the drivers who used a trailblazer and saw a Ramp Information sign (there were 143 such drivers) also used the Ramp Information sign and 82.0% of the drivers who used a Ramp Information sign and saw a trailblazer (there were 133 such drivers) also used the trailblazer this trip. Thus, drivers who used either type of sign had a high degree of acceptance of the other.

Tables 7 and 8 give a breakdown of Ramp Information sign users this trip and trailblazer users this trip by zone of origin. As expected from the placement of the southern Ramp Information signs, the eight zones which ranked highest in percent of users of this sign are all south of Webb and five of the eight are adjacent to the Freeway. The eight highest zones in percent of users of the trailblazers are scattered.

TABLE 7

RAMP INFORMATION SIGN USE BY ZONE OF ORIGIN*

		DID YOU USE THESE SIGNS THIS TRIP?	
ZONES OF ORIGIN	TOTAL	YES	NO, NO RESPONSE
3, 5, 6, 9, 11, 12, 16, 19 (Eight Highest)	1365	25.6%	74.4%
2, 13, 17, 21, 22, 24, 26, 27 (Eight Lowest)	543	4.2	95.8
All Other Zones	916	11.5	88.5
TOTAL	2824	16.9	83.1

*See Figure 4, Page 91

TABLE 8

ROUTE GUIDANCE SIGN USE BY ZONE OF ORIGIN*

		DID YOU USE THESE SIGNS THIS TRIP?	
ZONES OF ORIGIN	TOTAL	YES	NO, NO RESPONSE
3, 7, 13, 15, 16, 18, 23, 28 (Eight Highest)	278	21.2%	78.8%
2, 9, 10, 11, 21, 27, 30, 32 (Eight Lowest)	1276	6.0	94.0
All Other Zones	1270	12.9	87.1
TOTAL	2824	10.6	89.4

*See Figure 4, Page 91

SIGHTING AND USAGE DETERMINANTS AND ATTITUDES TOWARD THE RAMP INFORMATION SIGN SYSTEM

Since the Ramp Information Signs were in operation long enough for most drivers to see and experiment with them, the question of what the driver would do when faced with an all-red Ramp Information Sign (Question Seven) is not hypothetical but rather reflects the driver's attitude toward these signs (this view is substantiated in the Comments Section). Table 9 presents the total response to this question.

In order to explore some of the determinants influencing drivers to use or disregard the signs and factors in driver attitudes toward the signs, the drivers were sorted into six groups, as shown in Table 10, by using the following variables: having sighted the Ramp Information Signs, using the Signs, Freeway trip distance, frequency of Freeway usage, and response to an all-red Ramp Information Sign display. The existence of major interactions among these variables can be easily identified. Many of them are discussed in the following sections.

TABLE 9

QUESTION 7: IF YOU HAD SEEN A SIGN SIMILAR TO FIGURE 1B* ON THIS TRIP, WHAT WOULD YOU HAVE DONE?

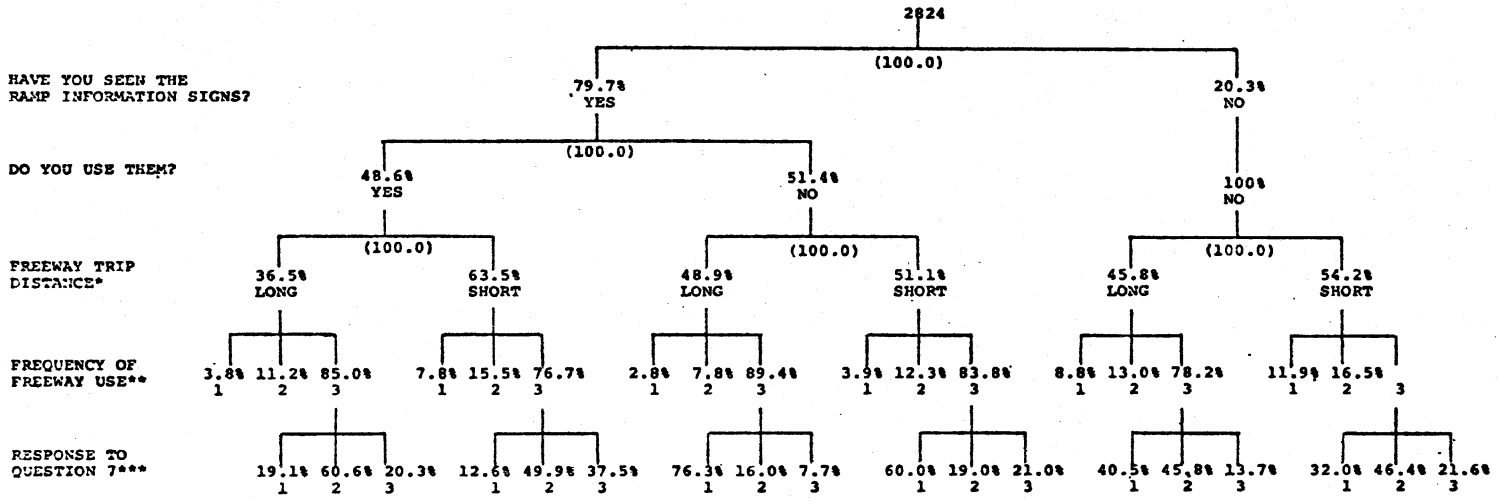
RESPONSE**	NUMBER	PERCENT
Disregarded the Sign and Entered the Freeway at a Ramp Shown in Red (1)	1105	39.1%
Continued on the Recommended Path and Entered at a Ramp Shown in Green (2)	1090	38.6
Decided Not to Use the Freeway at All (3)	629	22.3

* Ramp Information Sign with all-red display for ramps shown

** Anticipated activities if Ramp Information Sign with all-red display was sighted

TABLE 10

FACTORS IN DRIVER ATTITUDES TOWARD RAMP INFORMATION SIGNS



* LONG ≥ 8 Miles SHORT < 8 Miles

** 1 = Never or Seldom, 2 = Once or Twice a Week, 3 = Almost Every Day

*** See Key on Table 9

SIGHTING THE SIGNS

The first question to be considered is whether drivers who used the Freeway more often were more likely to see the Ramp Information Signs. The 1969 questionnaire study found that after one month of Ramp Information Sign operation there was no apparent relationship between the frequency of Freeway usage and sighting of the Ramp Information Signs (26). However, the 1970 data presented in Table 11 show that after a year there was a high degree of significance between the frequency of Freeway usage and sighting the signs with more of the frequent users having seen the sign ($P_{\chi^2} < .001$). Undoubtedly, the reason for this change is that in 14 months of sign operation, drivers who used the Lodge Freeway more frequently had many more opportunities to see the signs. The on-ramp distribution of this relationship is given in Table 12. As would be expected, the preponderant viewing experience was for those drivers entering at the southern four ramps where the signs were prominantly displayed.

FACTORS IN RAMP INFORMATION SIGN USE

In order to isolate some of the reasons a driver did or did not use the Ramp Information Signs, two key variables identified in Table 10 were examined, Freeway trip distance and frequency of use of the Freeway. Freeway trip distance was chosen rather than total trip distance because it was

TABLE 11

RELATIONSHIP BETWEEN THE FREQUENCY OF FREEWAY USE AND SIGHTING FRONTAGE ROAD SIGNS

FREQUENCY	SAMPLE SIZE	% WHO HAVE SEEN THE SIGNS
Never or Seldom	168	64.3%
Once or Twice A Week	355	76.1
Almost Every Day	2301	81.4
TOTALS	2824	79.7

$$\chi^2 = 31.95$$

$$\chi^2_{2,.001} = 13.82$$

TABLE 12

PERCENT OF DRIVERS WHO HAVE SEEN THE RAMP INFORMATION SIGNS DISTRIBUTED BY ON-RAMP AND FREQUENCY OF FREEWAY USAGE

	FREQUENCY OF FREEWAY USE			
ON-RAMP	NEVER OR SELDOM	ONCE OR TWICE A WEEK	ALMOST EVERY DAY	TOTAL
West Grand Boulevard	58.6%	89.9%	96.2%	92.6%
Seward	87.0	91.4	97.0	95.3
Chicago	87.5	73.9	90.9	87.9
Webb	75.0	78.9	92.8	89.4
Davison	61.1	61.3	68.0	67.0
Linwood	47.1	64.3	72.4	70.1
Livernois	77.8	61.9	62.7	63.3
Wyoming	33.3	46.9	64.6	61.0
AVERAGE	64.3	76.1	81.4	79.7

$$\chi^2 > (\chi^2_{14,.001} = 36.12)$$

believed that drivers who desired to use only a short section of the Freeway, even though they were on long trips, would have the same reaction to the signs as drivers on short trips. A Freeway trip of eight miles was chosen as the dividing line between long and short trips because 9 Mile Road was the last specifically identified exit ramp choice on the questionnaire and drivers who entered at Wyoming Road and stayed on past 9 Mile Road had a Freeway trip distance of at least eight miles. Figure 3 shows the distribution of Freeway distances for the sample. Table C-2 in Appendix C was the source of data that show only 7.4% of the respondents leaving the Freeway south of Wyoming, and 35.1% going beyond 9 Mile Road.

The relationships among these variables are explored in Tables 13 through 17. Tables 13 and 14 compare the use of the signs with the frequency of use of the Freeway and Freeway trip distance, respectively. Both interrelationships are statistically highly significant. However, as Table 15 shows, there is also a highly significant interaction between frequency of use of the Freeway and Freeway trip distance with drivers who used the Freeway never or seldom being more likely to be on short Freeway trips. Hence, to examine the relationship between Freeway trip distance and sign use, Table 16 considers only drivers who used the Freeway almost every day and had seen the signs. Similarly, to examine the

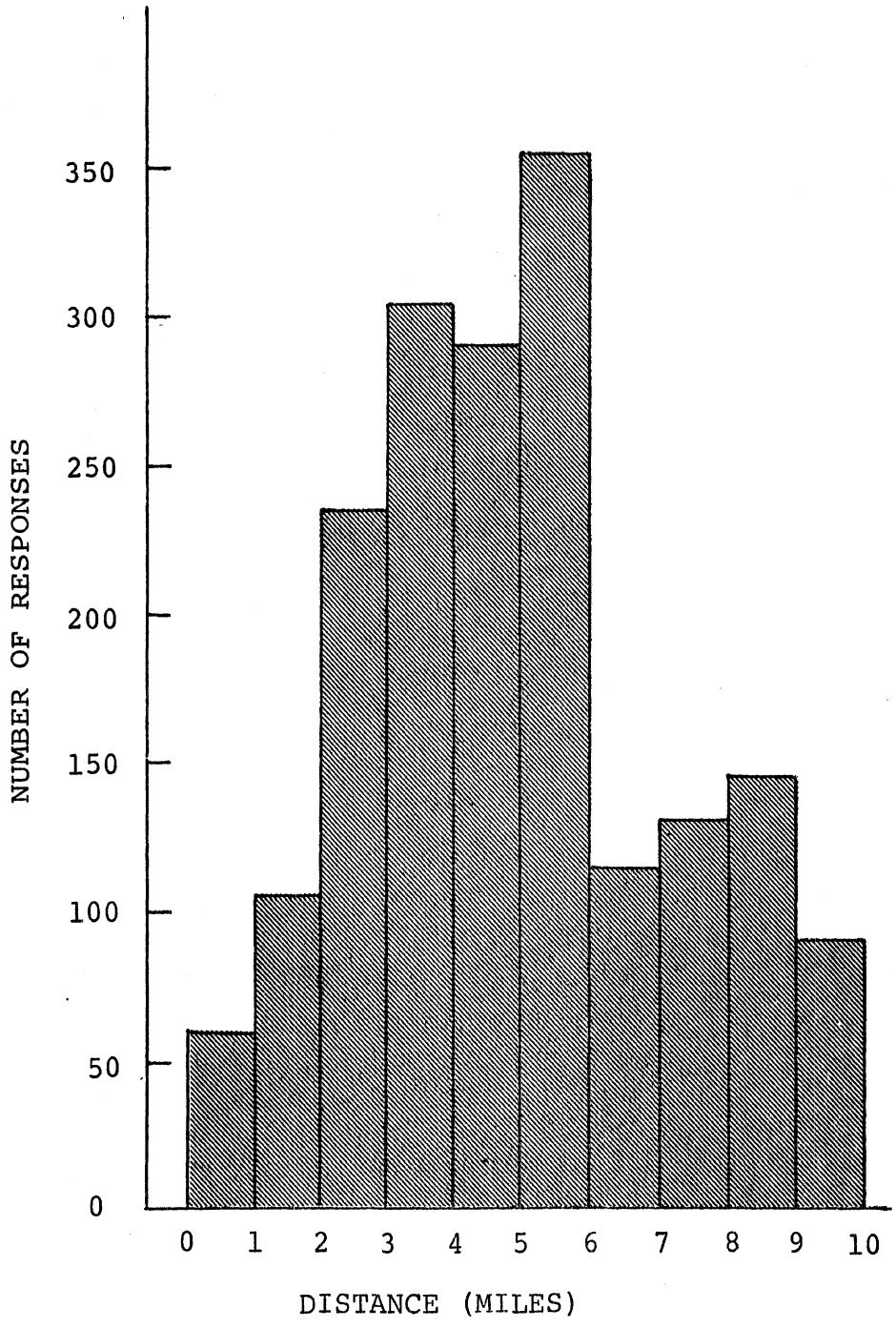


FIGURE 3

FREEWAY DISTANCES

TABLE 13

RELATIONSHIP BETWEEN RAMP INFORMATION SIGN USAGE AND FREQUENCY OF FREEWAY USAGE*

FREQUENCY	SAMPLE SIZE	USE THE SIGNS	
		YES	NO
Never or Seldom	108	63.9%	36.1%
Once or Twice A Week	270	56.7	43.3
Almost Every Day	1874	46.6	53.4
TOTAL	2252	48.6	51.4

$$\chi^2 = 20.19$$

$$\chi^2_{2,.001} = 13.82$$

*Only those drivers who have seen the signs are considered in the table.

TABLE 14

RELATIONSHIP, FOR DRIVERS WHO HAVE SEEN THE SIGNS, BETWEEN FREEWAY TRIP DISTANCE AND USE OF THE RAMP INFORMATION SIGNS

USE THE SIGNS	FREEWAY TRIP DISTANCE		TOTAL
	EIGHT MILES OR MORE	LESS THAN EIGHT MILES	
Yes	41.4%	54.0%	48.6%
No	58.6%	46.0%	51.4%
SAMPLE SIZE	966	1286	2252

$$\chi^2 = 34.75$$

$$\chi^2_{1,.002} = 9.55$$

TABLE 15

RELATIONSHIP BETWEEN FREQUENCY OF FREEWAY USAGE AND FREEWAY TRIP DISTANCE

		FREEWAY TRIP DISTANCE	
FREQUENCY	SAMPLE SIZE	EIGHT MILES OR MORE	LESS THAN EIGHT MILES
Never or Seldom	168	32.1%	67.9%
Once or Twice A Week	355	34.6%	65.4%
Almost Every Day	2301	45.7%	54.3%
TOTAL	2824	43.5%	56.5%

$$\chi^2 = 24.55$$

$$\chi^2_{2,.001} = 13.82$$

TABLE 16

RELATIONSHIP BETWEEN FREEWAY TRIP DISTANCE AND USE OF THE RAMP INFORMATION SIGNS*

USE THE SIGNS	EIGHT MILES OR MORE	LESS THAN EIGHT MILES	TOTAL
Yes	40.2%	51.8%	46.6%
No	59.8%	48.2%	53.4%
SAMPLE SIZE	846	1028	1874

$$\chi^2 = 24.88$$

$$\chi^2_{1,.002} = 9.55$$

*Only drivers who use the Freeway almost every day and have seen the signs are considered in the table.

relationship between frequency of use of the Freeway and sign use, Table 17 considers only those drivers who indicated they had seen the signs before. These drivers were divided into two groups according to Freeway trip distance.

As seen in Table 16, there was a statistically highly significant interaction between Freeway trip distance and sign use with drivers on Freeway trips of less than eight miles being more likely to use the Ramp Information Signs.

Surprisingly, Table 17 shows no significant interaction between frequency of use of the Freeway and sign use for drivers on long trips, but a highly significant interaction for drivers on short trips with drivers who used the Freeway never or seldom being most likely to use the signs.

In summary, the data indicate that drivers on short, infrequent Freeway trips were the most likely to use the Ramp Information Signs. Some possible reasons for this will be discussed in Chapter Three.

TABLE 17

RELATIONSHIP BETWEEN USE OF THE RAMP INFORMATION SIGNS AND FREQUENCY OF USE OF THE FREEWAY*

DRIVERS ON FREEWAY TRIPS OF EIGHT MILES OR MORE			
FREQUENCY OF FREEWAY USE	SAMPLE SIZE	USE THE SIGNS	
		NO	YES
Never or Seldom	31	51.6%	48.4%
Once or Twice A Week	89	49.4%	50.6%
Almost Every Day	846	59.8%	40.2%
TOTAL	966	58.6%	41.4%

$\chi^2 = 4.20 \quad \chi^2_{2,.10} = 4.61$

DRIVERS ON FREEWAY TRIPS LESS THAN EIGHT MILES			
FREQUENCY OF FREEWAY USE	SAMPLE SIZE	USE THE SIGNS	
		NO	YES
Never or Seldom	77	29.9%	70.1%
Once or Twice A Week	181	40.3%	59.7%
Almost Every Day	1028	48.2%	51.8%
TOTAL	1286	46.0%	54.0%

$\chi^2 = 12.34 \quad \chi^2_{2,.01} = 9.21$

*Only drivers who have seen the signs are considered.

ATTITUDES

Striking differences in attitudes are observed if drivers are divided into three groups on the questions of seeing and using the Ramp Information Signs (Questions Five and Six) and compared on their responses to an all-red display (Question Seven). These results are shown in Table 18. Drivers who had seen the signs but did not use them were twice as likely to disregard the all-red display as were drivers who had never seen the signs and more than four times as likely to disregard the message as drivers who used the signs. Other evidence suggests that this was due to poor results in individual attempts to use the signs which will be discussed in Chapter Three. It is also noteworthy that 30.3% of the sign users, compared with 19.9% of those who had never seen the signs, would not use the Freeway at all when faced with an all-red display. When the 14.3% of sign users who would disregard the sign and enter anyway is added in it is clear that "using the signs" is not equivalent to "using the alternate route when advised" as might be intuitively expected.

Table 19 shows the significant and complex interaction between Freeway usage frequency and the hypothetical response to a congested indication at all ramps. Further examination of only those drivers who had never seen the signs reveals

TABLE 18

RELATIONSHIP BETWEEN RESPONSE TO AN ALL-RED RAMP INFORMATION SIGN AND SIGHTING AND USING THE SIGNS

INDICATED RESPONSE TO AN ALL-RED DISPLAY	HAVE YOU EVER SEEN THE SIGNS?			
	NO	YES		AVERAGE
		DO YOU USE THEM?		
		NO	YES	
Disregard and Enter Anyway	32.4%	66.0%	14.3%	39.1%
Continue On Recommended Path	47.7%	18.2%	55.4%	38.6%
Not Use Freeway At All	19.9%	15.8%	30.3%	22.3%
SAMPLE SIZE	572	1157	1095	2824

$$\chi^2 >> (\chi^2_{4,.001} = 18.47)$$

TABLE 19

RELATIONSHIP BETWEEN FREQUENCY OF USE OF THE FREEWAY AND RESPONSE TO AN ALL-RED RAMP INFORMATION SIGN

INDICATED RESPONSE TO AN ALL-RED DISPLAY	FREQUENCY OF FREEWAY USE			TOTAL
	NEVER OR SELDOM	ONCE OR TWICE A WEEK	ALMOST EVERY DAY	
Disregard and Enter Anyway	28.0%	25.1%	42.1%	39.1%
Continue On Recommended Path	50.6%	45.3%	36.7%	38.6%
Not Use the Freeway At All	21.4%	29.6%	21.2%	22.3%
SAMPLE SIZE	168	355	2301	2824

$$\chi^2 >> (\chi^2_{4,.001} = 18.47)$$

a statistically significant interaction between frequency of use of the Freeway and response to an all-red display for drivers on long trips but not for drivers on short trips. This is shown in Table 20. Among the drivers on long trips, those who used the Freeway almost every day were not as likely to follow the alternate route or to not use the Freeway at all. Instead they were twice as likely to disregard the signs as were drivers who used the Freeway less frequently.

Using Table 20 again, drivers who used the Freeway almost every day were studied to examine the relationship between Freeway trip distance and response to an all-red Ramp Information Sign display. This association gave a χ^2 of 5.94 ($\chi^2_{2,.05}$ = 5.99) and so statistical significance is not quite established. This weak result is somewhat surprising since this relationship was highly significant when tested among drivers who used the signs or among drivers who had seen but did not use the signs.

Table 21 considers a second group of drivers, those who had seen but did not use the signs, and again there was a statistically significant interaction between the frequency of use of the Freeway and response to an all-red Ramp Information Sign for drivers on long trips but not for drivers on short trips. Of drivers on long trips who used the Freeway almost every day, 76.3% said they would disregard the all-red display and enter at a ramp shown in red while only 53.3% of the less frequent users indicated such a choice.

TABLE 20

RELATIONSHIP BETWEEN FREQUENCY OF USE OF THE FREEWAY AND RESPONSE TO AN ALL-RED RAMP INFORMATION SIGN FOR DRIVERS WHO HAVE NEVER SEEN THE SIGNS

A. DRIVERS ON FREEWAY TRIPS OF EIGHT MILES OR MORE

INDICATED RESPONSE TO AN ALL-RED DISPLAY	FREQUENCY OF USE OF THE FREEWAY			TOTAL
	NEVER OR SELDOM	ONCE OR TWICE A WEEK	ALMOST EVERY DAY	
Disregard and Enter Anyway	21.7%	14.7%	40.5%	35.5%
Continue On Recommended Path	52.2%	52.9%	45.8%	47.3%
Not Use the Freeway At All	26.1%	32.4%	13.7%	17.2%
SAMPLE SIZE	23	34	205	262

$\chi^2 = 14.33, \quad \chi^2_{4,.01} = 13.28$

B. DRIVERS ON FREEWAY TRIPS OF LESS THAN EIGHT MILES

INDICATED RESPONSE TO AN ALL-RED DISPLAY	FREQUENCY OF USE OF THE FREEWAY			TOTAL
	NEVER OR SELDOM	ONCE OR TWICE A WEEK	ALMOST EVERY DAY	
Disregard and Enter Anyway	35.1%	15.7%	32.0%	29.7%
Continue On Recommended Path	46.0%	56.9%	46.4%	48.1%
Not Use the Freeway At All	18.9%	27.4%	21.6%	22.2%
SAMPLE SIZE	37	51	222	310

$\chi^2 = 5.97 \qquad \chi^2_{4,.10} = 7.78$

TABLE 21

RELATIONSHIP BETWEEN FREQUENCY OF USE OF THE FREEWAY AND RESPONSE TO AN ALL-RED RAMP INFORMATION SIGN FOR DRIVERS WHO HAD SEEN BUT DID NOT USE THE SIGNS

A. DRIVERS ON FREEWAY TRIPS OF EIGHT MILES OR MORE				
INDICATED RESPONSE TO AN ALL-RED DISPLAY	FREQUENCY OF USE OF THE FREEWAY			TOTAL
	NEVER OR SELDOM	ONCE OR TWICE A WEEK	ALMOST EVERY DAY	
Disregard and Enter Anyway	50.0%	54.5%	76.3%	73.9%
Continue On Recommended Path	25.0%	27.3%	16.0%	17.1%
Not Use the Freeway At All	25.0%	18.2%	7.7%	9.0%
SAMPLE SIZE	16	44	506	566

$\chi^2 = 16.37$ (first two columns combined)

$\chi^2_{2,.001} = 13.82$

B. DRIVERS ON FREEWAY TRIPS OF LESS THAN EIGHT MILES				
INDICATED RESPONSE TO AN ALL-RED DISPLAY	FREQUENCY OF USE OF THE FREEWAY			TOTAL
	NEVER OR SELDOM	ONCE OR TWICE A WEEK	ALMOST EVERY DAY	
Disregard and Enter Anyway	56.6%	49.3%	60.0%	58.6%
Continue On Recommended Path	21.7%	19.2%	19.0%	19.1%
Not Use the Freeway At All	21.7%	31.5%	21.0%	22.3%
SAMPLE SIZE	23	73	495	591

$\chi^2 = 4.48$, $\chi^2_{4,.10} = 7.78$

To test the relationship between Freeway trip distance and response to an all-red display among drivers who had seen but did not use the signs (Table 21), only drivers who used the Freeway almost every day were considered and the χ^2 value for this relationship was 42.00 ($\chi^2_{2,.001} = 13.82$). The percent of drivers who would follow the alternate route was almost the same for drivers on long and short trips and the major difference between the two groups was that almost three times as many drivers on short trips would have chosen to not use the Freeway at all (21.0% compared with 7.7% of drivers on long trips). Thus, if "disregard and enter anyway" are considered as the only "undesirable" choice, it is found that even among drivers who did not use the signs those on short trips were more likely to utilize the information in an "acceptable" manner.

Among drivers who used the signs, the relationship between frequency of use of the Freeway and response to an all-red display, as shown in Table 22, again was statistically significant for drivers on long Freeway trips but not for drivers on short Freeway trips. However, the major difference among drivers on long trips in this group, as contrasted with drivers on long trips who did not use the signs, was that those who used the Freeway every day were much more likely to not use the Freeway at all when faced with an all-red display than were drivers who were less frequent Freeway users. Corresponding to this greater percent who would not use the Freeway at all it is seen that a lesser

TABLE 22

RELATIONSHIP BETWEEN FREQUENCY OF USE OF THE FREEWAY AND RESPONSE TO AN ALL-RED RAMP INFORMATION SIGN FOR DRIVERS WHO USE THE SIGNS

A. DRIVERS ON FREEWAY TRIPS OF EIGHT MILES OR MORE				
INDICATED RESPONSE TO AN ALL-RED DISPLAY	FREQUENCY OF USE OF THE FREEWAY			TOTAL
	NEVER OR SELDOM	ONCE OR TWICE A WEEK	ALMOST EVERY DAY	
Disregard and Enter Anyway	20.0%	11.1%	19.1%	18.3%
Continue On Recommended Path	80.0%	77.8%	60.6%	63.2%
Not Use the Freeway At All	0.0%	11.1%	20.3%	18.5%
SAMPLE SIZE	15	45	340	400

$\chi^2 = 7.41$ (first two columns combined)

$\chi^2_{2,.05} = 5.99$

B. DRIVERS ON FREEWAY TRIPS OF LESS THAN EIGHT MILES				
INDICATED RESPONSE TO AN ALL-RED DISPLAY	FREQUENCY OF USE OF THE FREEWAY			TOTAL
	NEVER OR SELDOM	ONCE OR TWICE A WEEK	ALMOST EVERY DAY	
Disregard and Enter Anyway	9.3%	10.2%	12.6%	12.0%
Continue On Recommended Path	64.8%	49.1%	49.9%	50.9%
Not Use the Freeway At All	25.9%	40.7%	37.5%	37.1%
SAMPLE SIZE	54	108	533	695

$\chi^2 = 5.24$, $\chi^2_{4,.10} = 7.78$

percent of drivers who used the Freeway almost every day would continue on the alternate route and a slightly greater percent would disregard the signs (19.1% compared with 13.3% for all the less frequent Freeway users).

From Table 22 it can also be seen that every day users on short trips were much more likely to not use the Freeway at all when presented an all-red display than every day users on long trips. The drivers on short trips were less likely to disregard the signs, but they were also less likely to follow the alternate route than drivers on long trips. This relationship between Freeway trip distance and response to an all-red display was tested for everyday users and the χ^2 value was 30.26 ($\chi^2_{2,.001} = 13.82$).

In summary, it can be said that the frequency with which a driver used the Freeway was an important factor in his response to an all-red Ramp Information Sign only if he was making a long (eight miles or more) Freeway trip. Freeway trip distance was a statistically highly significant factor in his hypothetical response to an all-red display if he had seen the signs, whether or not he used them, but significance was not shown for those who had not seen the signs.

SPECIFIC COMMENTS

A comparison of the coded comments with the response on questions on the use of Ramp Information and Route Guidance Signs shows that, in general, drivers who did not use the signs were more likely to make unfavorable comments about the signs and the alternate route. These results are shown in Tables 23, 24 and 25.

Examination of the relationship between comments and frequency of Freeway use shown in Table 26 reveals that drivers who used the Freeway almost every day were the most likely to make unfavorable comments on ramp metering, trail-blazers, and the alternate route and in each of the cases the interaction was statistically significant at the 1% level. Only when considering comments on the Ramp Information Signs was there a statistically non-significant interaction with the frequency of Freeway use and here there was a relatively high level of unfavorable comments from all Freeway users.

Drivers who indicated that their response to an all-red Ramp Information Sign would be to disregard it and enter the Freeway at a ramp shown in red were the most likely to make unfavorable comments on ramp metering, Ramp Information Signs and the alternate route (Table 27). Their percent of unfavorable comments on the alternate route was five times

TABLE 23

RELATIONSHIPS BETWEEN USE OF THE
RAMP INFORMATION SIGNS AND COMMENTS

		USE THE SIGNS		
		YES	NO	
RAMP INFORMATION SIGN COMMENTS	No Comment	86.3%	76.3%	$\chi^2 >> (\chi^2_{2,.001}=13.82)$
	Favorable	5.4%	1.6%	
	Unfavorable	8.3%	22.1%	
	Sample Size	1095	1729	
ALTERNATE ROUTE COMMENTS	No Comment	97.3%	92.2%	$\chi^2 >> (\chi^2_{1,.002}=9.55)$
	Unfavorable	2.7%	7.8%	
	Sample Size	1094	1727	

TABLE 24

RELATIONSHIP BETWEEN USING THE RAMP INFORMATION SIGNS THIS TRIP AND ALTERNATE ROUTE COMMENTS

ALTERNATE ROUTE COMMENTS	USE THE SIGNS THIS TRIP	
	YES	NO
No Comment	97.7%	93.5%
Unfavorable	2.3%	6.5%
Sample Size	475	2346

$\chi^2 = 11.84$, $\chi^2_{1, .002} = 9.55$

TABLE 25

RELATIONSHIPS BETWEEN USING THE TRAILBLAZERS THIS TRIP AND COMMENTS

		USE THE TRAILBLAZERS THIS TRIP	
		YES	NO
TRAILBLAZER COMMENTS	No Comment	92.7%	78.7%
	Favorable	4.0%	3.0%
	Unfavorable	3.3%	18.3%
	Sample Size	300	2524

$\chi^2 >> (\chi^2_{2,.001} = 13.82)$

ALTERNATE ROUTE COMMENTS	No Comment	97.7%	93.8%
	Unfavorable	2.3%	6.2%
	Sample Size	300	2521

$\chi^2 = 6.62$, $\chi^2_{1,.01} = 6.63$

TABLE 26

RELATIONSHIPS BETWEEN COMMENTS AND FREQUENCY OF USE OF THE FREEWAY

		FREQUENCY OF USE OF THE FREEWAY		
		NEVER OR SELDOM	ONCE OR TWICE A WEEK	ALMOST EVERY DAY
RAMP METERING COMMENTS	No Comment	97.1%		86.6%
	Unfavorable	2.9%		13.4%
	Sample Size	520		2287

$\chi^2 = 45.30$, $\chi^2_{1,.002} = 9.55$

RAMP INFORMATION SIGN COMMENTS	No Comment	83.3%	81.7%	79.7%
	Favorable	3.6%	2.8%	3.1%
	Unfavorable	13.1%	15.5%	17.2%
	Sample Size	168	355	2301

$\chi^2 = 2.55$, $\chi^2_{4,.10} = 7.78$

TRAILBLAZER COMMENTS	No Comment	89.2%	90.1%	84.8%
	Favorable	4.8%	2.8%	3.2%
	Unfavorable	6.0%	7.1%	12.0%
	Sample Size	168	355	2301

$\chi^2 = 13.70$, $\chi^2_{4,.01} = 13.28$

ALTERNATE ROUTE COMMENTS	No Comment	99.4%	97.5%	93.3%
	Unfavorable	0.6%	2.5%	6.7%
	Sample Size	168	355	2298

$\chi^2 = 18.42$, $\chi^2_{2,.001} = 13.82$

TABLE 27

RELATIONSHIPS BETWEEN RESPONSE TO AN ALL-RED FRONTAGE ROAD SIGN AND COMMENTS

		INDICATED RESPONSE TO ALL-RED DISPLAY		
		DISREGARD AND ENTER ANYWAY	CONTINUE ON RECOMMENDED PATH	NOT USE THE FREEWAY AT ALL
RAMP METERING COMMENTS	No Comment	84.7%	92.1%	89.1%
	Unfavorable	15.3%	7.9%	10.9%
	Sample Size	1098	1083	627

$\chi^2 = 29.36$, $\chi^2_{2,.001} = 13.82$

RAMP INFORMATION SIGN COMMENTS	No Comment	71.9%	86.7%	83.5%
	Favorable	2.0%	3.9%	3.5%
	Unfavorable	26.1%	9.4%	13.0%
	Sample Size	1105	1090	629

Between No Comment and Favorable $\chi^2 = 3.65$, $\chi^2_{2,.10} = 4.61$

Between No Comment and Unfavorable $\chi^2 >> (\chi^2_{2,.001} = 13.82)$

ALTERNATE ROUTE COMMENTS	No Comment	88.4%	97.7%	98.4%
	Unfavorable	11.6%	2.3%	1.6%
	Sample Size	1104	1089	628

$\chi^2 >> (\chi^2_{2,.001} = 13.82)$

greater than the percent of unfavorable comments from drivers who would continue on the recommended path and over seven times as great as the percent of unfavorable alternate route comments from drivers who would not use the Freeway at all when faced with an all-red display.

In summary, it seems reasonable to conclude that many of the drivers who did not use the information system did so because they found it unsatisfactory in some respect, not because of their indifference to it.

RAMP USAGE DISPERSION

In order to measure dispersion among drivers in their use of ramps, the respondents were asked where they would have entered the Freeway if the signs had not been operating (Question Nine). The results from the response to the question are shown in Table 28 where the heavy desires for the West Grand Boulevard, Seward Avenue and Davison Expressway ramps account for over 60% of the usable responses. The response to this question is compared with the actual on-ramp used in Table 29 to show the diversion due to the information signs and is also compared with the most convenient ramp (MCR) in Table 30 to show the "normal" dispersion. A comparison of the totals for these two results (Table 31) shows that the main overall effect of the information system was to help drivers enter the Freeway sooner. The figures for the normal dispersion suggest that without timely information on ramp conditions many drivers found it expedient to regularly use a ramp other than their MCR. These drivers probably chose one particular ramp as their usual entry point by evaluating ramp conditions over a period of days or months. By using the information system they could vary their entry point to take advantage of current ramp conditions. Consequently, as shown by the figures for sign dispersion, more drivers were able to enter at the ramp they desired.

TABLE 28

QUESTION 9: IF THE SIGNS HAD NOT BEEN IN OPERATION TODAY, AT WHICH RAMP WOULD YOU HAVE ENTERED?

RESPONSE	NUMBER	PERCENT
South of West Grand Boulevard	41	1.5
West Grand Boulevard	769	27.2
Seward Avenue	298	10.6
Chicago Boulevard	126	4.5
Webb Avenue	110	3.9
Davison Expressway	524	18.6
Linwood Avenue	209	7.4
Livernois Avenue	170	6.0
Wyoming Road	224	7.9
North of Wyoming Road	45	1.6
No Response	308	10.9
TOTAL	2824	100.0

TABLE 29

DISPERSION DUE TO INFORMATION SIGNS

		0	1	2	3	4	5	6	7	8	9	TOTALS
ACTUAL ENTRY	Two or More Ramps Upstream	-	-	-	9	10	15	7	10	8	13	72
	One Ramp Upstream	-	-	21	11	15	2	15	15	8	32	119
	Same	-	638	248	85	80	453	180	141	208	-	2033
	One Ramp Downstream	26	92	12	13	1	39	5	4	-	-	192
	Two Ramps Downstream	6	13	7	6	0	6	2	-	-	-	40
	Three or More Ramps Down-stream	9	26	10	2	4	9	-	-	-	-	60

* 1-8 are the same as the on-ramp code (Table B-1).

0 is south of the West Grand Boulevard ramp.

9 is north of the Wyoming ramp

TABLE 30

NORMAL DISPERSION

		MCR*								
		1	2	3	4	5	6	7	8	TOTALS
IF THE SIGNS HAD NOT BEEN IN OPERATION TODAY, AT WHICH RAMP WOULD YOU HAVE ENTERED?	Two or More Ramps Upstream	-	0	4	2	1	0	2	4	13
	One Ramp Upstream	19	2	3	7	5	29	5	25	95
	MCR	518	26	59	41	303	157	41	137	1282
	One Ramp Downstream	242	3	21	41	20	20	9	23	379
	Two Ramps Downstream	42	1	39	2	26	2	1	-	113
	Three or More Ramps Downstream	87	3	21	4	10	3	-	-	128

* The MCR code is the same as the on-ramp code (Table B-1).

TABLE 31

COMPARISON OF NORMAL AND INFORMATION SYSTEM RELATED DISPERSION

RAMP USED	NORMAL DISPERSION	SIGN DISPERSION
Two or More Ramps Upstream	0.6%	2.9%
One Ramp Upstream	4.7	4.7
Same Ramp	63.8	80.8
One Ramp Downstream	18.9	7.6
Two Ramps Downstream	5.6	1.6
Three or More Ramps Downstream	6.4	2.4
SAMPLE SIZE	2010	2516

$$\chi^2 >> (\chi^2_{5,\ .001} = 20.52)$$

While the overall effect of the signs was to allow more drivers to enter at the ramp they desire, if the diversion pattern for drivers who actually used one or the other or both of the signs is examined (Table 32), it can be seen how this overall effect was achieved.

Table 32 shows that the signs had the opposite effect for those who used them since 71.3% of the sign users were diverted from the ramp they said they would have used had the signs not been operating. These diverted drivers comprise only 16.9% of the total volume but, as shown in Table 31, they had a statistically significant effect on the overall dispersion pattern. It is also notable that, of the drivers diverted by the signs, 35.7% were able to enter the Freeway sooner by using the signs.

When the dispersion attributable to the sign display system for drivers who actually saw either a route guidance (Trailblazer, Variable Message or Blank-out) or a Ramp Information Sign or both this trip, (Table 33) is compared with the total sign dispersion (Table 29 on page 82) it is found that 726 of the 871 drivers who did not see the signs this trip responded that their entry point would have been the same if the signs were not operating. This is the "correct" response and the question which arises is why 145 drivers gave a seemingly inconsistent response. The first and perhaps most likely possibility is that these drivers

TABLE 32

RAMP USED, RELATIVE TO DESIRED RAMP, BY DRIVERS WHO USED THE SIGNS THIS TRIP

THE RAMP USED WAS	UPSTREAM	25.5%
	DESIRED RAMP	28.7%
	DOWNSTREAM	45.8%
	SAMPLE SIZE	668

TABLE 33

DISPERSION DUE TO SIGNS, CONSIDERING ONLY THOSE DRIVERS WHO SAW A SIGN THIS TRIP

ACTUAL ENTRY	WHERE WOULD YOU HAVE ENTERED IF THE SIGNS HAD NOT BEEN OPERATING?										
	0	1	2	3	4	5	6	7	8	9	TOTAL
TWO RAMPS OR MORE UPSTREAM	-	-	-	8	9	10	4	3	6	8	48
ONE UPSTREAM	-	-	15	8	8	1	10	9	2	13	66
SAME	-	499	176	54	48	339	76	34	81	-	1307
ONE DOWNSTREAM	16	70	11	8	1	38	1	3	-	-	148
TWO OR MORE DOWNSTREAM	9	34	14	6	1	13	0	-	-	-	76

did not understand the question. Since 10.9% of the total number of drivers failed to answer the question, this implies that the question was confusing and misunderstood. An interesting second possibility is that these drivers represent a secondary or residual effect of the information signs. Perhaps some of these drivers found that, due to the information signs, their usual on-ramp became slightly more congested so they used a different on-ramp. While this type of secondary effect is not unlikely, particularly at the Seward ramp, it is probably unlikely that drivers would be able to discern the signs as the cause. On the other hand, if the signs consistently guided a driver to the same uncongested on-ramp, it is possible that, after a while, the driver would proceed directly to that ramp without using the signs. This residual effect is more likely to be recognized by the driver as being due to the signs and this effect is possibly part of the reason for the increased use of the Freeway by drivers from Zone 12 (see later section - trip origins).

The sum of normal and sign use dispersion can be obtained by comparing the MCR to the actual on-ramp and this is done in Table 34.

TABLE 34

TOTAL DISPERSION

	MCR*								
RAMP USED	1	2	3	4	5	6	7	8	TOTALS
ONE RAMP OR MORE UPSTREAM	-	0	8	10	10	34	3	32	97
MCR	528	29	67	59	320	196	61	182	1442
ONE RAMP DOWNSTREAM	302	6	22	45	45	13	10	-	443
TWO RAMPS DOWNSTREAM	49	1	39	4	5	2	-	-	100
THREE OR MORE RAMPS DOWNSTREAM	107	3	31	0	7	-	-	-	148

*See Table B-1 for MCR code

TRIP ORIGINS AND DESTINATIONS

At the time of the 1970 questionnaire study, the information system had been in operation for more than one year and a comparison with the 1969 study indicates that there were some basic changes in travel patterns during the intervening 13 months. The 1970 data giving the on-ramps used by drivers from each zone of origin (see Figure 4) appear in Table 35. One of the most noticeable changes is in trips originating in the Wayne State University area (Zone 9). The 1969 study (for complete 1969 data see Reference 26) showed that this zone contributed 8.7% of the total volume entering the eight ramps under surveillance but in 1970 this zone contributed only 4.8%, a highly significant change. West Grand Boulevard is the most convenient downstream ramp for this zone and in 1969 this zone contributed 25.7% of the total entering volume at West Grand Boulevard, but in 1970 contributed only 14.0%. The most probable conclusion is that drivers from this zone found it more expedient to enter the Freeway at a ramp upstream from West Grand Boulevard and since ramp metering was also in effect before the 1969 questionnaire study (although the metering strategy has been changed, see Reference 27), this effect must be mostly attributed to the information system.

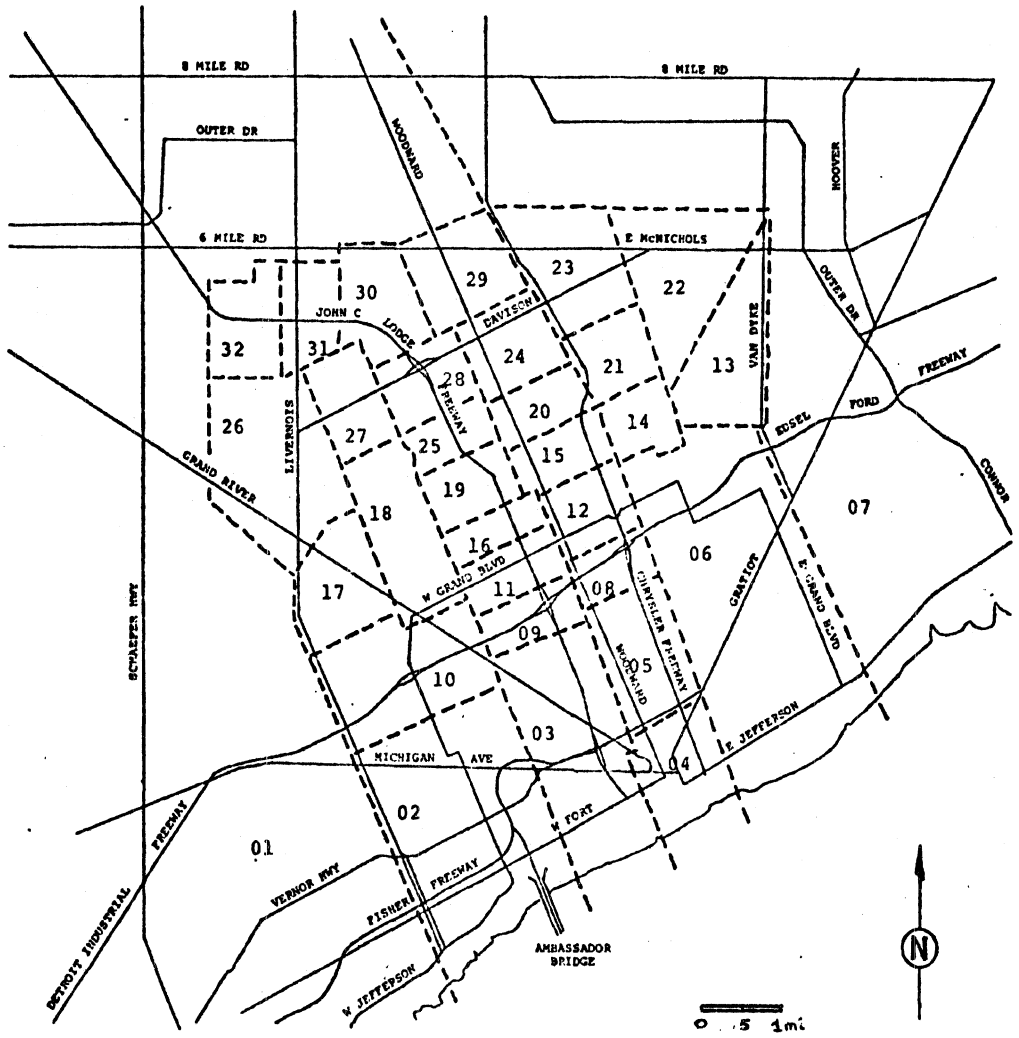


FIGURE 4

1970 ORIGIN ZONES

TABLE 35

ON-RAMPS USED BY ZONE OF ORIGIN

ZONE OF ORIGIN	1	2	3	4	5	6	7	8	TOTAL
1	2	3	0	1	2	3	9	74	94
2	1	0	0	0	1	0	60	2	64
3	15	3	1	2	3	2	4	3	33
4	11	4	2	6	2	1	2	2	30
5	36	14	4	3	10	2	0	1	70
6	8	10	2	2	20	1	4	1	48
7	0	0	2	0	19	1	1	1	24
8	58	12	4	0	6	1	0	0	81
9	108	23	2	1	0	2	0	0	136
10	2	1	0	0	0	0	9	2	14
11	421*	235	33	20	35	10	1	0	755
12	107*	67	16	15	23	2	1	0	231
13	0	0	0	0*	25	2	0	0	27
14	0	0	2*	1	30	6	1	0	40
15	1	2	21*	2	7	0	0	2	35
16	0	29*	6	1	2	0	1	0	39
17	0	0	0	0	0	0	22*	0	22
18	1	1	9*	5	1	9	11	2	39
19	0	3	35*	14	1	0	0	0	53
20	0	0	10	7*	6	2	0	0	25
21	0	0	0	0*	13	0	0	0	13
22	0	0	0	0	44*	5	0	1	50
23	0	0	0	0	26*	2	0	0	28
24	0	0	0	4	217*	27	3	5	256
25	0	0	0	52*	1	0	0	0	53
26	0	0	0	0	0	0	31	66*	97
27	0	0	0	0	0	18*	9	0	27
28	0	0	0	6	33*	11	2	1	53
29	0	0	0	0	30	36*	1	1	68
30	0	0	0	0	4	142*	3	1	150
31	0	0	0	0	0	3	39*	10	52
32	0	0	0	0	0	0	1	116*	117
TOTAL	772	407	149	142	561	288	215	290	2824

* Indicates Most Convenient Ramp for this zone. Zones 1-10 were not coded for MCR.

** See Figure 4 for Zones of Origin, Table B-1 for On-Ramps key.

Corresponding to this reduced volume of drivers from Zone 9 there was an increase in the volume of trips originating in Zone 12, the zone centered on West Grand Boulevard east of Woodward Avenue. In 1969 Zone 12 contributed 4.6% of the total volume and 6.3% of the West Grand Boulevard volume while in 1970 it contributed 8.2% of the total and 13.9% of the West Grand Boulevard volume. Trips originating in Zone 8, located south of Zone 12, also served to balance the decrease in Zone 9 trips as the proportion of the West Grand Boulevard volume originating in Zone 8 had increased from 2.6% in 1969 to 7.5% in 1970.

The change in the distribution of total volume between on-ramps (Table 36), particularly the increased use of the Seward ramp, reflects the increase in the number of trips originating in Zone 12 and a change in the on-ramp distribution of trips originating in Zone 11 (the New Center area). As seen from Table 37, the percent of trips with origins in Zone 11, using the Seward ramp, roughly doubled in the year after the 1969 study while the percent using the Chicago and Webb ramps decreased by more than one-half. This indicates that drivers from the New Center area developed an increased reluctance to utilize the alternate route beyond Seward. There was an increase from 3.6% in 1969 to 4.6% in 1970 in the number of Zone 11 drivers who used the Davison ramp so apparently many drivers willing to use the alternate

TABLE 36

PERCENT OF TOTAL VOLUME ENTERING EACH RAMP*

	1969	1970
West Grand Boulevard	22.5%	21.6%
Seward	6.8	10.7
Chicago	9.2	8.0
Webb	6.7	6.6
Davison	24.4	23.9
Linwood	11.1	11.1
Livernois	8.6	7.0
Wyoming	10.8	11.1
	100.0%	100.0%

* On the days the questionnaires were handed out.

TABLE 37

ON-RAMPS OF DRIVERS WHOSE MCR IS WEST GRAND BOULEVARD

	ZONE 11		ZONE 12	
	1969	1970	1969	1970
West Grand Boulevard	59.7%	55.8%	37.5%	46.3%
Seward	15.8	31.1	28.8	29.0
Chicago	10.1	4.4	13.5	6.9
Webb	8.6	2.6	9.6	6.5
Davison	3.6	4.6	9.6	10.0
Linwood	1.5	1.3	1.0	0.9
Livernois	0.5	0.1	0.0	0.4
Wyoming	0.2	0.0	0.0	0.0
TOTAL VOLUME	583	755	104	231

route for metering strategy discovered the high metering rate introduced at Davison (27). The change in the on-ramp distribution of trips originating in Zone 12 was not as pronounced as the change in Zone 11, but the fact that the number of trips originating in Zone 12 nearly doubled certainly affected the distribution of total volume between ramps.

Davison and the ramps downstream from it handled very nearly the same fraction of the total volume in 1970 as they did in 1969 except for Livernois which decreased slightly, from 8.6% to 7.0%. There were no major changes in traffic patterns discernable in this section of the Freeway and the zones which contributed the largest proportion of the volume entering each particular on-ramp remained the same. It was found that 38.7% of the Davison on-ramp volume originated in Zone 24 where Chrysler Corporation is located and this was close to the 1969 figure of 40.9%. Zone 30, which surrounds the Linwood ramp, was again the major zone of origin for drivers using that ramp and contributed 49.3% of the Linwood volume compared with 51.1% in 1969. Zone 2 contributed 29.8% of the Livernois ramp volume for 1970 (28.1% in 1969). The Wyoming ramp is surrounded by Zone 32 and this zone was still the largest contributor to the Wyoming volume with 40.0% (38.0% in 1969).

In 1969, Zone 11 (the New Center area) was the largest contributing zone of origin for the West Grand Boulevard, Seward, Chicago and Webb ramps and this was still true for the West Grand Boulevard and Seward ramps in 1970. However, due to the fact pointed out earlier that these drivers seemed reluctant to use the alternate route past Seward (Table 35), the 1970 study showed that Zone 11 had been replaced as the major contributor to the Chicago and Webb ramps. In both cases the zone which surrounds the ramp became the major contributing zone for that ramp, Zone 19 for the Chicago ramp and Zone 25 for the Webb ramp.

ORIGINS AND DESTINATIONS

Table 38 compares the on-ramp by off-ramp data obtained from the 1970 questionnaire study with the data available from previous studies in 1965, 1967 and 1969. For every on-ramp the percent of drivers continuing beyond 8 Mile Road was greater in 1970 than it was in either 1965 or 1967 and this implies that the combination of ramp metering and the sign information system discouraged short trips. A comparison with the 1969 data is inconclusive since the percent of drivers continuing beyond 8 Mile Road was greater in 1970 at the West Grand Boulevard, Davison, Livernois and Wyoming ramps, but was less than the 1969 percent at the other four ramps. However, there is other data available from the questionnaires and this comparison will be examined more closely in Chapter Three by using actual Freeway trip distances.

TABLE 38

FOUR ON-RAMP TO OFF-RAMP ORIGIN-DESTINATION STUDIES

EXIT RAMP / ENTRANCE RAMP	DATE	CLAIRMOUNT	CHICAGO	WEBB	GLENDALE	DAVISON EAST	DAVISON WEST	LINWOOD	LIVERNOIS	WYOMING	MEYERS	7 MILE	8 MILE	9 MILE	BEYOND 8 MILE	
WEST GRAND BLVD	1965	0.8	2.2	0.3	0.1	4.1	2.5	1.9	4.6	12.2	16.2	9.6	9.5	NA	36.0	
	1967	0.5	3.2	0.3	0.6	4.1	2.2	1.5	3.3	11.6	12.3	7.8	9.3	NA	43.3	100%
	1969	0.3	1.1	0.8	0.6	2.6	1.4	2.4	3.8	9.5	13.4	7.0	18.6	NA	38.5	
SEWARD	1965	1.4	1.5	0.9	0.2	3.8	3.4	1.7	5.3	13.8	12.2	9.1	10.1	NA	36.6	
	1967	1.6	1.9	0.3	0.3	3.8	3.1	1.6	5.0	9.6	12.5	7.6	12.3	NA	40.4	100%
	1969	0.9	---	---	---	2.5	2.5	3.8	6.0	8.9	13.2	6.4	11.5	NA	44.3	
CHICAGO	1965	---	---	0.3	0.8	4.5	3.4	4.2	7.5	18.4	15.4	13.4	10.3	NA	21.8	
	1967	---	---	0.6	0.6	4.2	1.9	6.4	4.2	16.4	23.5	9.6	10.3	NA	22.3	100%
	1969	---	---	---	---	6.6	3.8	6.6	3.8	10.4	21.8	5.7	13.3	NA	28.0	
WEBB	1965	---	---	---	0.5	2.1	1.6	5.2	4.1	10.8	27.8	10.3	13.9	NA	23.7	
	1967	---	---	---	4.5	2.2	1.5	4.5	5.4	15.1	22.7	6.9	10.6	NA	26.6	100%
	1969	---	---	---	0.6	3.8	---	3.1	1.9	13.2	13.8	10.7	15.1	NA	37.8	
DAVISON	1965	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	1967	---	---	---	---	---	---	4.0	3.8	14.7	14.5	9.0	14.8	NA	39.2	100%
	1969	---	---	---	---	---	---	2.6	3.8	9.8	15.4	8.4	17.0	NA	43.0	
LINWOOD	1965	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	1967	---	---	---	---	---	---	---	3.3	12.1	16.2	9.9	23.1	NA	35.4	100%
	1969	---	---	---	---	---	---	---	4.0	7.5	21.8	5.2	16.1	NA	45.4	
LIVERNOIS	1965	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	1967	---	---	---	---	---	---	---	---	1.8	22.0	14.9	22.6	NA	38.7	100%
	1969	---	---	---	---	---	---	---	---	3.6	11.9	15.5	22.0	NA	47.0	
WYOMING	1965	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	1967	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	100%
	1969	---	---	---	---	---	---	---	---	---	3.3	6.1	21.6	NA	69.0	

NA---Not Available

Sample Size:		Date	Percent Returned
1965 (NPG)	2322*	June 8-10, 1965	38.3%
1967 (TTI)**:	NA	Spring, 1967	NA
1969 (UM)	2316	July 17, 1969	22.8%

* Four ramps only
** 3:00-6:00 p.m. only

RAMP DIFFERENCES

One of the most striking results of the questionnaire study was the conclusive demonstration of the non-homogeneity of the Lodge Freeway Corridor users. On every bivariate comparison involving on-ramps, the χ^2 value was much greater than the .001 probability level and this illustrates the difficulty inherent in planning, implementing and analyzing systems designed for the corridor as a whole.

Table 39 presents a breakdown of the frequency of Lodge Freeway use by drivers entering at each on-ramp. Many unmeasured factors undoubtedly contributed to the observed variance between ramps and it is not possible to adequately explain this variance for each ramp. However, it is interesting to note that the four lowest ramps in percent of drivers who used the Freeway almost every day were West Grand Boulevard, Seward, Chicago and Webb and the four highest were Davison and those ramps downstream from it. Thus, the Corridor can be divided in half on the question of frequency of use and this allows a tentative explanation of one of the factors involved. As noted earlier, the zones of origin which made the major contributions to the Chicago and Webb ramps were the residential zones surrounding these ramps and therefore it can be expected that many Chicago

TABLE 39

FREQUENCY OF FREEWAY USAGE
BY ON-RAMPS

ON RAMP	FREQUENCY OF USE			TOTAL ENTERING VOLUME
	NEVER OR SELDOM	ONCE OR TWICE A WEEK	ALMOST EVERY DAY	
West Grand Boulevard	7.5%	11.5%	81.0%	772
Seward	5.7	19.9	74.4	407
Chicago	10.8	15.4	73.8	149
Webb	8.4	13.4	78.2	142
Davison	3.2	11.1	85.7	561
Linwood	5.9	9.7	84.4	288
Livernois	4.2	9.8	86.0	215
Wyoming	5.2	11.0	83.8	290
TOTALS	5.9	12.6	81.5	2824

$$\chi^2 >> (\chi^2_{14,.001} = 36.12)$$

and Webb users were making non-work trips. Since West Grand Boulevard and Seward served primarily the New Center business and shopping districts, it would not be unreasonable to expect that many of the drivers using these ramps were making infrequent business or shopping trips. Davison and the ramps downstream all served major traffic arteries and the zones of origins for these ramps were quite diffuse. However, as noted earlier, both Davison and Livernois received approximately half of their volume from an industrial zone, Zone 24 for Davison and Zone 2 for Livernois, and the proportion of daily work trips should be high for these ramps.

SIGHTING AND USING THE INFORMATION SIGNS

The 1970 questionnaire asked six different questions about sign sighting and use and the results, distributed by on-ramp, appear in Table 40. Because of the placement of the signs, the observed variation among the ramps was expected (26, 27). Drivers using the West Grand Boulevard and Seward ramps passed a Ramp Information Sign in order to use either of these ramps and, as expected, the table shows that a larger percentage of the drivers using these ramps saw the Ramp Information Signs. An unexpected result for these two ramps is that the percent of drivers who sighted the signs on this trip is only 70.6% for West Grand Boulevard and 68.3% for Seward. Probably many drivers had

TABLE 40

SIGHTING AND USAGE OF RAMP INFORMATION SIGNS BY ON-RAMP

	ON-RAMP								TOTAL
	1	2	3	4	5	6	7	8	
ENTERING VOLUME	772	407	149	142	561	288	215	290	2824
	% YES								
Have You Ever Seen A Ramp Information Sign?	92.6	95.3	87.9	89.4	67.0	70.1	63.3	61.0	79.7
	% YES OF THOSE WHO HAVE SEEN THEM								
Do You Use Them?	36.5	63.6	62.6	63.8	42.0	51.2	52.9	51.4	48.6
	% YES								
Did You See A Ramp Ramp Information Sign This Trip?	70.6	68.3	42.3	46.5	22.1	27.4	10.7	28.3	44.6
	% YES OF THOSE WHO SAW ONE THIS TRIP								
Did You Use One This Trip?	26.1	53.6	65.1	57.6	25.0	53.2	26.1	34.1	37.9
	% YES								
Did You See A Trail-blazer Sign This Trip?	16.7	19.7	29.5	28.9	58.6	31.2	14.9	15.9	28.0
	% YES OF THOSE WHO SAW ONE THIS TRIP								
Did You Use One This Trip?	44.2	60.0	59.1	46.3	17.6	55.6	50.0	54.3	37.8

All χ^2's > ($\chi^2_{7,.001} = 24.32$)

made their decision to enter or not before seeing the signs and they did not see the signs because they were concentrating on maneuvering, in heavy traffic, to implement their decision.

It was pointed out earlier that these two ramps were among the four lowest in percent of drivers who use the Freeway almost every day and as can be seen in Table 40 (page 102), there was a statistically significant relationship between frequency of Freeway use and seeing the Ramp Information Signs.

The Chicago and Webb ramps ranked fourth and third in the percent of users who had seen the Ramp Information Signs and this must be due to the fact that Zone 11 was the second largest contributor to the volume at each ramp. For many drivers from this zone the alternate route (Hamilton Avenue) was the most convenient route to the Chicago or Webb ramp and, additionally, some drivers from Zone 11 were using these ramps because they were using the signs. In either case, they passed one or more of the Ramp Information Signs.

Drivers who used the Davison, Linwood, Livernois and Wyoming ramps had a higher sighting percent than might be expected. The majority of the Davison ramp users came from the Davison Expressway and did not pass a Ramp Information Sign. The Ramp Information Signs for the other three ramps

were placed along the alternate route and a previous study showed that the majority of the users of these ramps did not approach the ramps along the alternate route (26). In fact, the license plate study showed that at Livernois as low as 7% of the ramp users passed the Ramp Information Sign for that ramp. Indeed, the percent of drivers who saw a Ramp Information Sign this trip is very low for these three ramps and particularly low for the Livernois ramp. This suggests that many of the 60-70% of the drivers who had seen a Ramp Information Sign did not see them very frequently.

The differences among ramps in use of the Ramp Information Signs was largely due to the nature of the surveillance system, the design of the Freeway and travel patterns discussed in the previous section dealing with origins. The West Grand Boulevard ramp had a very high volume and the Ramp Information Sign at this ramp, particularly during the rush hour, advised drivers to use a ramp downstream much of the time (26). Also, West Grand Boulevard was the first ramp in the system and so there was no sign use diversion to this ramp from upstream and since the predominant pattern at this ramp was for sign users to be diverted downstream, this ramp had the lowest percent of sign users. The downstream diversion by drivers whose most convenient ramp was West Grand Boulevard (Table 39, page 100) and the fact that these drivers constituted the largest or second largest segment by zones of origin of the volume at Seward, Chicago

and Webb ramps (Table 35, page 92) explains the high percent of sign users at these ramps. The high metering rate at Davison and the poor alternate route service beyond were probably the main reasons for the low observed percent of sign users at Davison. Table 37 implies that drivers were reluctant to follow the alternate route beyond Davison and it can be expected that drivers determined to enter at Davison did not use the signs. The percent of sign users at the Linwood, Livernois and Wyoming ramps was consistently close to the total average and these ramps are probably indicative of what might be expected on a section of Freeway without the unusual features of the West Grand Boulevard and Davison ramps and the curve between the Davison and Linwood ramps.

The percent of drivers who used a Ramp Information Sign this trip reflects the same factors as the percent of general users except for the Linwood ramp. The high percent at this ramp was possibly due to the fact that if a driver was following the Ramp Information Signs, he was usually advised that he could enter at Linwood.

As noted earlier, when a driver states that he used a Ramp Information Sign it does not necessarily mean he followed the advice given by the sign. Apparently, many drivers utilized the information to make decisions but did not follow the alternate route when it was advised by the sign. This, of course, reduces the value of Table 38 in evaluating the effectiveness of the information system.

The percent of drivers who saw a route guidance sign on this trip reflects the placement of these signs (see Figure 1). The Davison ramp had the highest percent because most of the drivers using this ramp approached it on the Davison Expressway and passed the Blank-out Sign located on Davison just before the ramp. The difference in use of these signs again illustrates the uniqueness of the West Grand Boulevard and Davison ramps. Both had high metering rates and drivers were reluctant to use alternate ramps. Additionally, the alternate route advised by the route guidance sign on the Davison Expressway required the driver to pass by the on-ramp, under the Lodge Freeway, and use surface streets through neighborhoods which many drivers consider "undesirable." So it is not surprising that very few drivers used this advice.

For drivers who had seen either the Ramp Information or the route guidance signs this trip, the percent of use was the same for the two types of signs, but because a lower percent of drivers saw the trailblazers only 10.6% (Table 8, page 51) of the total Freeway volume used the trailblazers this trip while 16.9% (Table 7, page 51) of the total used the Ramp Information Signs. To compare driver willingness to use the two different types of information signs, it is worthwhile to not consider drivers using the Davison ramp since the Blank-out Sign at this location was frequently

seen but seldom used due to the special circumstances mentioned above. With this deletion, the percent of drivers who used the Ramp Information Sign this trip (of those who saw it this trip) was 39.3% while the comparable figure for the route guidance signs was 52.2% and this implies that drivers were more willing to use the trailblazers.

COMMENTS

After reviewing the nature of the comments and classifying them by the response to the Freeway itself, the ramp metering system, the information and control system and the alternate route, the general tenor of the comments were coded and used as input as described previously. In this section, the specific character of many of the comments are explored, particularly with input to the ramp metering system, the signs and the alternate routes. Some general remarks are then treated.

RAMP METERING

The written comments concerning the ramp metering system indicate that many of these drivers did not understand the purpose of the system. Apparently, they felt that the system's sole function was to facilitate an easier entry into the Freeway traffic stream. With this limited viewpoint, they did not believe the system to be worthwhile.

> "Plenty of times I've had to wait for the light but I've seen spaces where I could have merged."
>
> "Ramp traffic will flow far better without traffic lights."
>
> "Almost every afternoon I have been held up by the red light...and watched the traffic on the Freeway moving at a good pace with many spots to ease into from the ramp."

The highest percentage of negative comments came from the Linwood and Livernois ramps where drivers were commencing shorter than average Freeway trips and their comments reflect the fact that ramp metering discourages short trips.

"...causes congestion...traffic backs up into Livernois."

"The line of cars waiting to enter the Linwood ramp constitutes a major traffic hazard."

"Since...light installed...takes me 40-60% longer to get home. This system is a complete failure."

A few drivers had at least a partial understanding of the system, but they still disliked it.

"...people from downstream arrive home sooner than they formerly did...we in this area...discriminated against...(by)...ramp-light system...face a red light, watching the privileged whiz by."

"Harassment...to dissuade us from using the traffic arteries."

"They should be removed. Such signals seem to allow travelers from downtown high-speed travel, while others who enter further (sic) up are hindered."

Very few people made favorable comments on the ramp metering system and no one commented specifically upon the reduced risk of rear end collisions involving cars trying to enter the expressway. However, this may be implicit in the following comment:

> "the flashing light is an excellent addition. During rush hours...advantage for moving traffic on to expressway. As a safety factor this is certainly mandatory."

The operational problem resulting from the ramp metering system is illustrated by:

> "...dangerous to enter freeway at such slow speed after stopping for light."

Other favorable comments took note of improved traffic conditions.

> "...ramp lights...have improved the traffic conditions ...a noticeable difference."

> "...biggest aid to evening motor navigation is the meter set up in the entrance ramps...has saved the x-way system from being totally useless during the rush hour traffic."

It is hard to measure how effectively the ramp metering system deterred short trips on the Freeway, but one indication that it was effective was that even some drivers on long trips adjusted their routes because of ramp metering.

"I now enter at Davison because the "red light" is seldom on as opposed to the West Grand Boulevard or Seward entrances."

"Because of confusion at West Grand Boulevard I take Second to Davison. I skip other ramps because the lights are timed too long."

RAMP INFORMATION SIGNS

Respondents commented on both the design and the placement of the eight Ramp Information Signs, with the majority of comments being complaints on the design of the sign. There were a few complaints on the graphics as being "hard to read due to the poor contrast," the most common complaint seemed to be that the signs presented too much information and were confusing.

"Signs attempt to show too much."

"Signs require entirely too much time to interrogate and interpret."

"Confusing, I don't understand them at all."

"Signs are not understandable."

It is interesting to note that all of the above comments were made by drivers whose answers to other questions indicated that, although they had seen the signs, they did not use them. It is, of course, easy to say that since they didn't understand the signs they couldn't use them, however, consider these comments made by drivers whose answers to another question indicate that they had never seen an actual Ramp Information Sign:

"Signs are too confusing."

"...not only confusing, but downright unintelligible."

One may wonder why people commented on the signs if they had never seen them. The placement of the Ramp Information Signs along the alternate route, especially in the Linwood, Livernois and Wyoming areas, allowed a large number of local drivers to enter the Freeway without passing the signs. It appears that, particularly in these downstream entrance areas, a large number of drivers made negative comments about the signs, even though they had never seen one in operation. This was because they did not understand the drawing which was incorporated in the questionnaire for identification purposes.

The following comment was made by a driver whose answers to questions indicate that he used the signs and did so on this trip.

"many drivers do not know how to read signs...I, myself, did not until someone explained it to me... signs are a big help to me."

The driver's main complaint about the placement of the signs was that they didn't receive the information soon enough to make a decision.

"By the time you read the sign, its too late, you have committed yourself."

"Signs are too close to ramp...usually committed to enter ramp."

"Signs should be larger and installed across streets."

"Sign at Wyoming ramp is almost impossible to see."

"Sign at Wyoming is practically useless. Making a left turn....driver is too busy...doesn't see sign."

The majority of these complaints concern the Wyoming ramp where it is difficult for turning drivers to respond to the sign.

ALTERNATE ROUTE SYSTEM

Some drivers commented that they like the alternate route system.

"Signs extremely helpful...journey quicker and much less frustrating."

"The signs are helpful."

"Any guidance or information is most welcome."

However, most of the comments, even those which are not critical, illustrate why drivers did not use the alternate route system. Probably the most common complaint was that the system did not always appear to be giving the driver accurate information. Many drivers ignored the signs and entered the Freeway or they were able to make a visual inspection of the Freeway after passing a Ramp Information Sign and concluded that the sign was inaccurate.

"I've learned to disregard the signs as they are generally inaccurate."

"Completely useless because they provide false information."

"No observable correlation between signs and actual traffic conditions."

"Quite often the signals bare (sic) no relationship to conditions."

"Signs are not reliable...ignore them."

"Have seen red arrows...when Freeway was moving quite well...have little faith in the signs."

"I don't feel signs accurately reflect X-way conditions."

"Sign at Wyoming has been wrong so often I no longer respect it."

Particularly at the West Grand Boulevard ramp a number of drivers indicated that they had tried the alternate route when it was recommended by the signs. They found that their driving time was actually greater on the alternate route than their usual Freeway driving time. These drivers usually indicated that they no longer used the signs to assist them in their trip.

"Have tested the recommended path...doesn't make any difference."

"Every time I followed the routes indicated by the signs I was substantially delayed enroute home."

"...followed the sign...once...entrance to which I had been directed...plugged solid."

"I have tried these signs in the past and have been terribly misled."

"Once...followed directions...took longer than the worst time on the X-way."

"Although the Freeway appears to be crowded, I have found that I can usually make better time than on the surface."

"....alternate routes are much more time consuming and congested."

"One day...followed instructions...used 12th Street... arrived home about 30 minutes later than when I had followed freeway route at peak traffic time."

"Tried it twice...both times total time exceeded normal route."

"Used the alternate route method...one month...found it 10 to 15 minutes longer per trip."

"...just as fast to enter at ramp shown in red."

Drivers also expressed the opinion that the Freeway was always quicker even if it was crowded. One reason they gave was that the lights were not properly timed on the alternate routes. Also, some drivers who were making long trips felt they definitely needed to use the Freeway and several stated that they used the West Grand Boulevard bulk metering ramp regardless of traffic conditions because the ramps further north had more restrictive ramp metering.

"Even in heavy traffic on the freeway I make better time than I would on the surface streets."

"Would use other ramps if it were not for the rule of "one car only" (metering)."

"Traffic lights on the alternate route are not synchronized."

"Entering at W. Grand Blvd., even when the sign is red is faster than some of the smaller ramps."

"Even though congested, the Freeway is nevertheless quicker than surface routes."

"Invariably the delay at the next, or indicated, entry takes longer than the delay at West Grand."

"Length of trip necessitates my using X-way."

"Additional travel time on surface streets seems to cancel any shorter delay at green ramps."

"More convenient and faster to enter the Davison ramp regardless of red because of length of trip and service driver is much slower."

"Need better parking enforcement and light timing along the alternate routes."

"Next ramp is a long way down Service Drive and an apparently obvious delay over freeway."

Several respondents did not appreciate the updating of display information. Some indicated that they no longer used the alternate route system.

"Usually after proceeding to green arrowed entrance, it's red."

"West Grand Boulevard...red, showing Seward to be green. Continued on to Seward...entrance is red."

"Signs often tell me to go on to next entry and when I get there is red and tells me to keep going."

More than two-thirds of the peak-hour drivers made the same trip every day and the following comments indicate that force of habit remained a powerful deterrent to the use of alternate routes, even after a year of operation:

"Automatic to enter at same place each day."

"Being a creature of habit I take the same route despite the signs."

"Have developed my trip to the point where I even change lanes at the same points along the freeway each day."

"Always get on and off at the same place daily."

"Since I follow same route daily I do not require help from the signs."

Lack of knowledge of Detroit streets confines some drivers to the Freeway and makes them hesitant to use the alternate route system, especially if they feel the directions are not clear enough.

"Don't know my way around Detroit well enough to get home without expressway."

"It is difficult to get home without the use of the expressway."

"Directions for alternate route are not clear."

"I have seen the sign many times but not knowing where 12th Street is or where it goes I disregard it."

"By-pass route via 12th Street is insufficiently marked."

"...there is no other way to get home."

Many of the commentators, especially those entering at the Davison Expressway ramp, indicated that they were hesitant to use some of the alternate routes.

"Use 12th Street - you must be kidding I drive a Chevrolet, - not an armored car."

"My husband insists I use the X-way...rock thrown through the window at Euclid and 12th."

"12th Street is not a safe area to be in."

"I don't care to use 12th Street...rather be tied up on the Lodge."

"I would rather wait 1/2 hour to enter the Lodge than venture onto notorious 12th Street...I am afraid to venture off them (freeways) in most inner city areas."

"The alternate routes are through neighborhoods that are too dangerous for women to drive through."

"...routes go through bad neighborhoods which I like to avoid."

A number of drivers ignored the information provided because they use an alternate route system of their own. The following comments were all made by drivers who indicated they had seen the Ramp Information Signs, but did not use them because they were able to make a visual inspection of Freeway and ramp conditions.

"I let traffic congestion around a ramp entrance dictate whether I will enter...not the signs."

"If ramp is crowded I use the next open ramp."

"The ramp I use is determined by the visible traffic on the Freeway."

"Signs...not helpful to me. I use the speed of traffic on the X-way, congestion on the X-way, and stack-up on the ramp as clues to enter or not."

"Traffic lined up at entrance is the determining factor."

"I drive down the service drive and check entrance ramps."

"I arrange my route to allow a visual check of expressway conditions."

A few drivers have made the assumption that Freeway conditions at any particular time do not vary greatly from day to day and their route decision is based upon the time of day or even the time of year.

"If I don't get out of work by 4:30 I drive an alternate route on surface streets."

"I use the expressway...in the summer. However, in fall, winter and spring...crowded and slow... use (surface routes)."

"...5 p.m. go to Webb...quarter or half past five go to Seward."

"(doesn't use signs during rush hour) since road conditions have never varied much for me at this particular time."

"I generally avoid Freeway travel at peak hours."

GENERAL REMARKS

The following comment expresses the objective of the project.

"I would gladly use alternate routes if I was sure of the fact that it was easy to follow and I was convinced that it was faster than any other choice."

Lack of confidence seems to be the main reason a driver didn't use the alternate route system and a lack of knowledge of the system contributed to this lack of confidence.

The complaint that the signs are often inaccurate is both a technical problem and a driver education problem. There were frequent equipment malfunctions which resulted in inaccurate displays. However, the complaint of inaccuracy may be partly due to the fact that the computer and the driver were not using the same criterion to reach a decision. In particular, many drivers seemed to base their complaint on the fact that traffic on the Freeway was moving well but the sign advised them not to use that ramp. Some of these drivers apparently disregarded the Ramp Information Sign, entered the Freeway, and found that traffic was moving well on the Freeway.

While many of the commentators seem to feel that the system worked, although imperfectly, others generally felt that it just didn't work. Those drivers who consistently tried the alternate route system and found it was slower were almost all drivers who normally used the West Grand Boulevard or Davison ramps. The relatively higher metering rate at West Grand Boulevard coupled with the fact that most of the drivers were at or near that ramp when first seeing the sign, they indicated they had used the alternate route on the advice of the Ramp Information Sign, explains the increase in trip time for those who usually entered at the West Grand Boulevard ramp. Davison also had a high metering rate and again drivers would be close to that ramp before

seeing a sign. But another important factor here is that the alternate route service was often poor. Some comments illustrate that many drivers preferred to make their own decision based on visual observation of ramp and Freeway conditions and therefore it is possible that driver confidence could be increased if, at least initially, there were no Ramp Information Signs in the immediate vicinity of those ramps where there was a service drive. At these points, ramp metering alone is probably sufficient to implement the selection of an alternate route. The lack of a sign at these points should also reduce the number of drivers whose reluctance to use the system stems from the belief that the information presented is often inaccurate.

Some drivers expressed the opinion that the Freeway is quicker even if crowded.

> "Aside from a delay on the ramp itself it seems I make faster progress on the Lodge, even if slow... than on the alternate route."

This comment illustrates some of the reasons these drivers were not using the alternate route system. A trip involving stop and go driving seemed to take longer than one of equal time at a steady speed, but if traffic lights along the alternate routes were favorably timed this misconception can be reduced. Of course, it is erroneous to discount ramp waiting time, but the large number of negative comments on

ramp metering would seem to indicate that most drivers did not in fact discount ramp waiting time. Drivers who believed the Freeway is always faster and those who ran their own experiments might have developed greater confidence in the system if, during an initiation period, the ramp metering was slightly biased in favor of the alternate routes.

Some drivers were apparently willing to use an alternate entrance ramp, but they disliked being in a state of uncertainty. The information changed before the driver could implement his decision based on the old information. There were, however, very few comments of this type and the actual number of drivers who avoided the alternate route system because of insecurity may well be negligible.

Other problems pointed out seem to be primarily due to the drivers' lack of knowledge. However, these groups also may be so small that no special effort should be made to educate them.

Not much can be said about "bad neighborhoods" except that this problem was raised by a significant number of drivers and requires some consideration when planning an alternate route system.

CHAPTER THREE

INTERPRETATION, APPRAISAL AND APPLICATION OF RESEARCH FINDINGS

It is believed that the carefully prepared and thoughtful responses of the more than 3400 motorists who cooperated with this questionnaire study and who, as freeway drivers, have had opportunities over the last several years to participate in several traffic engineering efforts to improve flow on the Lodge Freeway and in its Corridor should be carefully considered by those responsible for the implementation of Freeway Corridor Dynamic Information and Control Systems. In this chapter, some implications of their responses are investigated.

First, there are indications that the responding drivers were not indifferent to the displays but experimented after they saw the signs. One reason for believing this is developed by comparing the hypothetical reaction of drivers who had never seen a Ramp Information Sign with the reactions of drivers who had seen them but did not use them when faced with a picture showing an all-red display. The drivers who had seen the signs but did not use them were much more likely to disregard the signs and this is interpreted as these drivers saying that they did not like the

system. Additionally, many drivers commented that they had tried the system and found that it did not "work." Some drivers said that it took much longer for them to use the alternate route. The response to an all-red Ramp Information Sign was also compared with the 1969 response and, again, the 1970 data showed that quite a few more drivers said they would disregard the sign than said so in 1969. One reason that drivers did not like the signs is because they did not understand the purpose of the system. Many drivers in their comments said that the signs did not accurately reflect the Freeway conditions. If the driver saw that the Freeway was uncongested and the Ramp Information Signs told him to use another ramp then his confidence in the system could have been undermined, and it seems that this was particularly likely to happen at the West Grand Boulevard and Seward ramps where the drivers could easily see the Freeway. It also appears that many drivers thought they were receiving accident or very unusual information about the Freeway. After they experimented and used the Freeway, they found that this was not true and so they did not believe the signs to be of much value. One driver said that he did not need to use the signs because he knew that conditions were always bad at that time of day.

The data showed that drivers on long trips were not as likely to use the information system as drivers on short

trips. One reason for this could be that the ramp metering and the Ramp Information Signs appeared to work at cross-purposes for drivers on long trips. Ordinarily, effective ramp metering makes it advantageous for the long-trip driver to wait in the queue and get on a relatively uncongested freeway. In this study, signs advised him to not wait in a long queue but to enter at another ramp where there was to be a saving in time to reach the same point on the Freeway.

The data showed that those drivers who used the Freeway almost every day and had long trips were less likely to use the information correctly. The possible reason for this is that those drivers who used the Freeway almost every day were more familiar with the alternatives and felt that the Freeway was almost always the best alternative. This opinion also appeared in the comments as some drivers said the Freeway was always the best route. Of those drivers who used the signs, 30.3% said they would not use the Freeway at all if faced with an all-red Ramp Information Sign. Since one of the other choices to the question was to continue on the recommended path, there is a question as to how many would do this because that was the most convenient alternate route for them. It may be that drivers feel that they do not need alternate route guidance. Further

evidence for this is the fact that drivers seemed to be just as willing to follow the trailblazers as they were to follow the Ramp Information Signs. It is clear that even drivers who said they used the Ramp Information Signs did not always exactly follow the recommendations given. Rather, they used the information to help them make their own decision. For instance, there were users who said they would disregard an all-red display and enter the Freeway anyway.

Even among drivers who had seen but did not use the signs, there were some who said they would not use the Freeway at all if they saw an all-red Ramp Information Sign and some who said they would continue on the recommended path. This indicates that there may be some sort of factor involved with the amount of red displayed on the sign; that these drivers, when they saw an all-red display, thought that conditions must be really bad so they did not use the Freeway. This implies that drivers used this information even though they did not use the signs every day. They would like some information on when conditions are particularly bad on the Freeway, such as when there is an accident or other incident. It seems clear that the signs had very little effect in routing drivers past the Davison Expressway. There are probably two main reasons for this. The ramp metering at Davison was relaxed and the Freeway is clearly

the easiest and most convenient path, and the alternate route goes through neighborhoods that many drivers commented upon as being "bad neighborhoods."

In the lower half of the Freeway it appears that the signs, even though they were not followed by great numbers of drivers, were effective in redistributing some of the demand and making it easier for more drivers to get on the Freeway where they desired to get on.

Comparison of the number of short and long trips reported in 1969 with those found in 1970 (Table 41) shows a small but statistically significant reduction in the number of short trips. It appears that drivers who were willing to use on type of sign were also willing to use the other type of sign, and so one conclusion would be that for those who desired to use the system both types of signs were comprehensible.

Some drivers complained that a Ramp Information Sign guided them to a ramp but when they got close to that ramp another sign told them to go on because that ramp was congested. This problem is completely avoided with the simple trailblazer.

One suggestion for a more useful trailblazer-type sign would be to have a display which would indicate when there was an accident or other serious incident on the Freeway

because many drivers indicated that, although they would not regularly use the dynamic signs, they would like to know when there is a serious incident on the Freeway.

TABLE 41

1969-1970 COMPARISON OF FREEWAY TRIP DISTANCE

YEAR	FREEWAY TRIP DISTANCE		SAMPLE SIZE
	SIX MILES OR MORE	LESS THAN SIX MILES	
1969	54.1%	45.9%	1761
1970	57.4%	42.6%	2031

$$\chi^2 = 3.90 \ , \quad \chi^2_{1,.05} = 3.84$$

The new data, comparisons with the 1969 data, and drivers' comments make it possible to reconstruct a probable course of driver reaction to the information system since its implementation.

Earlier studies have shown that drivers desire timely information on freeway conditions, yet many Detroit drivers indicated that they do not use the information system and commented that they had tried it. It appears that as drivers saw the signs they experimented with them and each driver decided for himself if the system worked well or not. As drivers experimented, they decided how much of the information they would use and how much reliance they would place on the signs. The data imply that many drivers

would vary their response according to the number of ramps shown in red. For instance, 30.3% of the drivers who indicated that they used the signs also indicated that if presented an all-red display they would not use the Freeway at all. Yet, the very fact that these drivers received a questionnaire indicates that, despite facing a negative sign display, many of them did use the Freeway and the question is would they use the alternate route and then the Freeway if only the next two ramps were shown in red. Also, 14.3% of the drivers who used the signs indicated that they would disregard the sign and enter at a ramp shown in red if presented an all-red display, so the question is raised if they are willing to divert to only the next downstream ramp or to the second or third downstream ramp. There are no data available to evaluate the driver reactions to different sign states, but the point which can be made is that the issue is more complex than whether or not a driver "uses" the signs.

Over half the drivers who had seen the signs indicated that they did not use them, but their response to an all-red display seems to indicate that not using the signs was not the result of a lack of interest in timely information. By using drivers who had never seen the signs as a base for comparison, it was found that drivers who had seen the signs but did not use them were over twice as likely to

disregard an all-red display and enter at a ramp shown in red. It seems reasonable to conclude that this difference in attitude is due to drivers experimenting with the signs and deciding that, at least for them, the system was not satisfactory. This adverse reaction to the Ramp Information Signs and the alternate route system can be further illuminated by comparing driver response to a similar question on the 1969 questionnaire (Table 42). As can be seen in the table, there was a very significant shift in driver attitudes and a much larger percent of drivers would be expected to disregard the all-red display.

TABLE 42

1969-1970 COMPARISON OF DRIVER RESPONSE TO AN ALL-RED RAMP INFORMATION SIGN DISPLAY

1969		1970	
Enter at First Ramp or Guess Least Congested Ramp and Enter There	24.2%	39.1%	Disregard and Enter Anyway
Continue on Trail of Signs	46.7%	38.6%	Continue on Recommended Path
Abandon Freeway	29.1%	22.3%	Not Use Freeway At All
TOTAL VOLUME	2150	2824	

$$\chi^2 = 125.10 \text{ , } \chi^2_{2,.001} = 13.82$$

One of the main reasons drivers did not use the signs was that they did not believe the signs were accurate and this was partly because drivers misunderstood what type of information they were receiving. It seems that many drivers expected to be advised to use another ramp only if conditions were very abnormal, as in the event of an accident or other incident. There is little doubt that most drivers with these misconceptions stopped using the signs.

It is believed that the attitude of Davison Expressway users indicates the serious problem associated with diverting motorists from a freeway to another freeway via a city street.

Finally, the large number of unsolicited negative comments on the ramp metering system is both surprising and disappointing. This belief is held because of the positive effects recorded in the ramp metering experiment (32).

CHAPTER FOUR

CONCLUSIONS

Although there were a number of problems associated with the experiment, notably hardware reliability difficulties, it is believed that the lack of a strong positive response by the motorists who cooperated by participating in this study is a poor omen for operational systems in daily use. It is believed that the habits and patterns of years of driving experience will be difficult to overcome and that an inadequate fraction of the motorists will respond voluntarily to efforts to control their routes in conjunction with a ramp metered system.

There was no indication that the various types of signs used, Ramp Information, Variable Message, Trailblazer and Blank-out, elicited a differential response by the cooperating motorists. However, it is believed that evidence from other studies in this research program supports the accomplishment of the Ramp Information Sign function by a Trailblazer or a simple Blank-out Sign providing information for only the decision point at hand.

As would be expected, this analysis has shown the strong relationship between trip length and system responses and attitudes.

After one year's operation, 80% of the respondents recalled seeing a Ramp Information Sign (RIS). About half of the drivers seeing RIS's used them as an aid in route selection. Only three-quarters of those users used the signs on their trip the day of the study.

Drivers who used RI signs also used the Route Guidance Signs (RGS) located in the Corridor.

When faced with an hypothetical RIS with all the ramps displaying red and the system recommending traveling on to the fourth or farther ramp downstream, almost as many respondents indicated a willingness to follow the recommendation as to enter at one of the red indications. Long trip regular Freeway users recorded a more negative response to the recommendations. Almost one-quarter of the motorists indicated that they would not use the Freeway at all that trip.

The relationship among frequency of Freeway use, trip length and RIS use was quite complex. Sign use is greater for those on shorter trips and much greater for infrequent users than for daily users, with this effect being particularly strong for short trip makers.

It is concluded that many of the drivers who did not use the FCDRICS did so because they found it unsatisfactory, not because they were indifferent to it.

The main effect of the FCDRICS was to help drivers enter the Freeway sooner since they attempted to enter at their most convenient ramp after the system was in operation while before that may have diverted downstream on a regular basis.

A study of significant changes in origin-destination patterns indicated a tendency for origins upstream from the first controlled ramp to enter upstream rather than at that ramp and it is believed that this effect is due to the information system, not the ramp metering system. Drivers from the New Center area developed a reluctance to use more than the natural first two ramps in the system, although some took advantage of the relaxed metering strategy employed at the Davison Expressway ramp.

There has been a significant increase in trip length over the years. For every one of the eight on-ramps, the fraction of drivers going beyond 8 Mile Road was greater in 1970 than it was in 1965 or 1967 and greater than 1969 at the four main on-ramps.

There were great differences in most variables by ramp of entry, reflecting the many different characteristics of users of the various ramps.

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PART TWO

APPENDIX A

PUBLIC RELATIONS AND INFORMATION

TABLE A-1

LOG OF NEWS COVERAGE OF QUESTIONNAIRE DISTRIBUTION

August 10, 1970

Channel 4 6:00 p.m. News

Interview of Dr. Pretty and Inspector Reuben Ricard to explain purpose of the questionnaire and urge motorist cooperation.

August 11, 1970

Channel 7 6:00 p.m. News

Interview of Karl Kleitsch to explain purpose of questionnaire.

Channel 50 10:00 p.m. News

Interview of Dr. Pretty to explain purpose of questionnaire. Shots of questionnaire distribution

Channel 2 11:00 p.m. News

Shots of questionnaire distribution.

August 12, 1970

Channel 2 7:30 a.m. News

Shots of questionnaire distribution.

Detroit Police Department
Public Information Center

No. 70-134

NEWS RELEASE

1300 Beaubien
Detroit, Michigan 48226
224-1205

ROMAN S. GRIBBS Mayor
PATRICK V. MURPHY Commissioner

August 10th, 1970.

Motorists entering the northbound John C. Lodge Freeway Tuesday afternoon will be given questionnaires to aid in a traffic survey being conducted by the Highway Safety Research Institute (HSRI) of the University of Michigan.

The HSRI is trying to find ways of reducing freeway congestion to help motorists make afternoon rush-hour trips with less delay.

The survey is being conducted with the cooperation of the City of Detroit, Wayne County Road Commission, Michigan Department of State Highways and the Highway Research Board of the National Academy of Sciences.

Inspector Reuben L. Ricard, commanding officer of the Motor Traffic Bureau, today asked the cooperation of drivers in filling out the questionnaires and dropping the self-addressed, stamped forms into the mail.

"A slight delay may be experienced at these entrance ramps," said Ricard, "but additional officers from the Motor Traffic Bureau will be assigned to help expedite the traffic flow.

"We ask the driving public to be patient in this project. These are the motorists who will be helped the most by a survey of this type."

Questions include the following: where did you begin this trip; where did you end this trip; which exit ramp did you use; how often do

(continued)

FIGURE A-1

PRESS RELEASE ON QUESTIONNAIRE DISTRIBUTION

you use or want to use the Lodge Freeway between 2:30 PM and 6:30 PM; how useful are the freeway guidance signs.

The questionnaires will be distributed to motorists at northbound freeway ramps between 2:30 PM and 6:00 PM, Tuesday, August 11th. Two people wearing orange jackets will hand the forms to drivers. No attempt will be made to force drivers to take the questionnaires. The forms are to be read and filled out and mailed after the drivers reach their destinations.

The questionnaires will be distributed at the following ramps: West Grand Boulevard, Seward, Chicago, Webb, Davison, Linwood, Livernois (east) and Wyoming.

The HSRI has been working on the Lodge Freeway Corridor to develop new techniques of providing motorists with information on the best route to their destinations.

The latest of these innovations is a series of ramp information and route guidance signs installed in the northbound Lodge Freeway Corridor in 1969.

Donald E. Cleveland, principal investigator for HSRI, said the answers to the questionnaires will help his organization to evaluate those signs and to determine what additional improvements are needed.

FIGURE A-1

(CONTINUED)

PLATE A-1 (Opposite Page)
NEW SIGNS AND ALTERNATE ROUTES TO
AID NORTHBOUND DRIVERS

There Is Another Way

The alternate route provides a quick way home during rush hours.

Eight new ramp condition information signs will begin operation on the ramp-metering segment of the northbound John C. Lodge Freeway Tuesday, June 3, 1969. These signs *(See reverse side.)* will inform northbound motorists of traffic conditions on the nearest entrance ramp and the two ramps immediately following. They advise drivers either to enter the Lodge Freeway by the nearest ramp or to proceed farther along the *alternate route* to a ramp where there is less congestion and easier access.

One way to improve traffic conditions for the individual motorist without building new highways is to suggest that he use existing street systems. Many of these systems provide satisfactory routes but are not currently being used to their full capacity, especially during rush hours.

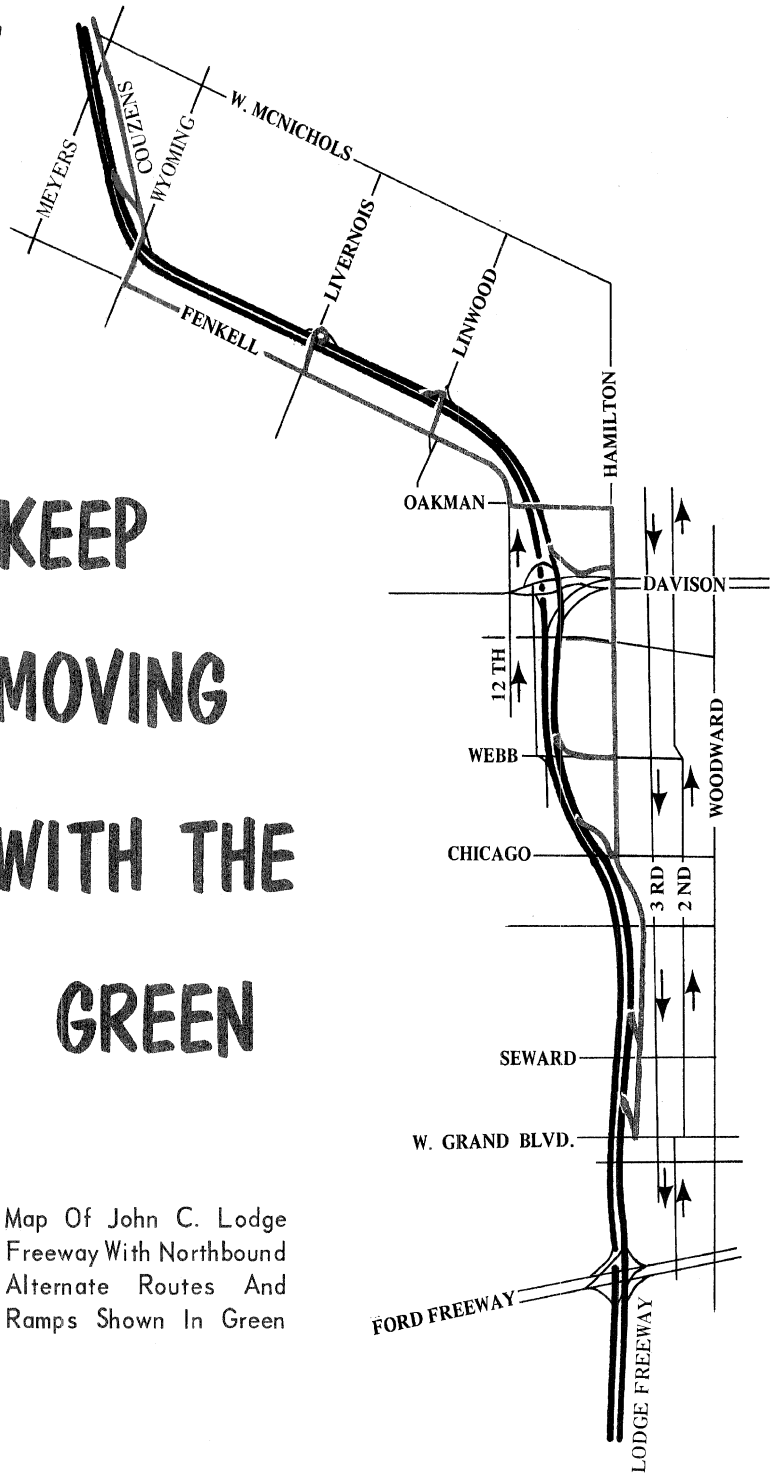
Each sign tells you the best point to enter the Freeway in order to avoid heavy traffic and delays in reaching home.

During 1969, the northbound Lodge Freeway Corridor will provide a testing ground to determine whether motorists will change their route habits when provided with reliable, up-to-the-minute information on attractive *alternate routes*. This information is based on computerized processing of traffic flow data continually gathered from more than fifty locations within the Freeway Corridor.

By using the alternate route to by-pass crowded portions of the Freeway, you escape congestion at the entrance ramps.

The *alternate route* suggested here runs parallel to the Lodge Freeway as indicated by the *green line* on the map. This route provides a helpful alternative to freeway travel by lessening travel time and delays due to congestion on entrance ramps. Also, traffic diverted to the *alternate route* will relieve the burden presently carried by the freeway and help everyone to get home earlier.

KEEP MOVING WITH THE GREEN



Map Of John C. Lodge Freeway With Northbound Alternate Routes And Ramps Shown In Green

The new freeway ramp signs are the first of a series of innovations designed to assist the motorist in route selection by providing information on Freeway Corridor traffic conditions, and are used in conjunction with the ramp-metering signals and television surveillance of accidents during afternoon rush-hour traffic.

The project is being carried out by The University of Michigan under contract with the Highway Research Board and in cooperation with the Michigan Department of State Highways, the Wayne County Road Commission, the City of Detroit, and the City of Highland Park.

Prepared By The Traffic Safety Association Of Detroit For The University of Michigan Highway Safety Research Institute

New Signs And Alternate Routes To Aid Northbound Drivers

- The Alternate Route Provides A Quick Way Home During Rush Hours.
- By Using The Alternate Route To By-Pass Crowded Portions Of The Freeway, You Escape Congestion At The Entrance Ramps.
- Each New Sign Tells You The Best Point To Enter The Freeway In Order To Avoid Heavy Traffic And Delays In Reaching Home.

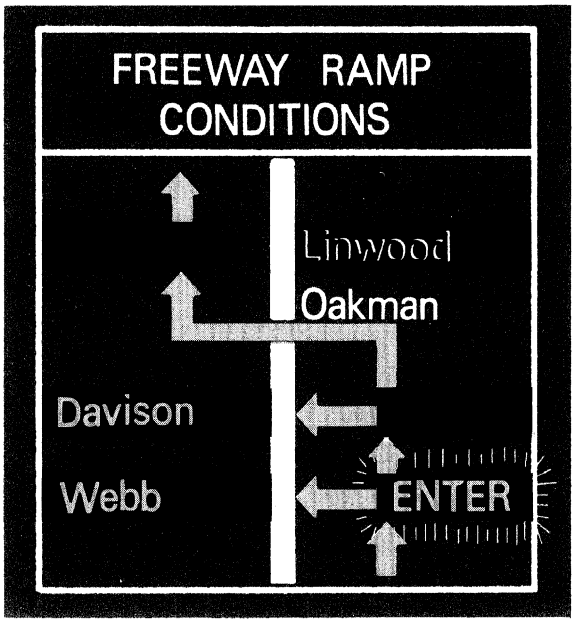
SIGNS WITH A MEANING FOR YOU

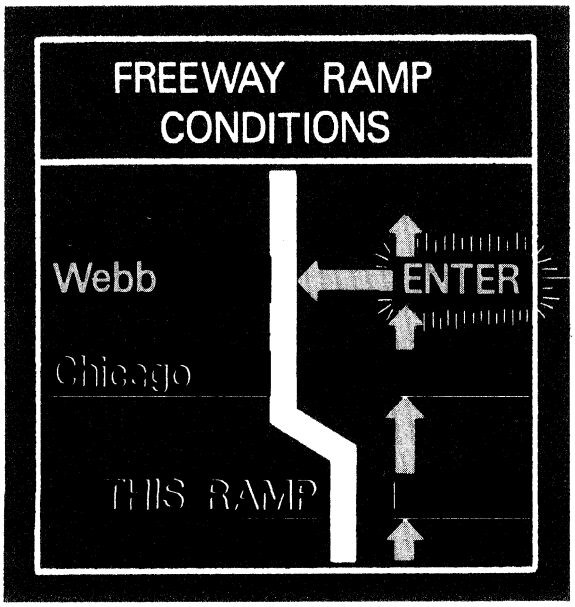
The new signs give information on traffic conditions on the nearest entrance ramp and the two ramps immediately following. The conditions are indicated:

ENTER (flashing green) – **Enter Freeway at this ramp.**
GREEN – Conditions here are not congested.
FLASHING GREEN – Continue along alternate route.
RED – This ramp is congested.

EXAMPLE 1: You are driving north along Hamilton Avenue approaching Webb Avenue and want to enter the Freeway. The name of the street, Webb, and its arrow are both illuminated in green. The ENTER sign next to Webb is also flashing in green. You can expect to enter the Freeway via the Webb ramp with little or no delay.

All the ramps shown on the sign will be shown in RED if the ramps are congested and you may be delayed in entering at any of these points. The arrow at the top of the sign will then be *flashing in green* directing you to proceed farther along the alternate route to find the best point for entering the Freeway.





EXAMPLE 2: You are driving north along the East Lodge Service Drive approaching Seward Avenue. You want to enter the Freeway by the Seward ramp. You see, however, that this ramp and its arrow are illuminated in red – an indication of congestion on the ramp. The green arrow tells you to proceed past the Chicago Boulevard ramp which is also congested (notice the red street name and red arrow) to the Webb Avenue ramp, which is clear as shown by the flashing green ENTER sign, green street name, and green arrow. Here you should be able to enter the Lodge Freeway with little or no delay.

Since 1955, drivers sweating out the evening rush on Detroit's northbound Lodge Freeway often had served as captive guinea pigs for a new traffic research project. At various times the Lodge has been decked out like a vast pinball machine featuring red "X"'s and red arrows, illuminated maps and "DON'T ENTER" signs and flashing speed ramp signals. All this seems to have little to do with actual Freeway conditions.

The latest experiment which began in 1967 involved an often infuriating system of metered traffic on entrance ramps with little stop lights supposedly admitting one car at a time as Freeway conditions allowed. Well, to the relief of thousands, this metering system worked for the last time on December 4. All too often, with Freeway traffic going by at maximum speed, the ramp lights became hung up indefinitely on red. The result was unlawful but widespread disregard for the signals, often as enraged drivers recklessly pulling around some timid souls who appeared ready to wait all night for the light to turn green. The ramp metering system also contained an element of discrimination. Operating on only eight ramps north of Grand Boulevard, this permitted unrestricted access to the Freeway anywhere else from the Boulevard south to downtown. With this particular bit of research behind us, they are now involved in a $5,000,000 computerized control system for all Detroit freeways. TV 2 hopes that this project will benefit fully from the costly and generally futile experimentation already undertaken in trying to make traffic move on the Lodge.

FIGURE A-2

WJBK (TV 2) EDITORIAL
TUESDAY, DECEMBER 15, 1970

APPENDIX B

QUESTIONNAIRE CODE AND DATA LISTING

TABLE B-1

METERED ENTRANCE RAMPS

Code	On-Ramp
1	West Grand Boulevard
2	Seward Avenue
3	Chicago Boulevard
4	Webb Avenue
5	Davison Expressway
6	Linwood Avenue
7	Livernois Avenue
8	Wyoming Road

TABLE B-2

FREEWAY EXIT RAMPS

Code	Ramp
01	Clairmount Avenue
02	Chicago Boulevard
03	Webb Avenue
04	Colendale Avenue
05	Davison East
06	Davison West
07	Linwood Avenue
08	Livernois Avenue
09	Wyoming Road
10	Meyers Road
11	7 Mile Road
12	8 Mile Road
13	9 Mile Road
14	Southfield and Beyond
00	No Response

TABLE B-3

COMPARABLE ZONES OF ORIGIN

1969 Study	1970 Study
01	01
02 + 03 + 12 + 13	02
04 + 11 + 16	03
05 + 06	04
10 + 17	05
07 + 09 + 18 + 19	06
08	07
20	08
21	09
14 + 15	10
22	11
26	12
45	13
27	14
28	15
25	16
23	17
24 + 30 + 32	18
29	19
34	20
35	21
44	22
42	23
36	24
33	25
31	26
38	27
37	28
43	29
41	30
40	31
39	32

TABLE B-4

FREQUENCY OF FREEWAY USE
(QUESTION FOUR)

Code	Response
0	No Response
.1	Never or Seldom
2	Once or Twice a Week
3	Almost Every Day

TABLE B-5

EVER SEEN A SIGN?
(QUESTION FIVE (a))

Code	Response
0	No Response
1	Yes
2	No

TABLE B-6

USE THESE SIGNS?
(QUESTION FIVE (b))

Code	Response
0	No Response
1	Yes
2	No

TABLE B-7

SAW THE SIGN IN THIS TRIP?
(QUESTION 6(a))

Code	Response
0	No Response
1	Yes
2	No

TABLE B-8

USED THE SIGN ON THIS TRIP?
(QUESTION 6(b))

Code	Response
0	No Response
1	Yes
2	No

TABLE B-9

HYPOTHETICAL RESPONSE TO ALL-RED DISPLAY
(QUESTION 7)

Code	Response
0	No Response
1	Enter the Freeway at a ramp shown in red
2	Use recommended path and enter the Freeway at a ramp shown in green
3	Decide not to use the Freeway at all

TABLE B-10

SAW THE ROUTE GUIDANCE SIGN ON THIS TRIP?
(QUESTION 8(a))

Code	Response
0	No Response
1	Yes
2	No

TABLE B-11

USED THE ROUTE GUIDANCE SIGN ON THIS TRIP?
(QUESTION (b))

Code	Response
0	No Response
1	Yes
2	No

TABLE B-12

CHOICE OF RAMP IF SIGNS DID NOT EXIST
(QUESTION 9)

Code	Response
99	No Response
00	South of West Grand Boulevard
01	West Grand Boulevard
02	Seward Avenue
03	Chicago Boulevard
04	Webb Avenue
05	Davison Expressway
06	Linwood Avenue
07	Livernois Avenue
08	Wyoming Avenue
09	North of Wyoming Avenue

TABLE B-13

COMMENTS ON FREEWAY

Code	Response
0	No Response
1	Favorable Response
2	Unfavorable Response

TABLE B-14

COMMENTS ON RAMP METERING

Code	Response
0	No Response
1	Favorable Response
2	Unfavorable Response

TABLE B-15

COMMENTS ON RAMP INFORMATION SIGNS

Code	Response
0	No Response
1	Generally Favorable Response
2	Generally Unfavorable Response
3	Idea Behind the Signs Good
4	Idea Behind the Signs Bad
5	Favorable Comment on Sign Design
6	Statement That Sign Design Was Bad
7	The Signs Were Operating Well
8	The Signs Were Operating Poorly
9	Neutral Comment

TABLE B-16

COMMENTS ON ROUTE GUIDANCE SIGNS

Code	Response
0	No Response
1	Generally Favorable Comment
2	Generally Unfavorable Response
3	Idea Behind the Signs Good
4	Idea Behind the Signs Bad
5	Favorable Comment on Sign Design
6	Statement That Sign Design Was Bad
7	Felt the Signs Were Operating Well
8	Felt the Signs Were Operating Poorly
9	Neutral Comment

TABLE B-17

ORIGIN ZONE AND MOST CONVENIENT RAMP

ZONE OF ORIGIN	MOST CONVENIENT RAMP*
01	9
02	9
03	9
04	9
05	9
06	9
07	9
08	9
09	9
10	9
11	1
12	1
13	4
14	3
15	3
16	2
17	7
18	3
19	3
20	4
21	4
22	5
23	5
24	5
25	4
26	8
27	6
28	5
29	6
30	6
31	7
32	8

*See Table B-1 for key

TABLE B-18

COMMENTS ON ALTERNATE ROUTE

Code	Response
0	No Response or commented that the alternate route was neither slower nor faster than the normal route
1	Generally favorable comment
2	Stated that alternate routes are always or almost always slower
3	Got lost or feared getting lost in following the alternate route
4	Indicated objection to the neighborhoods passed through
5	Objections to alternate route stated in general terms
6	Stated that use of alternate route resulted in increased travel time
7	Indicated objections to both the slowness of the alternate routes and the neighborhood

TABLE 19

LODGE FREEWAY DISTANCE
ON-RAMPS TO OFF-RAMPS
(MILES)

OFF-RAMP \ ON-RAMP		1*	2	3	4	5	6	7	8	9
Clairmont	01	0.64	0.34	-80.00	-80.00	-80.00	-80.00	-80.00	-80.00	+80.00
Chicago	02	0.81	0.51	-80.00	-80.00	-80.00	-80.00	-80.00	-80.00	+80.00
Webb	03	1.53	1.23	0.30	-80.00	-80.00	-80.00	-80.00	-80.00	+80.00
Glendale	04	2.08	1.78	0.85	0.34	-80.00	-80.00	-80.00	-80.00	+80.00
E. Davison	05	2.29	1.99	1.06	0.55	-80.00	-80.00	-80.00	-80.00	+80.00
W. Davison	06	2.50	2.20	1.27	0.76	-80.00	-80.00	-80.00	-80.00	+80.00
Linwood	07	3.35	3.05	2.12	1.61	0.80	-80.00	-80.00	-80.00	+80.00
Livernois	08	3.99	3.69	2.76	2.25	1.44	0.34	-80.00	-80.00	+80.00
Wyoming	09	4.99	4.69	3.76	3.25	2.44	1.34	0.91	-80.00	+80.00
Meyers	10	5.73	5.43	4.50	3.99	3.18	2.08	1.65	0.49	+80.00
7-Mile	11	8.05	7.75	6.82	6.31	5.50	4.40	3.97	2.81	+80.00
8-Mile	12	9.12	8.82	7.89	7.38	6.57	5.47	5.04	3.88	+80.00
9-Mile	13	10.19	9.89	8.96	8.45	7.64	6.54	6.11	4.95	+80.00
Others	14	+80.00	+80.00	+80.00	+80.00	+80.00	+80.00	+80.00	+80.00	+80.00

* See Table B-1 for key

TABLE B-20

LODGE FREEWAY DISTANCE ORIGIN ZONES TO ON-RAMPS
(MILES)

ORIGIN \ ON-RAMP	1*	2	3	4	5	6	7	8	UPSTREAM
01**	+90	+90	+90	+90	+90	+90	+90	+90	+90.00
02	3.93	4.28	5.54	5.89	7.14	6.78	7.14	7.85	
03	2.86	3.21	4.08	4.73	6.43	5.89	6.96	7.50	
04	3.75	4.10	4.97	5.62	6.45	6.84	8.49	9.62	
05	2.86	3.21	4.08	4.73	5.56	6.95	7.60	8.73	
06	4.28	4.63	5.50	6.15	6.98	8.37	9.02	10.15	
07	+90	+90	+90	+90	+90	+90	+90	+90	
08	1.61	1.96	2.83	3.48	4.31	5.70	6.35	7.48	
09	0.89	1.24	2.11	2.76	3.59	4.98	5.63	6.76	
10	2.68	3.03	3.75	3.93	5.35	5.00	5.54	6.25	+90.00
11	0.35	0.70	1.57	2.22	3.05	4.44	5.09	6.22	-90.00
12	1.07	1.42	2.29	2.94	3.77	5.16	5.81	6.94	
13	-90	4.65	4.82	5.35	6.17	7.57	8.22	9.35	
14	2.68	2.86	2.86	3.51	4.30	5.73	6.38	7.51	
15	1.79	1.07	1.25	1.90	2.72	4.12	4.77	5.90	
16	0.89	0.35	1.22	1.87	2.70	4.09	4.75	5.87	
17	-90.00	-90		3.57	5.00	4.65	3.75	4.88	
18	2.50	3.58	1.79	2.53	3.35	4.75	5.40	6.53	
19	2.50	1.79	0.71	1.45	2.27	4.41	4.32	5.45	
20	-90.00	1.79	1.07	1.43	2.25	3.65	4.30	5.43	-90.00
21	-90.01	3.04	2.32	2.50	3.32	4.72	5.37	6.50	
22		-90.00	4.82	5.47	4.10	5.49	6.15	7.33	
23		-90.00	5.00	5.65	2.32	3.71	4.37	5.50	
24		-90.00	1.97	1.43	1.43	2.82	3.48	4.61	
25		2.86	1.07	0.35	00	2.22	2.87	3.92	
26						2.32	1.97	2.32	
27				1.79	2.32	1.25	1.91	3.04	
28			1.25	0.71	1.25	2.64	3.30	4.43	
29				2.50	1.43	2.50	3.59	4.72	
30				3.22	1.25	0.71			
31				2.86	2.32	0.71	0.71	1.84	
32	-90.00					1.43	0.89	0.35	-90.00

*See Table B-1 for key

TABLE B-21

LODGE FREEWAY DISTANCE UPSTREAM ON-RAMP
TO DOWNSTREAM ON-RAMP
(MILES)

UPSTREAM ON-RAMP	DOWNSTREAM ON-RAMP							
	1*	2	3	4	5	6	7	8
1*	0.00	0.31	1.23	1.74	2.57	3.65	4.09	5.26
2	-70.00	0.00	0.92	1.43	2.26	3.34	3.78	4.95
3	-70.00	-70.00	0.00	0.51	1.34	2.42	2.86	4.03
4	-70.00	-70.00	-70.00	0.00	0.83	1.91	2.35	3.52
5	-70.00	-70.00	-70.00	-70.00	0.00	1.08	1.52	2.69
6	-70.00	-70.00	-70.00	-70.00	-70.00	0.00	0.44	1.61
7	-70.00	-70.00	-70.00	-70.00	-70.00	-70.00	0.00	1.17
8	-70.00	-70.00	-70.00	-70.00	-70.00	-70.00	-70.00	0.00
9	+70.00	+70.00	+70.00	+70.00	+70.00	+70.00	+70.00	+70.00

*See Table B-1 for key

TABLE B-22(A)

DATA FORMAT

CARD COLUMNS	VARIABLE
1	Ramp Issued
2-5	Serial Number
6-7	Origin
9-10	Exit Ramp
11	Frequency
12	Ever Seen
13	Use
14	Seen This Trip
15	Use This Trip
16	All-Red Display
17	See Trailblazer
18	Use Trailblazer
19-20	Alternate Ramp
21	Comments - Freeway
22	Comments - Ramp Metering
23	Comments - Ramp Information Sign
24	Comments - Trailblazer Signs
25	Comments - Alternate Route
26	MCR
27-30	Origin to MCR
31-34	MCR to Off
35-38	Freeway Distance
39-42	MCR to On
43-46	Minimum Trip
47-50	Excess Distance
51-54	Street Fraction

End

TABLE B-22 (B)

DATA LISTING

1000102	08111112120100000	99999999903999999999799979997
1000211	14312221220100000	10035999999990000999799979997
1000311	14311221220100220	10035999999990000999799979997
1000411	13211121220100000	10035091909190000095400000004
1000511	14312122220100000	10035999999990000999799979997
1000608	14312121120100002	99999999999999999999799979997
1000712	14311113220100660	10107999999990000999799979997
1000809	14112121200100222	99999999999999999999799979997
1000912	14222221120100600	10107999999990000999799979997
1001009	14312121200102220	99999999999999999999799979997
1001103	14312223220100220	99999999999999999999799979997
1001211	14322221220100002	10035999999990000999799979997
1001409	12312121220102006	99999999908129999999799979997
1001512	10312121120100660	10107057305730000068000000016
1001611	03211113220100000	10035015301530000016800000019
1001709	09312121220100000	99999999904999999999799979997
1001811	09311223220100000	10035049904990000053400000007
1001909	09312122220100080	99999999904999999999799979997
1002012	09222222229900000	10107049904990000060600000018
1002112	13212121220100600	10107091909190000102600000010
1002212	09322222220200000	10107049904990000060600000018
1002312	10122221220100000	10107057305730000068000000016
1002411	14312221220000000	10035999999990000999799979997
1002508	09312121220100880	99999999904999999999799979997
1002611	09312122220100000	10035049904990000053400000007
1002712	14312222120100000	10107999999990000999799979997
1002811	09311113220102000	10035049904990000053400000007
1003005	09311113110100000	99999999904999999999799979997
1003111	10312121220100000	10035057305730000060800000006
1003211	12312121220120000	10035081208120000084700000004
1003311	02311121120100000	10035008100810000011600000030
1003412	11312122120200000	10107070507050000081200000013
1003511	10312123200100000	10035057305730000060800000006
1003711	14312121220102000	10035999999990000999799979997
1003811	14312123220100660	10035999999990000999799979997
1003908	06312123120200000	99999999902509999999799979997
1004011	14312121220100002	10035999999990000999799979997
1004111	14311113200100000	10035999999990000999799979997
1004211	13120202209900330	10035091909190000095400000004
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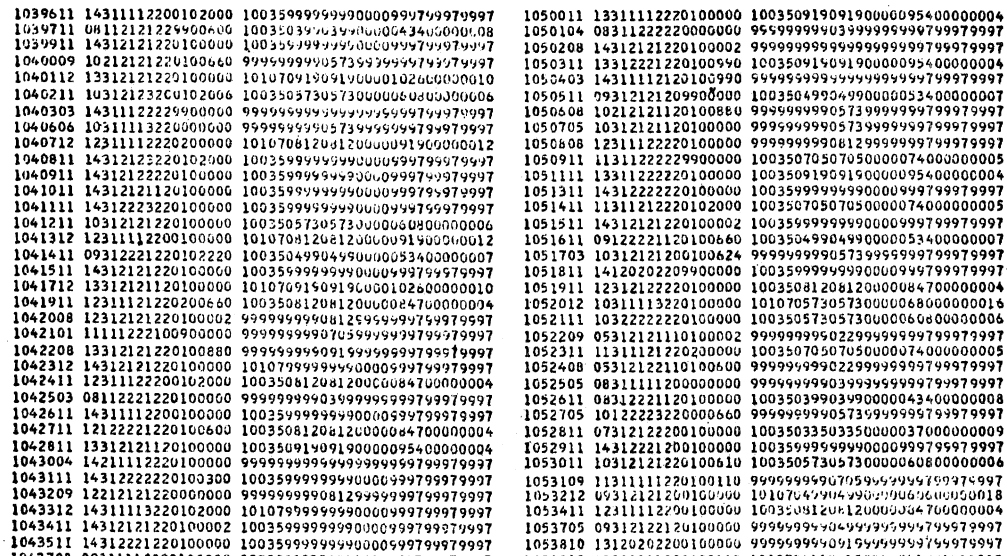

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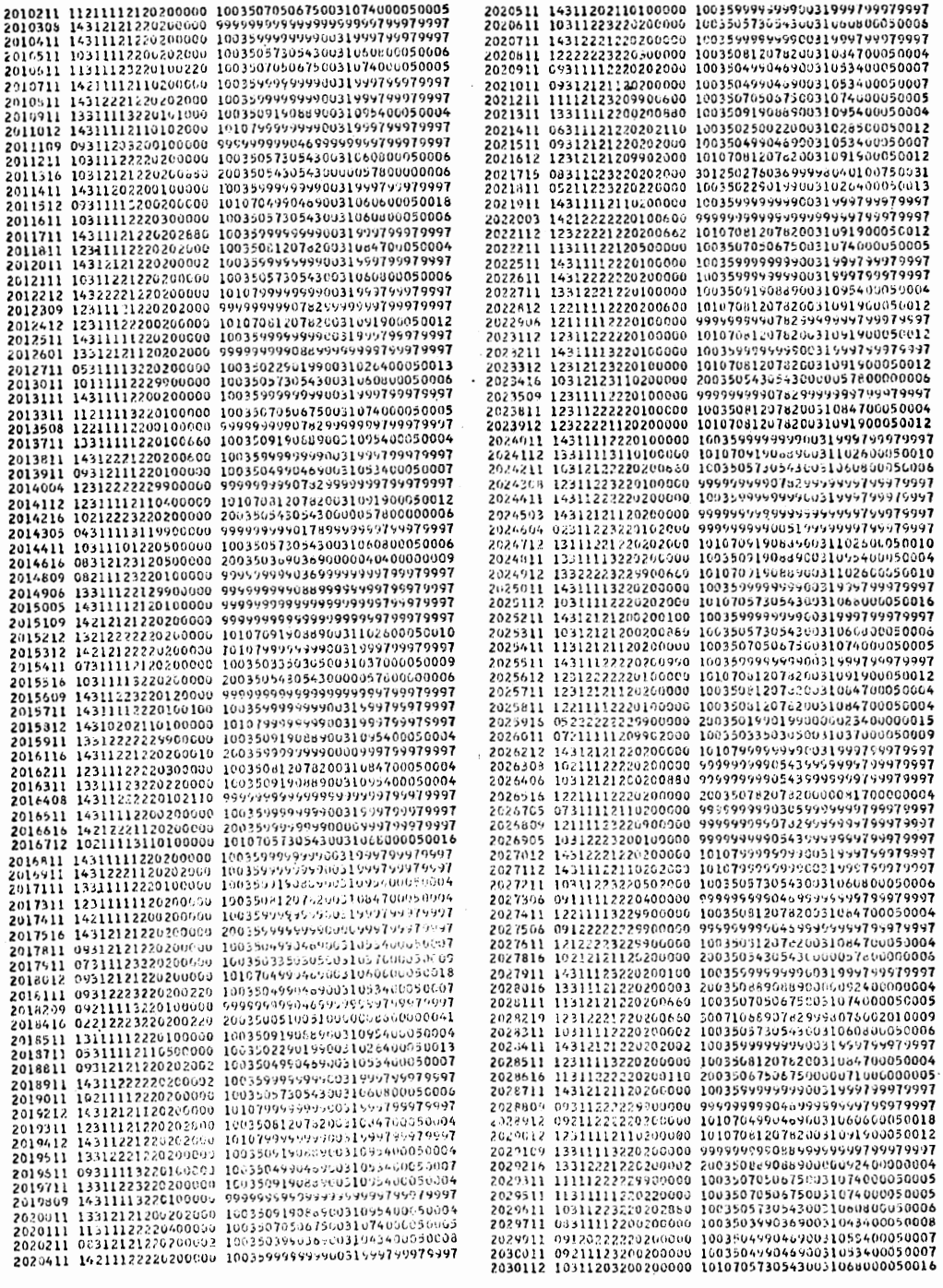

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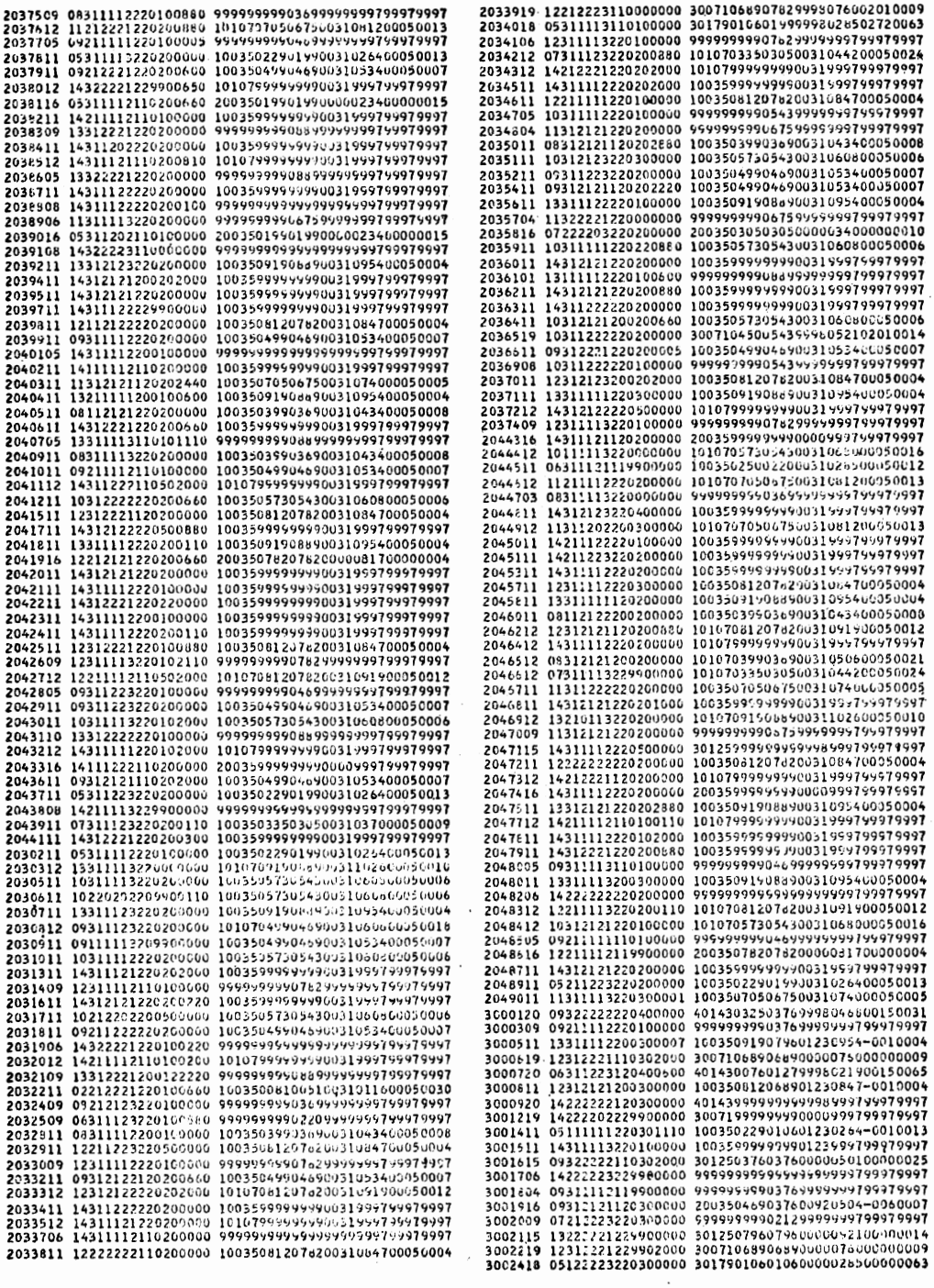

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TABLE B-22 (B)

(CONTINUED)

TABLE B-22(B)

(CONTINUED)

TABLE B-22(B)

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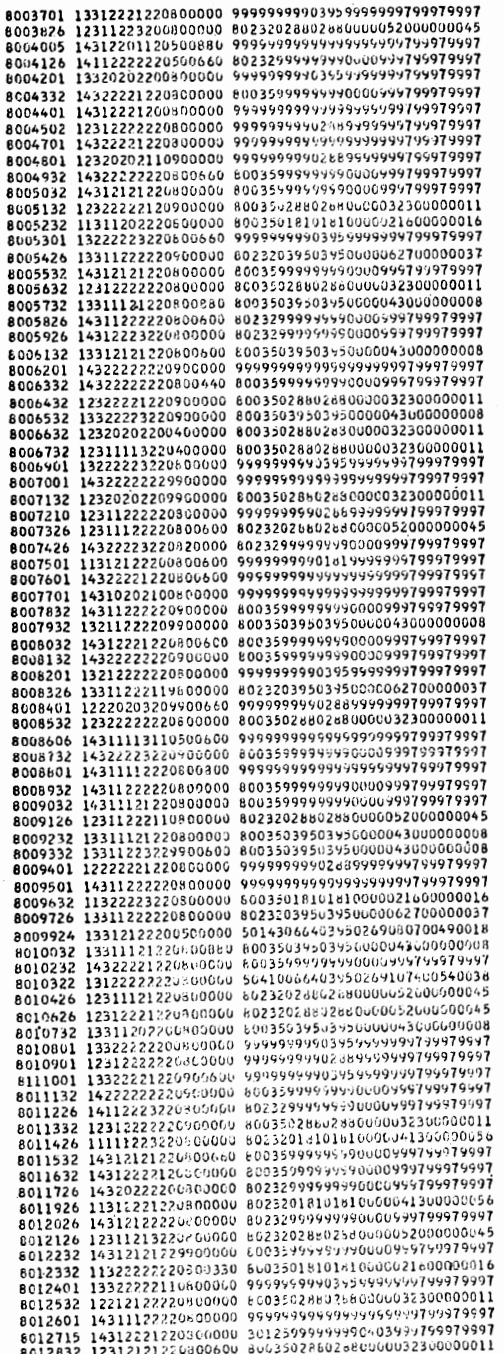

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8034701 13312221220800880 99999999903959999999799979997
8034801 12320202220900000 99999999902889999999799979997
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APPENDIX C

RESULT TABLES

TABLE C-1

QUESTION 1: ZONE OF ORIGIN

ZONE OF ORIGIN	NUMBER	PERCENT	ZONE OF ORIGIN	NUMBER	PERCENT
01	94	3.3%	17	22	0.8%
02	64	2.3	18	39	1.4
03	33	1.2	19	53	1.9
04	30	1.1	20	25	0.9
05	70	2.5	21	13	0.5
06	48	1.7	22	50	1.8
07	24	0.9	23	28	1.0
08	81	2.9	24	256	9.1
09	136	4.8	25	53	1.9
10	14	0.5	26	97	3.4
11	755	26.6	27	27	1.0
12	231	8.1	28	53	1.9
13	27	1.0	29	68	2.4
14	40	1.4	30	150	5.3
15	35	1.2	31	52	1.8
16	39	1.4	32	117	4.1
			TOTAL	2824	100.0

TABLE C-2

QUESTION THREE: EXIT RAMP

EXIT RAMP	NUMBER	PERCENT
Clairmont	2	0.1
Chicago	14	0.5
Webb	7	0.2
Glendale	6	0.2
Davison East	36	1.3
Davison West	15	0.5
Linwood	48	1.7
Livernois	79	2.8
Wyoming	234	8.3
Meyers	364	12.9
7 Mile Road	233	8.3
8 Mile Road	441	15.6
9 Mile Road	355	12.6
Beyond 9 Mile Road	990	35.1

TABLE C-3

QUESTION FOUR: FREQUENCY OF USE OF FREEWAY

FREQUENCY	NUMBER	PERCENT
Never or Seldom	168	5.9
Once or Twice a Week	355	12.6
Almost Every Day	2301	81.5

TABLE C-4

QUESTION 5A: HAVE YOU EVER SEEN A RAMP INFORMATION SIGN?

RESPONSE	NUMBER	PERCENT
Yes	2252	79.7
No	572	20.3

TABLE C-5

QUESTION 5B: DO YOU USE THESE SIGNS?

RESPONSE	NUMBER	PERCENT
Yes	1095	38.8
No & No Response	1729	61.2

TABLE C-6

QUESTION 6A: DID YOU SEE ONE OF THESE SIGNS ON THIS TRIP?

RESPONSE	NUMBER	PERCENT
Yes	1260	44.6
No	1564	55.4

TABLE C-7

QUESTION 6B: DID YOU USE THE SIGNS ON THIS TRIP?

RESPONSE	NUMBER	PERCENT
Yes	477	16.9
No & No Response	2347	83.1

TABLE C-8

QUESTION 8A: DID YOU SEE A TRAILBLAZER SIGN ON THIS TRIP?

RESPONSE	NUMBER	PERCENT
Yes	791	28.0
No	2033	72.0

TABLE C-9

QUESTION 8B: DID YOU USE THESE SIGNS TO HELP YOU DECIDE WHERE TO ENTER THE FREEWAY ON THIS TRIP?

RESPONSE	NUMBER	PERCENT
Yes	300	10.6
No & No Response	2524	89.4

TABLE C-10

RESPONDENT'S COMMENTS ON THE FREEWAY

TYPE	NUMBER	PERCENT
Favorable	5	0.2
Unfavorable	57	2.0
No Comment	2762	97.8

TABLE C-11

RESPONDENT'S COMMENTS ON RAMP METERING

TYPE	NUMBER	PERCENT
Favorable	17	0.6
Unfavorable	322	11.4
No Comment	2485	88.0

TABLE C-12

COMMENTS ON THE RAMP INFORMATION SIGNS

TYPE	NUMBER	PERCENT
Generally Favorable	65	2.3
Good Idea	19	0.7
Good Design	3	0.1
Operated Well (Gives Correct Information)	0	0.0
Generally Unfavorable	63	2.2
Poor Idea	12	0.4
Poor Design	272	9.6
Operated Poorly	126	4.5
Signs Are Not Necessary (Or Indifferent Response)	24	0.8
No Comment	2240	79.3

TABLE C-13

COMMENTS ON THE TRAILBLAZER SIGNS

TYPE	NUMBER	PERCENT
Generally Favorable	59	2.1
Good Idea	15	0.5
Good Design	18	0.6
Operated Well	0	0.0
Generally Unfavorable	64	2.3
Poor Idea	11	0.4
Poor Design	137	4.9
Operated Poorly	99	3.5
Signs Are Not Necessary	23	0.8
No Comment	2398	84.9

TABLE C-14

COMMENTS ON THE ALTERNATE ROUTE SYSTEM

TYPE	NUMBER	PERCENT
Works Well	3	0.1
Alternate Routes Are Slower	103	3.6
Got Lost or Might Get Lost on Alternate Route	6	0.2
Objection to Neighborhoods Traversed by Alternate Routes	9	0.3
General Objections	23	0.8
Alternate is Slower Due to Ramp Metering on Alternate Ramps	18	0.6
Both Slower and Passes Through Objectionable Neighborhoods	4	0.1
No Comment	2658	94.1

APPENDIX D

PROJECT STATEMENT

APPENDIX D

"Excerpts From"

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Highway Research Board
National Academy of Sciences-National Research Council

FY '67

Project Statement

Research Project Title:

Optimizing Freeway Corridor Operations Through Traffic Surveillance, Communication, and Control

General Problem Area:

Special Projects

Research Problem Statement:

To meet present and future traffic demands, the combined freeway and surface street system must operate more efficiently. Freeways through heavily developed areas have limited right-of-way which prevents, on an economic basis, their reconstruction for increased capacity. Practical measures for increasing operational efficiency of these facilities through heavily traveled corridors should be developed by judicious application of traffic surveillance, communication, and control.

Urban freeways comprise a major portion of the traffic-carrying capacity of the total vehicular route system in American cities. It is believed that surveillance, communication,

and control of traffic on freeways as well as on the supplemental street systems can be improved, resulting in better service to the motoring public as a whole.

It is desired to apply the best traffic surveillance, communication, and control techniques in a typical urban freeway corridor and to study the results. Innovations that may be expected to enhance the operational efficiency should be explored.

The National Proving Ground for Freeway Surveillance Control and Electronic Traffic Aids located on the John C. Lodge Freeway in Detroit has been extensively equipped for freeway surveillance, and this freeway and the adjacent corridor is designated as the study site to develop and evaluate improved surveillance, communication, and control techniques.

Objectives:

1. Determine method(s) for increasing the effectiveness of the system which involves the freeway and the adjacent surface street network within the corridor. Evaluate the methods on the study site with or without the use of additional hardware.

2. Recommend equipment configurations (that is, type and location) for the improved system which will represent the optimum balance in cost-effectiveness.