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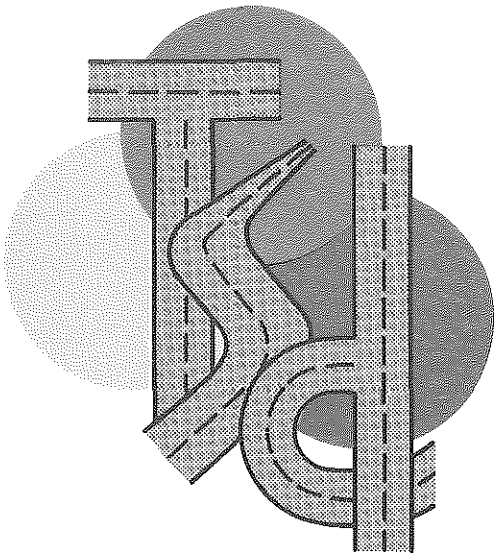
FINAL REPORT

STUDY OF RURAL FREEWAY EMERGENCY COMMUNICATIONS FOR STRANDED MOTORISTS

TSD-TR-132-71



TRAFFIC and SAFETY DIVISION

DEPARTMENT OF STATE HIGHWAYS
STATE OF MICHIGAN

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FINAL REPORT

STUDY OF RURAL FREEWAY EMERGENCY COMMUNICATIONS FOR STRANDED MOTORISTS

TSD-TR-132-71

By

Walter J. Roth

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and
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The opinions, findings and conclusions expressed in this publication are those of the authors and not necessarily those of the Federal Highway Administration.

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

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ABSTRACT

This is the third and final report on Michigan's "Study of Rural Freeway Emergency Communications for Stranded Motorists".

This study had an overall dual objective; 1) to plan, install and operate a system of voice communication by wire for stranded motorists and 2) to determine the needs of stranded motorists and how the installed system met these needs.

In early 1966, design work for the system was begun and a research study plan prepared. The contract for the project was let in May 1967 and installation was completed January 1968.

Throughout much of early 1968, operation of the system was interrupted several times due to component changes and modifications necessitated by system malfunctions.

Extensive studies were performed in the summer of 1968 and January 1969. By April 1970, additional data on usage and operation of the system was ready for final report compilation.

The adjacent-resident survey showed a considerable number of requests for assistance before phone installation and these were greatly reduced following the system installations.

Based on the Mobile Summer Survey (1968), 28 percent used the Aid Phones for assistance, 32 percent helped themselves, 16 percent were aided by others and 24 percent walked, hitchhiked or abandoned their vehicles. In the Winter Survey (1969), the above percentages

were as follows: 42 percent, 8 percent, 8 percent, and 42 percent. In the summer, 23 percent were not aware of the phones.

As was predicted, the use of the aid phones kept the motorist from being stranded for hours, as accurred several times for those not using the phones. A number also received aid faster from passing motorists than those who called for aid, which also was anticipated.

Trucks consistently showed a greater percentage of need than their percentage in the traffic stream.

The handout questionnaires given to I-94 motorists showed 87 percent of all drivers strongly favored such a motorist aid system, and not very surprisingly, a much higher percentage of users of the system favored it.

The I-94 traffic trip lengths consist of about one-third under 100 mile trips, one-third 100-250 miles and one-third more than 250 miles. The return mailer questionnaires sent to users of the system indicated 78 percent used the freeway once per month or more and primarily on work or recreation trips. The closer spaced phones (3400 feet) evidenced no greater service to the motorists than the 5400-foot spacings.

Summer to winter stranded rates were very close - one per 33,000 vehicle miles and 38,000 vehicle miles, respectively. The stopping rates seem to follow precisely the varying ADT's. The stopping rates (number of stops per day) varied from one-half per mile per day in the winter to eight-tenths per mile per day in the summer.

About 57 percent more of the stranded motorists in the winter used the phones than those in the summer.

Most stranded motorists used less than ten minutes to get to a phone. From this, one might conclude phones could be further spaced; however, some drivers may not be able to traverse that distance.

The comparative analysis of trip characteristics between the stranded motorist group and freeway traffic shows that stranded motorists are not a peculiarity in the stream but in fact have a very strong kinship.

The State Police reported that they feel the system has merit, particularly in conjunction with some patrol activity. They also feel the system would be of greater benefit in the more remote northern areas of the state. This would likely be true as regards possible serious consequences, but the system would serve fewer stranded motorists.

This study has provided considerable factual data concerning needs of stranded motorists on a rural freeway. The needs, similar to accident numbers, are rather small but to those in need often critical. A surprisingly high percentage of monthly calls are for assistance at accidents. No information is available as to whether or not these phones assisted in saving lives by speeding aid to the scene.

The foregoing needs and usages outlined must next be weighted against possible funding for any extension of such a system. A comparison has been provided between annual operating costs of this system and other routine freeway maintenance expenditures. This shows that funds equal to this system operation cost are being spent on roadside appearance programs such as mowing and cleanup and trimming activities. In this light it would seem a system for aid should be at least as valuable to the motorist and for actual stranded motorists much more valuable. This system's cost and operation over a 10 year period appears to average about $22.00 per call.

On the basis of present available knowledge of operating Motorist Aid Systems, we would recommend a telephone communication system. This approach, coupled with some patrol activity and ready reference to the appropriate commercial agency, seems to provide the most desirable elements of a system of aid for stranded motorists.

INTRODUCTION

This is a final report of a two-year experiment with a Motorist Aid Telephone System in Michigan. This project was a cooperative effort by the Michigan Department of State Highways and the Federal Highway Administration which funded 90 percent of installation costs and, through the Highway Planning and Research program, aided in the various research phases.

The study was designed to determine the usefulness of a roadside Motorist Aid Telephone System to stranded motorists on a rural freeway and to observe and record the needs of motorists who stop on the facility.

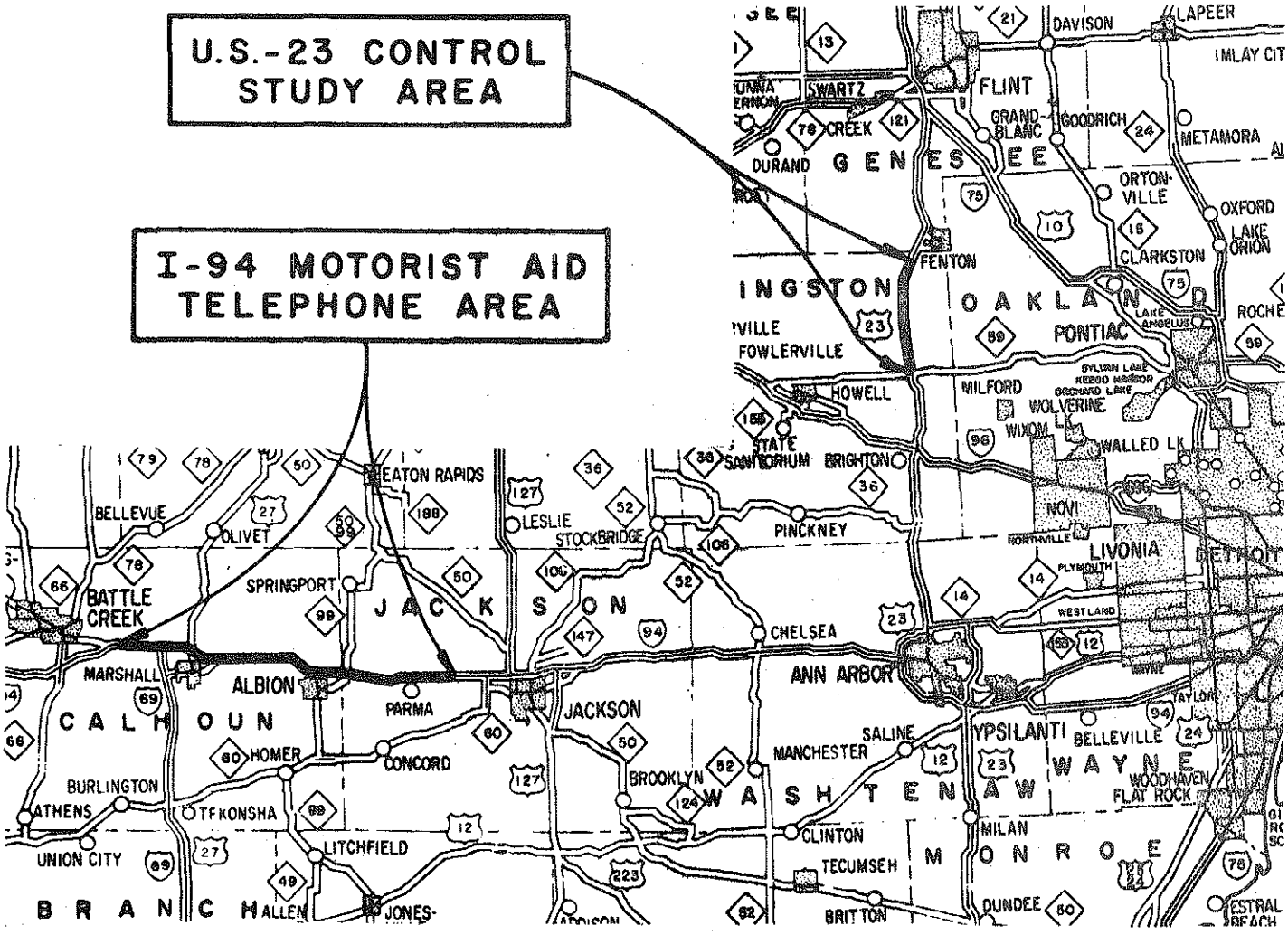
In addition, operational aspects of such a system were reviewed as well as the maintenance activities required.

The interest expressed by many other states and agencies in the stranded motorist problem is also an indication of the merit of research in this area.

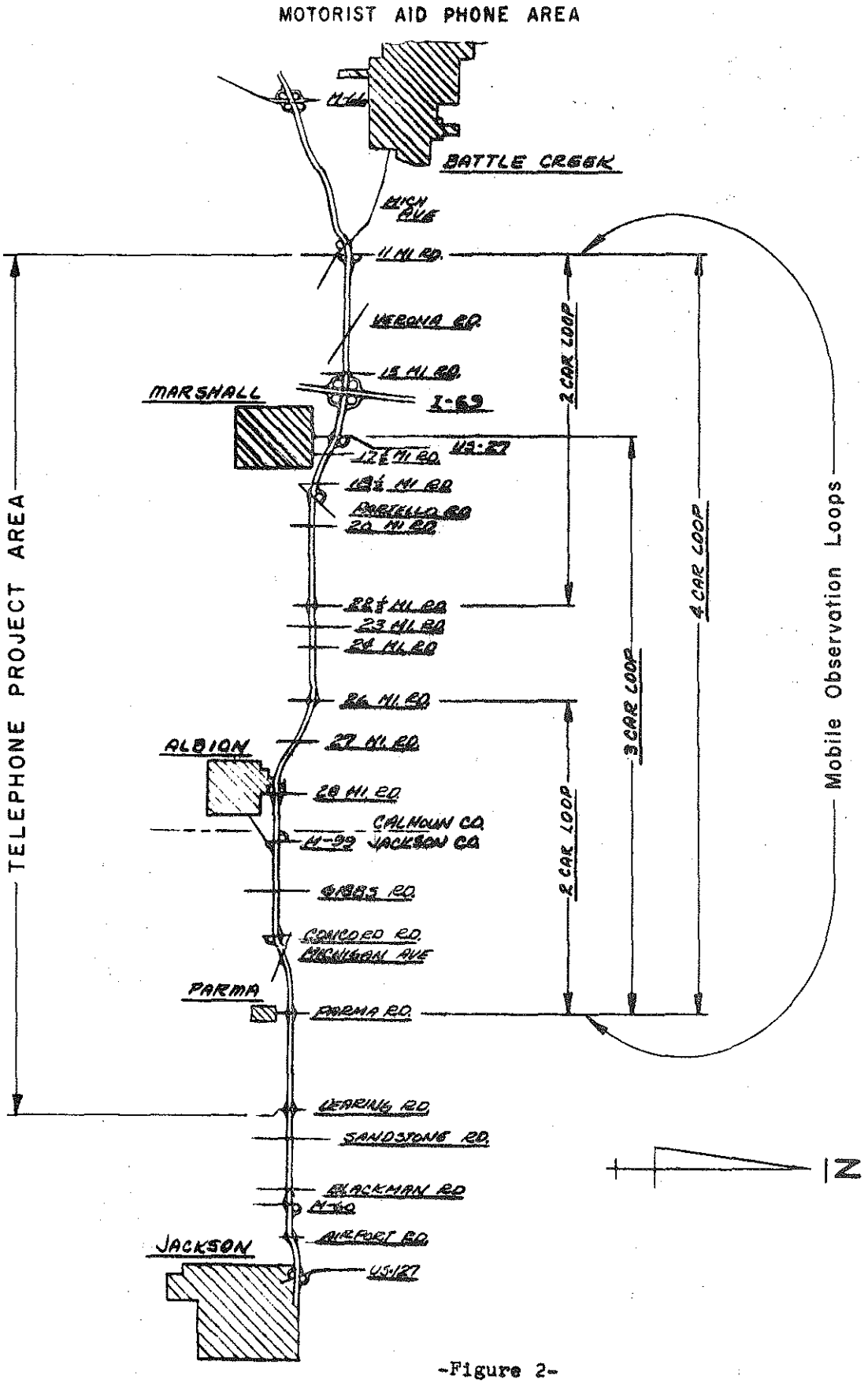
DESCRIPTION OF MOTORIST AID TELEPHONE SYSTEM

A thirty-mile section of I-94, between Jackson and Battle Creek, was selected for the experiment (Figures 1 and 2). I-94 is a major east-west freeway connecting Detroit to Chicago. About 21 percent of the 14,000 average annual daily traffic on I-94 is commercial.

STUDY LOCATIONS MAP



-Figure 1-


MOTORIST AID PHONE AREA
M-66
BATTLE CREEK
HIGH AVE
11 MI RD.
VERONA RD.
15 MI RD.
I-69
MARSHALL
US-27
17½ MI RD.
DARBELLO RD
20 MI RD.
TELEPHONE PROJECT AREA
22½ MI RD.
23 MI RD.
24 MI RD.
26 MI RD.
27 MI RD.
ALBION
28 MI RD.
CALHOUN CO.
M-99
JACKSON CO.
CONCORD RD.
MICHIGAN AVE
PARMA
PARMA RD.
4 CAR LOOP
3 CAR LOOP
2 CAR LOOP
Mobile Observation Loops
WEARING RD.
SANDSTONE RD.
BLACKMAN RD
M-50
AIRPORT RD.
JACKSON
US-127
N

-Figure 2-

The telephone system is entirely state-owned with the exception of the leased lines connecting the freeway circuits to the State Police Posts. These lines are leased from the Michigan Bell Telephone Company.

There are 31 pairs of phones over the 30 miles. The east 17 pairs of phones are spaced approximately 3400 feet and the remaining 14 pairs are approximately 5400 feet apart. The phones are numbered 1 through 62. Three circuits comprising phones 1 through 28 are connected to the Jackson State Police Post, and three circuits connect phones 29 through 62 to the Battle Creek State Police Post. The number of phones per circuit varies from 6 to 18.

Each Motorist Aid Telephone is 13.5 feet from the edge of the pavement. At each site, there is a 12-foot aluminum pole with a blue light on top. A red weather-proof cabinet containing the handset is attached to this pole on the downstream side. A blue sign displaying a white telephone symbol is also attached facing traffic (Figures 3a and 3b).

All telephone and power cables within the right-of-way are underground. The 30-mile section is signed at the beginning, end and midpoint (Figures 3c and 3d). Mileage markers are placed every two-tenths mile in the experimental area to identify stopping locations as a part of one study (Figure 3e).

To use the telephones, the motorist opens the cabinet door and

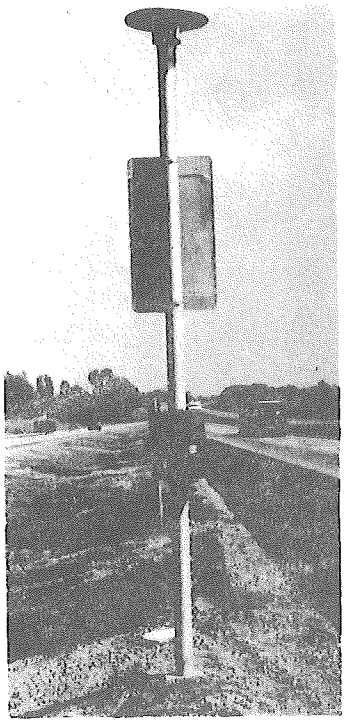


Fig. 3a

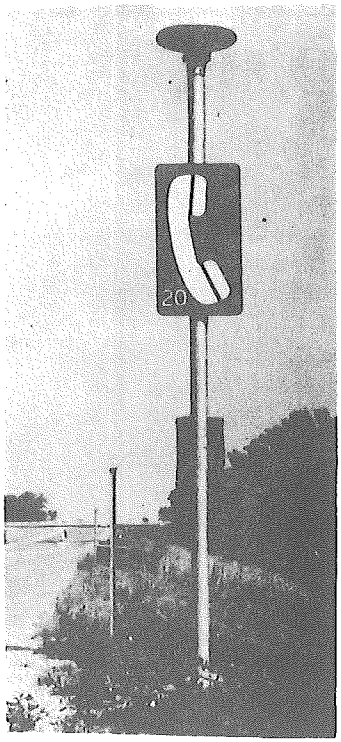


Fig. 3b

Fig. 3c

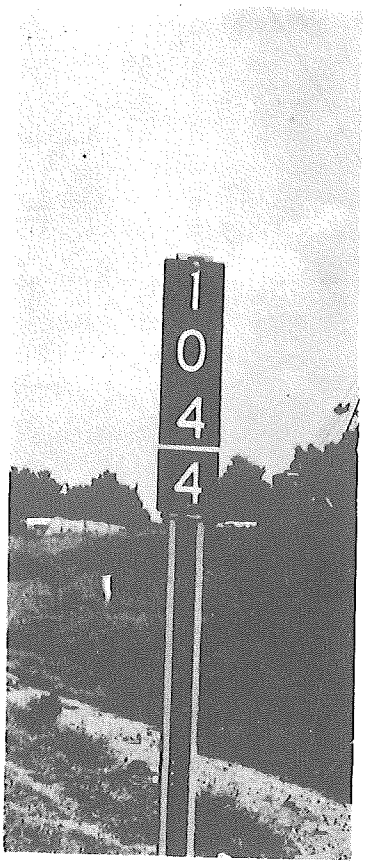


Fig. 3e

Fig. 3d

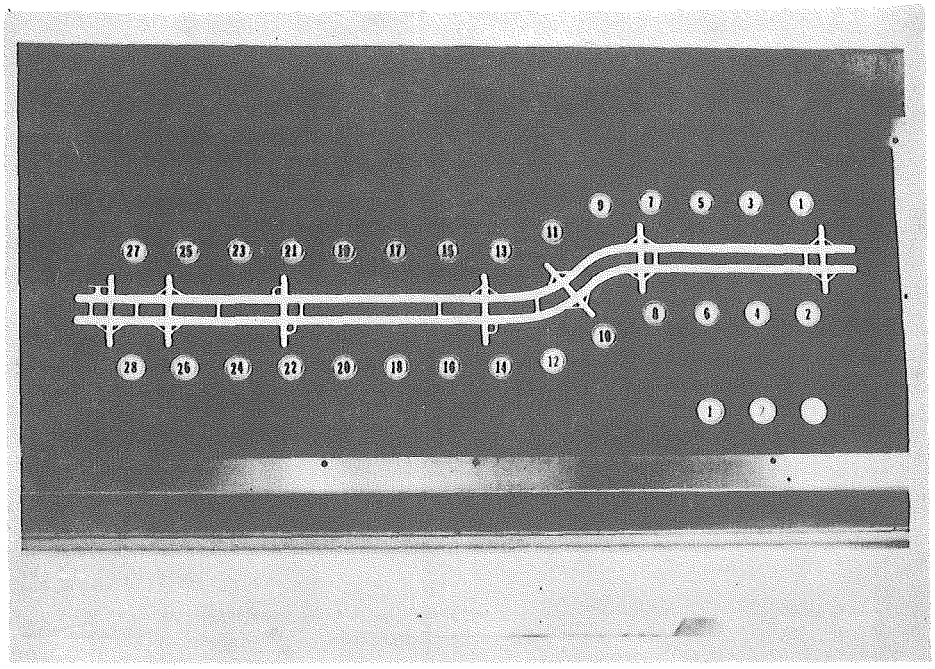


Fig. 4a
Site locations from Dearing Road to 28 Mile Road

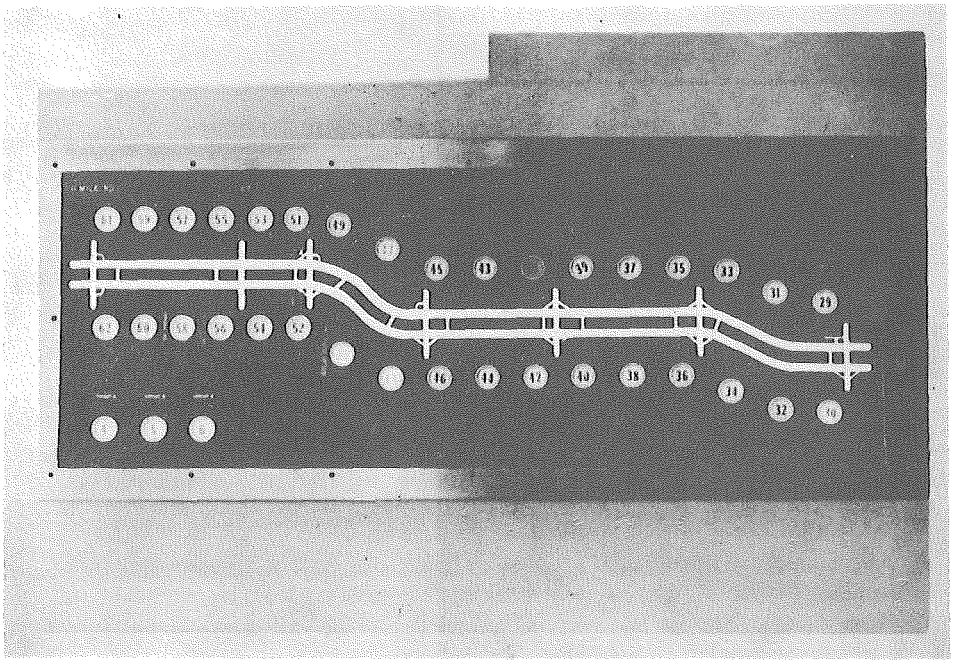


Fig. 4b
Site locations from 28 Mile Road to 11 Mile Road

lifts the handset from the hook. The dispatcher at the police post is notified by a ring and a red light which identifies the calling site (Figure 4). The dispatcher answers the call and obtains information necessary to assist the motorist and completes a questionnaire (Appendix 4). The State Police usually supply gasoline to a motorist with this need. For other needs, the State Police call an appropriate agency from a list of area commercial enterprises who then provide the service to the motorist.

A stick-on label in the phone box states "when ringing stops, your call is answered by the Michigan State Police. Speak directly into the phone". The transmitter of the handset is equipped with a confidencer to restrict extraneous ambient noise from interfering with voice transmission.

SYSTEM OPERATION AND MAINTENANCE

The contractor had most of the system installed by November 1967 when operational checks were begun. The first operating problems began in December 1967 when moisture in the field encoder units caused system malfunctions. The two-year maintenance contract began January 3, 1968.

During 1968, the following occurrences should be mentioned in connection with this experimental prototype aid system for the first year of operation.

February: Small resistance heaters were installed in each phone

box to attempt to alleviate the moisture problem with the encoders. High voltage suppressors were installed at each site to protect the system from voltage surges, primarily from lightning.

March: All field circuitry was sprayed with waterproof material. All field units encoder modules were vented at the time they were removed from the freeway and checked out. About one-half of the problem with the encoders appeared to be moisture and the other one-half associated component failures. Contractor and Department representatives traveled to the encoder manufacturer's plant to attempt resolution of non-operation. Representatives of the manufacturer came to Michigan to modify the units.

Daily to weekly operational inspection checks were begun.

April: Encoder problems appeared unsolvable as modifications have not corrected the problems.

May-June: Existing encoders and decoders were all changed to another type which necessitated some circuit modifications. Jackson Post phone and cable had to be moved due to remodeling at the Post.

July-August-September: Storm and lightning problems were intense these months causing numerous component and circuitry damages besides blown fuses.

October: Capacitors were placed in all phone sites to override brief power breaks as a means of preventing some false ringing. Switches were installed on the phone bell at each Post

to allow the dispatcher to shut off the bell when any false ringing was occurring. A small light would still flash on. The blue lamps were all replaced at each field site. These are replaced on a six months schedule and burn continuously. A five week system test ending in October showed that a phone did not ring in from the highway in 13 out of 186 calls. Eleven other times, Posts did not answer the ring as they were occupied with other police matters.

November: System checks continued with 93 calls reported this month by the State Police. A hum on circuit #1 was traced to a leased line through the Parma exchange system. Line noise, shorts and grounds have occurred periodically, usually on circuits #1, #2, or #3.

Our periodic checks during the first half of 1969 showed very good operation of the system, although data received from the State Police was limited. In late September 1969, tape recorders were placed at each Police Post to record all call activity and approximately 150 calls per month were recorded.

The following summation lists operational occurrences during 1969:

a. On 26 occasions handsets were torn out, components stolen or other vandalism occurred which accrued to approximately $2,000 damage.

b. Two sites were struck by vehicles, system repair cost was $1,300. Five sites were struck during 1968.

c. Lightning struck and damaged components seven times.

d. On five occasions, water in the underground terminals shorted out a circuit or a portion of one. Late in 1969, all these terminals were drained to eliminate this problem.

e. Eleven times during the year, circuitry problems were traced to the leased telephone lines.

f. False ringing difficulties have continued sporadically. The present contract for maintenance excludes lightning damage, costs incurred as a result of leased line problems and also costs related to vehicle damage and vandalism. The latter two were also excluded in the original maintenance contract.

Considerable maintenance activity was continued in the first five months of 1970. Twenty-five handsets that were torn out needed replacement - four doors on the cabinets and a broken hood switch were replaced. The tenth site was struck in May and circuits #1 and #3 had lightning strikes that burned the underground cable, and on circuit #3, the cable flooded necessitating replacement.

PROJECT CONSTRUCTION AND OPERATING COSTS

Total System	$ 290,170.00
Cost per Mile	9,670.00
Cost per Phone Site	4,680.00
First 2 years Maintenance	7,200.00
6 Months Maintenance	2,100.00
1 year to July 1971 Maintenance	12,400.00
3½ year total	$ 21,700.00

Leased Lines - 6 pair annual costs	$	3,414.00
Power Costs - annual		1,700.00
Vandalism & Vehicle Damage (15 Sites replaced)		
Average Annual Cost		3,500.00
Lightning Damage		
Average Annual Cost		5,500.00
Leased Line Troubleshooting		
Average Annual Cost		770.00
Annual Operating Costs on Above Experience		24,550.00
10 Year Basis - Construction & Operation		535,670.00
20 Year Basis - Construction & Operation		781,220.00
At an average of 2400 calls per year		
Cost per call (10 yr. period)		22.00
Cost per call (20 yr. period)		16.00

Routine maintenance, plus repairs from lightning and vandalism and vehicle damage account for about three fourths of the annual operating costs. The first two years maintenance figure was of course a rough estimate and operating experience has dictated the increases in the following year and a half activity. The project should show more cost effectiveness were it about twice the length, to more efficiently use one man full time in maintenance activity.

It has been amazing that so many sites have struck by vehicles over the 30 mile section. The number of handsets stolen, boxes damaged and light globes broken is also surprising along this frequently traveled route.

If we equate construction and operating costs to an average of 2400 calls per year, then on a 10-year basis, each call costs $22.00. Motorists driving through the 30 mile section during one year will supply approximately $945,000 in State gas tax funds. The average annual operating costs ($24,550) of this system equals 2.6 percent of this fund. If we also consider the Federal and sales tax monies, then the system operation would cost 1.5 percent of these funds.

Appendix 6 equates costs of other activities on 30 miles of freeway to the Motorist Aid System. Perhaps motorist aid communications could be considered as important to the motorist as mowing and roadside cleanup.

SURVEY OF OCCUPANTS OF HOMES ADJACENT TO TELEPHONE AREA

Letters have been received by the Highway Department which indicated persons living near Interstate Freeways were often called upon to assist stranded motorists. Motorists are requesting use of residents' telephones or asking to borrow equipment to repair their car. The occupants of 41 homes readily visible along I-94 within the telephone project were interviewed and asked if aid had been requested of them.

The following is a breakdown of the replies:

28 had given aid before the telephone system was installed but not after

15 indicated they had given aid more than once a week

1 indicated they had given aid once a month

12 indicated they had given aid less than once a month

13 had given aid before and after the installation

During the before period:

9 indicated they had given aid more than once a week

1 indicated they had given aid less than monthly

3 did not specify how often

After the telephones were installed:

3 claimed no reduction or increase in the requests

2 noted a slight reduction

4 noted a sizeable reduction

4 noted the request had almost stopped

The minimum length of time the residents had lived in the house was one year. The average was eight years.

The study asked opinions of the occupants as to how often they actually provided aid. No accurate estimate of type of aid provided can reasonably be made and a more careful breakdown of the replies than listed above does not seem warranted as the home interview study was intended to provide a consensus of opinion. The home interviews extended over a three-month period which introduced statistical bias in the data. Persons interviewed during April were less likely to have been asked to provide aid than the group interviewed in July. The period after the telephones were operational was also about one-fourth longer. Difficulties with the operation of the telephones as discussed under "System Operation and Maintenance" may have contributed to the rather large percentage

of homes where aid was still requested in 1968.

The home interview study partially indicated the level of needs of motorists and the usefulness of this system during a period of operational difficulties.

It is noted that:

(a) All of the homes had been asked to provide aid prior to the installation

(b) Over 50% of the homes were contacted more than once a week by stranded motorists before the telephones were installed, and this incidence has been substantially reduced.

MOBILE OBSERVATIONS OF STRANDED MOTORISTS

Mobile observations were made of the number of stopped vehicles and approximate duration of stops during the summer of 1968, and winter of 1969, in the motorist aid telephone area and the control section of US-23.

The 10-mile section on US-23 (Figure 1) was chosen as a "control" as defined in the Research Study Plan to provide a comparison of stranded motorist activities on this section of roadway to I-94. The procedure followed for the mobile observations is given in Appendix 1, and the form used to record all the available data for each stranded motorist is shown in Appendix 3.

It is apparent from Table 1 that passenger cars on I-94 comprise 69 percent of the stranded vehicles; however, trucks at 31 percent have a disproportionate share of the breakdowns as they comprise only 21 percent of the traffic on the freeway. It also shows that tires account for the major need for passenger cars at 48 percent. The greatest need in the truck group was for mechanical aid at 43 percent, while tire needs were nearly as great at 36 percent.

The "others helped" category (Table 2) under the miscellaneous group, is not combined with those needing off-freeway aid, as there will always be some number of passing motorists willing to give aid. The 26 people who walked or hitchhiked, but were aware of the aid phones, apparently assumed they could obtain aid either faster, or cheaper, themselves. It is rather puzzling, however,

that while there were 77 percent of the off-freeway needy motorists aware of the phones, only 52 percent made use of them.

TABLE 1

1968 MOBILE SUMMER SURVEY ON I-94 - REASONS FOR STOPS

172 interviews or observations of motorists stopped over 12 minutes (192 hours of observation over 26 days)

Passenger Vehicles 119 (69%)

Reason	No.	Percent	No. Using Aid Phones
Tire Failure	57	48	10
Gas, Water, or Oil	21	18	4
Mechanical (tow)	19	16	12
Mechanical (no tow)	21	18	5
Miscellaneous	1	0	0
	119	100	31

Trucks, Buses (3) and Motorcycles (2), 53 (31%)

Reason	No.	Percent	No. Using Aid Phones
Tire Failure (1 motorcycle)	19	36	7
Gas, Water, or Oil	6	11	1
Mechanical (tow)	4	7	2
Mechanical (no tow)	19	36	6
Accident, (1 motorcycle)	2	4	0
Fire	1	2	1
Miscellaneous	2	4	0
Total	53	100	17

TABLE 2

DRIVER'S ACTION FOR AID ON I-94 (SUMMER)

	No.		Percent
Used Aid Phones	48	(52% eff.)*	28
Used Public Phones	4		2
Walked (11 Aware of Aid Phones)	14		8
Hitchhiked (15 Aware of Aid Phones)	18		11
Abandoned Vehicle (Over 10 Hours)	6		3
Sub Totals	90		52
Miscellaneous **	82		48
Total	172		100

**Miscellaneous 82

Self Help:		
Tire	36	(49% of Total Tire Needs)
Mechanical	9	(15% of Total Mechanical)
Used Own Radio	2	
Drove to Service	8	
Others Helped:		
Survey Group	7	
Passerby	11	
Police	1	
Unknown	8	
Total	82	

*Percent of the 90 needing Off-Freeway Aid.

Of those interviewed, 40 motorists or 23 percent were not aware of the Phones and 32 percent were in the "Self Help" category.

Although the total number of interviews is small, the distribution of cars and trucks equals the Summer Survey. Trucks still have a disproportionate share of the breakdowns. The changes in percents of the reasons for stops in Table 3 can be attributed largely to the cooler weather and correspondingly fewer tire failures. Trucks obviously have more mechanical needs in winter; however, gas, water and oil needs were not evident in winter for trucks. Some of these variations may also be due to the small winter sampling obtained.

Table 4 displays the actions taken by drivers to meet their various needs when their travel was interrupted. Even more than the Summer Study, we note a high awareness level of the phones (89 percent); however, only 50 percent chose to utilize them.

From Table 5 it is apparent that trucks on the US-23 control section are having a larger proportion of the troubles as they were also on I-94. They make up 21 percent of the traffic and 29 percent of the stops in the summer and 51 percent in the winter. The major summer problem for passenger cars is tires while trucks have more mechanical problems. In the winter car tire problems were still dominant and tire and mechanical needs for trucks were equal at 28 percent each.

TABLE 3

1969 MOBILE WINTER SURVEY ON I-94 - REASONS FOR STOPS

36 interviews or observations of motorists stopped over 12 minutes (71 hours of observation over 10 days)

Passenger Vehicles 25 (69%)

Reason	No.	Percent	No. Using Aid Phones
Tire Failure	6	24	1
Gas, Oil, or Water	4	16	1
Mechanical (tow)	4	16	3
Mechanical (no tow)	3	12	1
Accident	3	12	3
Fire	1	4	1
Miscellaneous	4	16	0
Total	25	100	10

Trucks 11 (31%)

Reason	No.	Percent	No. Using Aid Phones
Tire Failure	3	27	1
Gas, Oil, or Water	0	0	0
Mechanical (tow)	7	64	3
Mechanical (no tow)	1	9	1
Accident	0	0	0
Total	11	100	5

TABLE 4

DRIVER'S ACTION FOR AID ON I-94 (WINTER)

	No.	Percent	
Used Aid Phones	12	33	
Other Motorists Used Aid Phones	3	8	(50% eff.)*
Other Motorists Used Public Phones	1	3	
Walked	4	11	
Hitchhiked	6	17	
Abandoned Vehicle (Over 10 hours)	4	11	
Sub Total	30		
Miscellaneous**	6	17	
Total	36	100	

**Miscellaneous

Self Help:	
Tire	3
Others Helped:	
Passerby	1
Police	1
Unknown	1
Total	6

*Percent of the 30 needing Off-Freeway Aid.

Of those interviewed, four motorists or 11 percent were not aware of phones.

TABLE 5

MOBILE SURVEYS ON US-23 - REASONS FOR STOPS

Data covers interviews or observations of motorists stopped over 12 minutes (no motorist aid phones in this control area).

Passenger Vehicles

	Summer		Winter	
Reason	No.	Percent	No.	Percent
Tire Failure	17	38	6	35
Gas, Oil, or Water	12	26	0	0
Mechanical (tow)	5	11	1	6
Mechanical (no tow)	5	11	3	18
Accident	2	5	2	12
Miscellaneous	4	9	5	29
Sub Total	45 (71%)	100	17 (49%)	100

Trucks

	Summer		Winter	
Reason	No.	Percent	No.	Percent
Tire Failure	3	17	5	28
Gas, Oil, or Water	3	17	4	22
Mechanical (tow)	3	17	2	11
Mechanical (no tow)	7	38	3	17
Stuck Off Road	0	0	2	11
Miscellaneous	2	11	2	11
Sub Total	18 (29%)	100	18 (51%)	100
Total	63		35	

TABLE 6

DRIVER'S ACTIONS FOR AID US-23

	Summer		Winter	
	No.	Percent	No.	Percent
Used Public Phones	6	10	1	5
Walked	14	22	3	8
Hitchhiked	6	10	0	0
Abandoned Vehicle (Over 10 Hours)	4	6	4	12
		48 Sub Total		
Miscellaneous*	33	52	24	75
Total	63	100	32	100
*Miscellaneous				
Self Help:				
Tire	10	30	4	17
Mechanical	8	24	4	17
Drove to Service	0	0	2	8
		54 Sub Total		42 Sub Total
Others Helped:				
Survey Group	3	9	7	29
Passerby	9	27	4	17
Police	1	3	1	4
Unknown	2	7	2	8
Total	33	100	24	100

The lack of aid phones forced more of the motorists to leave the freeway to obtain aid (48 percent on US-23 versus 24 percent on I-94). The group leaving the freeway was considered to be those who:

1. Used Public Phones
2. Walked
3. Hitchhiked
4. Abandoned Vehicle

Table 6 presents the action taken for aid by this group. These varying percentages may not be entirely realistic with the small numbers involved, however, it clearly demonstrates the forced high reliance on "self help" and "passing motorist". One-third of the stranded motorists received aid from other freeway motorists.

LEVELS OF SERVICE TO STRANDED MOTORISTS IN TERMS OF AID TIME

Figures 6-18 show the empirical cumulative distribution function for levels of service. These graphs relate causative factors to total time required for stranded motorists to obtain aid. Figure 5 shows an ideal cumulative distribution function.

Characteristic 1: The DNUP (Did Not Use Phone) begins to increase to the left of the UP (Used Phone).

Justification: Motorists who are relatively fortunate to be disabled near an intersection with service, or otherwise are able to obtain aid immediately will realize less delay than most phone users. Thus, there may well be this small "privileged" class when the system is in the ideal state.

Characteristic 2: The UP increased at a greater rate than the DNUP.

Justification: The use of the phone should initiate a chain of communications and service links which is reasonably uniform in its capability to aid the stranded motorist. Thus, the spread of time over which aid is given should be less for the phone user than for the individual who does not use the phone.

Characteristic 3: The UP obtains 100 percent to the left of the DNUP.

Justification: The use of the phone should insure that one is not left an extreme length of time on the

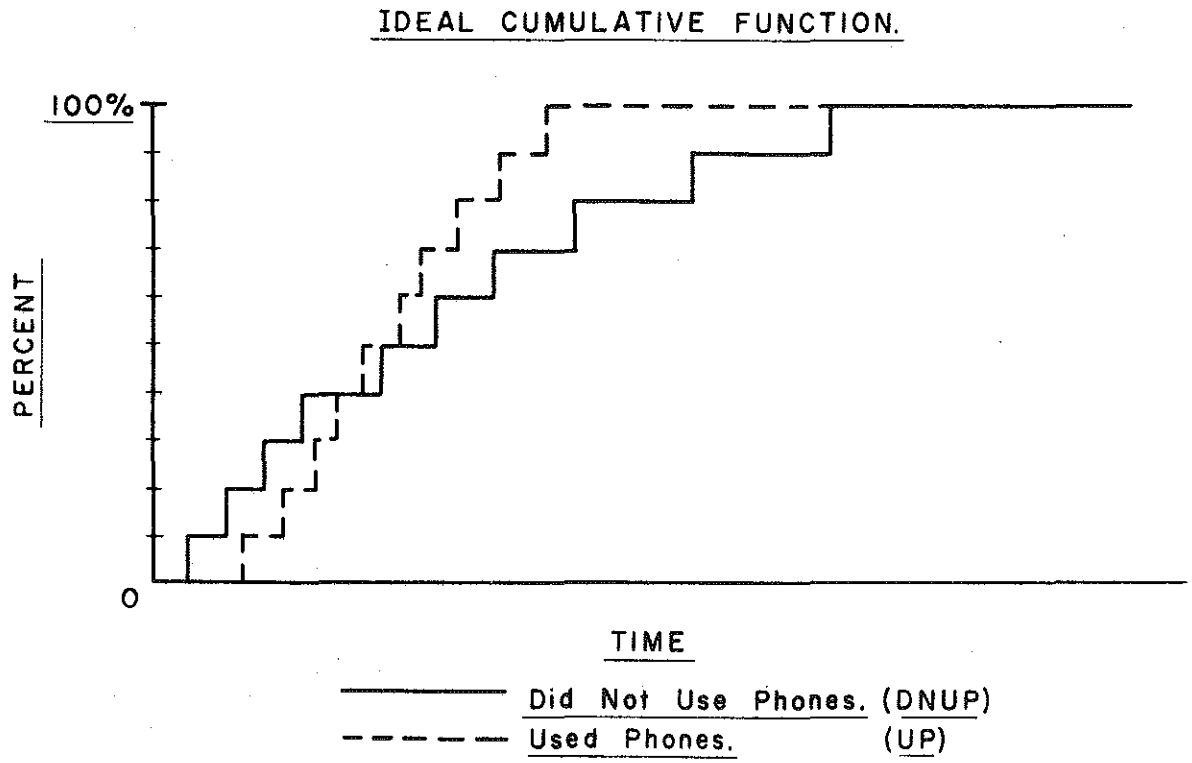

IDEAL CUMULATIVE FUNCTION.
100%
PERCENT
0
TIME
Did Not Use Phones. (DNUP)
Used Phones. (UP)

Figure 5

shoulder. The person who does not use the phone does not have this insurance.

In summary, the greater percentages of the DNUP during the "excellent" level of service times is not a defect in the system and might be anticipated. However, the UP should quickly overcome this advantage and reach 100 percent without long "flat" periods of time as might also be anticipated for the DNUP.

SUMMER STUDY

Figure 6 (Passenger cars with tire aid required).

There were 56 stranded passenger cars with tire aid required. Of these, 36 were self-help (64 percent) and 20 received help from others (36 percent). Among these 20, 9 (45 percent) used the phone. Figure 6 shows there is little difference in aid time between those who used the phones and those who did not. More than 80 percent of the group took less than one hour to fix their tires.

Figure 7 (Passenger cars with mechanical aid required).

The cumulative curve is very close to the ideal curve as it shows that half of those who used the phones were delayed a shorter time (beyond the first 40 minutes) than those who chose not to call. Of 40 in this whole group, 9 (23 percent) helped themselves, and 31 (77 percent) received outside help. Of this 31, 17 (55 percent) used the phones. For this high percentage who needed outside assistance the phones provided more than one-half of them with a means to aid.

FIGURE 6 - Tire Failure Aid Required

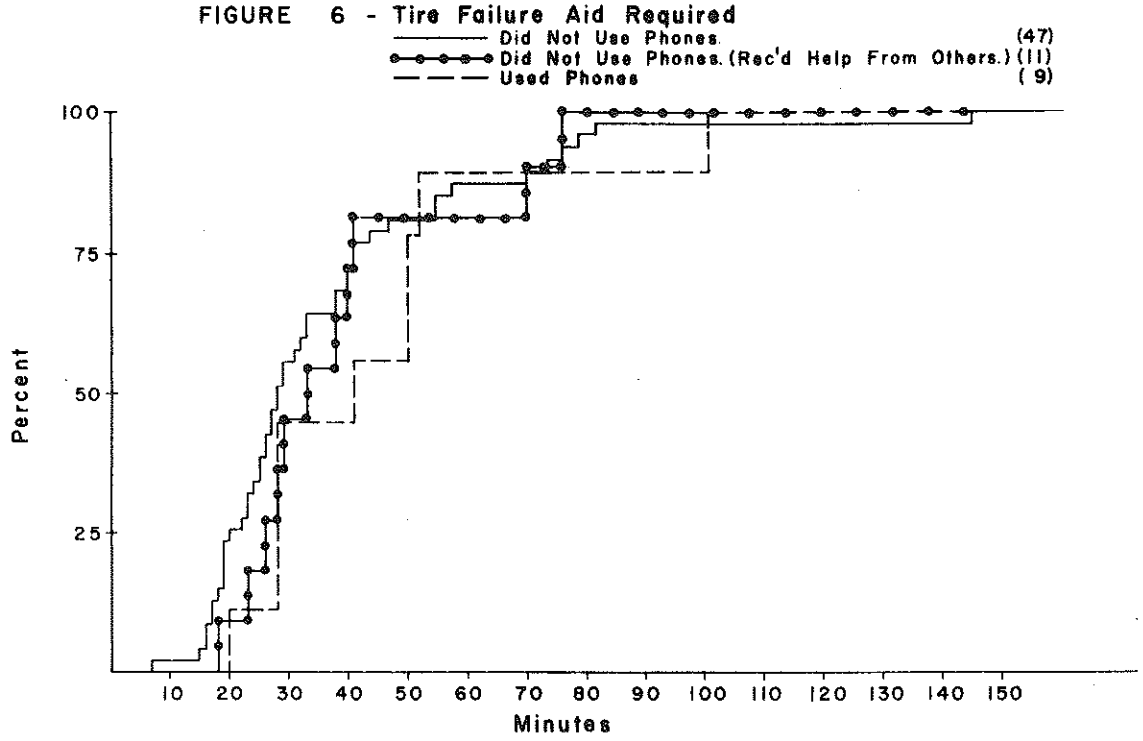


FIGURE 7 - Mechanical Aid Required

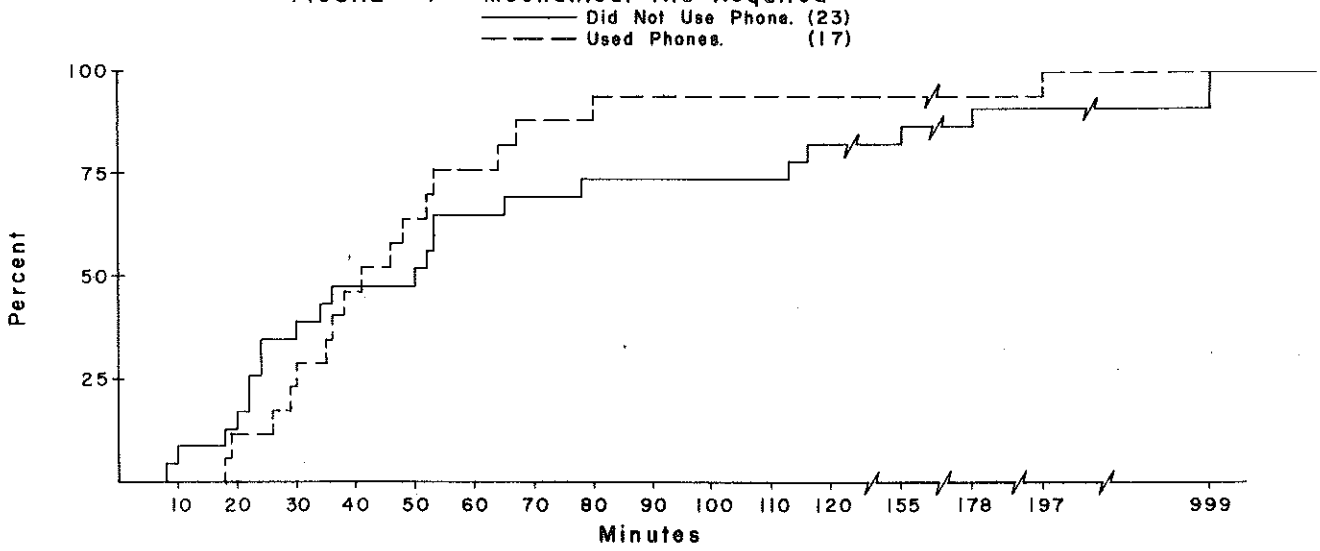


FIGURE 8 - Water, Gas & Oil Aid Required

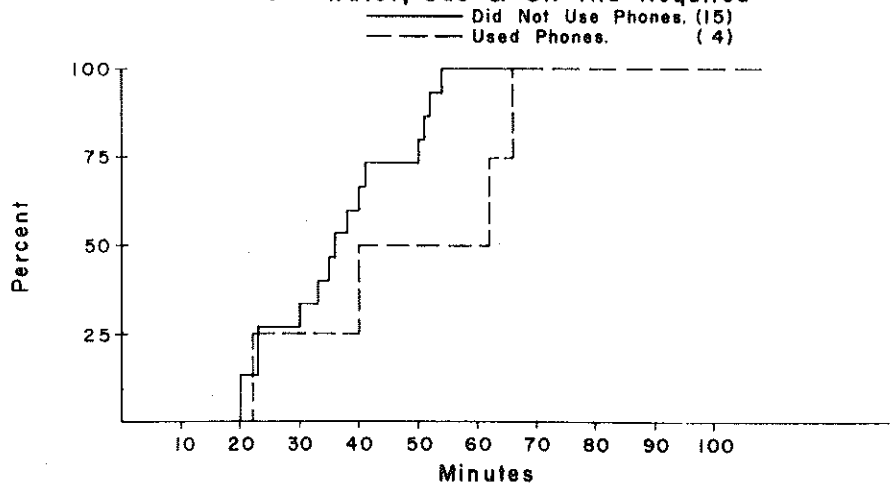


Figure 8 (Passenger cars with gas, water, or oil aid required).

Four out of 19 of this group used the phones; however, one of these received help from the highway survey group in 22 minutes, and another hitchhiked to get gas and took 62 minutes. The other two who called waited 40 to 66 minutes to get help from the State Police. The 15 who did not call received help as follows:

Help Received From	Time Required (Minutes)
(1) Highway survey group	23, 25
(2) Other motorists	23, 33, 38, 50
(3) Drivers walked to the nearest gas station	30, 40, 51
(4) Walked to rest area for water	41
(5) Self-help	36
(6) Unknown assistance	20, 20, 52, 54

Of this 15, 14 were aware of the phones before they tried to get help. It is obvious that in this category, drivers will do many things rather than use the Aid Phones--even though they are well aware of them. The reason for this reluctance can only be guessed at this point as these motorists were not asked this specific question.

Figure 9 (Trucks with tire aid required).

31 percent (5) of this group used the phone; 69 percent (11) did not use the phone. Of this 11, four were self-help, one used the pay phone, one received help from his own company by using his truck phone, four drove to the gas station, and one received help from another truck.

FIGURE 9 - Tire Failure Aid Required.

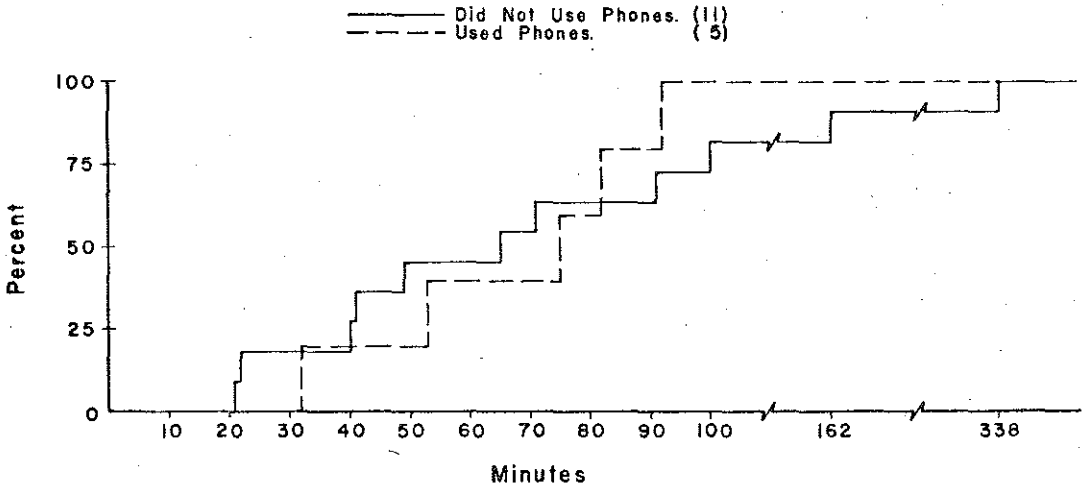


FIGURE 10 - Mechanical Aid Required.

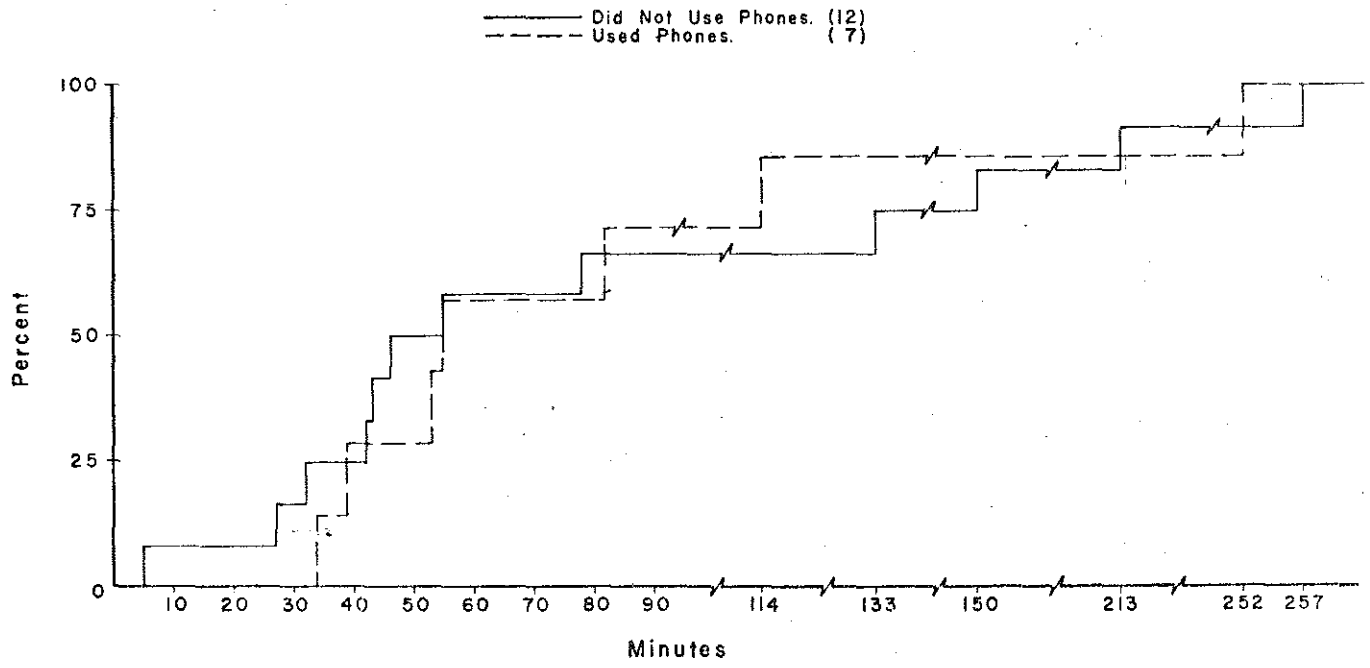


FIGURE 11 - Water, Gas & Oil Aid Required.

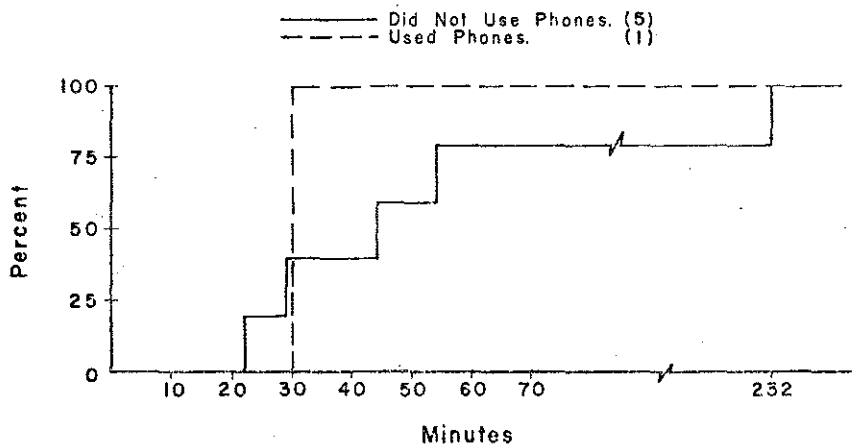


Figure 10 (Trucks with mechanical aid required).

37 percent of this group used the phones. There is little aid time difference between those who used the phones and those who did not use the phones.

Figure 11 (Trucks with water, gas or oil aid required).

The time distribution here is very close to the ideal curve, however, the sample size is very small.

WINTER STUDY

A total of 36 stopping vehicles was interviewed. 15 of these used the phones and 21 did not use the phones.

Figures 12-16

Again the sample sizes are small; however, they show promise of being close to the ideal as the sample size increases.

Figures 17-18

The aid time distributions are depicted for three categories of needs for vehicles stopped in the control area on US-23.

The short time groupings for passenger cars apparently were a result of two factors. The sample is limited, and twice the percentage of vehicles on US-23 were aided by other motorists as opposed to those on I-94. Hence, some of these short time aids may well have gone to two or three hours under other circumstances.

The truck stranded activity shows a marked reduction in all three categories for the delay of I-94 trucks whose drivers used the phones, compared to the group on US-23 (Figure 18) who had to obtain aid by other means. In both of these distributions, the sample sizes are rather limited.

PASSENGER CARS (Winter Study.)

FIGURE 12 - Tire Failure Aid Required.

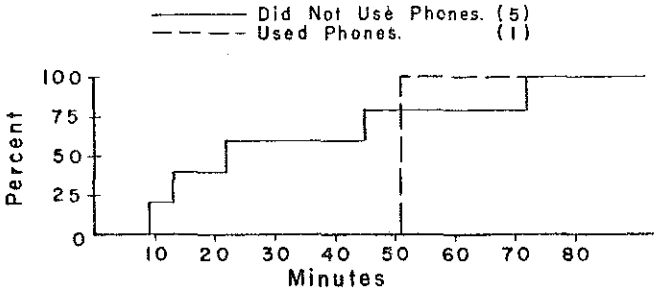


FIGURE 13 - Mechanical Aid Required.

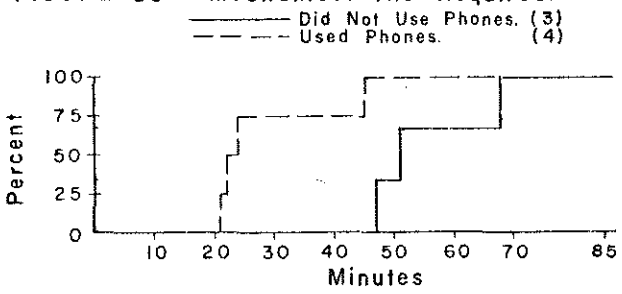
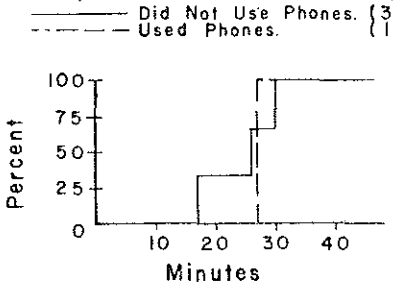


FIGURE 14 - Water, Gas And Oil Aid Required.



TRUCKS (Winter Study.)

FIGURE 15 - Tire Failure Aid Required.

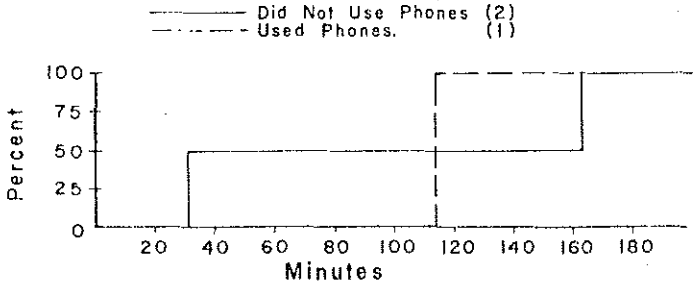
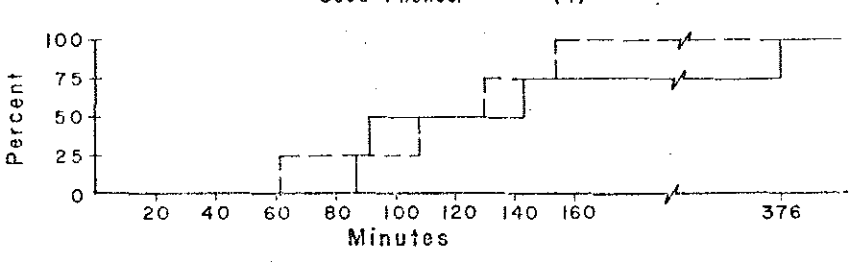


FIGURE 16 - Mechanical Aid Required.



CONTROL AREA (U.S. 23)
Summer Interviewed Vehicles

FIGURE 17 - PASSENGER CARS

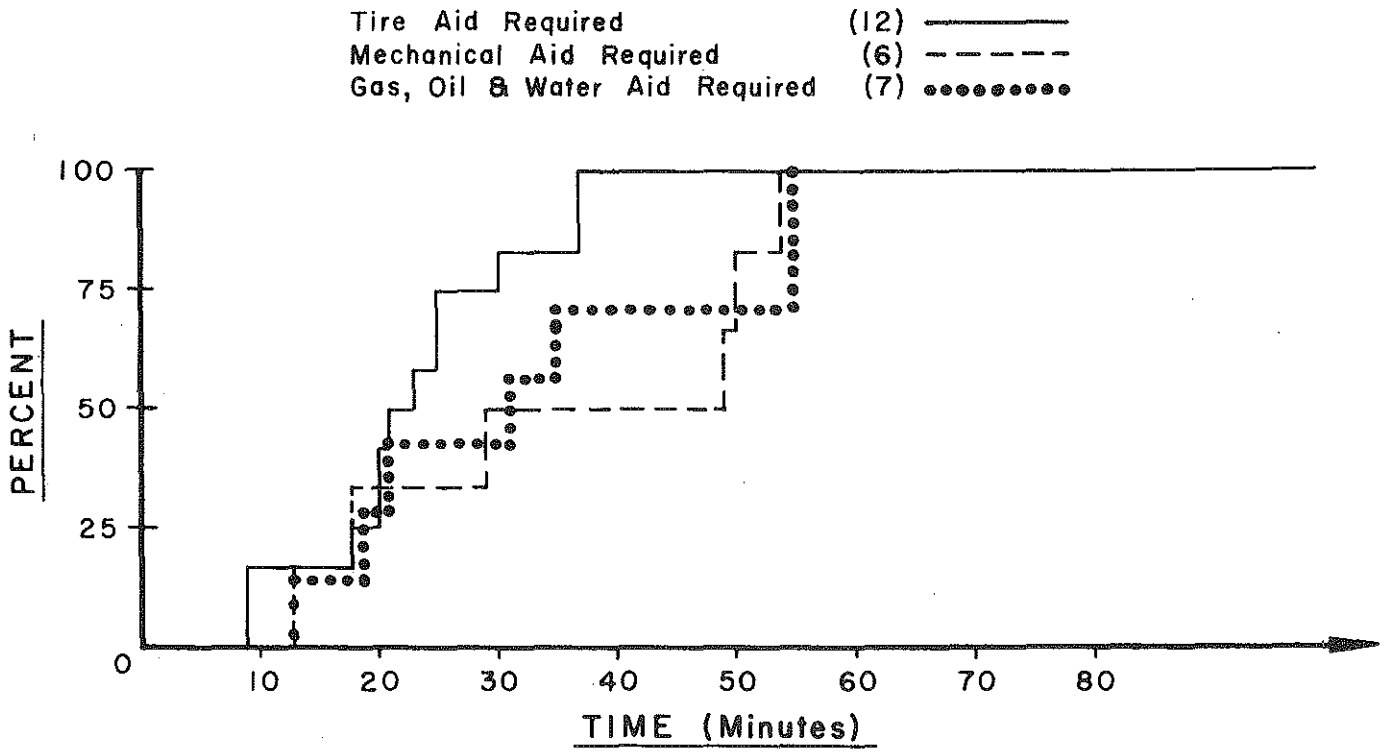
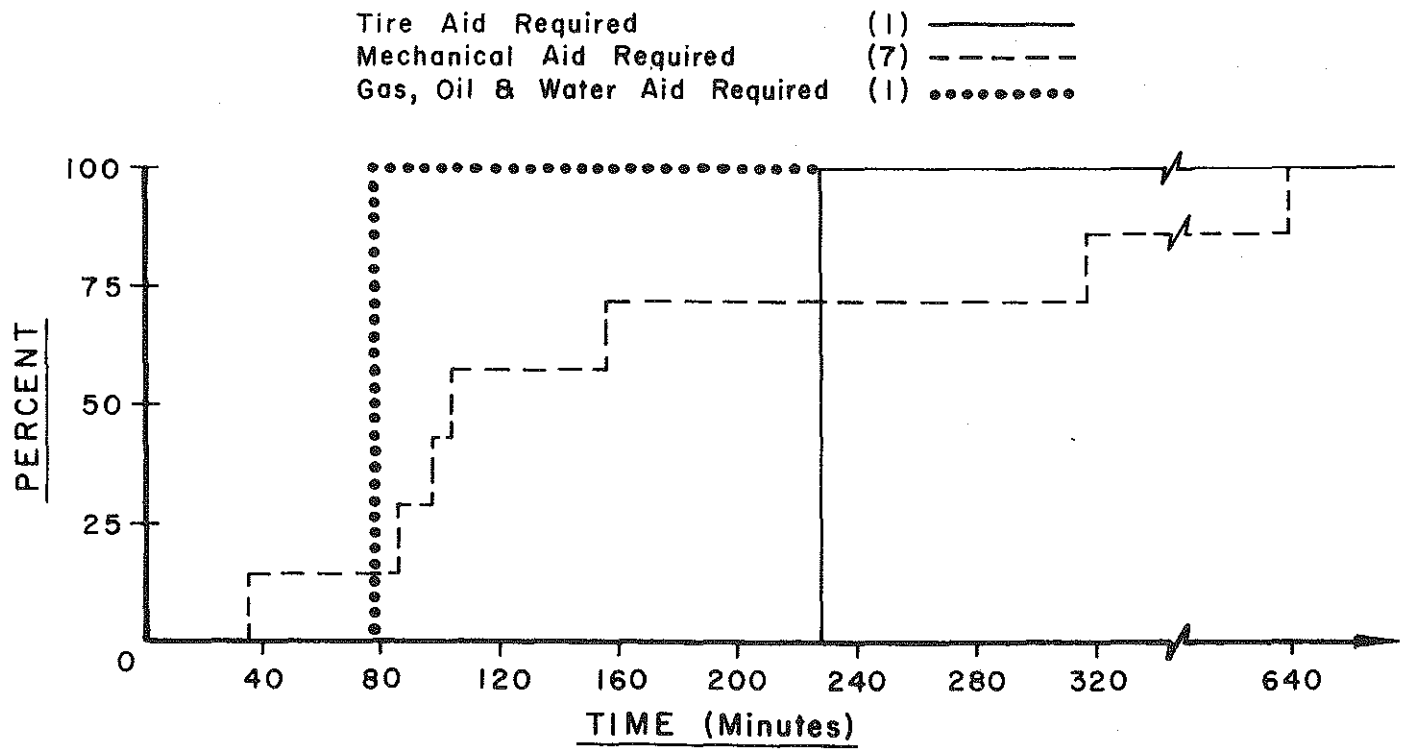


FIGURE 18 - TRUCKS



STATISTICAL ANALYSIS OF TOTAL ELAPSED TIME FOR STRANDED MOTORISTS

This analysis was applied to the summer 1968 and winter 1969 motorist interviews.

Those data have been broken down by vehicle types and aid required. To fit those data in a specified distribution curve we have chosen the Normal Curve. Then by Maximum Likelihood Estimate.

Set $\mu = \overline{X}$ and $\sigma^2 = S^2$ (Sample Variance)

Which Yields

$$F_o(X_r) = \frac{1}{S\sqrt{2\pi}} \int_{-\infty}^{X_r} \exp\left[-\tfrac{1}{2} \left(\frac{Y-\overline{X}}{S} \right)^2 \right] dy \quad r = 1,2,3,\ldots n$$

Where $F_o(X)$ is the Cumulative Distribution Function

Where $x_1, x_2, \ldots x_n$ are elapsed time of one specific category and $x_1 \leq x_2 \leq x_3 \ldots \leq x_n$

Testing Hypothesis: (Anderson & Darling Test)

H_o: The sample fits the normal curve with mean $\overline{X}$ and variance S^2

VS.

H_a: The sample does not fit the normal curve with mean $\overline{X}$ and variance S^2

Calculate

$$nw^2 = \frac{1}{12n} + \sum_{r=1}^{n} \left[F_o(X_r) - \frac{2r-1}{2n} \right]^2$$

Use $\alpha = 0.01$ $nw_o = 0.743$ (Critical Point)

if $nw^2 > 0.743$ reject H_o

if $nw^2 \leq 0.743$ accept H_o

By applying the above hypotheses to the various distributions shown in Figures 6 through 18, we find the hypotheses are accepted in all cases except the group in Figure 7 "Did not use Phone". As was mentioned earlier under this section, several of the samples were rather small; however, the time functions for some categories still showed significant differences.

In the following, a mathematical model was derived equating "total elapsed time from stopping until vehicle departs" to the various means of obtaining aid during the summer study. Gamma distribution by Maximum Likelihood Estimate* was chosen and a computer program has been run for the density functions in the category of "types of aid required".

The following equations list these predicted Gamma density functions:

Methods of Obtaining Aid	Predicted Functions
1. Aid phones used by vehicle occupant	
a. Not patrol aided	$f(x)=0.0092456\ x^{0.108}\exp\left(-\frac{x}{86.803}\right)$
b. With patrol aid	$f(x)=0.0006792\ x^{0.951}\exp\left(-\frac{x}{45.386}\right)$
2. Public phones used by vehicle occupant	
a. Not patrol aided	$f(x)=0.0000139\ x^{1.60375}\exp\left(-\frac{x}{36.486}\right)$
3. Walked	
a. Not patrol aided	$f(x)=0.0018055\ x^{0.9264}\exp\left(-\frac{x}{29.305}\right)$

4. Hitchhiked

   a. Not patrol aided $f(x)=0.0022847\ x^{0.75239}\exp\left(-\frac{x}{43.69}\right)$

5. Miscellaneous

   a. Not patrol aided $f(x)=0.003074\ x^{0.870}\exp\left(-\frac{x}{25.775}\right)$

   b. With patrol aid $f(x)=0.0052012\ x^{0.455}\exp\left(-\frac{x}{59.109}\right)$

   Where x is the elapsed time in minutes.

*For details, see the article "Aids for Fitting the Gamma Distribution by Maximum Likelihood" by J. Arthur Greenwood and David Durand.

Total Stranded Times Relationship To Users and Non-Users Of Phones By Season

The following figures show the seasonal relationships between usage and non-usage of phones in terms of total elapsed stranded times. These show that for all needs as a group, no significant differences occur in total stranded times between users and non-users of phones. However, as stated earlier, times for specific needs will vary greatly for use or non-use of phones.

The waiting times aid for both users and non-users were increased somewhat for more people in the winter than in the summer.

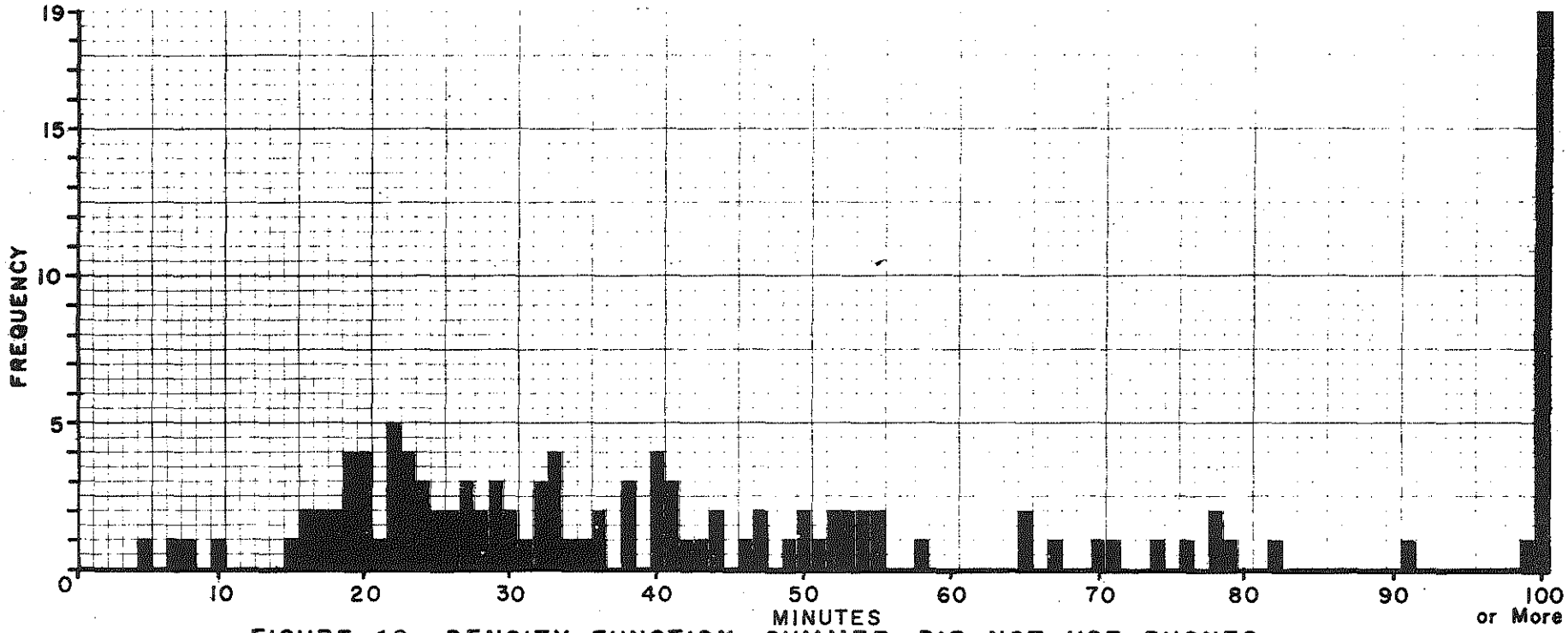


FIGURE 19 - DENSITY FUNCTION: SUMMER - DID NOT USE PHONES.

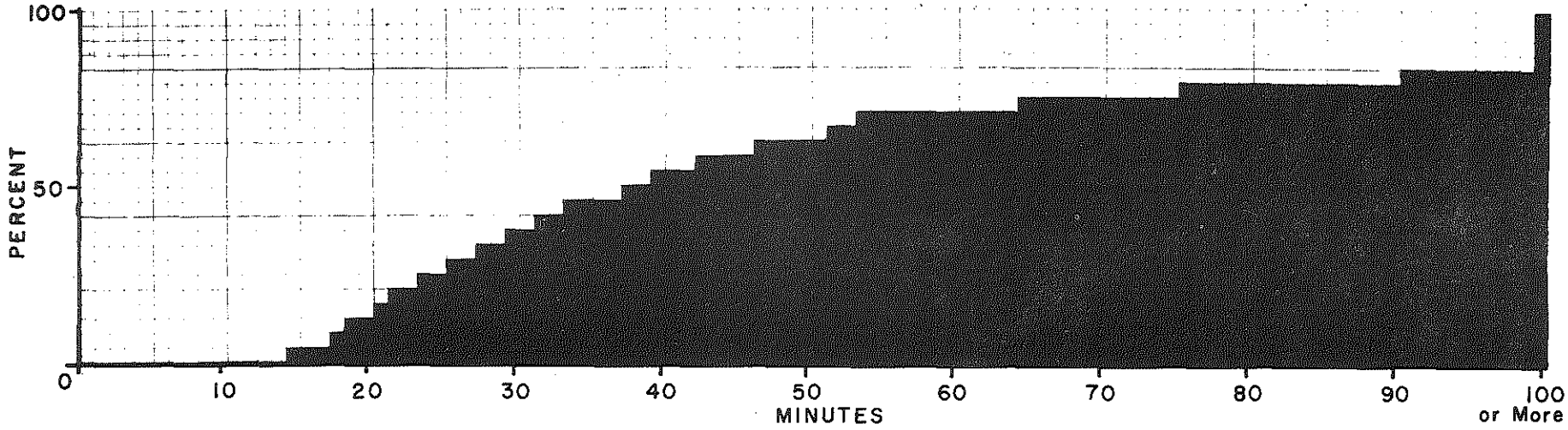


FIGURE 20 - CUMULATIVE FUNCTION: SUMMER - DID NOT USE PHONES.

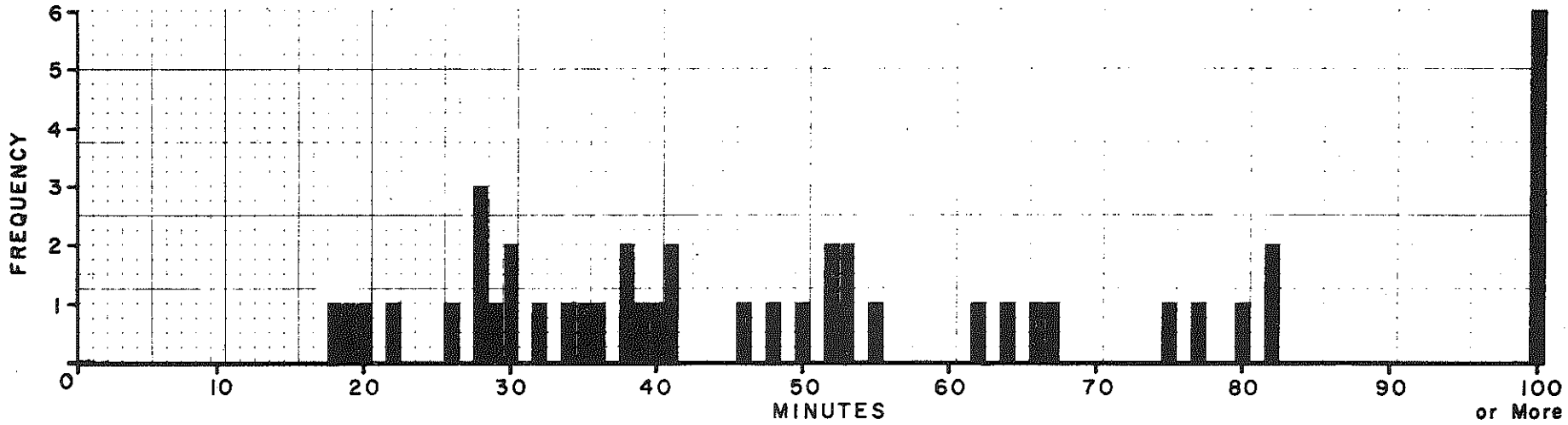


FIGURE 21 - DENSITY FUNCTION: SUMMER - USED THE PHONES.

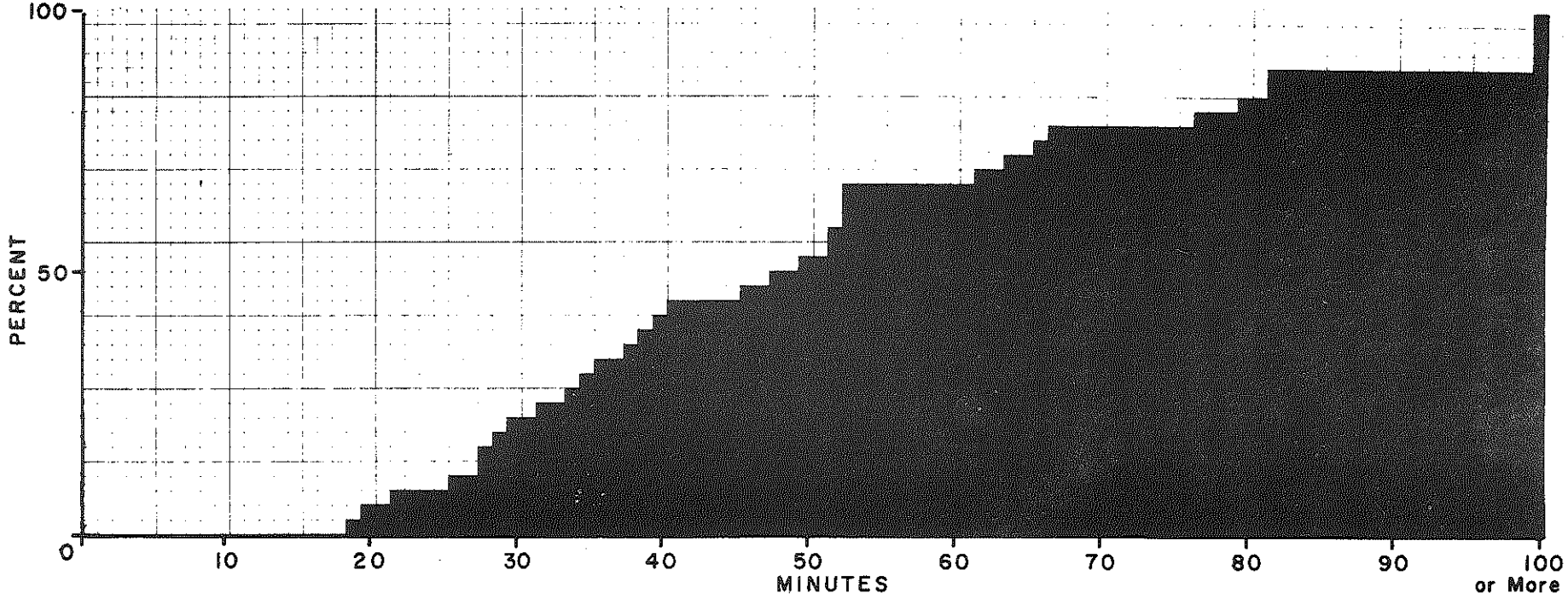


FIGURE 22 - CUMULATIVE FUNCTION: SUMMER - USED THE PHONES.

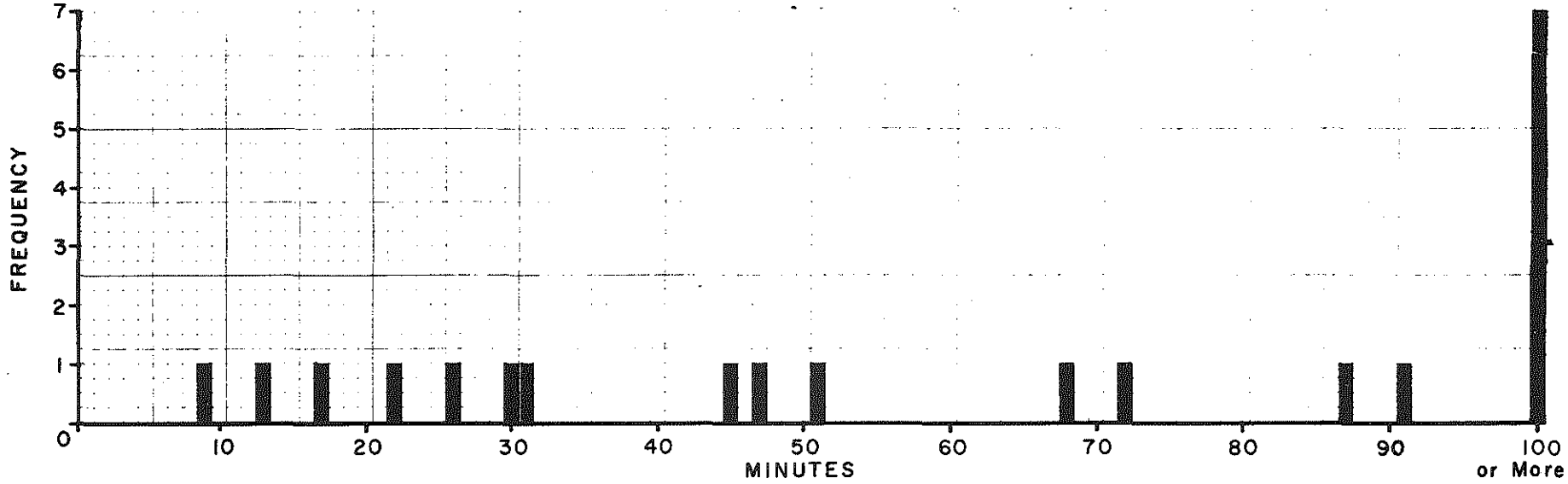


FIGURE 23-DENSITY FUNCTION: WINTER-DID NOT USE THE PHONES.

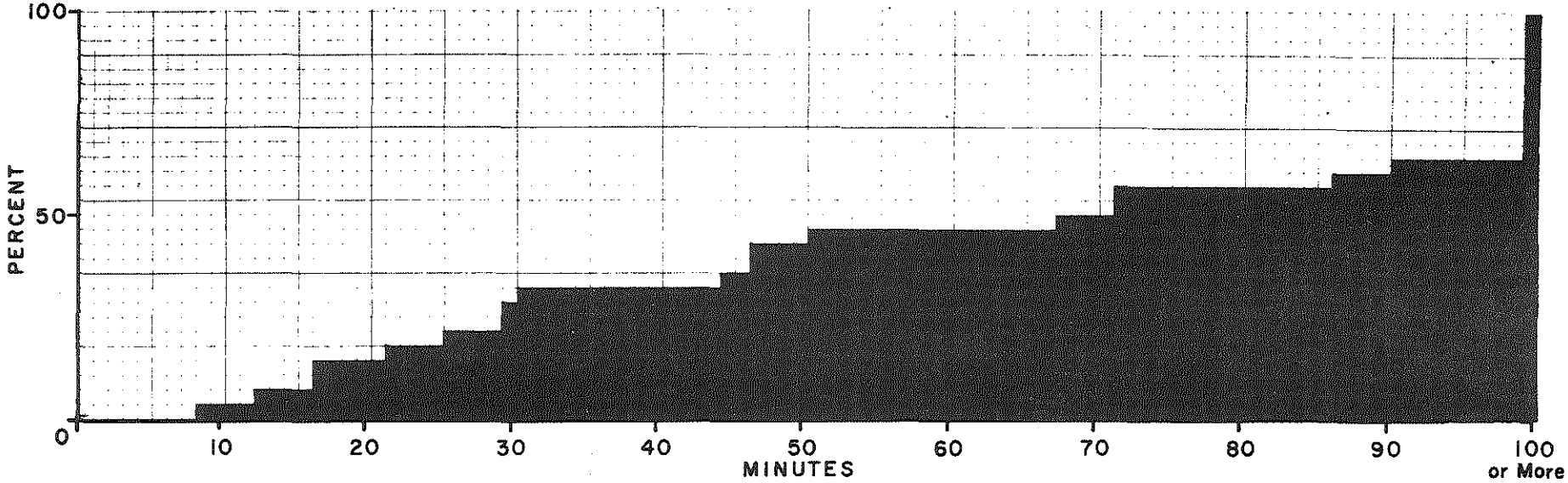


FIGURE 24 -CUMULATIVE FUNCTION: WINTER-DID NOT USE THE PHONES.

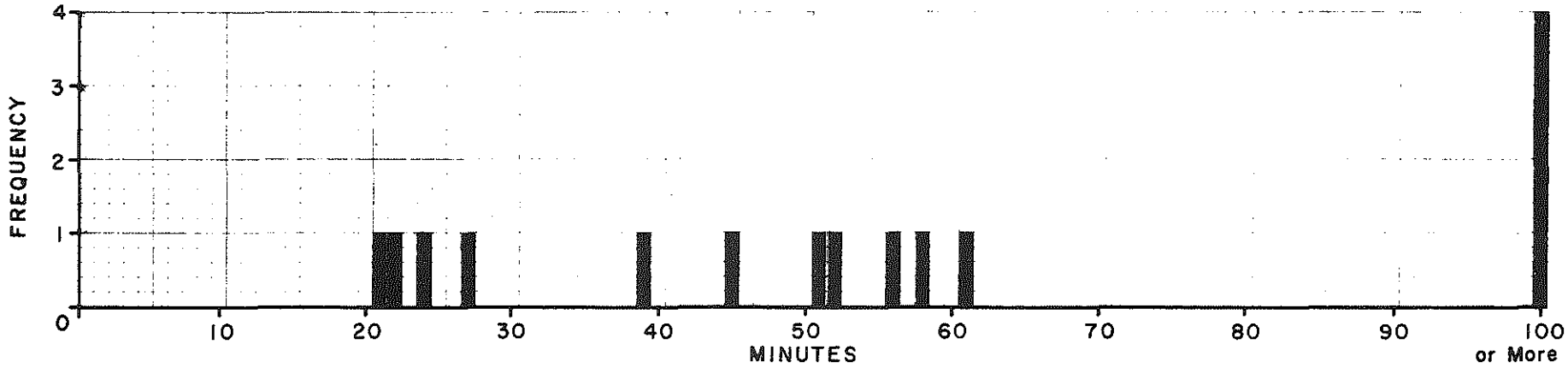


FIGURE 25-DENSITY FUNCTION: WINTER-USED THE PHONES.

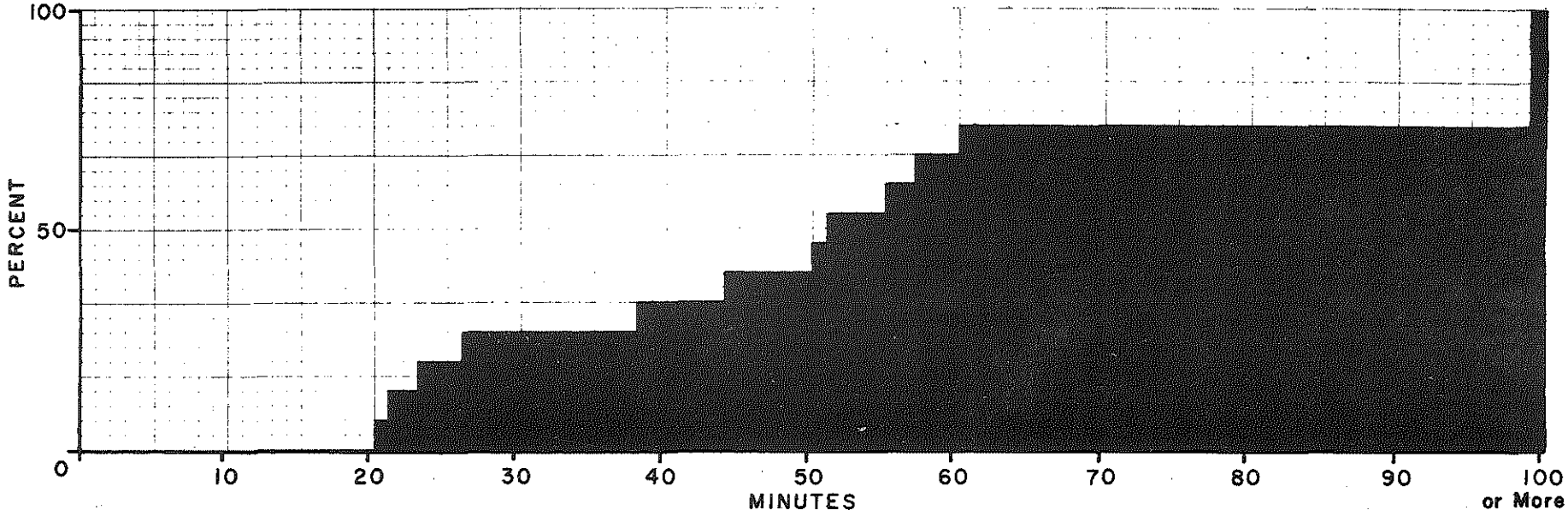


FIGURE 26 -CUMULATIVE FUNCTION: WINTER-USED THE PHONES.

HIGHWAY HANDOUT QUESTIONNAIRE SURVEY

This survey of drivers on I-94 was taken in August 1968 and again in January 1969. A return mailer questionnaire (Appendix 2) was distributed to approximately 5,000 drivers each time and about 28 percent were returned. A summary of these by Vehicle Type, Opinions of Motorist Aid System, Frequency of Use of I-94 and Trip Purposes is shown in Table 7.

The summer group under vehicle types shows a high volume of out-of-state traffic (30 percent) compared to 16.3 percent in the winter. This is also reflected in the Frequency of Use category. The truck groups show up less than actual percentages, as far more of the surveys were daytime rather than at night. The relative volumes of trucks to cars increase greatly at night.

In both the summer and winter surveys, a nearly identical high percentage of the drivers indicated strong favor for the system (87 percent) as shown by items 1 and 2 under the Opinion Section. The seasonal changes in character of traffic shows up strongly under the Trip Purpose categories with the high social-recreational percentage in the summer and the high business and work group percents in the winter.

TABLE 7

HANDOUT QUESTIONNAIRE SUMMARY

Vehicle Type and Origin	Summer Percent	Winter Percent
1. Passenger - in county	18.8	21.4
2. Passenger - in state - out of county	43.5	48.4
3. Passenger - out of state	28.6	16.0
4. Panel and pickup cars with trailer - in county	0.3	1.3
5. Panel and pickup cars with trailer - in state	1.9	1.6
6. Panel and pickup cars with trailer - out of state	1.4	0.3
7. Truck - single unit	1.1	1.6
8. Truck - combination	4.1	9.4
9. Bus - motorcycle	0.3	0.0
Opinion		
1. Necessary service, should be expanded.	46.9	45.1
2. A convenience, would like to see it expanded.	40.3	42.4
3. A convenience, but not necessary.	10.3	10.5
4. Prefer past method of obtaining aid, such as raised hood, flare, handkerchief on door, etc.	1.1	1.3
5. Others	1.4	0.7
Frequency of Use		
1. Almost every day	12.7	15.8
2. Almost every week	18.7	27.3
3. Almost every month	25.4	34.5
4. Once or twice a year	28.0	19.1
5. Less than once a year	15.2	3.3
Trip Purpose		
1. Social-Recreational	44.1	14.8
2. School	2.9	5.7
3. Shopping	2.3	1.6
4. Business	6.9	56.6
5. To or from work	28.8	8.8
6. Miscellaneous	15.0	12.5

10.9 percent of this summer group considered the Motorist Aid Phone signing inadequate.

6.4 percent of the winter group considered the Motorist Aid Phone signing inadequate.

The following three summations from the summer and winter handout questionnaires have been selected by random sampling and adjusted to fit 24 hour traffic volumes on I-94.

The adjusted 24 hour traffic percentages by vehicle types as shown in Tables 8 and 11 compare very favorably with the percents given in Table 7. Only the combination truck group varies to any degree as a percent of traffic volumes.

The data presents:

a. Total trip lengths by vehicle type.

b. Trip distance from origin.

c. Frequency of use of I-94 by vehicle type.

d. Trip purpose by vehicle type.

TABLE 8

TABULATION OF DATA RECEIVED FROM THE SUMMER 1968 HANDOUTS

FOR THE

EMERGENCY TELEPHONE FACILITY SURVEY

MILES	TOTAL TRIP LENGTH (%) 0-100	100-250	250-500	OVER 500	ADJUSTED 24HR. TRAFFIC PERCENT
Passenger In County	86.9	12.1	0.0	1.0	14.8
Passenger In State Out Of County	24.0	52.4	15.4	8.1	37.5
Passenger Out Of State	4.1	17.1	43.5	35.2	28.4
Panels, Pickups, and Cars With Trailers In County	100.0	0.0	0.0	0.0	.2
Panels, Pickups, and Cars With Trailers In State Out Of County	22.2	48.1	18.5	11.1	4.0
Panels, Pickups, and Cars With Trailers Out Of State	0.0	27.3	18.2	54.5	2.0
Trucks - Combination	61.5	23.1	15.4	0.0	11.1
Trucks - Single Unit	37.5	12.5	25.0	25.0	2.0
All Traffic	28.6	32.4	22.2	16.7	
	TRIP DISTANCE FROM ORIGIN (%)				
All Traffic	70.6	16.0	6.8	6.6	

TABLE 9

TABULATION OF DATA RECEIVED FROM THE SUMMER 1968 HANDOUTS

FOR THE

EMERGENCY TELEPHONE FACILITY SURVEY

	FREQUENCY OF USE OF I-94 (%)				
	Almost Daily	Almost Every Week	Almost Every Month	Once or Twice Every Year	Less Than Once A Year
Passenger In County	41.4	32.3	18.2	8.1	0.0
Passenger In State Out Of County	5.7	17.1	36.2	36.2	4.9
Passenger Out Of State	0.5	6.2	11.4	39.9	42.0
Panels, Pickups, and Cars With Trailers In County	100.0	0.0	0.0	0.0	0.0
Panels, Pickups, and Cars With Trailers In State Out Of County	29.6	22.2	14.8	22.2	11.1
Panels, Pickups, and Cars With Trailers Out Of State	9.1	0.0	9.1	36.4	45.5
Trucks - Combination	30.8	61.5	7.7	0.0	0.0
Trucks - Single Unit	50.0	50.0	0.0	0.0	0.0
All Traffic	12.4	17.4	22.6	30.8	16.9

TABLE 10

TABULATION OF DATA RECEIVED FROM THE SUMMER 1968 HANDOUTS

FOR THE

EMERGENCY TELEPHONE FACILITY SURVEY

	TRIP PURPOSE (%)				
	Social Or Recreational	School	Shopping	Business	Miscellaneous
Passenger In County	28.3	1.0	11.1	51.6	8.1
Passenger In State Out Of County	41.5	3.7	0.8	35.8	18.3
Passenger Out Of State	64.8	0.5	0.5	19.2	15.0
Panels, Pickups, and Cars With Trailers In County	0.0	0.0	0.0	100.0	0.0
Panels, Pickups, and Cars With Trailers In State Out Of County	37.0	0.0	0.0	55.5	7.4
Panels, Pickups, and Cars With Trailers Out Of State	72.7	0.0	0.0	18.2	9.1
Trucks - Combination	0.0	0.0	0.0	76.9	23.1
Trucks - Single Unit	0.0	12.5	0.0	87.5	0.0
All Traffic	45.7	2.0	2.3	35.3	14.7

TABLE 11

TABULATION OF DATA RECEIVED FROM THE WINTER 1969 HANDOUTS

FOR THE

EMERGENCY TELEPHONE FACILITY SURVEY

MILES	TOTAL TRIP LENGTH (%) 0-100	100-250	250-500	OVER 500	ADJUSTED 24 HR. TRAFFIC PERCENT
Passenger In County	91.7	6.3	1.0	1.0	19.1
Passenger In State Out Of County	28.1	50.4	18.5	3.1	45.6
Passenger Out Of State	7.6	28.8	51.5	12.1	15.4
Panels, Pickups, and Cars With Trailers In County	100.0	0.0	0.0	0.0	.6
Panels, Pickups, and Cars With Trailers In State Out Of County	47.4	52.6	0.0	0.0	3.7
Panels, Pickups, and Cars With Trailers Out Of State	0.0	33.3	66.7	0.0	.5
Trucks - Combination	36.4	27.3	27.3	9.1	12.5
Trucks - Single Unit	12.5	33.3	43.1	11.1	2.6
All Traffic	36.3	36.5	22.4	4.9	

	TRIP DISTANCE FROM ORIGIN (%)			
All Traffic	78.7	17.4	2.8	1.1

TABLE 12

TABULATION OF DATA RECEIVED FROM THE WINTER 1969 HANDOUTS

FOR THE

EMERGENCY TELEPHONE FACILITY SURVEY

	FREQUENCY OF USE OF I-94 (%)				
	Almost Daily	Almost Every Week	Almost Every Month	Once or Twice Every Year	Less Than Once A Year
Passenger In County	36.5	38.5	21.9	1.0	2.1
Passenger In State Out Of County	6.9	20.4	45.8	23.8	3.1
Passenger Out Of State	1.5	3.0	39.4	42.4	13.6
Panels, Pickups, and Cars With Trailers In County	60.0	20.0	20.0	0.0	0.0
Panels, Pickups, and Cars With Trailers In State Out Of County	26.3	47.4	15.8	10.5	0.0
Panels, Pickups, and Cars With Trailers Out Of State	0.0	100.0	0.0	0.0	0.0
Trucks - Combination	18.2	45.5	18.2	9.1	9.1
Trucks - Single Unit	41.7	50.0	5.6	2.8	0.0
All Traffic	17.7	27.4	33.1	18.0	3.8

TABLE 13

TABULATION OF DATA RECEIVED FROM THE WINTER 1969 HANDOUTS

FOR THE

EMERGENCY TELEPHONE FACILITY SURVEY

	TRIP PURPOSE (%)				
	Social Or Recreational	School	Shopping	Business	Miscellaneous
Passenger In County	14.6	6.3	6.3	64.6	8.3
Passenger In State Out Of County	16.5	5.4	0.0	62.3	15.8
Passenger Out Of State	24.2	4.5	1.5	54.5	15.2
Panels, Pickups, and Cars With Trailers In County	0.0	0.0	0.0	80.0	20.0
Panels, Pickups, and Cars With Trailers In State Out Of County	10.5	5.3	0.0	79.0	5.3
Panels, Pickups, and Cars With Trailers Out Of State	0.0	0.0	0.0	66.7	33.3
Trucks - Combination	0.0	0.0	0.0	90.9	9.1
Trucks - Single Unit	0.0	0.0	0.0	97.2	2.8
All Traffic	14.1	4.5	1.3	67.9	12.2

Trip Length Distributions From Interviews of Stranded Motorists

The following Table 14 presents the trip lengths by percent ranges for those stranded motorists using the phones and those not using the phones.

The summer group appears only to reflect the increased number of longer trips during this season with the 100-250 mile trips having the highest percent of stranded motorists. The winter group also seems to follow the seasonal trend with more short trips; however, twice the percentage in this group used the phones in the winter. The long trips in this group are too few to be meaningful.

Table 14

Summer (Percents)

No.		Miles 0-100	100-250	250-500	Over 500	Missing Data
48	Used the phones	27.1	39.6	22.9	8.3	2.1
124	Did not use phones	21.0	34.6	33.1	8.9	2.4
	Total	22.7	36.0	30.2	8.7	2.3

Winter (Percents)

No.		Miles 0-100	100-250	250-500	Over 500	Missing Data
16	Used the phones	56.3	37.5	0	6.2	0
21	Did not use phones	28.6	33.4	19.0	0	19.0
	Total	40.6	35.1	10.8	2.7	10.8

CALL DISTRIBUTIONS AND TYPES OF AID REQUIRED

(Analysis of State Police Reports)

The data presented in Table 15 is based on Motorist Aid Phone user information compiled from the "Stranded Driver Interview Form For Dispatcher" (Appendix 4).

The call distribution rates vary somewhat within the Motorist Aid Phone System area; however, it cannot be stated with any assurance on the basis of these variances that the closer spaced phone grouping (1-34) provides a better service to the motorist over the longer spaced group (35-62).

The categories of aid required shows a great similarity to that reported on most motorist aid systems with tires and gas at about 21 percent each and 36 percent needing mechanical aid. The 7.3 percent involving calls for accident aid seem rather high for this type of need. Information is not available concerning details of these accidents.

ANALYSIS OF MAILER QUESTIONNAIRE REPLIES

An analysis of data received from mailer questionnaires (Appendix 5) sent to users of the Motorist Aid System is shown on Table 16.

The user opinion percentages certainly reflect a high value placed on the Motorist Aid System to those who were in need of aid. 69.2 percent considered the system a necessity, and 28.2 percent more thought the system a convenience that should be expanded. 97.6 percent of the users replied they would use the phone again if the need arose.

Most all of the users also reported the charges involved for commercial services as reasonable. This should not be a real reason then for one not using the phones.

TABLE 15

CALL DISTRIBUTION OF MOTORIST AID PHONE GROUPS

	Percent
*All Sites I-34	52.0
**All Sites 35-62	48.0
Total Eastbound Group	47.7
Total Westbound	52.3
Eastbound Sites 2 thru 34 (even)	25.0
Eastbound Sites 36 thru 62 (even)	22.6
Westbound Sites 1 thru 33 (odd)	26.6
Westbound Sites 35 thru 61 (odd)	25.8

*Average 3,400 feet spacing between pairs.

**Average 5,400 feet spacing between pairs.

Types of Aid Required by Percent	Percent
Tires	22.0
Gas	21.0
Water	4.4
Oil	2.0
Mechanical (tow required)	19.2
Mechanical (no tow required)	16.8
Accident (medical aid and tow required)	1.1
Accident (medical aid and no tow required)	0.0
Accident (tow required and no medical aid)	1.3
Accident (neither medical or tow required)	4.9
Stuck off Road	3.1
Fire	1.3
Police Action	2.0
Miscellaneous	.9
Total	100.0

TABLE 16

MAILER QUESTIONNAIRE REPLIES SUMMARY

(These were sent to users of the Phones reported to us in 1968)
(See Appendix 5)

Only 73 percent of the phone users were aware of the Aid Phones before they stopped.

A. Frequency of travel on this section I-94.

Almost every day	28.6
Almost every week	31.6
Almost every month	17.7
Once or twice a year	18.6
Less than once a year	3.5
	100.0

B. Trip Purpose of this group.

Social-Recreational	34.6
School	5.7
Shopping	1.9
Business	9.5
To or from work	37.3
Miscellaneous	11.0
	100.0

C. User's opinion of Motorist Aid Phones

Necessary service, should be expanded.	69.2
A convenience, would like to see it expanded.	28.2
A convenience, but not necessary.	1.7
Prefer past methods of obtaining aid, viz: raised hood, flare or handkerchief on door, etc.	0.9
A need for better motorist aid exists, but I recommend...	0.0
	100.0

RATES OF CALLS AND STOPS RELATED TO VEHICLE MILES AND ADT

These rates were developed from data obtained during the winter and summer mobile surveys on I-94 (Stops of 12 minutes or more).

SUMMER (1968)

1 stop per 33,000 vehicle miles

1 call per 117,000 vehicle miles

.825 stop per mile per day @ 17,960 ADT

.231 calls per mile per day or 208 calls per month total

WINTER (JANUARY 1969)

1 stop per 38,000 vehicle miles

1 call per 85,000 vehicle miles

.48 stop per mile per day @ 10,445 ADT

.208 calls per mile per day or 187 calls per month total

It could be a coincidence; however, it is seen that the winter to summer stopping rates and the winter to summer ADT's both increased by 72 percent.

In the relationship between stops and calls, it is notable that although the per mile call rates are very close for winter and summer (.208 to .231), yet the winter ADT is 42 percent less than summer. It is evident then that cold weather produces a much greater desire to call for aid. The total winter interviews at 36 with 16 using the phones equals 44 percent, as opposed to 48 of 172 calling in the summer at 28 percent. It should be noted that about 25 percent of the stranded motorists were not aware of the system.

SUMMARY OF TAPE RECORDER DATA

For approximately six months, we have collected call data from tape recorders at each post. These recorders are activated whenever the State Police answer an incoming call. From October 1969 to April 1970, we have summarized the tape information in the following:

Of 962 calls

595 70%* requested aid for themselves

137 16% requested aid for others

120 14% desired or gave information or curious

110 Test calls

*Test calls not included.

Needs of Motorists by Percents

Tire	16.6
Gas	18.2
Water-Oil	2.9
Mechanical	24.6
Accidents	27.9
Medical	2.2
Directional Information	7.6
Total	100.0

The distributions as shown are perhaps not as reliable as our summer and winter mobile observation studies inasmuch as the needs could not be determined from all conversations, and it is also true that more than one call for an accident would often be received.

FREQUENCY OF USE OF PHONES IN SYSTEM

Approximately a year and a half accumulation of data was analyzed to log the number of times phones were used. These data represent almost solely calls from stranded motorists as opposed to other informational calls, etc.

Of 730 calls the analysis shows a mean of 11.77 calls per phone, variance of 4.95, minimum of 3 and maximum of 25.

Usage appears rather uniform with some slightly greater usage near each end of the project.

The following is a tabular listing of usage of each of the phones for the group analyzed:

TELEPHONE SITE	NO. OF TIMES USED	TELEPHONE SITE	NO. OF TIMES USED
1	23	32	11
2	22	33	13
3	17	34	22
4	10	35	21
5	14	36	11
6	8	37	8
7	10	38	13
8	4	39	8
9	5	40	14
10	9	41	12
11	8	42	7
12	7	43	18
13	12	44	7
14	15	45	6
15	12	46	9
16	10	47	11
17	8	48	9
18	8	49	6
19	12	50	11
20	19	51	11
21	7	52	8
22	10	53	12
23	14	54	16
24	6	55	14
25	13	56	12
26	13	57	18
27	8	58	19
28	8	59	25
29	6	60	14
30	3	61	19
31	11	62	13

DISTANCE OF STOPPING POINT TO THE NEAREST PHONES

1. In the 172 summer interviewed stranded vehicles, the distance of stopping points to the nearest phones was in the range of 0 and 4390 feet with

   mean = 1240 ft.

   SDEV = 994 (STANDARD DEVIATION)

2. 39 winter interviews ranged from 0 to 4970 feet with

   mean = 1523 ft.

   SDEV = 1013

3. 48 used the phones in summer interview study

   mean = 1071 ft.

   SDEV = 1223

4. 16 used the phones in winter interview study

   mean = 1234 ft.

   SDEV - 1228

This shows that the average stranded motorist within the phone area could reach a phone by walking less than 2000 feet (more than 80%). However, in order to reach a phone, a stranded motorist has to leave his automobile and become a pedestrian on the freeway, which some drivers are reluctant to do.

Indications are those who used the phones walked only a little shorter distance than those who did not use, which would indicate the walking distance to reach a phone is not a main reason for not using a phone within the study area.

TIME REQUIRED FOR THE STRANDED MOTORISTS TO REACH A PHONE SITE IN THE TELEPHONE SYSTEM IN THE SUMMER AND WINTER INTERVIEW STUDY

A total of 48 stopping vehicles used the phones in the summer interview study. Of this 48, 30 had the records of time to reach the phones. Based on this data, we have found that most of the stranded motorists spent less than 10 minutes to reach the phones and the longest time required was 24 minutes. A Histogram and Cumulative Function are presented in Figures 27 and 28. Ten out of 16 who used the phones in the winter interview study had the records of time needed to reach the phone. Figure 29 and Figure 30 give the density function and cumulative function of these data. Again, a phone was rather quickly reached under winter conditions.

Apparently, the phone system provided a fast way for the stranded motorists to report their trouble and ask for help. Those who were aware of the telephone system and could use the phones to excellent advantage probably did not use them due to a fear of unreasonable charges.

Density function for "time from vehicle stopping until the motorist reached a phone" in the summer interviews:

N= 30 MEAN= 10.767

FREQUENCY SCALE: ONE * = 0.25 OCCURRENCES.

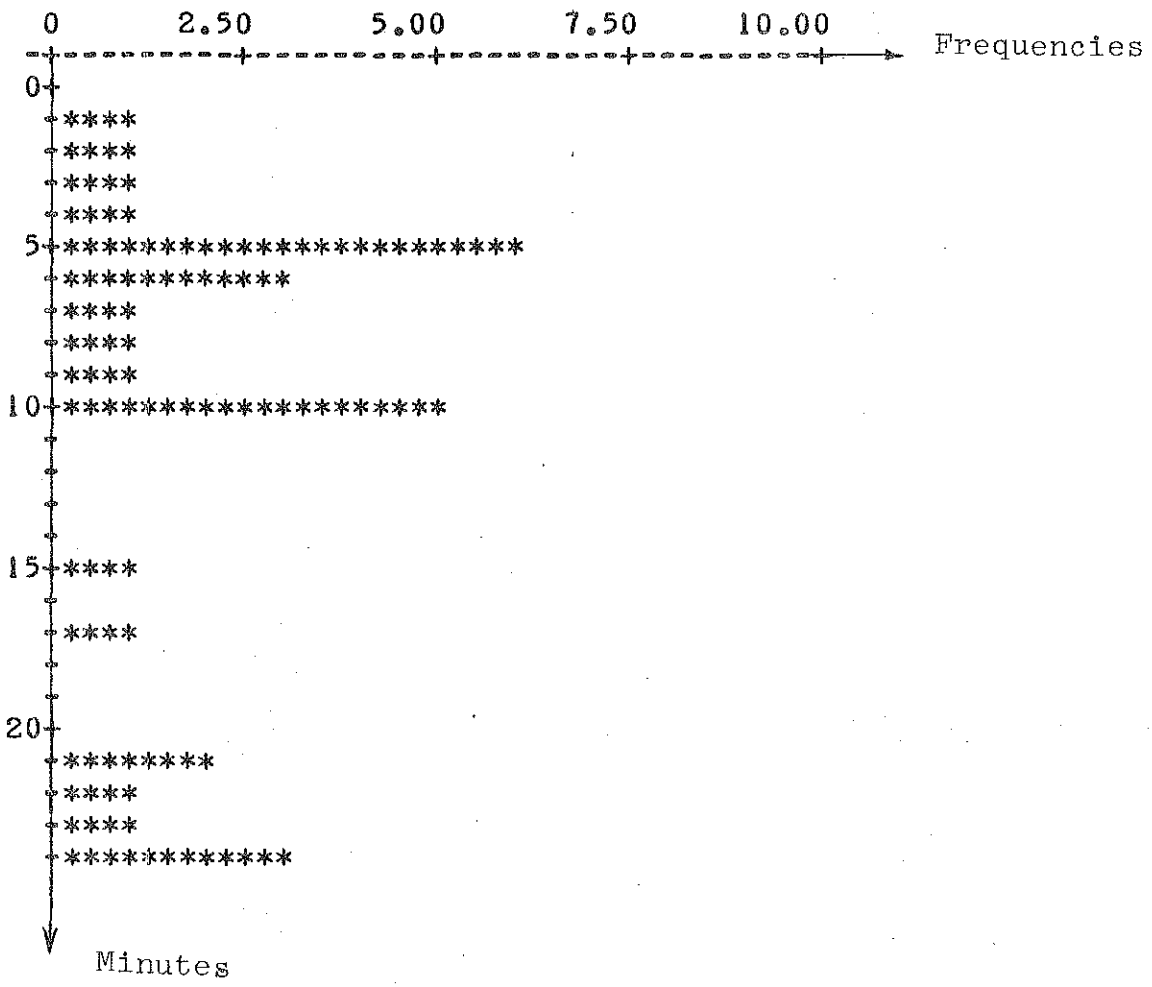


Figure 27

Cumulative function for "time from vehicle stopping until the motorist reached a phone" in the summer interviews:

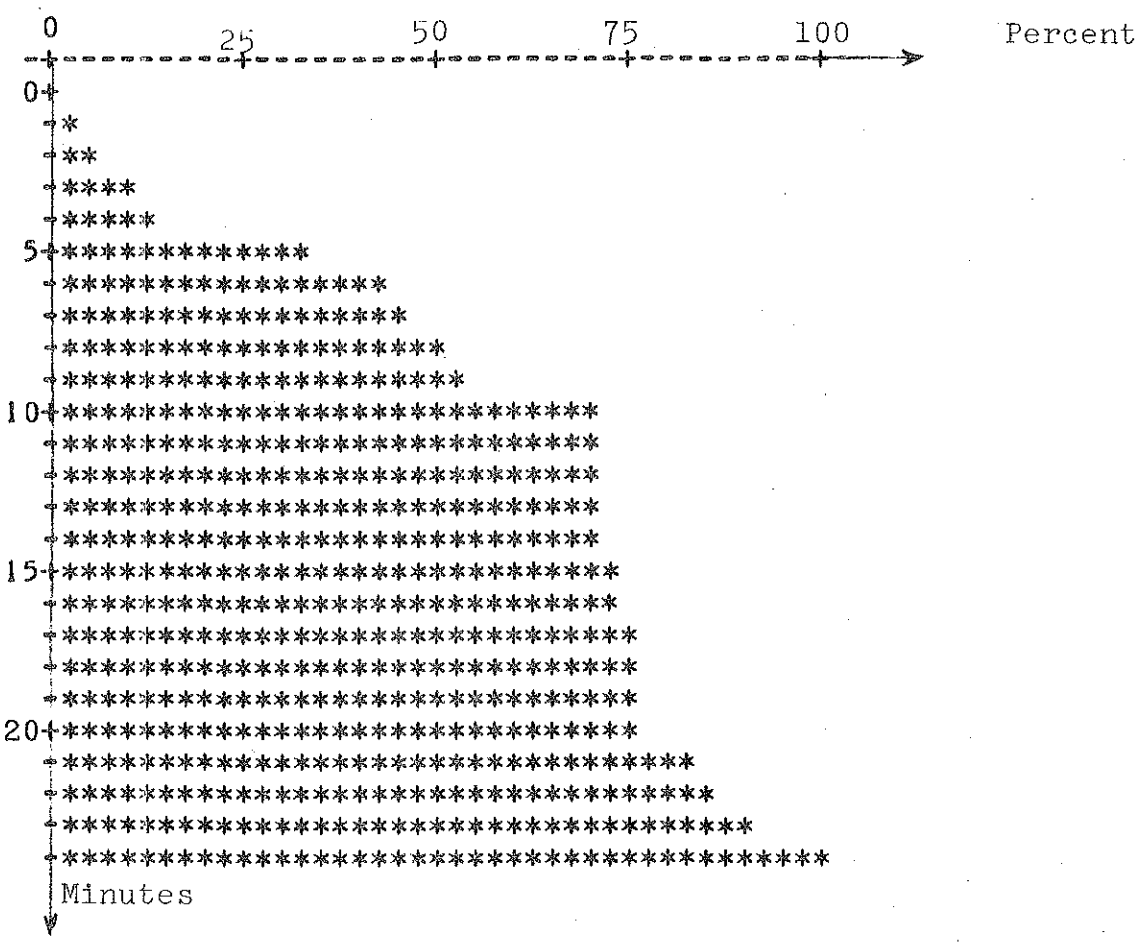


Figure 28

Density function for "time from vehicle stopping until the motorist reached a phone" in the winter interviews:

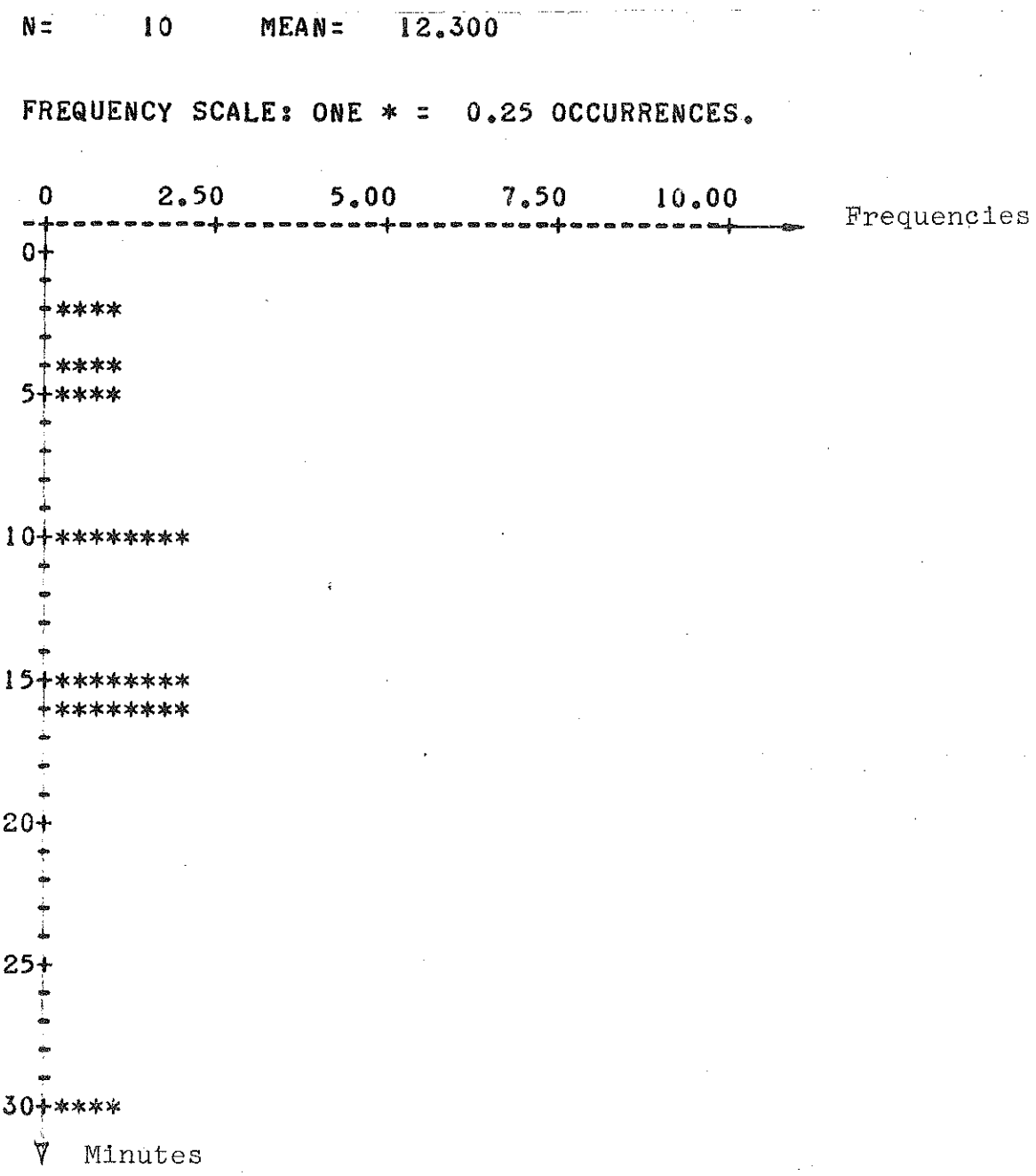


Figure 29

Cumulative function for "time from vehicle stopping until the motorist reached a phone" in the winter interviews:

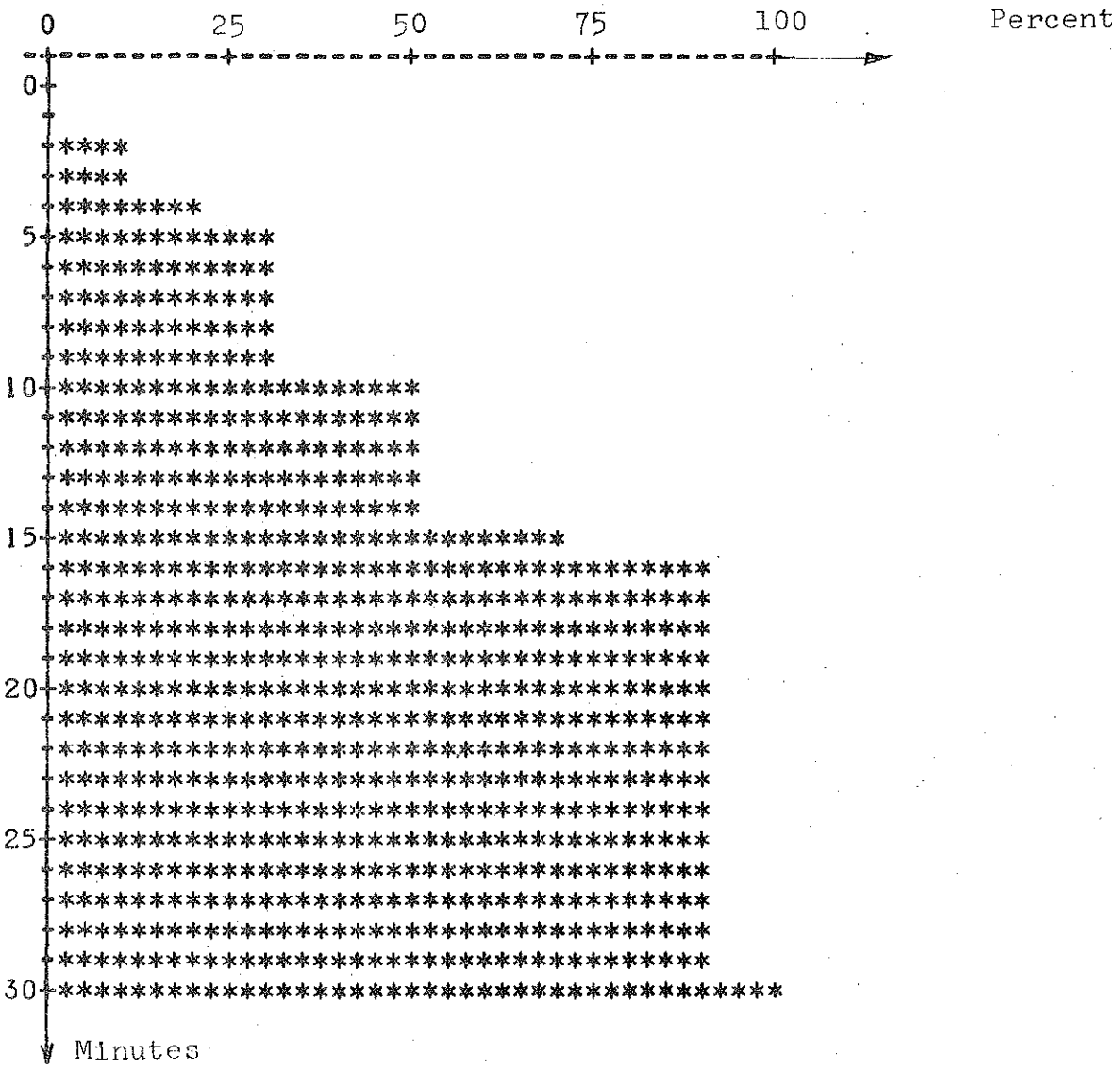


Figure 30

ANALYSIS OF TIME TO SECURE AID

These data cover motorist aid phone users delays from time of stop to time of aid arrival from January 1, 1968 to May 1, 1969. About 90 percent of these stranded motorists waited less than 45 minutes before the aid arrived, 85 percent of them waited only 30 minutes or less. It shows most of the service stations provided emergency aid to the highway stranded motorists. Those who were delayed more than 100 minutes were probably due to a busy wrecker schedule in the winter.

Density function of time to aid

N = 154
Mean = 28.93
SDEV = 33.24

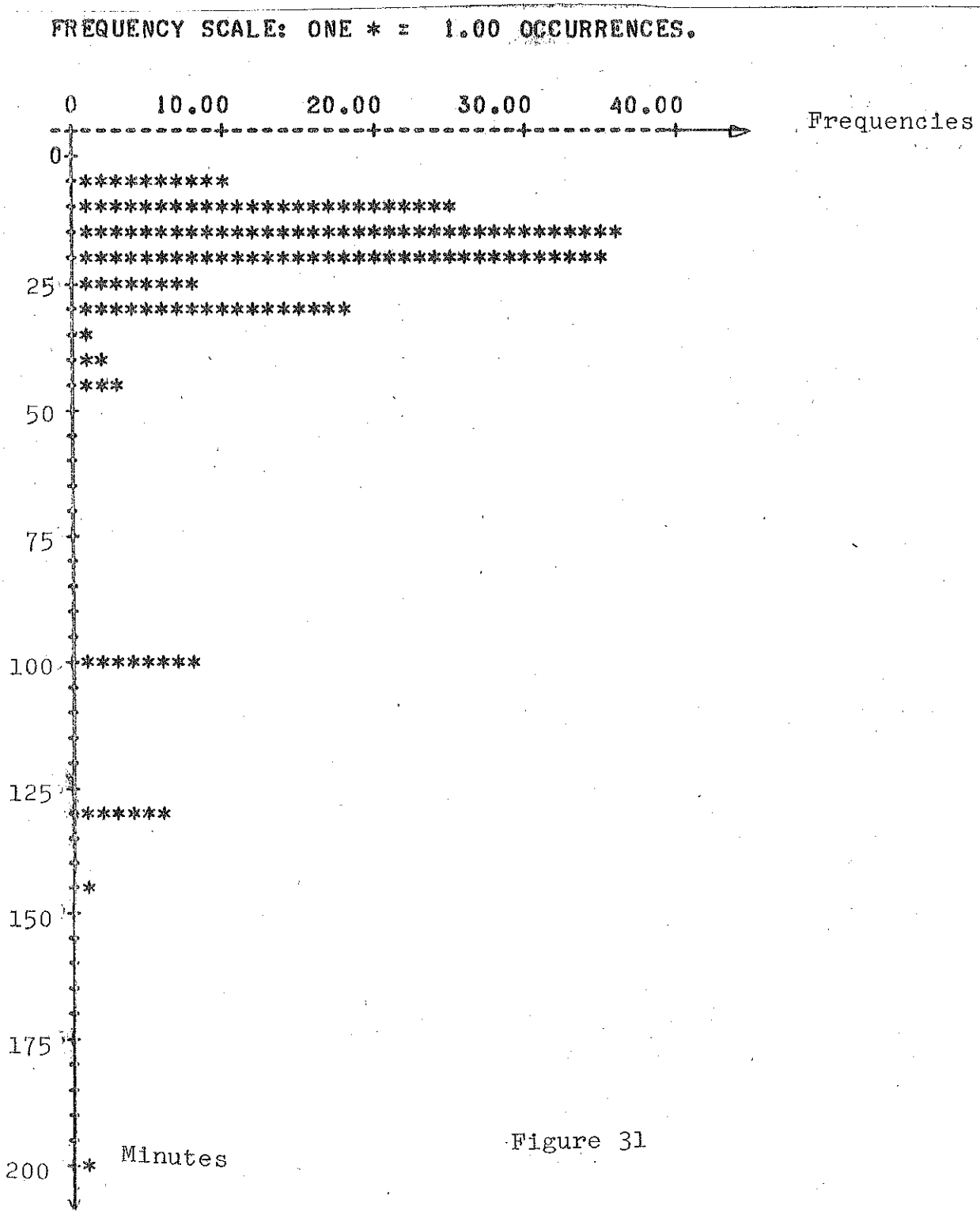


Figure 31

Cumulative distribution function of time to aid from time of stop

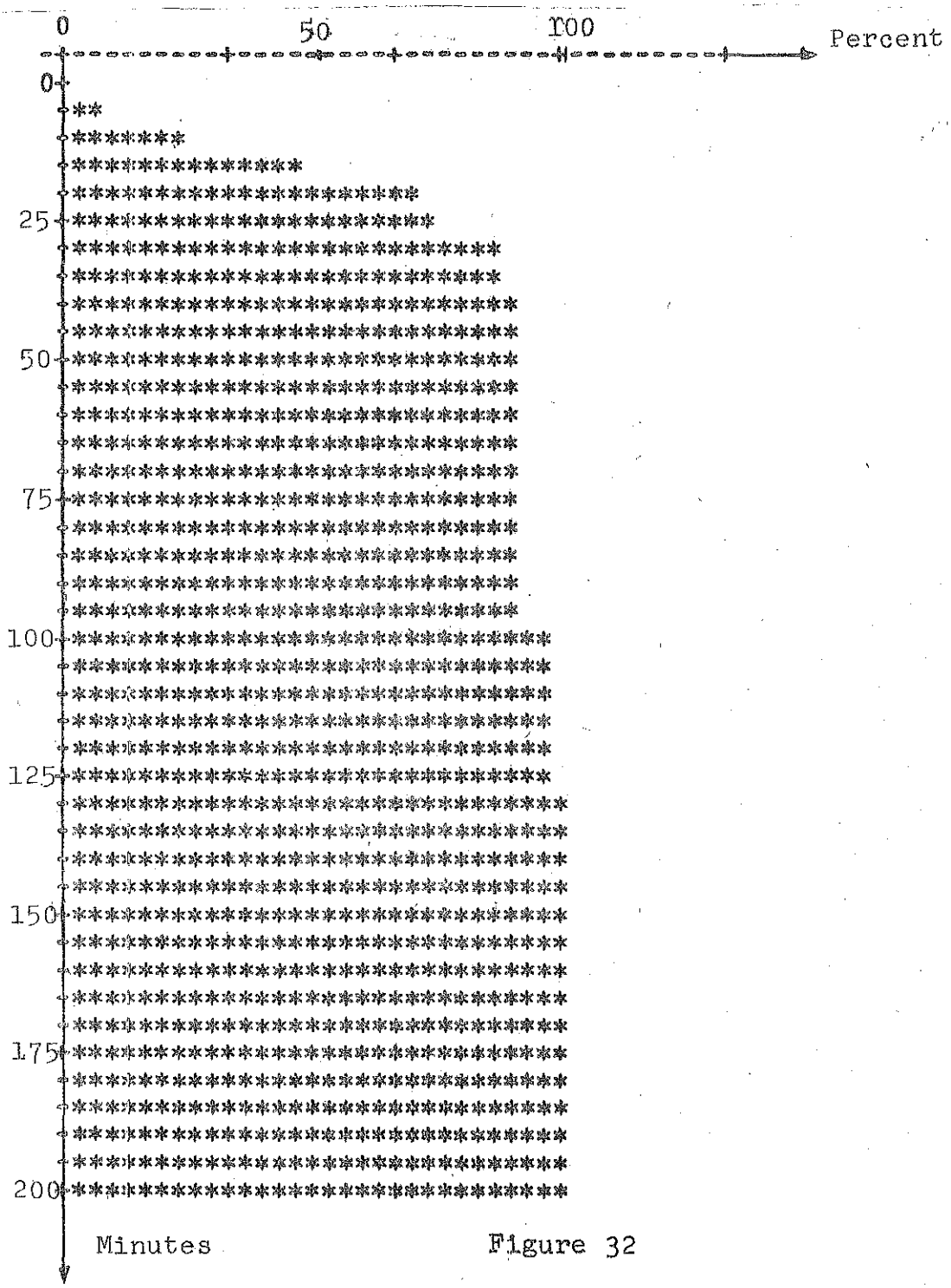


Figure 32

CORRELATION ANALYSIS OF FREEWAY TRAFFIC AND STRANDED MOTORISTS GROUPS

The following Tables 17 and 18 show percentage comparisons between freeway traffic distributions and the distributions of stranded motorists under four categories: Trip Lengths, Frequency of Use, Trip Purpose and Location of Vehicle Registry.

The "Freeway Traffic" percentage column is derived from data secured by the summer and winter handout questionnaires given to passing motorists on I-94.

Table 17 compares the summer groups. Most of the categories were found to be very similar in percentage distribution. This seems to indicate that stranded motorists may, in fact, be only one in the traffic stream and that this stranded group will be representative of the group as a whole who are driving the freeway.

About the only noticeable variations occur in the trip length group wherein the stranded motorists are less than the stream in the 0-100 mile trips and more of them in the 100-250 mile range. Additionally the "in county" group is less, and more in the "out of state" license group.

The winter group in Table 18 follows very similar to the above except that more of the short trip drivers (0-100 miles) are stranded than the percent they represent of the total stream.

TABLE 17
TRIP CHARACTERISTICS OF FREEWAY TRAFFIC
VS.
STRANDED MOTORISTS - SUMMER

(1) Trip Lengths

MILES	FREEWAY TRAFFIC	STRANDED MOTORISTS
0-100	28.6%	20.0%
100-250	32.4%	44.4%
250-500	22.2%	23.1%
Over 500	16.7%	12.5%

(2) Frequency of Road Use

	FREEWAY TRAFFIC	STRANDED MOTORISTS
Almost Every Day	12.4%	12.4%
Almost Every Week	17.4%	17.8%
Almost Every Month	22.6%	20.7%
Once or Twice a Year	30.8%	26.0%
Less than Once a Year	16.9%	23.1%

(3) Trip Purpose

	FREEWAY TRAFFIC	STRANDED MOTORISTS
Social & Recreational	45.7%	53.2%
School	2.0%	0.6%
Shopping	2.3%	0.6%
Business	35.3%	41.4%
Miscellaneous	14.7%	4.1%

(4) Vehicle Registration

	FREEWAY TRAFFIC	STRANDED MOTORISTS
In County	20.3%	12.8%
In State Out of County	47.8%	47.1%
Out of State	31.9%	40.1%

TABLE 18
TRIP CHARACTERISTICS OF FREEWAY TRAFFIC
VS.
STRANDED MOTORISTS - WINTER

(1) Trip Lengths

MILES	FREEWAY TRAFFIC	STRANDED MOTORISTS
0-100	36.3	47.1
100-250	36.5	29.4
250-300	22.4	23.5
Over 500	4.8	0

(2) Frequency of Road Use

	FREEWAY TRAFFIC	STRANDED MOTORISTS
Almost Every Day	17.7	18.1
Almost Every Week	27.4	36.4
Almost Every Month	33.1	30.3
Once or Twice a Year	18.0	15.1
Less than Once a Year	3.8	0

(3) Trip Purpose

	FREEWAY TRAFFIC	STRANDED MOTORISTS
Social & Recreational	14.1	27.3
School	4.5	3.0
Shopping	1.3	3.0
Business	67.9	57.6
Miscellaneous	12.2	9.1

(4) Vehicle Registration

	FREEWAY TRAFFIC	STRANDED MOTORISTS
In County	25.5	23.1
In State Out of County	56.2	48.7
Out of State	18.3	28.2

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, GOVERNOR

DEPARTMENT OF STATE POLICE

714 S. HARRISON RD., EAST LANSING, MICHIGAN 48823

COL. FREDRICK E. DAVIDS, DIRECTOR

May 15, 1970

Mr. G. J. McCarthy
Assistant Deputy Director
Department of State Highways
State Highway Building
Lansing, Michigan 48904

Dear Mr. McCarthy:

The Michigan Department of State Police has participated in the Motorist Aid Telephone System on I-94 by monitoring the telephones at the Jackson and Battle Creek State Police Posts.

Although our experience has shown many problems in the construction and maintenance of the equipment, we feel the system definitely has merit and is a valuable asset to the motoring public.

With corrections in design to give reliable performance, and in conjunction with the expressway patrols of the State Police, the public can expect a fast response to a distress call.

We do feel the system would be of a greater benefit to the public if it was installed in the areas of the state that do not carry a normal high rate of travel, such as I-75 in the northern portion of the state.

Very truly yours,

Fredrick E Davids

DIRECTOR

FED:oc:bh

MICHIGAN
THE GREAT LAKE STATE

SUMMARY

This study has been very successful in terms of meeting the requirements established when it was first recognized as an area of needed research.

Various studies were conducted over a two-year period directed toward determining the level of need for any motorist aid system, and how well these needs were met by the one installed.

This system proceeded from a research plan to system design to installation and operation. Many requirements and desirable aspects were detailed in the process for use in other system developments. Data of this nature has already been valuable to other states' approaches to the stranded motorist problem. This, of course, was one of the Federal Highway Administration's prime reasons for participating in this type of project to create a data base in an area of conjecture such that realistic planning for the future would be possible.

The studies have shown that the stranded motorist situation on a rural freeway is a problem and perhaps larger than our preconceptions would have let us believe. Our surveys show a summer stopping rate (over 12 minutes) of .825 stops per mile per day. It is possibly coincidental but the stopping rates increase exactly the same as the increase in winter to summer average daily traffic volumes. The problem is similar to accidents in that it will only affect a rather small portion of any stream of traffic. The end

result of being stranded would not normally have consequences as serious as involvement in an accident; however, a means of securing aid quickly could easily avoid a potential accident fatality.

Our Adjacent Resident Survey shows that the stranded motorist has been a perennial problem.

The observations made on I-94 tell us nearly one stop (lasting longer than 12 minutes) per mile per day occurs in the summer, and about one stop per two miles occurs in the winter. Approximately 50 percent of these motorists either proceeded to help themselves or received early passerby help. The rest chose to use the aid phones and secure needed assistance. Many other people who are aware of the phones and who seemingly could use the system to their advantage choose not to use it. We can only guess that they feel it will be more economical to secure aid by other means.

The time required to secure aid varies considerably by the actual need. Little advantage to use of the phones for a tire change is evident, although when a truck is involved, considerable time saving can be realized by using the phones. For mechanical needs the longest periods are involved, and by using the phones the motorist would normally exempt himself from experiencing several hours of delay.

The return mailer Handout Questionnaire surveys show a high desire for telephone aid availability (87 percent). 57 percent of the summer group used I-94 at least once per month and the winter group

was more local as 78 percent used the freeway at least once per month.

Those who have used the phone system value it even higher as 97.4 percent consider it a necessity or a convenience that should be expanded.

The tape recorded data shows a greater usage of the facility for general informational or curiosity calls than was previously realized. 86 percent requested aid for themselves or others and 15 percent were general calls. Calls per phone ranged from 2 to 25 during a one and one-half year period. The closer spaced east half of the system (3400 feet) appeared to have served motorists' needs no better than the (5400 feet) spacing in the western half. About 75 percent of those using phones took less than ten minutes to walk to a site.

If we presumed a 10-year operation of this present system, each call would average about $22.00. This may seem high, but when viewed in terms of equivalent costs involved with other routine freeway activities, the priority level for a motorist aid system could be set considerably higher (See Appendix 6). Communications for aid would appear as important to the motorist as mowing and roadside cleanup.

CONCLUSIONS AND RECOMMENDATIONS

Discussion

The foregoing studies have provided an intensive review of the stranded motorist problem at two relatively short rural locations on Michigan's Freeway System. This look into the problem has provided much more information than was previously available.

The instrumented 30-mile section on I-94 has been generating 150 to 250 calls per month to the State Police Posts. Many more stops occur since only 30 to 50 percent of drivers in need call for assistance. Many factors of the system concerning motorist need and benefits, and telephone usage, costs, and operation have been outlined. If the average rural stopping rate is expanded to cover the state's 1400 miles of freeway, then on the average day, approximately 840 vehicles in the state will be stopped on the shoulders for 12 minutes or more. The stopping rates per mile in urban areas should be much greater, as the rates from our studies varied directly with traffic volumes.

Many of the early telephone system operational problems have been resolved; however, some false ringing still occurs. At least part of the problem is due to leased line operating difficulties. Approximately one of every four phone sites has been struck by out of control vehicles and some vandalism occurs sporadically.

Relative usage of the system with and without area illumination was not a part of the study; however, the system would have cost

40 to 50 percent less had power needs for the phone site lights been eliminated. The 135 mile system being installed on I-80 in Illinois should answer part of the question concerning the need for lights at each site.

The Illinois study should also define whether operational problems may be avoided by not using leased telephone lines. It was recently found that our system has been operating for two and one-half years without the leased lines connecting our system to each Police Post being shown on the telephone company's engineering charts. Periodically these lines were used as test circuits by the phone company and extraneous signals would trigger our system equipment.

It appears that further investigations of operating characteristics and costs are merited to determine the efficacy of a leased telephone system operation as opposed to one wholly state owned. Information from a Battelle Memorial Institute report for the Ohio Department of Highways (February 1968) indicates some leased telephone systems without lighting are costing as much or more over a 10-year period as Michigan's test system. Also, some cost projections for regular official patrols appear several times more costly than a voice by wire communications system.

The studies have shown a high percentage of freeway drivers desire some system that will provide positive communication for aid for stranded motorists, and they seem to favor our type of telephone system.

RECOMMENDATION

It has been learned a problem is present for some number of freeway drivers and the magnitude of that problem can now be estimated. The criticality of the problem is based on variables, such as individual physical ability, the nature of need, the geographic location, weather and even time of day.

A telephone system, combined with partial State Police patrol activity plus referral to a commercial agency, is recommended for servicing the stranded motorist. It should be noted that we do not believe any system can necessarily be shown to be cost effective in monetary terms. It should be considered as a necessary public service with system selection judged on the basis of operation and cost factors of other candidate systems. It must also be viewed from the perspective of comparative costs of many other freeway services and maintenance functions that are deemed essential to perform. (See Appendix 6.) In such a comparison the relative importance of a motorist aid system seems to be greatly enhanced.

Until we can reach the ultimate of having voice communication for assistance directly from every car to a receiving point and with some privacy to the transmission, a telephone roadside service seems the best to utilize at present.

If a statewide telephone network were to be constructed, certain economies over our experimental system could be accomplished through

selective grouping and intermediate terminations of circuits, possibly at rest areas or information centers, and then transmitting by direct wire to a nearby State Police Post. In a large network, other design economies would be possible.

As a means of comparison, if a motorist aid telephone system without lighting was extended to the state's rural freeways, it is estimated it could be installed for a cost of about $3 million. This $3 million would buy approximately 1,000 feet of urban freeway.

MOBILE OBSERVATION PROCEDURE

The mobile survey was designed to let the stopped motorist take some action before being interviewed. Four cars were equally spaced in a 26-mile loop from Parma Road to 11-Mile Road on I-94 (Figure 2). The time interval between cars was 12 minutes. By definition, motorists stopped over 12 minutes were deemed stranded. The first survey car to spot a stopped vehicle reported to the next survey car in the loop by radio. If the stopped vehicle were still present when the next survey car approached, an interview was made. A fifth survey car took the stopped survey car's position in the loop. The questionnaire used is shown in Appendix 3.

There was one car in the "control" section. The driver of the survey car would stop when he saw a vehicle and wait at a distance for the stopped motorist to take some action. When the motorist started remedial action, the survey car driver moved up and interviewed the motorist. This method obviously caused many in interviews to be missed since the survey car would occasionally be stopped for prolonged periods of time. Because of this, "comparison" section would be a better name for the "control" section.

Appendix 1

MOTORIST AID TELEPHONE QUESTIONNAIRE

1. Vehicle Description: Type: _____ Year: _____

2. Are you pulling a trailer? ☐ Yes ☐ No

3. Registration: ☐ Jackson or Calhoun Co. ☐ Other, in State ☐ Out of State

4. Where did you start your trip? _____

5. What was your destination? _____

6. Where did you enter I-94? _____

7. The reason for this trip was: ☐ Social-Recreational ☐ School ☐ Shopping

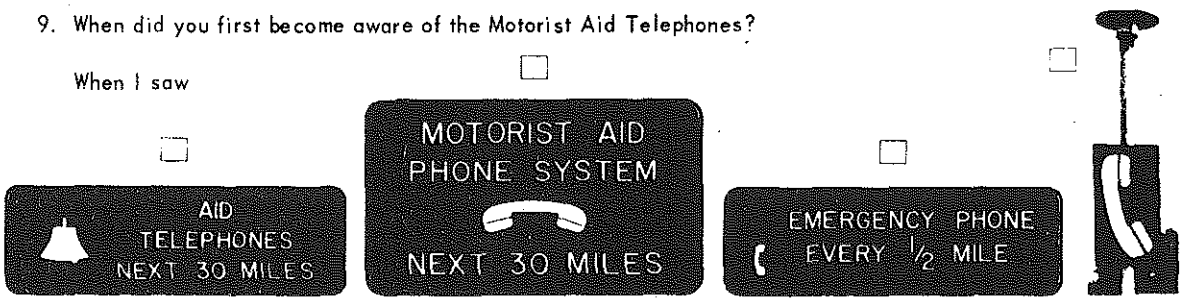
   ☐ To or from work ☐ Work (on the job) ☐ Misc. _____ *Specify*

8. How often do you use this section of I-94?

   ☐ Almost every day ☐ Almost every week ☐ Almost every month ☐ Only once or twice a year ☐ Less than once a year

9. When did you first become aware of the Motorist Aid Telephones?

   When I saw



   ☐ Prior to this trip. ☐ By this letter ☐ Other _____ *Specify*

10. What do you think of the Motorist Aid Phone System?

   ☐ Necessary Service, should be expanded.

   ☐ A convenience, would like to see it expanded.

   ☐ A convenience, but not necessary.

   ☐ Prefer past method of obtaining aid, such as raised hood, flare, handkerchief on door, etc.

   ☐ A need for better motorist aid exists, but I recommend:

11. Do you consider the motorist aid telephone signing adequate? ☐ Yes ☐ No

Further Comments: (Do you have further questions on this system? If so, please supply your name and address on the return. We will be glad to respond.)

_____

_____

_____

Appendix 2

From: _____

_____

_____

FIRST CLASS
Permit No. 487
LANSING, MICH.

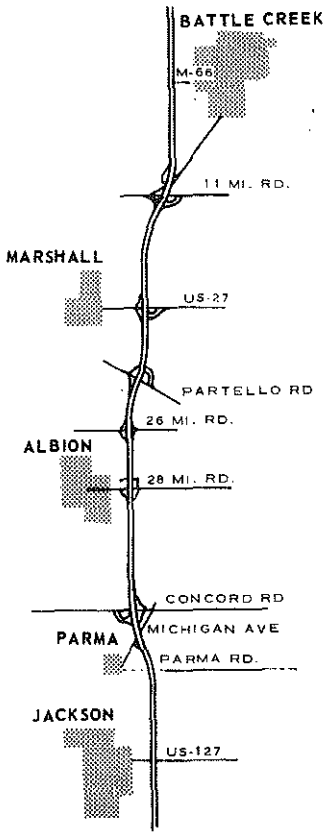
BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Michigan State Highways Building
Lansing, Michigan 48926

Traffic Research



YOUR OPINION COUNTS

Michigan is one of several states conducting experimental projects to determine the needs of a stranded freeway motorist and the effectiveness of various types of installations in providing for these needs.

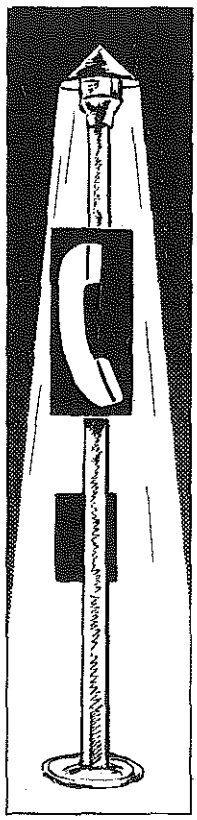
The Michigan installation consists of pairs of telephones mounted on opposite sides of I-94 Freeway at approximately one-mile intervals in the 30-mile test area between Jackson and Battle Creek.

All calls, which are toll-free, from the motorist aid telephones are received by a nearby State Police Post and arrangements are made to provide motorists with needed assistance.

Your response to the attached questionnaire and additional comments will be a meaningful contribution to this study. The results of this study will contribute to a safer and more efficient freeway system.

When you have completed the questionnaire, please place seal and drop in a mailbox. Postage is prepaid.

Thank you.



Appendix 2

STRANDED VEHICLE SURVEY

Date _____ Recorder _____ Route _____

TIME (00:00 – 2400)

_____ of Sighting Vehicle if Stopped

_____ of Stop

_____ of Call

_____ of Interview

_____ of Police Arrival

_____ of Other Aid _____ (Type)

_____ of Stranded Vehicle Leaving

REASON FOR STOP

_____ Abandoned _____ Police Action

_____ Weather _____ Illness Other _____

CAR TROUBLE

_____ Tire _____ Gas _____ Oil

_____ Mechanical _____ Stuck off Road

_____ Accident _____ Water _____ Fire

_____ Other

DID YOU CALL FOR AID? _____ No _____ Yes Phone No.

LOCATION: Milepost _____ ☐ WBD. ☐ EBD.

_____

VEHICLE:

_____ Pass Car _____ With Trailer

_____ Truck Single Unit _____ Pickup or Panel

_____ Truck Combination Units _____ Motorcycle

_____ Bus Other _____

REGISTRATION:

License No. _____

_____ Local

_____ Other in State

_____ Out of State

OCCUPANTS: Driver _____ Man _____ Woman

Passengers– _____ Man _____ Woman _____ Child

WEATHER:

_____ 75° +

_____ 50°–75°

_____ 30°–50°

_____ 0°–30°

_____ Below 0°

_____ Sunny

_____ Cloudy

_____ Fog

_____ Rain

_____ Snow

PAVEMENT:

_____ Dry

_____ Wet

_____ Snow

_____ Icy

NAME & ADDRESS

_____ Mr.

_____ Mrs.

_____ Miss _____ Age

_____ (Number & Street)

_____ (City) _____ (State) _____ (Zip)

Where Are You Coming From? _____

Where Are You Going? _____

TRIP PURPOSE:

_____ Social and Recreation _____ to or from work _____ Misc.

_____ Shopping _____ Work _____ School

HOW OFTEN DO YOU DRIVE THIS ROUTE?

Almost Every _____ Day _____ Week _____ Month

_____ Once or Twice a Year _____ Less than once a Year

WERE YOU AWARE OF THE PHONES BEFORE YOU STOPPED?

_____ No _____ Yes _____ (How?)

COMMENTS:

Appendix 3

STRANDED DRIVER INTERVIEW FORM FOR DISPATCHER

(Calls from Telephones on I-94)

1. DATE _____ TIME _____ TEL. NO. _____

2. LOCATION OF INCIDENT FROM PHONE:
DIST. _____ mi. ☐ EAST ☐ WEST

3. SEX OF CALLER ☐ MALE ☐ FEMALE

4. DOES CALLER REQUIRE INFORMATION ONLY?
☐ YES ☐ NO
(if yes to question # 4, interview is completed.)

5. CALLER REQUESTING AID FOR
☐ SELF ☐ ANOTHER
(if self, continue to 6 & 7)
A. Did caller talk to stranded motorist?
☐ YES ☐ NO
B. Did stranded motorist indicate distress?
☐ YES ☐ NO
If A & B "NO" comment _____

6. REASON FOR STOP
☐ Illness ☐ Abandoned car
☐ Police Action ☐ Misc. (Further aid not required)
☐ Car trouble (indicate)
☐ Tire ☐ Mechanical
☐ Gas ☐ Accident
☐ Water ☐ Struck off road
☐ Oil ☐ Fire
Tow Required? ☐ Yes ☐ No
Medical Aid? ☐ Yes ☐ No

7. ACTION TAKEN
☐ Police Patrol Sent
☐ _____ (COMMERCIAL AID SENT) _____ (NAME)
☐ Other _____
(if Police Patrol sent, form is complete; if not, continue)

"We are conducting a stranded motorist study in this area. We need to know more about the people we aid by this system. I would like to ask you a few questions, if you don't mind.

8. NAME ☐ Mr. ☐ Mrs. _____ Age _____ ☐ Miss

Address _____ (STREET AND NUMBER)

_____ (CITY) _____ (STATE) _____ (ZIP CODE)

9. WHERE ARE YOU COMING FROM?

WHERE ARE YOU GOING?

☐ Direct Route ☐ Indirect Route

10. PURPOSE OF TRIP
☐ Social-Recreational ☐ Shopping
☐ Work ☐ School
☐ To and from Work ☐ Misc.

11. HOW OFTEN DO YOU DRIVE THIS PART OF I-94?
☐ Almost every day ☐ Once or twice a year
☐ Almost every week ☐ Less than once a year
☐ Almost every month

12. WERE YOU AWARE OF THE "AID PHONES" BEFORE YOU STOPPED? ☐ YES ☐ NO

13. VEHICLE
☐ Passenger car ☐ Truck - panel or pick-up
☐ Truck - single unit ☐ Pass. car w/trailer
☐ Bus ☐ Truck - combin. units
☐ Motorcycle ☐ Other

14. REGISTRATION
☐ Calhoun or Jackson Co. ☐ Other In State
☐ Out of State

15. WEATHER
☐ 75° + ☐ 50 to 75 ☐ 30 to 50
☐ 0 to 30 ☐ Below 0
☐ Clear ☐ Cloudy ☐ Rain
☐ Fog ☐ Snow

16. OFFICER'S COMMENTS (If any)

DIRECTIONS FOR STRANDED MOTORIST INTERVIEW FORM FOR DISPATCHER

Form is to be used:

When Dispatcher receives a call on I-94 Motorist Aid Phones.

Specific Instructions:

1–4. Self Explanatory – – – If the answer to 4 is Yes (Information only), interview may be terminated.

5. If call for "Another" complete 5(a) and 5(b), then #6 if possible and #7. If "Self", skip to #6.

6. "Police Action": The reporting of a law violation or a traffic hazard (not an accident).

   "Misc.": Only when no other category is applicable and further aid is not required.

   "Tow Required" & "Medical Aid": Should be checked Yes or No.

7. More than one may be checked. (Fill in name of commercial service. List any other action taken).

8. If commercial aid is requested, securing #8 information should not be a problem – however, the interview statement may be used at this point.

9. Where are you coming from? If driver asks, "What do you mean?" We mean "the last stop you made other than for gas, food or lodging". "Where are you going?" means the next location where the motorist will fullfil a purpose of the trip other than gas, food or lodging or where the trip ends.

   Direct or indirect route is an opinion of the driver.

10, 11, 12, 13, 14 Self explanatory.

At Conclusion:

Dispatcher: "Thank you for your cooperation and information.

A questionnaire will be mailed to you later asking a few questions about the speed and cost (if any) of the service.

Please mail this questionnaire back to us."

15. Self explanatory.

16. Comments – State reasons if "Misc." is checked in questions 6 or 10.

State type if "other" is checked in 13.

Any further information which is applicable to the phone call not otherwise listed.

If patrol calls in, indicate this action in the box.

Appendix 4

MOTORIST AID TELEPHONE SYSTEM QUESTIONNAIRE

1. Description of vehicle you were driving: Body Type _____ Year _____ With Trailer ☐ Yes ☐ No

2. When did you first become aware of the Motorist-Aid Telephones?

☐ Prior to this trip or

When I saw

☐

☐

☐

☐

☐ Other _____

3. How long did it take you to get to the telephone? _____

4. How long did you have to wait for aid after the telephone call? _____

5. Who provided the aid? _____
(NAME OF AGENCY)

If charges were involved, how do you consider them?

Amount _____

☐ No expenses involved
☐ Reasonable
☐ High
☐ Excessive

6. If you needed assistance in the future would you use the Motorist-Aid Telephones? ☐ Yes ☐ No

7. What do you think of the Motorist-Aid Phone System?

☐ Necessary Service, should be expanded

☐ A convenience, would like to see it expanded

☐ A convenience, but not necessary

☐ Prefer past method of obtaining aid, such as raised hood, flare, handkerchief on door, etc.

☐ A need for better motorist aid exists, but I recommend:

The following blanks may already be filled in. If not, please complete:

8. Vehicle Registration:

☐ Jackson or Calhoun Co. ☐ Other in state ☐ Out of state

9. Where did you enter I-94? _____

10. Where did you start your trip? _____

11. What was your destination? _____

12. The reason for the trip was:

☐ Social-recreational ☐ School ☐ Shopping

☐ To or from work ☐ Work (on the job) ☐ Misc.

Appendix 5

APPROXIMATE COSTS OF MAINTENANCE ACTIVITIES FOR SOUTHERN PART OF STATE ON 30 MILES OF FREEWAY FOR ONE YEAR

Motorist Aid Telephone System (Avg. Annual Oper. Cost)	$ 24,550.00
Maintenance including surface, guardrail, sweeping and shoulder maintenance	31,200.00
Roadside Operations: viz. trees, drainage, cleanup, fence repair	16,500.00
Grass and Weed Control	10,250.00
Traffic Services	
Sign Maintenance	6,000.00
Pavement Markings	8,400.00
Tourist Facilities	6,600.00
Snow and Ice Removal	45,000.00
Administration, Inspection and Overhead on above maintenance activities	25,000.00
	$148,950.00

Appendix 6

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