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16. Abstract

A "Before" and "After" study to evaluate the benefits and costs of a Motorist-Aid Phone System, consisting of 302 phones and two control consoles located on a 138-mile section of I-80 in rural Illinois, was conducted.

The categories of the system measures of effectiveness were: system usage, response time, and system convenience. Data were gathered from various sources. The Illinois State Police furnished Accident Reports and Assistance-Rendered Reports. The Illinois Department of Transportation conducted stopped-vehicle surveys and public-opinion surveys. Cooperating service units furnished information concerning disabled vehicles on I-80, and motorist aid phone calls were recorded from actual phone usage.

The "After" study indicated a reduction in the number of secondary accidents and in motorist time involved with an incident. A desire for system expansion was expressed by a sample of the system users.

A need to improve system reliability and to increase public awareness to the system service capabilities exists in order to achieve a higher benefit-cost ratio.

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Expressway Surveillance Project

AN EVALUATION OF THE ILLINOIS I-80 MOTORIST AID COMMUNICATION SYSTEM

by
Moshe Levin
and
Jonathan J. Wierer

Final Report
IHR-002 Motorist Aid System for Rural Freeways

Project Conducted under Sponsorship of

STATE OF ILLINOIS in Cooperation With
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

March 1977

CONTENTS

FIGURES

PICTURES

TABLES

AN EVALUATION OF I-80 MOTORIST AID COMMUNICATION SYSTEM

INTRODUCTION

The State of Illinois, in its efforts to detect and handle various incidents in an efficient manner and to provide the motoring public with a safe operation on its rural freeways, has installed an experimental motorist-aid communication system along 138 miles of I-80 between I-74 (Rock Island) and Ill. 43 (Joliet). The primary goals of the system were:

To provide aid to the motorist in need.

To minimize the hazard caused by the motorist in distress.

To keep traffic flowing.

Secondary goals, with varying degrees of importance, were:

To provide a means of communicating the distressed motorist's needs and location to the proper aid agency.

To minimize the distressed motorist's waiting time for aid.

To maximize service quality.

To maximize the extent and quality of upstream warning of hazard.

To maximize utilization of existing and planned resources.

To minimize system obsolescence.

To provide for the collection of adequate statistical operative data to analyze and evaluate system performance and assure legal backup for each incident in case of motorist suit.

The installation of the system was part of a three-phase study to develop and evaluate such a system. The first two phases (1,2,3) were conducted by Peat, Marwick, Livingston & Co. (PML), while the third one was conducted by Illinois Department of Transportation. The objective of the first phase was:

To determine the physical, technical, and economic feasibility of various candidate motorist aid systems to meet the needs of rural freeways.

The objectives of the second phase were:

To develop an implementation plan, including functional operating specifications for the selected motorist aid system.

To prepare functional, technical specifications suitable for contractual purposes for furnishing and installing the associated communication network required.

To develop an evaluation program to assess the performance of the installed system.

The third phase, which is the topic of this report, had the following objectives:

To assemble records on the characteristics of motorist aid needs and system usage which, in combination with the records from other motorist aid projects, will form a data base for use in the evaluation and design of future motorist aid systems.

To observe and evaluate public reaction to the system by persons who use the system and by persons who benefit from the knowledge that the system is available.

To evaluate the effect of roadside terminal installations on the frequency and characteristics of roadside stops, to observe the actions of stopped motorists, and to determine if any hazard to traffic operations or reduction in safety results from the provision of terminals.

To evaluate the performance of all components and elements of the system, identify areas of weakness and opportunities for improvement.

To explore the operating benefits, technical problems, and attendant costs of providing dispatcher-controlled terminal flashers to warn approaching traffic of hazard at the roadside. (This objective, however, was not pursued due to technical difficulties).

The feasibility study in the first phase considered the following eight candidate systems:

1. Police Patrol - current practice
2. Police Patrol - modification of current practice
3. Patrol - combined police and other agencies
4. Involved Motorist Activated Voice Terminals (wire or radio transmission, two-way)
5. Involved Motorist Activated - Code Terminals
6. Cooperative Motorist Activated - Voice Terminals (wire or radio transmission)
7. Cooperative Motorist Activated - Code Terminals
8. Cooperative Motorist Activated - Headlight Signalling

The physical and technical aspects of each system were evaluated largely with respect to defined performance measures concerning the primary and secondary goals mentioned above and with respect to various system costs.

Selection of the optimum system was based on a utility-cost analysis. The systems based on involved-motorist terminals with voice communications, utilizing either two-way wire or radio transmission, were shown to be operationally the most effective. Further considerations led to the installation of the system utilizing two-way wire transmission.

Motorists traveling on the above-mentioned section of I-80 have access to a system that has 302 roadside terminals placed at the outside shoulder edges, and

spaced at approximately 0.9-mile intervals. The Illinois DOT-owned system is a two-way, voice-carrier, hard-wire installation operated through police headquarters located near Joliet and Rock Island. Toll-free calls from motorists requiring assistance are answered by a police desk sergeant who either dispatches the necessary services or provides the required information. The system accommodates both emergency and non-emergency situations.

In rural areas traffic densities are not great, but an accident or a vehicle stalled on the roadway can create a severe hazard because of the high speeds prevailing on rural freeways. An accident resulting in injuries, or requiring the service of a tow truck to clear the roadway, requires immediate service. The prevailing method, before installing the aid system, consisted of a passing motorist who traveled to the next interchange and contacted the state police by telephone. Usually the desk sergeant attempts to ascertain whether an ambulance or a tow truck is needed, and if such service is required he would dispatch these vehicles along with an investigating officer. But sometimes a trooper was dispatched to the scene first, which further delayed the arrival of necessary medical assistance or towing service to clear the roadway. For incidents of less severity, the motorist's first concern is to remove his vehicle from the traffic lanes to the shoulder. Once this has been accomplished, he looks for aid. In general, he has the following options: he may wait for a passing police patrol; he may obtain assistance from a passing motorist, who either transports him to a place where aid is available or sends him aid; or he may walk to an interchange where assistance might be available. Any of these options usually results in delay in receiving the service required.

The installed motorist aid phone system should enable a faster service to the driver in need and thus minimize the hazard for himself and other traffic.

The motorist aid system was evaluated based on data sets collected before and after the implementation of the system. The overall effectiveness of the system was assessed through data analysis from various surveys and reports. The primary data sources were:

Illinois State Police - Assistance-Rendered Reports

Service Units - Assistance-Rendered Reports

Public-Opinion and Questionnaire Survey

Illinois State Police - Accident Reports

Stopped-Vehicle Survey

Illinois State Police - Audio Tape Recording of Calls

A benefit-cost analysis was conducted for two investment situations. One considered the overall cost (initial and maintenance), while the other considered only maintenance costs.

Major findings of this study were:

1. Approximately 24 percent of forecasted aid-candidates used the system.
2. The average time between incident occurrence and police notification was significantly reduced from 15.5 minutes to 12.8 minutes in the "after" period.
3. The expected costs per aided call were found to be $37 and $15 for the above-mentioned investment situations, respectively.

SYSTEM DESCRIPTION

Interstate 80

With the exception of small segments near Joliet and Moline, I-80 traverses plains and farmland, typical of rural Illinois. The 138 miles in the study section were opened to traffic in sections from 1960 through 1967. There are four

through-traffic lanes, except for a length of 1.5 miles in the vicinity of Joliet and 2.6 miles at the eastern extremity of the section, where there are six lanes. All lanes are 12 feet wide. The median ranges between 64 and 40 feet wide. Shoulders are 12 feet wide and are paved for most of the study section. Eight-foot shoulders are incorporated in the median. The study section has two rest areas serving eastbound traffic and another one serving westbound traffic. There are 25 interchanges throughout the study section, with median crossover one-mile distant from each side of an interchange.

From time to time, much of I-80 is subject to fog. The most hazardous part parallels the Illinois River between Princeton and Morris, where local dense patches of fog are common, particularly near Marseilles.

In 1968, when the study was initiated, the 138-mile study section, between I-74 and Ill. 43, experienced daily traffic volumes ranging from 9,000 to 30,000 vehicles and accounted for nearly 628 million vehicle-miles of travel a year (4). In 1973, after the system was installed, daily traffic volumes ranged from 13,000 to 43,000 vehicles. The total travel during that year amounted to nearly 847 million vehicle-miles (5). A detailed breakdown of traffic volumes and total travel on the various subsections of the study section is presented in Table 1.

I-80 is serviced by Illinois State Police Districts 5 and 7. The study section, its termini and police district's boundary are shown in Figure 1.

Communication System

The Communication System on I-80 is owned by the Illinois Department of Transportation. The 302 aid phone terminals are spaced in pairs, a terminal for each travel direction, at an average of 0.9-mile intervals over the 138-mile study section. While locating terminal pairs, considerations were given to roadway geometric features as well as adjacent development; hence, terminal spacing varies between 0.1 mile and 1.6 miles.

TABLE 1

TRAFFIC VOLUMES AND TOTAL TRAVEL ON
VARIOUS SUBSECTIONS OF THE STUDY SECTION

Interchange At	Element Length (Miles)	Average Daily Traffic 1968	Average Daily Traffic 1973	(Thousands) Vehicle Miles Per Day 1968	(Thousands) Vehicle Miles Per Day 1973
Interstate 74	9.8	10,600	15,200	104	149
Illinois 82	7.3	9.500	14,200	69	104
Atkinson	6.4	9,200	13,700	59	88
Illinois 78	11.0	13,800	13,400	109	147
Illinois 88	11.9	9,200	14,000	109	167
Illinois 26	4.7	9,700	14,500	46	68
Interstate 180	8.8	10,800	15,900	95	140
Illinois 89	4.8	11,700	17,000	56	82
Cherry Road	6.6	11,400	16,100	75	106
Illinois 178	9.1	10,800	15,700	98	143
Illinois 23	2.6	11,400	16,200	30	42
Illinois 71	3.5	11,400	15,700	40	55
Marseilles	7.8	11,300	15,500	88	121
U.S. 6	7.2	11,800	16,300	85	117
U.S. 47	10.0	13,200	17,700	132	177
Minooka	4.1	15,000	19,300	61	79
Interstate 55	3.6	15,100	20,600	54	74
Rockdale	2.0	20,000	36,900	40	74
Illinois 53	0.7	22,700	42,700	16	30
U.S. 52	0.8	21,500	32,900	17	26
Joliet (at C4)	1.7	21,500	29,200	37	50
Joliet (at C4.1)	2.4	18,900	22,700	45	54
U.S. 30	8.5	22,200	19,600	188	167
U.S. 45	2.6	29,100	23,000	76	60
Illinois 43					
Totals	137.9			1,716	2,320
Total Per Year				628 Million	847 Million

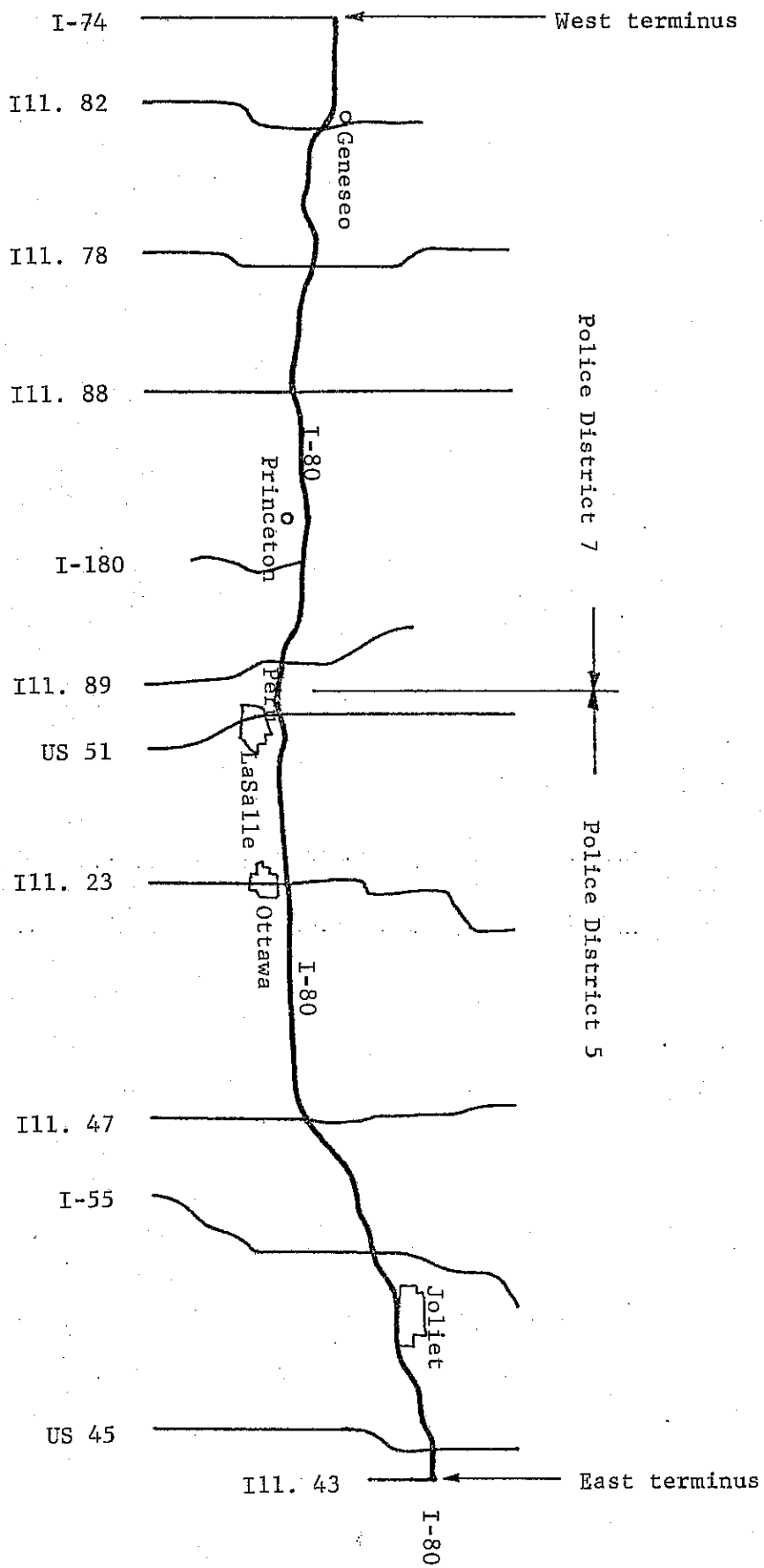


Figure 1. I-80 Motorist Aid Phone System

Of the 302 phones, 170 phones extend along the east 75 miles of the study section under the jurisdiction of Police District 5 (Joliet). The other 132 phones are spread over the west 63 miles, under the jurisdiction of Police District 7 (Rock Island). The Rock Island and Joliet headquarters are respectively 15 miles and 12 miles remote from I-80, and are interconnected to the motorist-aid phone system by cables installed in either State or County highway right of way.

At each end of the system, three signs inform drivers about the aid phones, and additional informational signs are located at major interchanges along I-80. Typical signs are shown in Pictures 1 and 2.

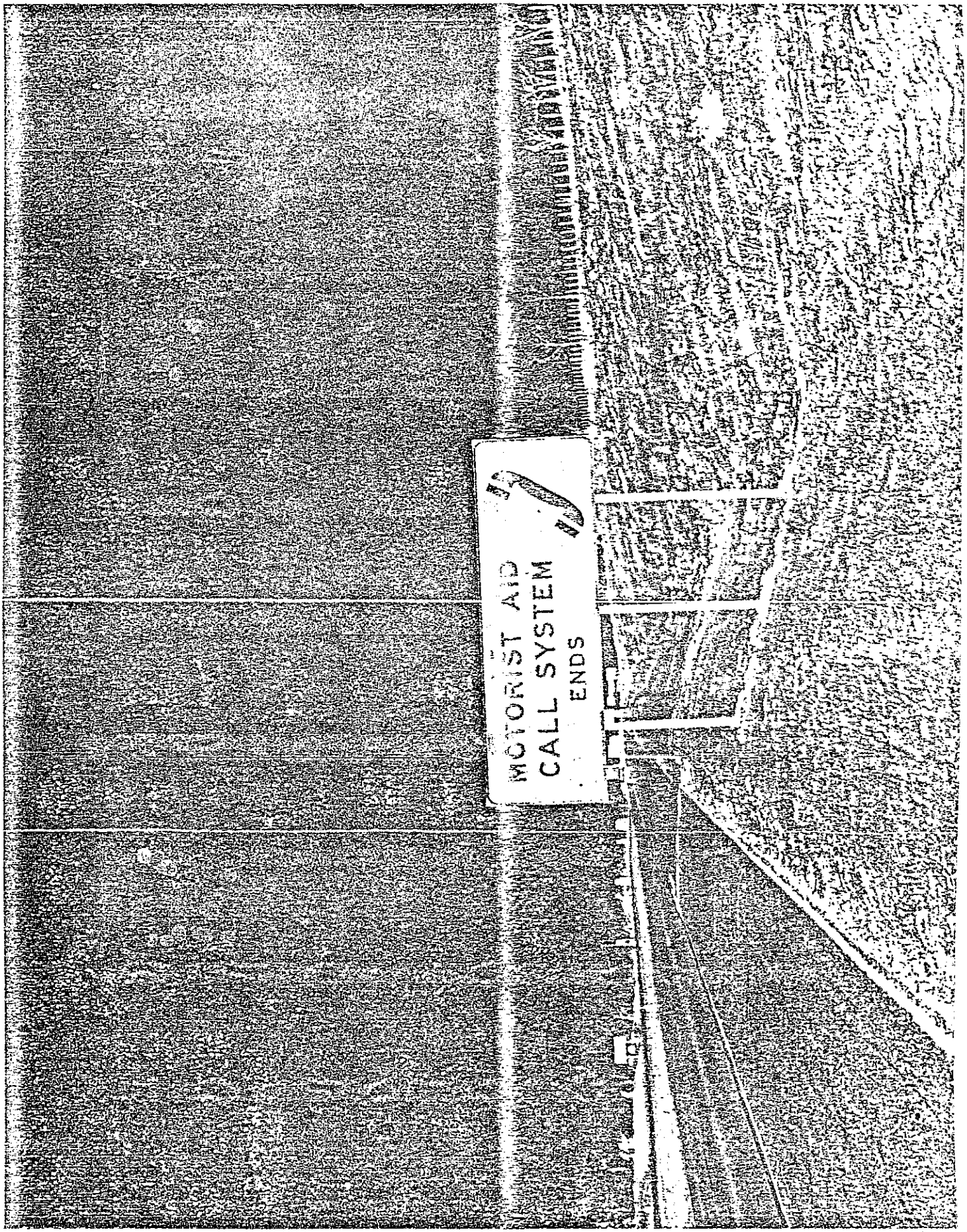
A motorist may have to walk from his disabled vehicle to the nearest phone. To aid the motorist in knowing which way to walk to the nearest phone, the Joliet subsystem (LaSalle-Bureau County Line to Ill. 43) has small signs mounted on delineator posts. If a person begins walking toward the farthest phone, he will see signs telling him to "Walk back to (the closest) phone."

Each phone terminal is installed off the right shoulder, 12 feet from the pavement edge, and consists of a 13-foot aluminum pole (5" diameter), which supports a double-face blue sign containing the legend "Motorist Aid" and handset symbol, and a blue reflectorized weatherproof terminal enclosure attached to the pole, as shown in Picture 3. The terminal enclosure is mounted 4 1/2 feet above grade.

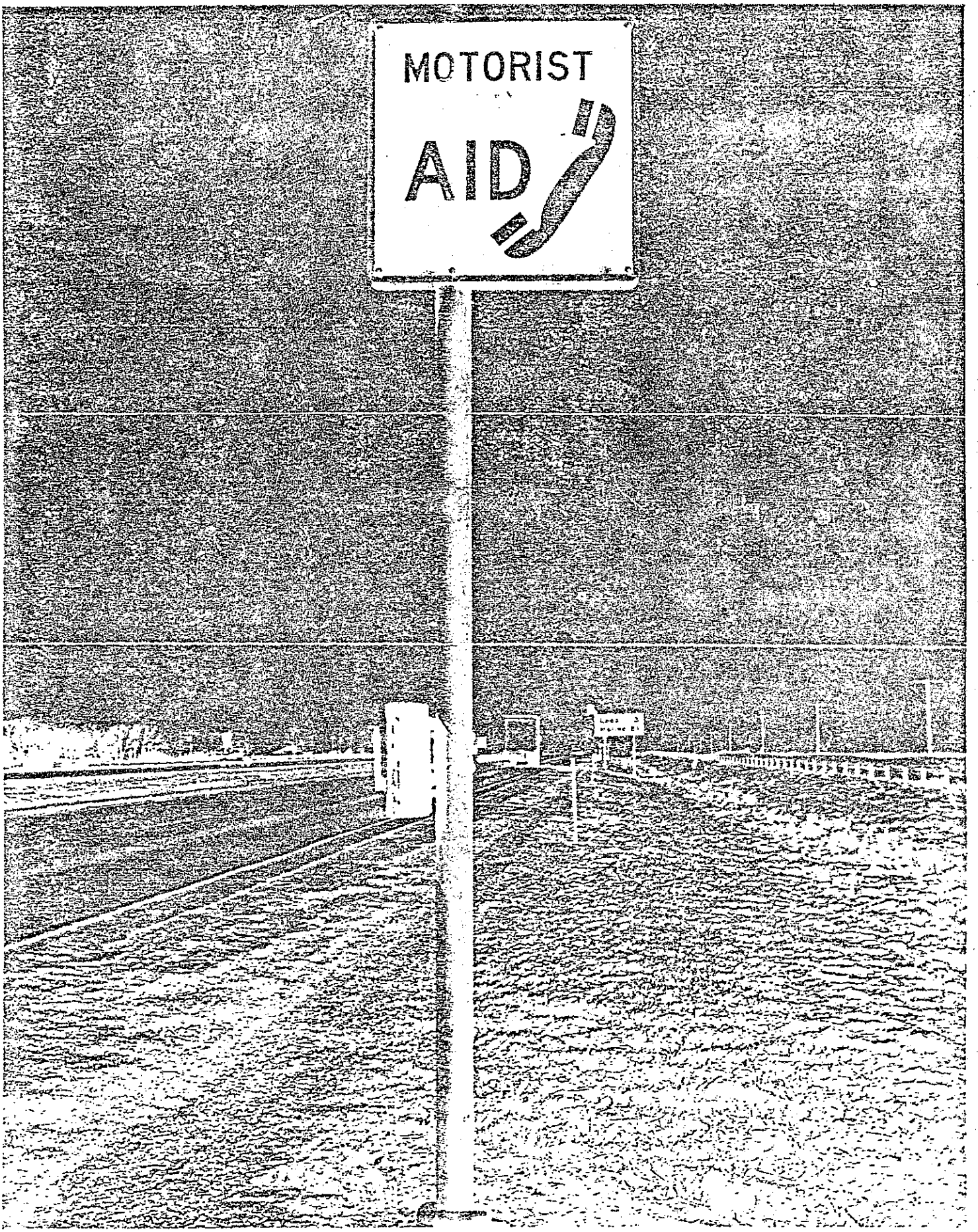
The phones are connected by a 25-pair direct burial cable to a control console located in either the Joliet (District 5) or Rock Island (District 7) State Police Headquarters.

The 25-pair cable was plowed just off the inside shoulder of the westbound roadway 18 inches deep in the I-80 median, and has laterals running under each roadway to connect terminals.

Picture 1. Motorist Aid Information Sign



Picture 2. Motorist Aid Information Sign



Picture 3. Motorist Aid Phone Terminal

Each phone uses three pairs of wires for signaling, voice-in, and voice-out (full duplex). The phones are party-line connected using three circuits, with the capability for up to ten phones to be on a switching mechanism. Every fourth phone is on the same circuit, and opposite phones are on different circuits.

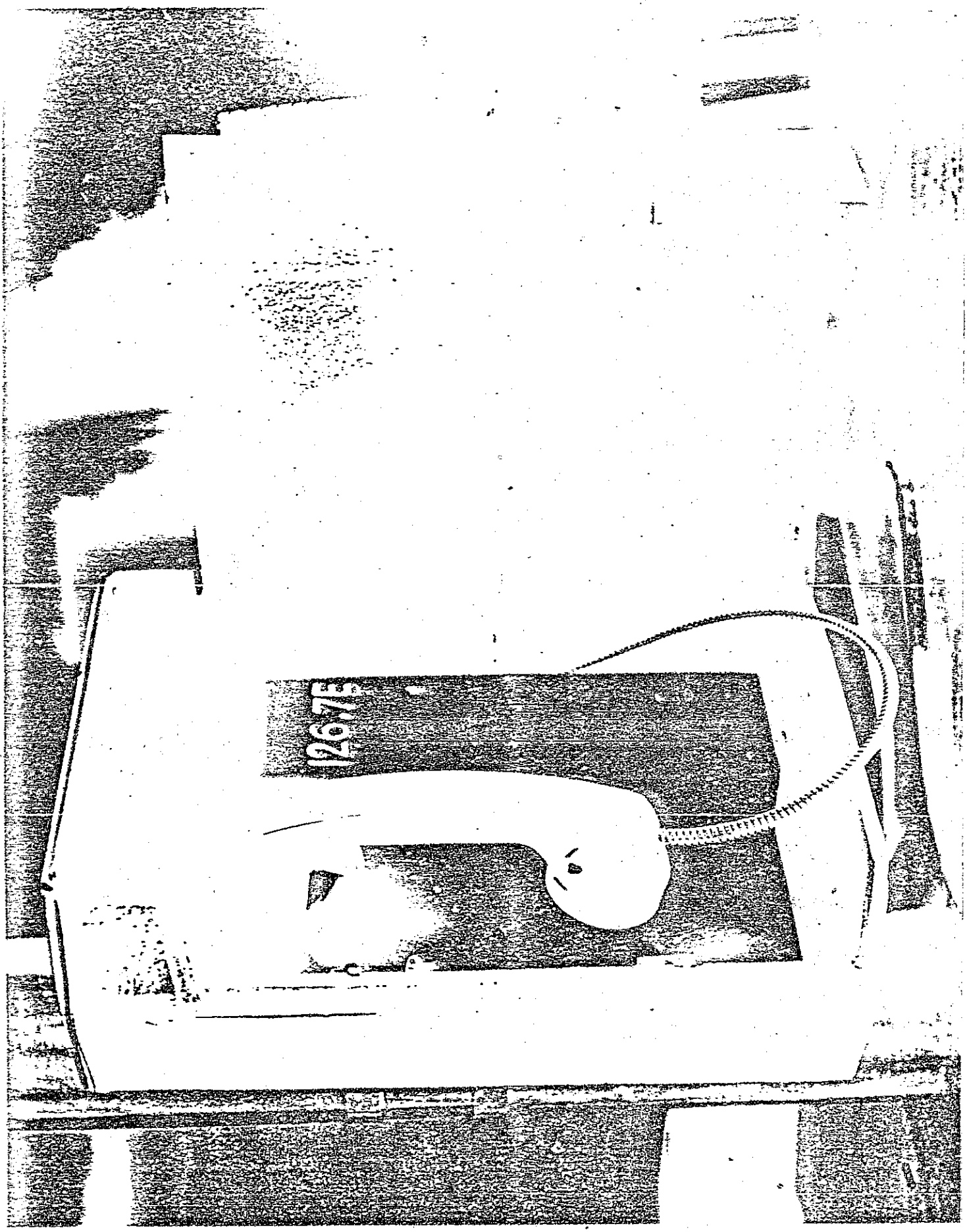
To use a phone, the motorist pulls the ice breaker handle to open the enclosure door and lifts up a conventional handset (Picture 4). Immediately he will hear the standard telephone ring. Instructions inside the enclosure inform him that his call will be answered by the Illinois State Police (Picture 5).

Each police headquarters is equipped with a control console as shown in Picture 6. The console produces a printed paper tape readout which yields the time and terminal number of the call. Each phone is identified according to milepost and direction. Incoming calls are indicated by both an audible ring and a flashing light, and cause the milepost number of the calling terminals to be displayed on the console. A business phone and a tape recorder to tape a call when required are also available.

Calls may be answered by use of either a conventional telephone handset or a speaker-microphone unit mounted in the console. When additional calls are generated during an on-going conversation, a visual signal indicates queued calls.

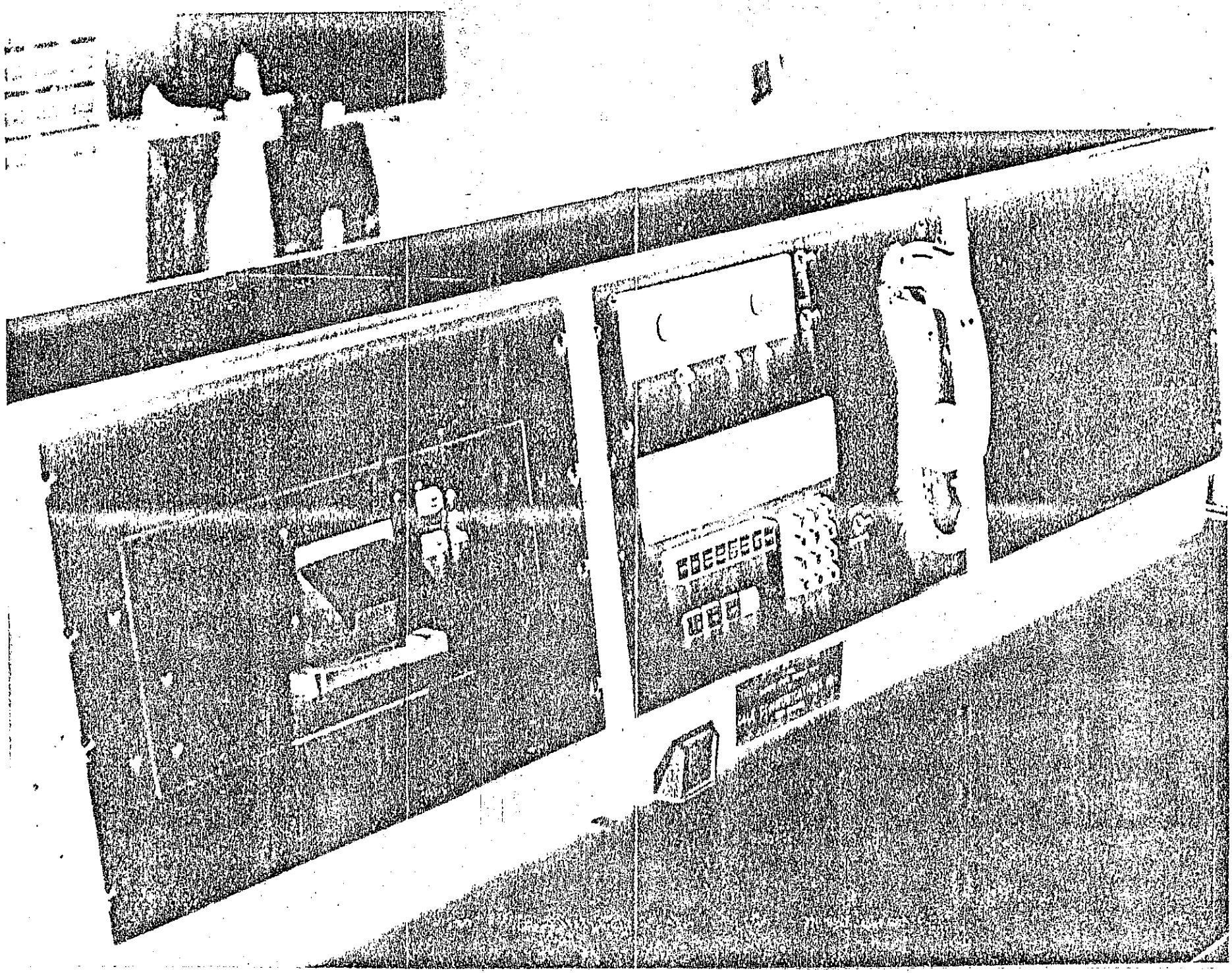
The console also permits the operator to generate a call to any terminal addressed. In turn, a loud ring at the terminal alerts the waiting motorist that the operator wishes to speak to him.

Through the use of controls in the console, the operator can select and interrogate the serviceability of any terminal. When the identity number of the interrogated terminal is displayed, another indicator displays either A-OK or FAIL. Likewise, the operator may initiate an automatic serviceability check sequency directed in turn to all terminals in that subsystem.



Picture 4. Phone Numbering System

Picture 5. Terminal Instructions Inside Enclosure



Picture 6. Police Headquarters Console Equipment

Several changes in the system features have been introduced since its final design. The original design called for three consoles; one in the Joliet Police Headquarters, a second in the Rock Island Headquarters, and a third in the LaSalle-Peru Headquarters. Since a future plan called for phasing out the LaSalle-Peru Headquarters, the aid phones planned for it were divided between the Joliet and Rock Island consoles.

The console concept was changed from a table with equipment on it to a custom desk console including a tape recorder to aid in data collection and to record calls as seen fit by the operator.

A test rack was installed in an adjacent room, so that equipment tests need not be made at the console. Also installed was a readout to identify which cable was in use.

Originally, the design called for steel terminal poles. However, as a result of crash tests, and advances in the "state of the art," aluminum breakaway poles were selected for use.

Another problem associated with the terminals was damage to the 3-foot motorist-aid sign at the top of the pole (Picture 3). When large trucks traveled too close to a terminal, the truck body or trailer could strike the overhanging sign. To avoid damage, the sign was offset-mounted away from the roadway.

Originally, the aid phones were identified by mileage from the Mississippi River, while the Illinois mile markers were numbered from the state line. This introduced confusion and the aid phone numbers were changed to coincide with the mile markers.

Lightning in the area was one of the main reasons for failures of the system. To rectify this problem, lightning resistors were added to each phone terminal.

Several cable cuts occurred while the system was being installed; therefore, cable markers were posted to identify cable location.

SYSTEM EVALUATION

An evaluation program designed to determine the effectiveness of the motorist aid system on I-80 was developed by PML & Co. within the framework of the second phase of the study. Pertinent measures of effectiveness were defined and placed in three categories:

System usage

Response time

System convenience

Specific surveys to collect the data were designed and scheduled for the "before" and "after" study periods as shown in Table 2. A detailed presentation of the measures of effectiveness and the studies necessary to obtain them are given in references (1) and (3).

System Usage. According to PML (1) the usage of the motorist aid system depends on the need for its use, the awareness of its availability and the existence of alternative methods, such as police patrol, for detecting motorists in need. Usage could be quantified by a system utilization ratio, by a system efficiency factor, and by a system success ratio. The system utilization ratio is defined as the ratio of the number of aid-candidates activating the system to the total number of aid-candidates. The system efficiency factor is defined as the ratio of the number of successful motorist aids to the number of aid-candidates activating the system. In the case of the police patrol type of system, an activation was defined as that moment when an aid-candidate stopped alongside the roadway, thus subjecting himself to patrol detection. In the case of the involved-motorist phone system, an activation was defined as the attempt of the motorist to convey his need for aid through an aid system phone. An aid-candidate was defined as a stopped motorist who could utilize assistance from any of the services

TABLE 2

SCHEDULE OF SURVEYS
I-80 MOTORIST AID SYSTEM EVALUATION

Survey	Before	After
Stopped-Vehicle Survey	Sept. 1969, March 1970	August 1973
Police-Assistance Survey	Aug. 1969 - Oct. 1971	April 1973 - April 1974
Accident Survey	Aug. 1969 - May 1972	April 1973 - April 1974
Public-Opinion Survey	Dec. 1969 - May 1972	April 1973 - April 1974
Service Units Assistance Survey	Dec. 1969 - May 1972	April 1973 - April 1974
Motorist Aid System Usage Survey	-	April 1973 - April 1974
Maintenance Survey	-	April 1973 - April 1974

provided by the motorist aid system (e.g. police, medical, fire, mechanical). Four basic categories of aid-candidates were contemplated:

1. Those who successfully activated the system (received aid).
2. Those who activated the system, but did not receive aid within prescribed time limits.
3. Those who chose not to activate the system.
4. Those who were not aware of the existence of the system.

Other usage measure of interest were the proportion of causes for stop and stop duration frequency distribution.

The stopped-vehicle survey and the recorded aid phone calls were the sources of data for evaluating the usage of the system.

Response Time. A candidate using the aid system desires the fastest possible response. He is concerned with detection time, need definition time, time for the service vehicle to reach the scene, time spent on the scene, and time to reach the aid center. In addition, the time for the service vehicle to return to its base is an important aspect of system performance.

Data for these measures of effectiveness were obtained from the following sources: Illinois State Police assistance-rendered reports, service units assistance-rendered reports, Illinois State Police accident reports, and Illinois State Police tape recordings of aid phone calls.

System Convenience. The convenience that the motorist aid system affords to the aid candidates should be determined by measuring the accuracy of need definition, the quality of service, the effect on safety to stopped motorists, and candidates' opinions regarding system performance.

A strong factor in favor of the recommended two-way voice communication system was its ability to provide precise need definition. The caller at a

terminal can communicate his best estimate of need to the dispatcher and the dispatcher can query the caller on any unclear matters. The caller, however, still may not be able to provide the dispatcher with sufficient information to send the proper service and, as a result, too little or too much service may be sent. A measure of this accuracy is the ratio of the number of activations with the correct initial dispatches to the total number of activations.

Some erroneous dispatches will be due to malicious false alarms. The proportion of the calls which are false alarms should, therefore, be measured for system evaluation.

The motorist aid system should improve safety on I-80 by reducing the time a stopped vehicle is exposed to traffic, either on the roadway or on the shoulder. Pedestrian exposure, however, should be increased by the system. To measure the net effect on highway safety, the proportion of primary incidents having secondary incidents and the Secondary Incident Factor, which is the average number of secondary incidents due to a primary incident, can be calculated.

The subjective opinion of aid candidates is a direct measure of convenience. Candidates under the stress of difficulties may formulate strong opinions which should be determined from a questionnaire survey.

Data for determining the above measures of system convenience were obtained from the public-opinion survey and the Illinois State Police audio tape recordings. Unfortunately, data to determine the effect that the system had on the recovery of the ill and accident victims were unavailable.

Stopped-Vehicle Survey (SVS)

The objective of the stopped-vehicle surveys was to determine the following:

1. System utilization ratio
2. System efficiency factor

3. System success ratio
4. Nature of incidents
5. Frequency of stoppage duration
6. Means of incident detection

Two "before" and one "after" stopped-vehicle surveys (SVS) were conducted on a 9-mile section of I-80, between Ill. 23 and Ill. 178. The two "before" surveys were conducted during September 1969 and March 1970. The "after" survey was conducted during August 1973. Each survey ran continuously for seven consecutive days. Data were collected by observers in "floating" cars continuously circulating on the study section at approximately 6-minute headways (section coverage averaging 3-minute intervals). The observers recorded information concerning any stopped vehicle on audio tapes, which were later transcribed and edited to produce a completed coding form for each observed stopped vehicle. Information on the cause for stoppage for drivers whose candidacy for aid had been difficult to determine was attempted to be obtained by questionnaires sent to them within the framework of the public-opinion survey discussed in a later section.

During the September SVS, 952,384 vehicle-miles of travel were monitored as compared with 696,256 in March 1970 and with 1,494,234 vehicle-miles in August 1970. Traffic classification counts recorded 62 percent passenger cars in September, 69 percent in March, and 72 percent in August; most of the remaining vehicles have been classified as various truck types.

As for weather, in September, 89 percent of the study was conducted in fair weather, with eight percent in rain, and nine percent in fog conditions; in March, 87 percent of the time was fair, with the remaining 13 percent as snow flurries; and in August, 100 percent of the time was fair weather.

The data for the three surveys were sorted and tabulated. Table 3 presents the reasons for vehicle stops for the three surveys. Type of service given to the stopped vehicle is presented in Table 4, and the duration of stops and the temporal distribution of these stops are presented in Table 5 and Figure 2, respectively.

As it is seen from Table 3, not every vehicle that stopped needed help. More specifically, only those with apparent reason to stop, classified as tire/wheel, mechanical, gas/oil/water, motor/engine, accident, or fire, could be defined on the scene as aid candidates. The percentages of stops of aid candidates out of the total number of stops during the two "before" studies and the one "after" study were 12.4 percent, 16.0 percent, and 25.1 percent, respectively. Reasons for about one half of the vehicle stops in the three surveys could not be identified on the scene, and the response to questionnaires sent to the owners of those vehicles was rather poor. However, as shown in Table 5, the number of vehicles stopping for 10 minutes or less ranged from 82 percent to 84 percent of all stops for the three studies. This suggests that most of the stoppages for unknown reasons were of short duration and could be expected to be of the "self servicing" type. Some of those that stopped could be aid candidates who probably grew tired of waiting for aid at the particular stop and resumed their journey. In these situations, one could assume that these needy drivers received aid somewhere else along the road, or elsewhere on the trip.

Although the number of stops per vehicle-mile of travel for the three study periods yielded an average of one for nearly 1500 vehicle-miles of travel, the number of aid candidates (defined on scene) per vehicle-mile of travel was one for every 8600 vehicle-miles. These figures are over two times higher than the expected rate of one stop for every 20,000 vehicle-miles, according to previous research (1).

TABLE 3

REASONS FOR VEHICLE STOPS

Apparent Reason for Stop	"Before" September(69)	"Before" March(70)	"After" August(73)
Police Action (assists, ticketing, etc.)	55 (6.4%)	40 (9.1%)	15 (1.7%)
Tire/Wheel	50 (5.8%)	42 (9.6%)	87 (10.1%)
Change Drivers	40 (4.7%)	11 (2.5%)	25 (2.9%)
Assist Others	36 (4.2%)	34 (7.8%)	52 (6.0%)
Adjust cargo	36 (4.2%)	17 (3.9%)	25 (2.9%)
Mechanical	34 (4.0%)	9 (2.1%)	55 (6.4%)
Consult Map	25 (2.9%)	9 (2.1%)	16 (1.9%)
Road Maintenance	17 (2.0%)	9 (2.1%)	24 (2.8%)
Sleep	17 (2.0%)	8 (1.8%)	17 (2.0%)
Gas/Oil/Water	7 (0.8%)	1 (0.2%)	9 (1.0%)
Toilet Stop	6 (0.7%)	2 (0.5%)	4 (.5%)
Hitchhiker	4 (0.5%)	0 (0.0%)	2 (.2%)
Accident	2 (0.2%)	0 (0.0%)	2 (.2%)
Illness	1 (0.1%)	1 (0.2%)	4 (.5%)
Motor/Engine	0 (0.0%)	10 (2.3%)	53 (6.2%)
U-Turn	0 (0.0%)	4 (0.9%)	1 (.1%)
Fire	0 (0.0%)	0 (0.0%)	0 (.0%)
Unknown (see Note A)	496 (57.9%)	218 (49.7%)	424 (49.3%)
Other	31 (3.6%)	23 (5.3%)	46 (5.3%)
Use Phone (see Note B)			
Total	857(100.0%)	438(100.0%)	861(100.0%)

Note A: Since most stopped vehicles were of short duration, most having been observed only once, the apparent reasons for stoppages, and services provided, if any, in these cases were difficult, if not impossible, to determine. Thus, short stoppages for unknown reasons, as well as for some apparent reasons, could be expected to be mostly of the "self-servicing" type.

Note B: Only 36 aid phone calls were recorded for the last section for the entire week of data collection. This represents 4.2% of the total amount of stopped vehicles. (These calls were already included in the number of stops for the various reasons.)

TABLE 4

TYPE OF SERVICE TO STOPPED VEHICLES

Observed Services Received	"Before" September(69)	"Before" March(70)	"After" August(73)
State Police (Assists)	12 (1.4%)	3 (0.6%)	6 (.7%)
Vehicle Towed	7 (0.8%)	11 (2.5%)	6 (.7%)
Service Truck	7 (0.8%)	9 (2.1%)	6 (.7%)
Passing Motorist	4 (0.5%)	0 (0.0%)	6 (.7%)
Fire Department	0 (0.0%)	0 (0.0%)	0 (.0%)
Ambulance	0 (0.0%)	0 (0.0%)	0 (.0%)
Unknown or None Needed (see Note A)	827 (96.5%)	415 (94.8%)	837 (97.2%)
Total	857(100.0%)	438(100.0%)	861(100.0%)

Note A: Since most stopped vehicles were of short duration, most having been observed only once, the apparent reasons for stoppages, and services provided, if any, in these cases were difficult if not impossible, to determine. Thus, short stoppages for unknown reasons, as well as for some apparent reasons, could be expected to be mostly of the "self-servicing" type.

TABLE 5

DURATION OF STOPS

Duration of Stop	"Before" September(69)	"Before" March(70)	"After" August(73)
0 to 10 minutes			
Observed only once	536 (62.5%)	292 (66.7%)	621 (72.1%)
Observed more than once	173 (20.2%)	76 (17.4%)	95 (11.0%)
11 to 20 minutes	48 (5.6%)	20 (4.6%)	38 (4.4%)
21 to 30 "	25 (2.9%)	11 (2.5%)	20 (2.3%)
31 to 40 "	12 (1.4%)	11 (2.5%)	11 (1.3%)
41 to 50 "	5 (0.6%)	5 (1.1%)	15 (1.8%)
51 to 60 "	7 (0.8%)	2 (0.5%)	9 (1.1%)
61 to 110 "	22 (2.6%)	10 (2.3%)	32 (3.7%)
111 minutes or more	29 (3.4%)	11 (2.5%)	20 (2.3%)
Total	857(100.0%)	438(100.0%)	861(100.0%)

Figure 2.

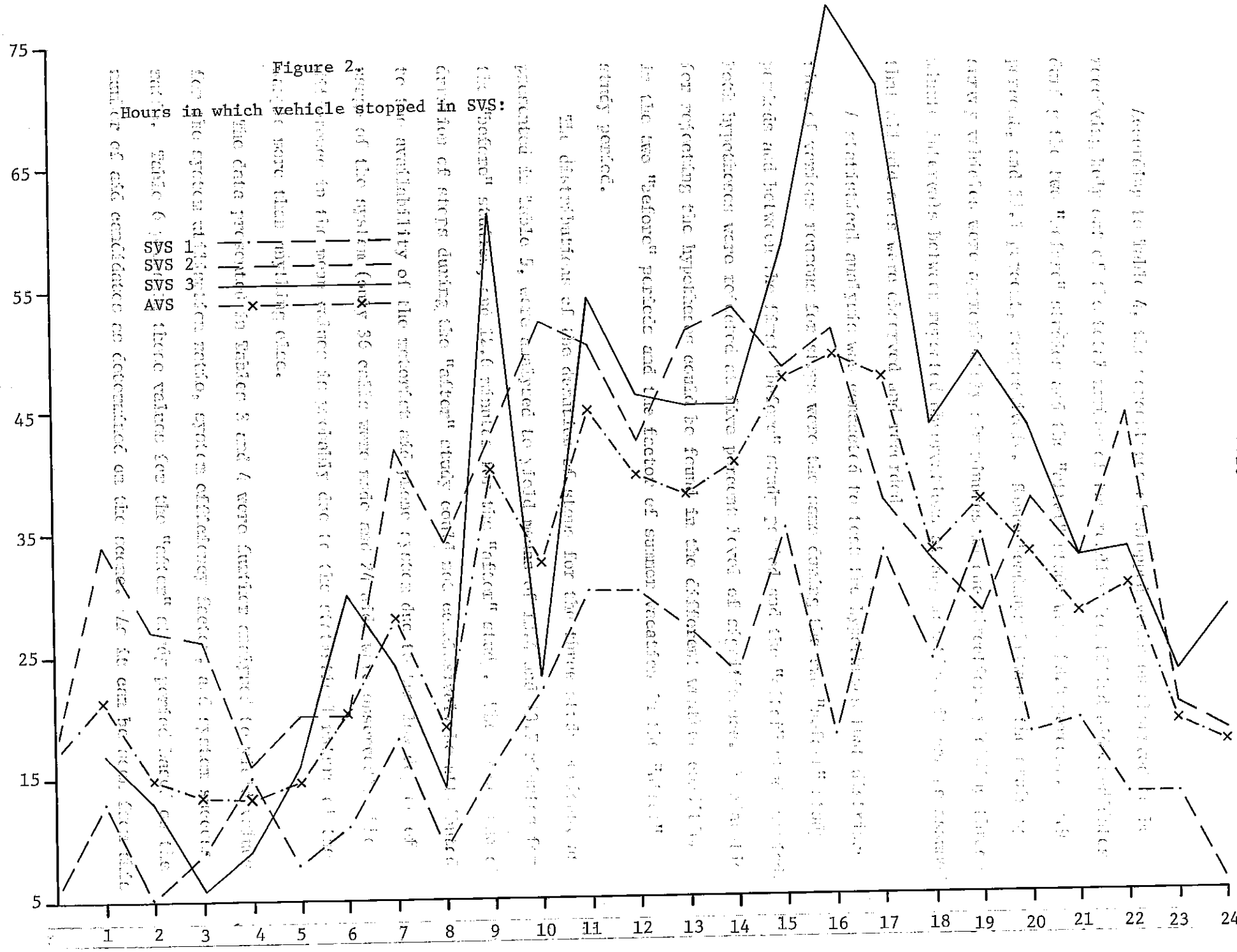

Hours in which vehicle stopped in SVS:
SVS 1
SVS 2
SVS 3
AVS
75
65
55
45
35
25
15
5
1
2
3
4
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TABLE 6

SYSTEM MEASURES OF EFFECTIVENESS VALUES
(STOPPED-VEHICLE SURVEY)

Measure of Effectiveness	"After" August 1973
System Utilization Ratio	0.17
System Efficiency Factor	0.11
System Success Ratio	0.67

table, the values of the system parameters are quite low, indicating low usage. However, the small samples of vehicles observed during the stopped-vehicle survey could not indicate any conclusive values for the system usage at that point in time.

The system usage parameters were not evaluated for the "before" study period since no meaningful comparison with the "after" results could be made. This is due primarily to the difference in definitions of system activations by an aid-candidate.

Illinois State Police Assistance-Rendered Reports

The Illinois State Police Troopers cooperated in the study by filling out a specially designed form for the purpose of this study (Figure A-1) each time an assist was made on Interstate 80. The information on the form was verified with data from the stopped-vehicle survey to get a better overall picture of the number of stops made on the route, the duration of each stop, and the reasons for the stops. Assistance reports were collected in the "before" study from August, 1969 to October, 1971 resulting in 3,040 assists, or 117 assists per month. In the "after" study, reports were collected from April, 1973 to April, 1974 resulting in 729 assist records, or 61 assists per month. The reduction in the number of recorded assists could be attributed to several factors: the shift from giving directional information by the police patrol to providing it through the new motorist aid phone system, failing to fill out forms for all assists, and the reduction in total travel due to the energy shortage.

The data were analyzed with two objectives in mind: (1) to determine the average times associated with an assist rendered by the State Police (i.e. waiting time of motorist before being detected by police patrol and time spent on

scene by police), and (2) to determine the number and type of assists rendered by the State Police. Table 7 presents average motorist waiting period for police arrival and average police-on-scene time for various environmental conditions. Table 8 presents the number of different police assists during the "before" and "after" study periods. Table 9 presents the action taken by the State Police during the assists in the "before" and "after" study periods.

From Table 7 it can be seen that motorist average waiting time for police arrival has increased from 13.4 minutes during the "before" period to 20.5 minutes during the "after" period. This could be attributed in part to the elimination of short-time field assists, such as information aid, from the "after" sample. Analysis of waiting time for information assists during the "before" study showed an average waiting time of less than five minutes, with this type of assist comprising nearly 17 percent of total police assists. This type of assist dropped down to nearly one percent during the "after" study. The almost complete exclusion of this type of assists from police activities during the "after" study, coupled with a lower speed limit due to the energy shortage, accounted for the increase in the average motorist waiting time during the "after" study.

During the "before" period, Police District 5, the headquarters of which are in Joliet, had nine men and cars on the road as compared with the "after" period when seven men and seven cars were engaged. Police District 7, with headquarters in Rock Island, had six men and six cars, and nine men and nine cars on the road during the "before" and "after" periods, respectively. The changes in police patrol levels resulted from reorganizational changes within the two police districts and not necessarily due to the availability of the motorist aid phone system.

Analysis of motorist waiting time by police districts revealed that in District 7, although the number of men and vehicles patrolling the facility

TABLE 7

MOTORIST WAITING PERIOD & POLICE-ON-SCENE TIME
FOR VARIOUS ENVIRONMENTAL CONDITIONS

	Overall		Daylight		Darkness		Rain/Snow		Dry	
	Before	After	Before	After	Before	After	Before	After	Before	After
Average Motorist Waiting Period (min.)	13.4	20.5	12.8	18.6	14.1	23.2	12.4	19.6	13.6	21.6
Average Police-on-Scene Time (min.)	22.3	30.2	22.0	28.6	22.0	32.4	21.9	32.5	22.0	29.4
Total Average Motorist Involvement Time (min.)	35.7	50.7	34.8	47.2	36.1	55.6	34.3	52.1	35.6	51.0

TABLE 8

ANNUAL POLICE ASSISTS

Type of Assist	Number of Assists		Percentage	
	Before	After	Before	After
Tire/Wheel	366	187	23.9	25.7
Directions/Information	256	6	16.6	0.8
Cooling System	215	106	13.9	14.5
Out of Gas	192	128	12.5	17.6
Ignition Trouble	114	39	7.4	5.3
Fuel Pump	46	139	3.0	19.1
Deliver Message	3	0	0.2	0.0
Illness/Injury	1	2	0.1	0.2
Other	345	122	22.4	16.7
Total	1538	729	100.0	100.0

TABLE 9

POLICE ACTION IN ASSISTS

Type of Action	Annual Number of Assists		Percentage	
	Before	After	Before	After
Provide Transportation	452	235	29.4	32.2
Call Tow Truck	360	286	23.4	39.2
Assist in Tire Change	172	101	11.2	13.9
Assist with Repair	125	51	8.1	7.0
Transfer Fuel	23	6	1.5	0.8
Other (Info., Direc., etc.)	406	50	26.4	6.9
Total	1538	729	100.0	100.0

increased during the "after" study period, there was an increase in the average motorist waiting time by nearly seven minutes over that during the "before" study period. In District 5, where a reduction in the patrol power occurred, the increase in the motorist waiting time was about six minutes.

Contributing to the increase in motorist waiting time could be other police activities that could be consuming time and the lower cruising speed due to the energy shortage, as mentioned before.

As to police time-on-scene, there was an increase from 22.3 minutes during the "before" study to 30.2 minutes during the "after study. This could be attributed to the increased usage of the phone system for information assists. These assists require relatively short time-on-scene and were almost completely eliminated from the "after" study period sample.

The significant trend of increased motorist involvement time during the "after" study period was consistent for the various environmental conditions as shown in Table 7. Averages were slightly higher during darkness for obvious reasons.

From Table 8 it can be seen that during the "after" study period, which coincided with the gasoline shortage, a reduction of nearly 53 percent in the number of police assists was recorded. As mentioned before, this reduction could be attributed to failing to fill out assist reports rather than to the availability of the motorist aid phone system. The availability of the motorist aid phone system, however, induced significant variations in the proportions of types of assists rendered by the police as presented in Table 8. The changes in the proportions are the results of the interaction between the availability of the communication system and the energy shortage. There were no data available to isolate the individual effect of either the communication system or the energy

shortage. The energy shortage was a factor in that a number of gasoline service stations curtailed their daily business hours and closed near the end of the month when gas allocations were already used.

Table 9 indicates the types of action taken by the police for the various types of assists shown in Table 8. The percentage of police arranging for assists has increased during the "after" study period (percent of providing transportation and percent of calling tow-trucks), while the percentages of assists in repair and fuel transfer have dropped. The availability of the motorist aid phone system could be considered as the major cause for the reproportion of the types of action.

From the facts that fuel transfer was a small proportion (0.8%) with respect to other types of action, and that there was a significant increase in the proportion of arranging for assists, one could deduce that with the availability of the system, the police operated more in terms of complementing the motorist aid system in arranging for services rather than as a source of service. This, of course, was in line with the general objectives of the motorist aid system.

Interstate 80 Accident Analysis

Two of the measures of effectiveness of the system convenience are the number of secondary accidents and the rate of recovery of ill and accident victims. The probability of occurrence of a secondary accident is a function of the duration of a primary incident. A primary incident was defined as any event that caused a vehicle to stop either on the roadway or on the shoulder. An early notification to police, thus an early arrival of a rescue vehicle, would tend to minimize such a probability and decrease the number of secondary accidents. The rate of recovery of ill and accident victims would be considered, in many cases, to be positively correlated with the duration of waiting for the arrival of a

rescue unit. An early notification to police or ambulatory service has a positive effect on the rate of recovery. Since evaluating the rate of recovery through the various health agencies was an impossible task, time to notify police was considered as a substitute measure of effectiveness. Data for the above measures of effectiveness were reduced from police accident reports.

The State Police furnished 2132 accident reports in the "before" study for the period between August 1, 1969 and May 31, 1972, representing a yearly average of 752 accidents. For the "after" study period, 723 accident reports were furnished for the period between April 15, 1973 and April 15, 1974. Among the "after" study accidents, 13 involved hitting aid system phone poles.

The above accidents represent accident rates of 124 and 77 (accidents per 100 million vehicle-miles) for the "before" and "after" study periods, respectively.

Of the 752 yearly accidents in the "before" study, 71 were analyzed to have been caused by a previous incident, compared with 27 out of 723 accidents recorded during the "after" study period.

Tables 10 and 11 present the types and severity of the secondary accidents during the "before" and "after" studies. The annual total number of secondary accidents decreased by 62 percent in the "after" study period while the reduction in rearend, sideswipe, and angle collisions comprised 73 percent of this total reduction. No fatal accidents occurred during the "after" study.

The reduction in the yearly number of secondary accidents, as well as the overall number of accidents, in the "after" study period could be attributed to the combined effects of the energy shortage, the availability of the motorist aid system and statistical fluctuations. An AASHTO study (6) suggests that the expected reduction in the number of accidents as the consequence of the energy

TABLE 10

ANNUAL NUMBER, TYPE OF SECONDARY ACCIDENTS

Type	Before	After	Change
Hitting Fixed Object	13	3	-77.0%
Rearend	22	16	-37.5%
Headon	2	1	-50.0%
Sideswipe	8	2	-75.0%
Angle	22	2	-91.0%
Noncollision Car in Motion	4	3	-25.0%
Total	71	27	-62.0%

TABLE 11

SEVERITY OF SECONDARY ACCIDENTS

Type	Before	After	Change
Fatal (persons)	2	0	-100.0%
Injury (persons)	32	4	-87.5%
Damage	37	23	-38.0%
Total	71	27	-62.0

shortage could amount to 23 percent. Thus, one could suggest that, since the reduction in the number of secondary accidents exceeded the 23 percent reduction allowed for the energy crisis consequences, the motorist aid system had an effect on the reduction in the number of secondary accidents. However, due to the small sample for the "after" study period (one year of data), no such statistically significant conclusions could be made.

Analysis of the "after" data as to police notification time after an accident revealed that this time amounted to 12.8 minutes. The motorist aid system was used in 46 percent of the accidents and 72 percent of the calls were made by a third party. On these occasions the average time to notify police was 9.6 minutes. In the remaining 54 percent of the accidents, the average time to notify the police was 15.5 minutes, as was that time during the "before" study. The system utilization ratio in accident situations was 0.46 compared to an overall ratio of 0.17 as derived from the stopped-vehicle survey.

As to the effect of the motorist aid system on the recovery of ill and accident victims, it was impossible to determine the exact effect of a reduction of 5.9 minutes in time-to-notify-police on the rate of recovery due to difficulties in obtaining information from the various health agencies. However, such a reduction could have only a positive effect.

Service Unit Assistance-Rendered Survey

With the installation of the motorist aid phone system, it was expected that, through centralized coordination of arrangements for service, improvements in time-to-scene, time-on-scene due to more accurate need definition, and time-to-aid center, in addition to that in detection time, would result.

To evaluate such improvements, a "before" and "after" analysis was conducted using service unit assistance-rendered reports received from participating service

units. The data for this analysis were collected from December, 1969 to May, 1972 and from April, 1973 to June, 1974 for the "before" and "after" study periods, respectively.

A total of 245 service units, consisting of service stations, wreckers, fire departments, police departments and ambulance units, were requested to provide details of any service calls made on I-80. These service units were selected as the most probable units by location to serve I-80. Of the 245 units contacted, 92 responded favorably to the request, but only 55 units submitted actual service unit assistance-rendered reports. A sample report is shown in Appendix B.

A total of 521 forms were returned in the "before" study. Three service units (6% of submitted units) were responsible for the return of 73.7 percent of all reports. These service units operated over 41.3 percent of the length of the study section. In the "after" study, 320 forms were returned where 82 percent of the returned reports were sent by three service units operating over 37.4 percent of the length of the study section. Analysis as to who reported the incidents to the service units revealed that in the "before" study, 42.6 percent of the reports were made by state police patrols, and 18.4 percent by the driver of the disabled vehicle. In 25.6 percent of the cases, assistance was delivered by service vehicles that detected disabled vehicles while on the road. The remainder of the reporting was done by a passing motorist (0.4%), city police (0.5%), sheriff (3.6%), and others (8.6%). In the "after" study, 70 percent of the calls to service units were through the motorist aid phone system. In 10 percent of the cases, assistance was delivered by service vehicles encountering a disabled vehicle while on the road. The remainder of the reporting was done by police (12%) and others (8%).

The data reduced from the assistance-rendered reports were analyzed to yield averages and standard deviations for time-to-scene, time-on-scene, and time-to-aid center or base for various types of service vehicles, as shown in Table 12. Averages and standard deviations of the distances from base-to-scene and from scene-to-base or aid center for the "before" and "after" studies are shown in Table 13. A statistical analysis revealed that there were significant differences at the five percent level, between the "before" and "after" total averages of time-to-scene, time-on-scene, time-to-aid center or base, distance from base-to-scene, and from scene-to-base or aid center.

Further analysis showed that there were no significant differences in time-to-scene and time-on-scene for ambulances and fire units. This was appropriate since in both study periods it was expected that the nearest ambulance service or fire department would be contacted in case of an incident.

During the "before" study period nearly 25 percent of the aids were delivered by service vehicles patrolling the road compared with 10 percent during the "after" period. The higher percentage of such service during the "before" study period could have had a minimizing effect on the differences between time-to-scene and time-to-base in the "before" and "after" study periods. Such an effect could also be experienced because of the reduction in speed limit due to the energy crisis.

The statistically significant differences between time-to-scene and time-to-base, despite the minimizing effects as discussed above, suggest theoretically that the motorist aid phone system could have had a significant positive effect in this case. However, the same two service units accounted for 60 and 70 percent of the reports in the "before" and "after" study periods, respectively. This fact tends to prevent analyzing, in this case, the contribution of the optimal service

TABLE 12

MEANS AND STANDARD DEVIATIONS OF TIME-TO-SCENE, TIME-ON-SCENE, AND TIME-TO-AID CENTER OR BASE FOR VARIOUS TYPES OF SERVICE*

Service Type	Assists		Time To Scene (min.)				Time on Scene (min.)				Time to Aid Center and/or Base (minutes)			
			Before		After		Before		After		Before		After	
	Before	After	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Tow Disabled Vehicle	306	133	22.9	11.	18.9	9.4	23.9	30.7	16.9	21.8	31.8	14.4	25.6	14.0
Service Vehicle (on scene service)	169	165	20.5	12.1	15.2	6.5	24.5	21.5	14.7	12.2	17.7	22.3	16.6	7.1
Ambulance	24	6	12.5	6.5	10.3	4.6	8.9	5.9	10.0	9.4	27.6	11.0	21.5	3.1
Fire Unit	22	16	9.1	4.2	9.6	2.6	24.5	20.7	35.1	37.7	15.5	7.5	15.0	3.1
Total	521	320	20.9	12.0	16.4	8.2	23.4	27.0	17.4	22.3	27.7	16.2	19.0	9.8

*These average figures include trips from the scene of the assist to the aid center, then back to the base of operation; and also trips from the assist scene directly to the base of operation. Repair times at an aid center or base are not included for towed vehicles.

TABLE 13

MEANS AND STANDARD DEVIATIONS OF DISTANCE-TO-SCENE AND DISTANCE-TO-AID CENTER AND/OR BASE

Service Type	Assists		Distance from Base to Scene (miles)				Distance from Scene to Aid Center and/or Base (miles)			
			Before		After		Before		After	
	Before	After	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Tow Disabled Vehicle	306	133	6.0	4.7	4.4	2.7	7.3	5.3	4.9	4.7
Service Vehicle (on scene service)	169	165	7.0	3.5	5.8	5.0	7.2	5.4	5.9	5.2
Ambulance	24	6	6.1	4.7	8.0	1.0	7.2	6.2	8.0	1.0
Fire Unit	22	16	5.0	2.2	5.4	1.9	5.0	2.2	5.4	1.9
Total	521	320	6.3	4.3	5.2	4.0	7.9	5.5	5.9	4.7

coordination capability of the phone system. It is suggested that other factors could also be responsible for the significant differences in time-to-scene and time-to-base, as well as distance-to-scene, and distance-to-base.

As to the significant reduction in time-on-scene during the "after" study, it could also be related to a reduction in percentage of assists by service vehicles patrolling the road. This could increase the probability of prolonging the time-on-scene, due to not being fully equipped to handle the vehicle disability. Also, the effect of the "after" system on the clarity of need definition could not be established.

Public-Opinion Survey

More insight into the convenience aspects of the motorists aid system was obtained through two public-opinion surveys, with one conducted before the installation of the motorist aid system and the other afterwards. These surveys were designed to obtain information on the user's service needs and expectations and the effectiveness of the installed system.

Survey questionnaires (Appendix C) were distributed by the Illinois State Police to motorists who received assistance or had some contact with the police on the study section (ticketing excluded). Survey questionnaires were also sent to motorists whose vehicles were spotted along the roadside during a stopped-vehicle survey in March of 1970. License plate information obtained in this survey was used to locate vehicle owners.

In the "before" study approximately 1700 questionnaires were distributed over a period of 30 months from December of 1969 to May of 1972 with only 231 returned. In the "after" study, 88 questionnaires were returned in a one-year period, from mid-April of 1973 to mid-April of 1974. For the "before" study, the response amounted to less than 15 percent. For the "after" study, it was impossible to determine the amount of response due to some technical difficulties.

The samples were extremely small compared with the total number of vehicles stopped on I-80 during the study periods. Of the mailed questionnaires very few were returned, and sometimes with denials as to being in the area at all. Thus, it could be suggested that the reason for the poor response could be that drivers felt their privacy was infringed upon. Also, a bias was introduced due to the fact that mostly those helped by the Illinois State Police received motorist aid questionnaires. Therefore, the results should only reflect general tendencies.

In general, people were aware of I-80 motorist aid phone system and favored its expansion. Nearly one half of the people who returned the questionnaires used the phone system. More than 90 percent of the respondents found the one-mile spacing between the aid phones "about right".

After the installation of the phone system nearly 89 percent of the respondents indicated that they were not unduly delayed in being detected as compared to approximately 76 percent before the installation. Those who indicated that they were not unduly delayed in receiving service amounted to nearly 70 percent of the respondents in the "before" study compared to approximatly 90 percent in the "after" study. It seems that providing more information to the motoring public, as to what the system can do in time of need, could increase the system utilization ratio.

Of the 231 returned questionnaires in the "before" study, 198 stated that aid was required. Of the remaining 33 questionnaires, only three failed to state whether aid was needed or not. Of the 88 questionnaires returned in the "after" study, 83 stated that aid was required and the remaining five did not require any help.

The 231 and 88 returned questionnaires were broken down by State in which the vehicle was registered. The following results were obtained:

	Before		After	
Illinois	138	(59.8%)	31	(35.2%)
Iowa	15	6.50	10	11.4
Michigan	10	4.3	5	5.7
Indiana	10	4.3	2	2.3
Wisconsin	5	2.2	3	3.4
9 Other States	43	18.6	12	13.6
Not Recorded	10	4.3	25	28.4
Total	231	100.0%	88	100.0%

Of the 231 and 88 questionnaires, 216 and 83 stated they stopped on the right shoulder, 7 and 4 on the left shoulder, 3 and 0 in the traffic lanes, and 5 and 1 questionnaires had no record of the position of the stop, respectively.

The reason for stopping was broken down with the following results:

	Before		After	
Mechanical	81	(35.1%)	27	(30.6%)
Tire/Wheel	68	29.4	31	35.2
Gas or Oil	39	16.9	7	8.0
Electrical	8	3.5	7	8.0
Accident	3	1.3	3	3.4
Other	31	13.4	13	14.8
Not Recorded	1	0.4	0	0.0
Total	231	100.0%	88	100.0%

In addition to the above information, the "before" questionnaire contained 13 questions which were aimed at determining the motorist viewpoint concerning the system of aid which was used to help them and also their preference for any other aid system. Seven of these questions were also contained in the "after" data questionnaire. The breakdown of each question follows:

Question No. 1 (1st of 2 parts) Did you need assistance?

	Before		After	
Yes	198	(85.7%)	83	(94.3%)
No	30	13.0	5	5.7
No Response	3	1.3	0	0.0
Total	231	100.0%	88	100.0%

Question No. 1 (2nd of 2 parts) Did you get assistance?

	Before		After	
Yes	201	(87.0%)	83	(94.3%)
No	13	5.6	1	1.1
No Response	17	7.4	4	4.6
Total	231	100.0%	88	100.0%

Question No. 2 How would (did) you try to summon help?

	Before		After
Signals on Vehicle	84	(35.3%)	
Police	52	22.5	Not
No Opinion	23	10.0	
Walk to Service	20	8.7	on
Passing Vehicle	19	8.2	
Other	15	6.5	Questionnaire
No Response	18	7.8	
Total	231	100.0%	

Question No. 3 Were you (or would you be) hesitant to leave your vehicle?

	Before		After	
Yes	143	(61.9%)	32	(36.4%)
No	80	34.6	46	52.3
No Response	8	3.5	10	11.3
Total	231	100.0%	88	100.0%

It seems that the availability of the system created feelings of security and safety as expressed by the reduction in the number of those that hesitated to leave their vehicle.

Question No. 4 How long did you have to wait for assistance? (in minutes)

	Before	
1-10	78	(33.8%)
11-20	37	16.0
21-30	22	9.5
31-45	19	8.2
46-60	11	4.8
Over 60	15	6.5
No Response	49	21.2
Total	231	100.0%

According to the above data, the average waiting time for assistance was nearly 24 minutes. This corresponded favorably with the ones estimated previously, considering the average waiting time for police patrol arrival, average time-to-scene of service vehicles, and the frequency of the various types of services.

Question No. 5 (1st of 2 parts) Were you unduly delayed in being detected?

	Before		After	
Yes	37	(17.3%)	8	(9.1%)
No	191	81.4	78	88.6
No Response	3	1.3	2	2.3
Total	231	100.0%	88	100.0%

Question No. 5 (2nd of 2 parts) Were you unduly delayed in receiving service?

	Before		After	
Yes	28	(12.1%)	8	(8.1%)
No	162	70.1	78	88.6
No Response	41	17.8	2	2.3
Total	231	100.0%	88	100.0%

The reduction in the number of drivers that were unduly delayed in being detected and receiving service could be attributed to the availability of the motorist aid system. In many cases police patrols were notified of a disabled vehicle by the dispatcher.

Question No. 6 How long did you expect to wait for a police patrol to stop? (in minutes)

	Before		After	
1-10	11	4.8%	4	4.6%
11-20	34	14.7	11	12.5
21-30	57	24.7	19	21.6
31-45	3	1.3	1	1.1
46-60	34	14.7	12	13.6
Over 60	7	3.0	6	6.8
No Response	85	36.8	35	39.8
Total	231	100.0%	88	100.0%

In both study periods, however, the expected waiting time for police arrival, 38.3 minutes in the "before" study and 41.1 minutes in the "after" study, far exceeded the actual average waiting times for police arrival which were 13.4 minutes and 20.5 minutes in the "before" and "after" studies, respectively.

A statistical analysis showed that at the 5% level of significance, there was no difference between the expected waiting time for police patrol in the "before" and "after" study periods. If people thought that the motorist-aid phone system would bring about the reduction in patrol level, they also thought that police patrols would still be able to reach them in the same amount of time as before, if not faster.

Question No. 7 Who provided you with assistance and/or service?

	Before		After	
Police	118	(51.1%)	68	(77.3%)
Service Truck	56	24.2	15	17.0
No Aid Needed	27	11.7	0	0.0
Passing Motorist	24	10.4	2	2.3
Other	4	1.7	0	0.0
No Response	2	0.9	3	3.4
Total	231	100.0%	88	100.0%

The high percentage of assists by police in this case is obvious since the police distributed the questionnaire to drivers it dealt with.

Question No. 8 Were you fairly charged for service?

	Before		After	
Yes	135	(58.4%)	68	(77.3%)
No	13	5.6	5	5.7
No Response	83	36.0	15	17.0
Total	231	100.0%	88	100.0%

Question No. 9 Were the service personnel courteous and competent?

	Before		After	
Yes	179	(77.5%)	73	(83.0%)
No	6	2.6	2	2.3
No Response	46	19.9	13	14.7
Total	231	100.0%	88	100.0%

Question No. 10 Would you like to see increased motorist aid systems, such as? (1 or more responses possible)

	Before	
Free Aid Telephones Along Road	146	(63.2%)
Increased Police Patrol	76	32.9
Pay Telephones Along Road	71	30.7
Push Button Boxes Along Road	59	25.5
Patrol by Public Trucks	41	17.8
Existing System is Best	22	9.5
Patrol by Private Trucks	17	7.4
Other	7	3.0
No Response	10	4.3
Total	231	100.0%

It seems that drivers were not that enthusiastic about the existing system and, also, the desire for pushbutton boxes was less than that for pay telephones.

Question No. 11 How far would you consider walking from a disabled vehicle to reach a roadside phone or call box?

	Before	
0 - 1/4 mile	13	(5.6%)
1/4 - 1/2 mile	51	22.1
1/2 - 1 mile	86	37.2
1 - 2 miles	15	6.5
Over 2 miles	31	13.4
No Response	31	13.4
Total	231	100.0%

Nearly 65 percent of the respondents preferred the roadside phones to be up to one mile apart.

Question No. 12 How much would the convenience of a roadside phone or call box be worth to you in obtaining future service?

	Before	
$0.01 - 0.50	3	(1.3%)
0.51 - 1.00	11	4.8
1.01 - 2.00	4	1.7
2.01 - 4.00	3	1.3
4.01 - 6.00	14	6.1
"Very Much"	19	8.2
No Response/Opinion	177	76.6
Total	231	100.0%

Due to the high percentage of no response, a meaningful value for the worth of the convenience of roadside phone or call box could not be determined.

Question No. 13 If you need help at the roadside, how long should you have to wait for service of the following type? (in minutes)

	Before					
	Ambulance		Fire		Vehicle Service	
1 - 15	130	(56.2%)	113	(48.9%)	29	(12.6%)
16 - 30	36	15.6	34	14.7	107	46.3
31 - 45	2	0.9	2	0.9	9	3.9
46 - 60	6	2.6	6	2.6	47	20.3
Over 60	0	0.0	0	0.0	5	2.2
No Response	57	24.7	76	32.9	34	14.7
Total	231	100.0%	231	100.0%	231	100.0%

While nearly 57 and 50 percent of the respondents were willing to wait up to 15 minutes for ambulance and fire engine, respectively, for vehicle service nearly 60 percent of the respondents were willing to wait up to 30 minutes. Nearly 85 percent were willing to wait up to one hour. The average desired waiting time for vehicle service was estimated to be approximately 30 minutes. Previous analyses (Question No. 4 above and Table 12) indicated that for the "before" study period the actual average waiting time was in the range of 22 to 24 minutes. This is less than the average desired waiting time, which indicates that the "before" system yielded an acceptable service as far as the waiting for service was concerned.

In the "after" study period public-opinion questionnaire there were questions aimed at determining the motorist view point of the I-80 motorist aid phone system and its usage.

Question No. 14 Did you know there were aid phones at one-mile spacings?

	After	
Yes	69	(78.4%)
No	17	19.3
No Response	2	2.3
Total	88	100.0%

Question No. 15 When did you first become aware of the motorist aid phone system?

	After					
	Instate		Out of State		Unknown	
Prior to this trip	27	(73.3%)	10	(31.2%)	18	(69.2%)
When I saw motorist aid Phone sign	5	16.7	9	28.1	5	19.2
When I saw Motorist Aid Call System next 61 Miles Sign	2	6.7	11	34.5	0	-
Other	1	3.3	1	3.1	2	7.7
No Response	0	-	1	3.1	1	3.9
Total	30	100.0%	32	100.0%	26	100.0%

The above data indicate that prior awareness of the system was high in Illinois and surprisingly quite considerable in other states. The fact that some people who were aware of the motorist aid phone system did not know that the aid phones were at one-mile spacing, as indicated in Question 14, suggests that information with regard to the spacing would be desirable.

Question No. 16 Have you heard any unfavorable publicity or comments regarding the aid phone system?

	After	
Yes	8	(9.1%)
No	78	88.6
No Response	2	2.3
Total	88	100.0%

Question No. 17 Did you use the aid phone system?

	After	
Yes	43	(48.9%)
Drove Up	6	6.9
Walked	35	39.8
Rode	2	2.2
No	42	42.7
No Response	3	3.4
Total	88	100.0%

According to Question 1, nearly 95 percent of the respondents needed aid. Out of these, according to the above, nearly 49 percent used the aid phone system. This indicates a system utilization ratio of 0.49 compared with a ratio of 0.17 estimated through the stopped-vehicle survey. Nearly 81 percent of those that used the system walked to the aid phone. However, the small sample size prevents the making of definite conclusions in this regard.

Question No. 18 Were you able to see an aid phone from where you stopped?

	After	
Yes	55	(62.5%)
No	28	31.8
No Response	5	5.7
Total	88	100.0%

Question No. 19 Do you think one-mile spacing is:

	After	
Too far	6	(6.8%)
About Right	80	90.0
Too Close	0	0.0
No Response	2	2.3
Total	88	100.0%

Nearly 91 percent of the respondents indicated that the one-mile spacing was "about right." In the "before" study (Question No. 11), nearly 65 percent of the respondents indicated that they would be willing to walk up to one mile to an aid phone. It seems that the relatively high percentage of walking to the aid phone (Question No. 17) proved that the one-mile spacing was acceptable.

Question No. 20 What do you think of the motorist aid system?

	After	
Necessary service, should be expanded	46	(52.3%)
A convenience, would like to see it expanded	29	32.9
A convenience, but not necessary	3	3.4
Prefer past method of obtaining aid	0	0.0
A need for better motorist aid exists	2	2.3
No Response	8	9.1
Total	88	100.0%

Nearly 85 percent of the respondents would like to see the system expanded.

Question No. 21 If you need assistance in the future, would you use a motorist aid Phone?

	After	
Yes	83	(94.3%)
No	0	0.0
No Response	5	5.7
Total	88	100.0

Even though only nearly 49 percent of those that needed aid used the system (Question No. 17), nearly 95 percent would use it in the future. This indicates that more information should be given to the motoring public as to what the system could do for them.

In the "before" study, 61 percent of all reported stops were made in daylight hours, 35 percent at night, with the remaining three percent not indicated. Sixty-three percent of the stops were made in clear weather, 24 percent in rain, six percent in snow or sleet, and seven percent not indicated. In the "after" study, 72 percent of all reported stops were made in daylight hours, 25 percent at night, with the remaining three percent not indicated. Fifty-nine percent of the stops were made in clear weather, 18 percent in rain, two percent in snow or sleet, and 21 percent not indicated.

Motorist Aid System Usage

In order to obtain insight into the nature of the system activations, recorded incidents, and dispatcher actions, and to evaluate the system utilization ratio, system efficiency factor, and system success ratio, all the phone calls recorded between April 15, 1973 and April 14, 1974 were analyzed.

A total of 17,689 activations were registered on audio tapes from motorist aid calls. Based on total recording time, this was estimated to represent

84.9 percent of the total number of activations during the data base period. The total number of system activations for the above period was estimated to be 20,846.

The system activations were classified into five categories: incident - first call, duplicate call, return call by police, maintenance call, and other. When a call (driver or passing motorist) regarding a need that was not recorded before was received, it was classified as an "incident - first call." At times a driver in need would call more than once to inquire about the aid or request additional aid. Also, sometimes a passing motorist would call about an incident already known to the police. Such calls were classified as "duplicate call." Sometimes the police would ask the caller to stand by until aid arrangements were complete or until another call was complete. These calls were classified as "return call."

Activations to test the system, such as after fixing an inoperative phone, were classified as "maintenance call." Prank calls, bad connections, and false calls were classified as "other." One of the major causes for false calls was lightning activating a call. This problem, however, was rectified after the study period by installing lightning arrestors at terminals.

A breakdown of the tape recorded and estimated system activations is given in Table 14.

TABLE 14
TAPE RECORDED AND ESTIMATED SYSTEM ACTIVATIONS

System Activation	Tape Recorded	Estimated	Percentage
Incident - First Call	8,646	10,191	48.9
Duplicate Call	1,985	2,339	11.2
Return Call by State Police	877	1,033	4.9
Maintenance Call	2,883	3,397	16.3
Other	3,298	3,886	18.7
Total	17,689	20,846	100.0%

According to Table 14, 65 percent of the activations were incident-related. The ratio of the total number of recorded system activations to the recorded number of incidents was 2.04. The ratio of the recorded number of incident-related calls to the number of recorded incidents was found to be 1.43. This particular ratio reflects the degree of effectiveness in informing and handling the incidents. The ideal value for both ratios above is 1.0. However, this can never be achieved due to certain unavoidable number of maintenance-related activations, passing motorists' calls, and problems related to providing aid.

Once a call about an incident was received, the type of problem was identified and arrangements for aid were made. Sometimes an incident represented more than one problem, and the dispatcher arranged for more than one type of service. This is reflected by the fact that for the 8,646 tape recorded incidents - first call, there were 10,500 and 9,087 vehicle needs and aids, respectively. The primary reasons for vehicle stops and the types of action taken by the dispatcher to handle these primary needs are presented in Table 15. According to this Table, 63.3 percent of the primary needs of stopped vehicles were due to some kind of disability. Stops for information amounted to 26.5 percent of all stops, and stops primarily because of accidents amounted to four percent. The remaining stops, which amounted to nearly five percent of all stops, were due to a car in a ditch (2.7%), making phone calls (1.6%), fire (0.7%), and illness (0.3%).

Approximately 60 percent of dispatcher actions in case of disability were sending either a tow truck or another service unit. In 18 percent of the disability cases the dispatcher placed phone calls, such as to local friends or relatives of the driver in need, relating a request for help. In nearly 12 percent of the cases, information was given as to the location of various service facilities in the area. In approximately eight percent of the cases, police were

TABLE 15

PRIMARY REASONS FOR AID PHONE USE AND RELATED DISPATCHER ACTIONS

Primary Reason Category	Percent of Calls	Dispatcher Actions (% of Action by Category)							
		Give Information	Sent Police	Sent Fire Unit	Send Ambulance	Send Tow Truck	Send Service Unit	Place Phone Call	Other
Vehicle Disability	63.3%	11.5%	8.2%			10.8%	49.3%	18.0%	2.2%
Fire	0.7	3.1	47.0	40.0%		1.5		3.1	4.6
Accident	4.0	1.2	81.4	0.6	8.1	4.1	1.7	0.6	2.3
Illness	0.4	26.5	61.8		2.9			5.9	2.9
Car in Ditch	2.7	1.7	59.5		0.4	34.2	0.8	2.1	1.3
Make Phone Call	1.6	4.4	0.7					35.3	59.6
Information	26.5	83.8	14.7					0.4	1.1
Other	0.8	2.9	52.2			1.5	2.9	4.3	36.2
Total	100.0%	29.8%	15.0%	0.3%	0.4%	7.9%	31.3%	12.2%	3.2%

sent out to help. Further analysis showed that stops for primarily being out of gas amounted to nearly 20 percent of all disability stops. This was during a study period, nearly half of which was during the energy shortage when many service stations were closed part of the time (the number of stops due to being out of gas amounted to less than 10 percent of all disability stops during a study period before the energy shortage). Sending police to the rescue, however, amounted to nearly five percent of the dispatcher action. Tow truck and other service unit aid amount to nearly 64 percent. In the remaining 30 percent of the cases, drivers asked to be put in contact with others or asked for direction to certain places where help could be obtained.

In the case of vehicle stops for information, in 83.8 percent of the cases information was given directly. In 14.7 percent of the cases police had to be sent to help orient the driver in need. In 0.4 percent of the cases information regarding directions was obtained through placing a call by the dispatcher.

In the case of accidents, ambulances were sent for only 8.1 percent of the accidents. Approximately 13 percent of the accidents were known to be with injuries, 43 percent were with no injuries, and in 44 percent of the cases, no information as to injuries was available. The remaining 91.9 percent of the accidents were handled by police (81.4%), tow trucks and service units (5.9%), giving directions to service locations (1.2%), and placing phone calls (0.6%).

When a car ran into a ditch, police were sent out in 59.5 percent of the cases, and tow trucks were called in 34.2 percent of the cases. The remaining cases were handled by giving direction to service locations (1.7%), sending ambulance (0.4%), sending other service units (0.8%), and placing calls (2.1%).

In the case of fire, fire units were sent in 40 percent of the cases, while the police handled it in 47 percent of the cases. The remaining fire cases

were handled by giving directions to service places (3.1%), sending tow trucks (1.5%), and placing phone calls (4.6%). Seventy-one percent of the fire cases occurred in the vehicle, 25 percent on the roadside, and the location for the remaining fire cases was unknown.

In case of stopping because of illness, police were sent in 61.8 percent of the cases, while an ambulance was sent only once. In the remaining cases, directions to clinics or hospitals were given in 26.5 percent of the cases and phone calls were placed in 5.9 percent of the cases.

When a primary need was to make a phone call, 35.3 percent of these needs were satisfied. In 59.6 percent of these cases, the system was mistaken to be part of the Illinois Bell Telephone system, or other than "collect" out-of-state calls were requested. Such requests were denied and the dispatcher action was classified under "other." In some cases (4.4%), requests to make a phone call were satisfied by information provided by the dispatcher.

Reasons for phone use categorized as "other" included stops to inform the police on highway conditions, safety hazards, and traffic violators. Of the 69 "other", 59.6 percent were dealt with by police patrols sent to the scene by the dispatcher. In 36.2 percent of the cases, either no action was taken or maintenance crews of the Illinois D.O.T. were informed. The remaining dispatcher actions included giving information (2.9%), sending tow truck (0.5%), sending service unit (2.9%), and placing phone calls (4.3%).

As to the dispatcher actions classified as "other," in some vehicle disability cases and others, calls would reach the dispatcher about the incident, but with a message that aid was already on the way and there was no need for the dispatcher to take any action. In a particularly interesting case, the

dispatcher was able, through prolonged conversation with a caller, to prevent a threatened suicide by stalling until a patrol car could reach the location.

As was mentioned before, the 8,646 tape recorded incidents were related to 10,500 primary and secondary needs of stopped vehicles and to 9,087 dispatcher primary and secondary actions as shown in Tables 16 and 17, respectively.

In Table 16, the secondary needs amounted to 18.1 percent of the total number of needs. The number of vehicle disability needs amounted to 53.1 percent of the total number of needs. The needs for information and making phone calls amounted to 38.9 percent. The remaining eight percent were classified under fire, accident, illness, car in ditch, and others. Among the secondary needs, 61.5 percent were due to a need to make a phone call. This is expected since having been involved in an incident a driver would tend to inform someone about his situation. The second highest percentage among secondary needs was that for information (26.5%). Secondary needs due to vehicle disability amounted to seven percent.

In Table 17, 30.3 percent of the total number of dispatcher actions were in the "giving information" category. Sending police to the scene amounted to 15.3 percent, while placing phone calls amounted to 12.7 percent. Sending tow trucks amounted to 7.8 percent of the total number of actions while sending other service units amounted to 30.2 percent. The remaining 3.7 percent of the actions were in the categories of "sending fire units," "sending ambulance," and "other." Of the 441 secondary actions, 39.9 percent were in the "giving information" category, 21.1 percent in the "placing phone call" category, as well as in the "sending police" category, 8.2 percent in the "sending other service unit" category, and the remaining 9.7 percent were in the categories of "sending fire unit," "sending ambulance," "sending tow truck," and "other."

TABLE 16

PRIMARY AND SECONDARY NEEDS OF STOPPED VEHICLES

Need Category	Primary Needs		Secondary Needs		Total Needs		Secondary Need as Percent of Total
	Number	Percent	Number	Percent	Number	Percent	
Vehicle Disability	5,473	63.3	133	7.0	5,606	53.1	1.30
Fire	65	0.7	11	0.6	76	0.7	0.10
Accident	345	4.0	8	0.4	353	3.3	0.07
Illness	34	0.4	6	0.3	40	0.4	0.05
Car in Ditch	237	2.7	68	3.6	305	2.9	0.60
Make Phone Call	136	1.6	1,171	61.5	1,307	12.4	11.10
Information	2,287	26.5	505	26.5	2,792	26.5	4.86
Other	69	0.8	2	0.1	71	0.7	0.02
Total	8,646	100.0	1,904	100.0	10,550	100.0	18.10

TABLE 17

DISPATCHER PRIMARY AND SECONDARY ACTIONS

Action Category	Primary Actions		Secondary Actions		Total Actions		Secondary Actions as Percent of Total
	Number	Percent	Number	Percent	Number	Percent	
Giving Information	2,574	29.8	176	39.9	2,750	30.3	6.4
Sending Police	1,296	15.0	93	21.1	1,389	15.3	6.7
Sending Fire Unit	28	0.3	8	1.8	36	0.4	22.2
Sending Ambulance	30	0.3	1	0.2	31	0.3	3.2
Sending Tow Truck	686	7.9	24	5.4	710	7.8	3.4
Sending Other Service Unit	2,711	31.6	36	8.2	2,747	30.2	1.3
Placing Phone Call	1,059	12.2	93	21.1	1,150	12.7	8.1
Other	264	2.9	10	2.3	274	3.0	3.6
Total	8,646	100.0	441	100.0	9,087	100.0	4.8

In addition, 22.2 percent of the dispatched fire units were considered as secondary action as a result of a secondary vehicle need. In the "giving information" and "placing phone call" categories, secondary actions were 6.4 and 8.1 percent, respectively. Police units were sent as secondary action for 6.7 percent of the cases. Secondary actions in the categories of "sending ambulance," "sending tow truck," and "sending other service unit" amounted to less than four percent for each.

Further analysis of motorist aid system usage revealed that 83 percent of the callers were males, and 78 percent of the calls were made by drivers or passengers of the stopped vehicles. Fifteen percent were made by passing motorists while four percent were made by police patrols. The remaining three percent of the calls were made by others.

Of the drivers or passengers who made the calls, 81 percent drove up to the terminal, 18 percent walked, and the remaining one percent received a ride to the nearest aid phone. The low walkup factor (18%), combined with relatively high percentage of vehicle disability (63.3%), suggests that the one-mile spacing of the terminals was, as expressed in the public-opinion survey, "about right." Furthermore, a high probability exists that a farther spacing of terminals could also be satisfactory.

As to environmental conditions, 71 percent of the calls were made during daylight while the remaining 29 percent were made after "dark." Seventy-six percent of the calls were made in clear weather, 20 percent were made while it was raining, and the remaining four percent were made during snow conditions.

A certain percentage of the calls (3.5%) were made from phones located in the opposite direction of travel of the stopped vehicle. The majority of these calls were made by passing motorists. Some were also made by motorists who

encountered a faulty phone in their direction of travel and could not or did not want to proceed to the next phone. Crossing the median, of course, resulted in an increased hazard to the motorist in need.

According to the Illinois Department of Transportation (5,7), approximately 847 million vehicle-miles were driven on the study section during the data base period. Observations made during the stopped-vehicle surveys yielded a rate of one stop of an aid-candidate for every 8,600 vehicle-miles of travel. The rate is significantly higher than the rate of one stop for every 20,000 vehicle-miles advocated by previous studies (1). However, due to the small sample of total travel during the stopped-vehicle survey (0.9% of the yearly total travel), the rate of one stop of an aid-candidate for every 20,000 vehicle-miles was selected as an input for further analysis.

Based on the selected rate of stops, an estimated 42,350 aid-candidates stopped for aid during the year of the "after" study. The number of phone system aid activations was estimated to be 10,102 (8,646 minus 69 non-aid activations divided by .849). A system utilization was found to be 0.24, which indicates that nearly 24 percent of those that could have used aid tried to get it through the aid phone system. If the higher rate of aid-candidate stops were used (one stop per 8,600 vehicle-miles), the system utilization ratio would be calculated to be nearly 0.11.

In order to evaluate the system success ratio and system efficiency factor, the number of successful motorist aids had to be determined. A successful motorist aid occurred when the need of the aid seeker was satisfied. Sometimes these needs could not be satisfied, due to the desire to make non-collect out-of-state calls or because of other reasons. Of the estimated 10,102 aid seekers,

167 did not receive the aid they expected (95 requests for out-of-state calls and 72 with no aid available). These figures yielded a system success ratio of 0.98. Therefore, the system efficiency factor was found to be approximately 0.23.

Communication System Reliability

Data on system failures were collected for the period from mid-April, 1973 to mid-April, 1974. Equipment malfunctions were due to circuitry failures, vandalism, accidents, and cable cuts due to maintenance and construction work. During that period there were 1,501 system malfunctions; 32 (2.1%) of these malfunctions were due to vandalism, 7 (0.5%) due to cable cuts, 13 (1.0%) due to accidents, and the remaining 1,449 (96.4%) were due to circuitry failures.

The expected number of daily failures was found to be 4.1 with a Mean Time Between Failures (MTBF) of approximately six hours. Assuming a failure rate according to a Poisson distribution, the probability of having a day with no failures was 0.016. This means that only six days with no failures occurring could be expected in one year. This rate of failures, with the associated distribution of down time, yielded a probability of terminal availability of 0.93, having seven percent of telephones out of order at any particular time. The probability of having two opposite phones out of order at the same time was found to be 0.005, meaning that in 99.5 percent of the time both or either phone will be operative.

In another aspect of reliability, 2,883 calls out of the 17,189 recorded calls were maintenance calls and 2,650 calls were triggered by lightning. These equipment malfunction-related calls represented nearly 32 percent of the total number of recorded calls. The lightning problem was rectified by installing lightning resistors on all aid phones after the study period. Redesign of a more reliable circuitry has also been investigated.

System Evaluation - Summary

The major difficulties in conducting a statistically sound evaluation of the "before" and "after" studies were quite numerous. Foremost was the energy crisis that prevailed during the latter part of the "after" study period (January 1974 - April 1974). The crisis affected the availability of service units on one hand, and the total travel on the other. The reduction in speed limit, from 70 m.p.h. to 55 m.p.h. (20% reduction), had its own effect on the number of primary and secondary accidents. No restructure of the study to isolate the system effect on accidents was possible at that time.

The data collection task was very involved, and required the cooperation of the motoring public, and many public as well as private units. However, the length of the study (5 years) definitely affected the enthusiasm of the participating agencies, as evidenced by the relatively small data sample. In the stopped-vehicle survey, it was impossible to identify the reasons for stops or establish the aid-candidacy status for more than 50 percent of the stops. In most cases these stops were of short duration and considered to be of the "self-servicing" type. However, a possibility always existed, remote as it might have been, that a stop was of an aid-candidate, but was cut short due to the impatience of the driver or the low urgency of the need which probably could be satisfied somewhere else along the road. The response to the questionnaires sent to some of those drivers was rather poor and did not clarify the situation. For further surveys it is recommended that roadside interviews of a sample of stopped motorists be conducted rather than relying on response to questionnaires.

During the course of the study, an organizational change took place in Districts 5 and 7 of the State Police. These changes were not necessarily to

reflect the operation of the motorist aid system, and thus the full impact of the system on the level of police patrolling could not be established. In addition, the fading enthusiasm of the police patrols in filling the assist forms had some effect on the estimates of motorist waiting time and police-on-scene time related to police assists.

The reduction in speed limit and decrease in total travel due to the energy crisis, the availability of the "after" system, and the statistical nature of the accident phenomenon yielded a reduced number of primary and secondary accidents during the "after" study period. The reduction in the number of secondary accidents was far beyond the adjustment factor of 23 percent discussed previously. However, the fact that only one year of accident data for the "after" system were available could not statistically establish the reduction of secondary accidents due to the availability of the system. For the purpose of this analysis the differences between the "before" and "after" injury and damage accidents were adjusted for the energy shortage factor (23%) only, and assumed to be the result of the availability of the phone system. In the case of the fatal accidents only 50 percent reduction was assumed.

The times involved with the various phases of handling an incident were analyzed from data obtained from the various studies for the "before" and "after" study periods. The values of these times are summarized in Table 18. Since the sample sizes of data from the various assist sources of response time did not reflect the true proportions of assists, there was a need to estimate representative response time values based on the expected need for various types of assist based on reasons for vehicle stops.

Usage measures of effectiveness for the "after" system were determined from data collected in the various studies as shown in Table 19. A meaningful comparison

TABLE 18

RESPONSE TIME MEASURES OF EFFECTIVENESS VALUES

Source	Time to Detect (min.)		Time to Scene (min.)		Time on Scene (min.)		Time to Base/ Mid center (min.)		Sample Size	
	Before	After	Before	After	Before	After	Before	After	Before	After
Service Unit Assists	N/A	N/A	20.9	16.4	23.4	17.4	31.8	25.6	306	133
Police Assists	N/A	N/A	13.4	20.5	22.3	30.2	N/A	N/A	1,538	729
Accident Analysis	15.5	12.5	12.5	10.3	8.9	10.0	27.6	21.5	752 24 24	732 (to-detect) 6 (to-scene) 6 (to-base)
Public-Opinion Survey	N/A	N/A	24	N/A	N/A	N/A	N/A	N/A	231	
Representative Value*	15.5	12.5	20.2	16.6	23.1	17.8	31.7	25.4		

* Values are based on expected need for various types of aid based on reasons for vehicle stops.

TABLE 19

USAGE MEASURES OF EFFECTIVENESS VALUES

Study	Sample Size After	System Utilization Ratio After	System Success Ratio After	System Efficiency Factor After
Stopped-Vehicle Survey	861	0.17	0.67	0.11
System Usage Survey	8,646	0.24	0.98	0.23
Public-Opinion Survey	88	0.49	0.94	0.46
Accident Survey	752	0.46	1.00	0.46
Representative Value		0.24	0.98	0.23

between these measures of effectiveness and the one estimated from the "before" system could not be made due to the difference in the definitions of activation in the "before" and "after" systems. Representative values for the "after" system usage measures of effectiveness were based on the data obtained in the system usage survey which seemed to best reflect the operation of the system.

BENEFITS AND COSTS

Determining the overall benefits due to the motorist aid phone system involves tangible and intangible benefits of which the relative importance and value are often difficult to determine.

Tangible measures of effectiveness or benefits considered in the analysis include

- Aid-candidate involvement time in an incident
- Number of secondary accidents
- Number of accidents involving phones
- Level of police patrol
- System utilization ratio
- System efficiency factor
- System success ratio
- Public acceptance

Intangible measures of effectiveness include

- System value to I.D.O.T.
- System value to State Police
- System value to national and state policies regarding aiding motorists on rural freeways
- Quality of service of assisting agencies

Table 20 presents "before" and "after" values for seven of the above tangible measures of effectiveness.

As with any "before" and "after" study, the differences in values cannot be precisely attributed to the effects of the system in question. However, in this case, if it were assumed that the changes were fully caused by the aid phones and, furthermore, that one hour of time was worth $4.00, then the time saving per incident would amount to approximately $1.00 for every vehicle occupant. Since 9,935 out of 10,102 aid candidates actually received aid, and assuming vehicle occupancy of 1.8, the time saved due to the system was worth nearly $17,883.

Several estimates exist for the loss involved with fatal, injury and damage accidents. The National Safety Council (NSC) estimate (1972) is as follows (8):

fatal - $82,000

injury - $3,400

damage - $480

If the difference in the number of secondary accidents after adjusting for the energy crisis factor had been due to the availability of the motorist aid system, then the yearly saving would have amounted to approximately $140,000 (1972), including the loss due to the accidents involving the aid phone (3 injury, 10 damage).

Assigning monetary values to human life and limb also can be approached from the standpoint of lost individual income in future years, and other factors resulting in extremely large benefits for even one serious incident. In such cases, any apparent reduction in fatal accident or injury can be expanded into substantial monetary benefits.

TABLE 20

SUMMARY OF MEASURES OF EFFECTIVENESS

Measures of Effectiveness	Before	After	Change
Aid-Candidate Involvement Time in Incident (minutes)	58.8[a]	46.9[a]	-20%
	90.5[b]	72.3[b]	-20%
Number of Secondary Accidents/yr.	71	27	-50%[c,f]
Severity of Secondary Accidents:			
Fatal (pers.)	2;1[c]	0	-1%[c,f]
Injury (pers.)	32;25[c]	4	-84%[c,f]
Damage	37;28[c]	23	-19%[c,f]
Number of Accidents Involving Phone Poles	0	13[e]	+13
Level of Police Patrol (men/cars):			
District 5	9/9	7/7[d]	-22%
District 7	6/6	9/9[d]	+50%
System Utilization Ratio	N/A	0.24	N/A
System Efficiency Factor	N/A	0.23	N/A
System Success Ratio	N/A	0.98	N/A

a. Aid-candidate involvement time ends on scene
b. Aid-candidate involvement time ends at aid center
c. Adjusted for energy shortage and speed limit reduction impact
d. Changes in police patrol level due to organizational changes
e. 3 injury accidents and 10 damage accidents
f. Sample too small for statistical significance

The yearly costs of highway patrol personnel and vehicle operation amounted to approximately $526,000 in the "before" study period, and to approximately $782,000 in the "after" period. This represents an increased cost of nearly $255,000 a year, which the State Police attributed to factors other than the aid phone system.

In order to estimate the motorist aid phone system cost per aided call, annual system costs were computed based on system life of 10 years (1973-1983), eight percent interest rate, and eight percent inflation rate. For the simplicity of the analysis, it was assumed that all costs involved in the program development and implementation were invested at the initial point in time. The total annual costs for the first two years considered the maintenance cost as part of the system implementation phase. For the remaining eight years of the life of the system, an average maintenance cost based on a 1975 estimated base cost of $120,000 and eight percent inflation rate was considered. The above costs, however, exclude system construction and maintenance supervision. Table 21 presents the system cost analysis.

The system cost per aided call, or the subsidy per aided call, could be evaluated with respect to two investment situations:

1. Development and installation of the I-80 system
2. Continuation of I-80 system operation beyond 1976.

Before proceeding with the analysis there is a need to estimate the average number of aided calls per year for the first two and remaining eight years of the economic life of the system. A ratio of 11.7 aided calls per million vehicle-miles was found based on 1973/74 data. Assuming an annual increase of traffic of four percent and the above ratio to remain constant throughout the economic life of the system, the average numbers of aided calls per year for

TABLE 21
ESTIMATED MOTORIST AID SYSTEM COSTS

	Total Cost	Annual Cost
Program Development		
Feasibility Study Program Administration Evaluation	240,300	$ 49,766
System Implementation		
System design, purchase, installation, training, and maintenance for first two years	1,055,300	218,552
Total annual cost (first two years)		$268,318
System Operations		
Maintenance (based on 1975 estimated cost)		$162,800
Total Annual Cost (last eight years)		$431,118

the first two years and remaining eight years were estimated to be 10,000 and 12,500, respectively. If aided calls are further classified into critical calls and non-critical calls (critical calls being those due to disability, accident, fire, illness, and car in ditch), then, according to Table 15, the critical calls amounted to 71.1 percent of the aided calls. The projected critical calls for the first two years and remaining eight years were estimated to be 7,181 and 8,887, respectively.

In the first investment situation, the costs per aided call and per aided critical call, during the first two years (1973-1975), were estimated to be approximately $27 and $37, respectively. For the remaining eight years, the average cost per aided call and per aided critical call was estimated to be approximately $34 and $48, respectively.

In the second investment situation, the costs per aided call and per aided critical call would amount to approximately $13 and $18, respectively.

If the differences in the values of the measures of effectiveness (time saved and reduced accidents) were considered to be the results of the availability of the system only, and their monetary value (adjusted for inflation) subtracted from the annual system cost, then the cost per aided call for the total investment would drop to approximately $10 for the first two years of operation (1973-1975). Considering the average maintenance cost only, and the ever-increasing monetary value of saved time and reduced accidents, it is expected that an average benefit-cost ratio of approximately 1 to 1 would exist during the remaining life of the system. Considering the total investment and the above benefits, the benefit-cost ratio was estimated to be in the range of 0.3 to 0.5.

SUMMARY OF FINDINGS

Based on the available data and the various analyses, the following are the major findings:

1. More than 10,000 motorists per year seek aid through the I-80 aid phone system.
2. Approximately 24 percent of all I-80 aid-candidates are utilizing the motorist aid system.
3. Approximately 98 percent of the aid-candidates who called successfully received aid.
4. Approximately 23 percent of all the aid-candidates on the facility are successfully aided by the motorist aid system.
5. For the I-80 accidents, approximately 46 percent involve reporting through the aid phones, with 72 percent of such calls made by passing motorists.
6. The average time between incident occurrence and police notification was significantly reduced from 15.5 minutes to 12.8 minutes in the "after" period, and to 9.6 minutes when aid phones were used.
7. The primary reasons for aid phone use were vehicle disability (63.3%), information request (26.5%), and accidents (4.0%).
8. The primary dispatcher actions were sending tow trucks or other service units (39.2%), providing information (29.8%), and sending a police vehicle (15.0%).
9. Aid phone calls were made by: stopped-vehicle occupant (78%), passing motorist (15.0%), police patrol (4.0%), and others (3.0%).
10. Of the vehicle occupants making calls, 81 percent drove up to the terminal, 18 percent walked, and one percent received a ride to the nearest phone.

11. The phone system operated at 93% reliability, since seven percent of the phones were out of service at any particular time.
12. The opinion of a sample of phone users is very favorable, and indicates recognition of reduced travel delays when compared with a "before" sample.
13. The "after" study period displayed reduced incident response times of 20 percent, and reduced secondary accidents of 50 percent.
14. During the "after" study period the system phone poles were involved in 13 accidents.
15. The Motorist Aid System costs per aided call and per aided critical call for the first two years of operation are approximately $27 and $37, respectively, considering total investment.
16. The expected costs per aided call and per aided critical call for the remaining system life (8 years) are approximately $34 and $48, respectively, considering total investment.
17. The expected costs per aided call and per aided critical call considering operation costs only for the remaining eight years of the economic life of the system are approximately $13 and $18, respectively.
18. System effectiveness analysis indicates that if the adjusted reduction in secondary accidents is wholly attributed to the availability of the aid phone system, then the expected benefit-to-cost ratio for the remaining economic life of the system, considering accident reduction and time saved only, is approximately equal to the average maintenance cost, or within the 0.3 to 0.5 range for the total investment.

CONCLUSIONS AND RECOMMENDATIONS

At the outset of this project, the need for a cost-effective operation was not a critical issue since a low probability of achieving such a positive ratio

was expected in a rural environment. However, among the secondary goals which involved optimization of certain system functions, the desire for an optimal allocation of resources was also expressed.

While the study results indicate favorable trends toward achieving these goals, the utility and value of the aid phone system to the various parties and issues involved vary in degree and importance. These parties and issues are:

the motoring public

Illinois State Police

Illinois Department of Transportation

National and state policies with regard to implementing motorist aid systems on rural freeways.

Definitely, to its users the system utility is quite high. Aid-candidates were able to reduce the time to notify a service agency about their need by nearly six minutes, and the overall average reduction in time involved with an incident amounted to approximately 15 minutes. This reduced the hazard caused by the motorist in distress, as expressed in a reduced number of secondary accidents during the "after" study period. Also, the system helps to instill a sense of safety and security in the driver, knowing that if something happens, help can be reached.

The utility of the system to the State Police could not be fully evaluated because of the reorganization within the Police Districts having jurisdiction over the study section. However, a letter from the State Police states:

> "While the Illinois State Police did not encourage the original installation of the emergency call service on Interstate 80, we now believe it is very important, since we have tailored our patrols to fit this type of operation. Should the phones be removed, we concur it would require a far heavier concentration of patrols on the Interstate and with our shortage of manpower we do not feel we could absorb any extra burden at each District Headquarters in monitoring the system and serving the people using the system." (9)

This, of course, indicates that the State Police consider the system as an integral part of its service, and utilize it to its satisfaction.

The major function of the Illinois D.O.T., as of any other D.O.T., is to provide for a safe and efficient movement of people and goods. Stated as such, the availability of the motorist aid system definitely aids in fulfilling this function. In an economy with dwindling financial resources, the D.O.T. investment in services to the motoring public contributing to these resources should be based on statewide priorities, and ultimately must be based on a determination of what the budget can support. In the case of I-80 motorist aid system, where the contribution to the resources is not through its usage but through the usage of the highway facility itself, the low system benefit-cost ratio, ranging between 0.3 and 0.5, is quite a crucial issue.

Any decision with regard to the future of the system, or installing a new, similar one has to consider, among other things, the following:

public relations

degree of usage of the system by the motoring public

traffic safety

reduction of system cost through the reduction of size, and improvement of reliability while maintaining an acceptable level of service

degree of usage of C.B. radios

In order to improve the "rating" of the system among other systems or projects competing for funds there is a need to improve its benefit-cost ratio. This can be done by either increasing the benefits or reducing the cost (maintenance), or both.

The study findings indicate that, at most, 24 percent of the aid-candidates used the system, and 23 percent successfully received aid. According to suggested guidelines (1), the latter percentage indicates a marginally effective system. An increase in public awareness of the motorist aid system services could increase the usage of the system, yielding higher benefits.

The fact that nearly 83 percent of those that used the system drove up to the terminal suggests that a greater spacing of terminals could achieve similar system utilization ratio for a smaller system maintenance cost. Spacing could be even greater at the vicinity of interchanges where access to aid is less remote. The effect of greater spacing on the time saved by the motorist should not be drastic if, for instance, the spacing were to increase to two miles.

As to national and state policies with regard to implementing motorist aid system on rural freeways, conclusions with regard to some technical aspects of such a system could be made. The two-way voice communication system with callback features proves to be very effective and seems to have an edge over other communication systems, since it enables relay of full information and needs in both directions, and callback to the aid-candidate for more information when necessary.

As to the implementation of such a system on similar facilities in Illinois, the issue of the low benefit-cost ratio emerges as a critical one, though some significant intangible factors are involved. A better aspect of the issues could be achieved by comparing the motorist aid system on I-80 in Illinois with the one on I-87 in New York (10). Table 22 presents this comparison. Based on data in this table it seems that the I-80 system compares favorably with the one on I-87, even though the installation and maintenance

TABLE 22

COMPARISON BETWEEN I-80 and I-87 MOTORIST AID SYSTEMS

	I-80 System (Illinois)	I-87 System (New York)
Type of System	2-way Communication, Buried Cable, w/Call-back feature	2-Way Communication, Buried Cable w/o Call-back feature
Length (Miles)	138	179
Number of Phones	302	712
Average Spacing of Phones (Miles)	0.9	0.5
Number of Control Consoles	2	5
Total Travel (Million Vehicle-Miles)	847 (1973)	720 (1969)
System Utilization Ratio	0.24[a] (1973)	0.71[b] (1968)
Number of Accidents	723 (1973)	488 (1968)
System Cost	$1,055,300[c] (1973)	$692,234 (1968)
System Cost/Phone	$3,494	$974
Annual Maintenance Cost	$120,000 (1975)[d]	$137,500 (Yr. Unknown)
Annual Maintenance Cost/Phone	$400	$193
Maintenance Agency	Private Contractor	N.Y. Telephone Co.
Benefit Cost Ratio	0.3-0.5[e]	0.10[e]
Cost Per Aided Call	$30[f]; $28[h]	$19[g]

a. Based on one aid-candidate stop per 20,000 vehicle-miles
b. Based on expanded stopped-vehicle survey
c. Includes maintenance cost for 2 years
d. Based on 1976 low bid price
e. Benefits might not be comparable
f. Based on 10 years economic life (interest rate 8%, inflation rate 8%)
g. Based on 20 years economic life (interest rate, inflation rate, and if included, unknown)
h. Based on 20 years economic life (interest rate 8%, inflation rate 8%)

costs per phone are higher for the Illinois system, and the usage is approximately one third of that in New York.

In consideration of implementing future motorist aid systems in Illinois, a major factor should be the ability to bring the installation and maintenance costs to more attractive levels.

Based on the findings of this study and the increased usage of C.B. radios, it is recommended that a feasibility study to incorporate C.B. radios into a motorist aid system on I-80 should be conducted. However, in order to improve the benefit-cost ratio of the existing I-80 motorist aid system, should a decision be made to continue its operation, the following should be undertaken:

1. Develop and implement a public information program to increase the awareness of the motoring public to the motorist aid system and its service capabilities.
2. Study and improve the system circuitry to increase reliability and reduce maintenance costs.
3. Analyze and implement lower cost maintenance procedures and system configuration changes, reducing maintenance requirements.

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APPENDIX A

ILLINOIS STATE POLICE ASSISTANCE REPORT - SAMPLE

1-80

ILLINOIS STATE POLICE
Assistance Rendered Report

Mile Post | Ramp | Date | I.D.No. | Radio No.

1. EE _____ 3. WE _____
2. EL _____ 4. WL _____

Motorist Waiting Period | Arrival Time | Completed Time

Vehicle Registration No. | State | Vehicle Abandoned
1. Yes____ 2. No. ____

Situation:
1. Out of Gas _____ 4. Ignition Trouble _____ 7. Deliver Message _____
2. Fuel Pump _____ 5. Cooling System _____ 8. Illness/Injury _____
3. Tire/Wheel _____ 6. Direction/Info _____ 9. Other _____
(Describe)

Action Taken:
1. Call Tow Truck _____ 4. Assist In Tire Change _____
2. Transfer Fuel _____ 5. Assist With Repair _____
3. Provide Transportation _____ 6. Other _____

Person Left Vehicle: | No. of Persons In Vehicle
1. Walked _____ 3. Unknown _____
2. Rode _____

Figure A-1
Illinois State Police
Assistance Rendered Report Form

APPENDIX B

SERVICE UNIT ASSISTANCE RENDERED REPORT - SAMPLE

SERVICE UNIT - ASSISTANCE RENDERED REPORT
I-80 MOTORIST AID STUDY

NAME OF YOUR SERVICE UNIT _____

DATE SERVICE WAS PROVIDED ON I-80 _____

CALL REQUESTING YOUR SERVICE RECEIVED FROM:
☐State Police ☐Other _____

LOCATION OF ROADSIDE SCENE _____
BY MILEPOST (be as specific as possible)

MOTORIST'S VEHICLE IDENTIFICATION: (If known)

Make _____ Color _____ Year _____

State _____ License No. _____

Type _____ Owner or Driver's Name _____

TIME:

Of receiving call requesting your service _____ am, pm

Of arrival on I-80 scene _____ am, pm

Of leaving I-80 scene _____ am, pm

Of arrival at aid center (hospital, garage, etc.) if applicable _____ am, pm

Of leaving aid center, if applicable _____ am, pm

Of arrival at your base of operation _____ am, pm

DISTANCE:

From your base of operation to I-80 scene _____ miles

From I-80 scene to aid center (if applicable)_____ miles

From aid center to your base of operation _____ miles

TYPE OF SERVICE YOU PROVIDED: (check those applicable)

☐Ambulance ☐Extinguish Fire ☐Assist with Repair of _____
☐Fuel ☐Towed to _____
☐Mechanical ☐Assist in tire change ☐Other _____

AMBULANCE AND/OR MEDICAL AID:

Accident? _____ Other _____

No. requiring first aid only _____ No. of Fatalities _____

No. requiring hospitalization _____ Where taken _____

SEND MORE CARDS _____ YES _____ NO

Figure B-1
Service Unit
Assistance Rendered Report Form

APPENDIX C

PUBLIC OPINION SURVEY - QUESTIONNAIRE FORMS

DATE_____TIME_____

LOCATION_____

VEHICLE TYPE:
- ☐ Car
- ☐ Bus or Taxi
- ☐ Pickup or Panel Truck
- ☐ Single Unit Truck
- ☐ Tractor-Trailer or Semi-Trailer Truck
- ☐ Other_____

STATE AND VEHICLE LICENSE NUMBER

_____

POSITION OF VEHICLE: (when stopped)
- ☐ Right Shoulder
- ☐ Left Shoulder
- ☐ In Traffic Lanes

REASON FOR STOP:
- ☐ Gas or Oil
- ☐ Tire
- ☐ Mechanical
- ☐ Electrical
- ☐ Accident
- ☐ Other_____

INTERSTATE ROUTE 80 MOTORIST AID QUESTIONNAIRE

Your answers to the following questions will provide the Illinois Division of Highways with information on the travel needs of motorists on rural freeways. Please complete this card in relation to your vehicle stopping on Interstate Route 80 and mail it - postage free. Thank you for your cooperation.

1. DID YOU NEED ASSISTANCE?___Yes___No DID YOU GET ASSISTANCE?___Yes___No
2. HOW WOULD (DID) YOU TRY TO SUMMON HELP?___Signals on vehicle;___Walk to Service:___Passing Vehicle;___Police;___Don't know;___Other_____
3. WERE YOU (OR WOULD YOU BE) HESITANT TO LEAVE YOUR VEHICLE? ___Yes___No
4. HOW LONG DID YOU HAVE TO WAIT FOR ASSISTANCE?_____
5. WERE YOU UNDULY DELAYED IN BEING DETECTED___Yes___No OR RECEIVING SERVICE? ___Yes___No
6. HOW LONG DID YOU EXPECT TO WAIT FOR A POLICE PATROL TO STOP?_____
7. WHO PROVIDED YOU WITH ASSISTANCE AND/OR SERVICE?_____
8. WERE YOU FAIRLY CHARGED FOR SERVICE? ___Yes___No
9. WERE THE SERVICE PERSONNEL COURTEOUS AND COMPETENT? ___Yes___No
10. WOULD YOU LIKE TO SEE INCREASED MOTORIST AID SYSTEMS, SUCH AS:
    - ☐ Increased police patrol
    - ☐ Patrol by private service trucks
    - ☐ Free aid-telephones along road
    - ☐ Push button signal boxes along road
    - ☐ Patrol by public owned service trucks
    - ☐ Pay telephones along road
    - ☐ Existing system is best
    - ☐ Other_____
11. HOW FAR WOULD YOU CONSIDER WALKING FROM A DISABLED VEHICLE TO REACH A ROADSIDE PHONE OR CALL BOX?_____
12. HOW MUCH WOULD THE CONVENIENCE OF A ROADSIDE PHONE OR CALL BOX BE WORTH TO YOU IN OBTAINING FUTURE SERVICE? $_____ ☐ No opinion
13. IF YOU NEED HELP AT THE ROADSIDE, HOW LONG SHOULD YOU HAVE TO WAIT FOR SERVICE OF THE FOLLOWING TYPE?
    Ambulance_____Fire Dept._____Service Truck_____

Figure C-1
"Before" Study Questionnaire Form

DATE _____ TIME _____

LOCATION _____

INTERSTATE ROUTE 80 MOTORIST AID QUESTIONNAIRE

Your answers to the following questions will provide the Illinois Dept. of Transportation with information on the travel needs of motorists on rural freeways. Please complete this questionnaire in relation to your vehicle stopping on Interstate Route 80 and mail it - postage free. Thank you for your cooperation.

VEHICLE TYPE:
- ☐Car
- ☐Bus or Taxi
- ☐Pickup or Panel Truck
- ☐Single Unit Truck
- ☐Tractor-Trailer or Semi-Trailer Truck
- ☐Other _____

STATE AND VEHICLE LICENSE NUMBER

_____

POSITION OF VEHICLE (WHEN STOPPED)
- ☐Right Shoulder
- ☐Left Shoulder
- ☐In Traffic Lanes

REASON FOR STOP
- ☐Gas or Oil
- ☐Mechanical
- ☐Tire/Wheel
- ☐Electrical
- ☐Accident
- ☐Other _____

1. DID YOU NEED ASSISTANCE?___Yes ___No DID YOU GET ASSISTANCE?___Yes ___No
2. DID YOU KNOW THERE WERE AID PHONES AT ONE-MILE SPACING?___Yes ___No
3. WHEN DID YOU FIRST BECOME AWARE OF THE MOTORIST AID PHONE SYSTEM?
   - ☐Prior to this trip, or
   - ☐When I saw  or ☐When I saw 
   - ☐Other _____
4. HAVE YOU HEARD ANY UNFAVORABLE PUBLICITY OR COMMENTS REGARDING THE AID PHONE SYSTEM?___Yes ___No. IF YES, PLEASE EXPLAIN _____
5. DID YOU USE THE AID PHONE SYSTEM? ___Yes ___No. IF YES, HOW DID YOU GET TO THE AID PHONE? ☐Drove up ☐Walked ☐Got ride
   IF NO, WHY NOT? _____
6. WERE YOU ABLE TO SEE AN AID PHONE FROM WHERE YOU STOPPED?___Yes ___No
7. DO YOU THINK ONE-MILE PHONE SPACING IS ☐Too far ☐About right ☐Too close
8. WERE YOU (OR WOULD YOU BE) HESITANT TO LEAVE YOUR VEHICLE?___Yes ___No
9. WHAT DO YOU THINK OF THE MOTORIST AID 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. ☐A need for better motorist aid exists. I suggest _____
10. WERE YOU UNDULY DELAYED IN BEING DETECTED OR RECEIVING SERVICE? ___Yes ___No
11. HOW LONG DID YOU EXPECT TO WAIT FOR A POLICE PATROL TO STOP? _____
12. WHO PROVIDED THE ASSISTANCE AND/OR SERVICE? _____
13. WERE YOU FAIRLY CHARGED FOR SERVICE? ___Yes ___No
14. WERE THE SERVICE PERSONNEL COURTEOUS AND COMPETENT? ___Yes ___No
15. IF YOU NEED ASSISTANCE IN THE FUTURE, WOULD YOU USE A MOTORIST AID PHONE? ___Yes ___No

Figure C-2
"After" Study Questionnaire Form

APPENDIX D

I-80 MOTORIST AID COMMUNICATION SYSTEM ACTIVATION REPORT - SAMPLE

DATE: _____ Month _____ Day _____ Year | DAY OF WEEK: S(L) M T W T(H) F S
C.C.1-2 C.C.3-4 C.C.5(Last Digit) C.C. 6

MILITARY TIME: _____ C.C. 7-10 | LOCATION/TERMINAL NO. _____ E. _____ W. _____
C.C.11-14 (omit decimal in coding) C.C.15

DIRECTION OF TRAVEL: ___E ___W ___Unrecorded (Coded Blank) C.C.16 | Sex of Caller: ___M ___F C.C. 29

CALLER: _____Driver/Passenger (1) _____Passing Motorist (2) _____Police (3) ___Other_____ (4) C.C. 17

WALK-UP FACTOR: _____Walked to Terminal (1) ___Drive Up (2) ___Received Ride (3) ___Unknown (Coded blank) C.C. 18

REASON FOR CALL: C.C.19-20 & 21-22 (Max. of 2 coded)
_____Make Phone Call (1) _____Directions/Info. (2) _____Sickness (3)
_____Highway Conditions (4) _____Car in Ditch (5)

FIRE: _____In Vehicle (6) _____On Roadside (7) ____Other_____ (8)

ACCIDENT: _____With Injuries (9) ____Without Injuries (10) _____Unknown (11)

DISABILITY: _____Out of Gas or Oil (12) _____Fuel System (13) ____Tire/Wheel (14) ____Fan Belt (15)
_____Cooling System (16) ____Electrical System (17) ____Transmission (18)
_____Mechanical (19) ____Unknown (20) ____Other_____ (21)

OTHER: _____ (22)

DISPATCHER ACTION: C.C. 23-24 (Max. of 2 codes)
_____Directions/Info (1) _____Police (2) _____Fire Unit (3)
_____Ambulance (4) _____Tow Truck (5) _____Service Unit (6)
_____Phone Call (7) _____Other_____ (8)

VEHICLE: C.C. 25-26
_____Passenger (1) _____Station Wagon (2) _____Pickup/Panel (3) _____Car W/Trailer (4)
_____Single Unit Truck (5) _____Combination Truck (6) _____Truck (Unknown Type) (7)
_____Bus (8) _____Motorcycle (9) ____Bicycle (10) _____Motor Home (11)
_____Other_____ (12)

State _____ (Use std. codes) C.C. 27-28 License No. _____ C.C.38-73

Make _____ C.C.38-73 Year _____ C.C.38-73 Color _____ C.C. 38-73

TYPE OF ACTIVATION: C.C. 30
New Incident, Request or Information (1)_____
Repeat Call by a Distressed Motorist (2)_____
Call by a Passing Motorist for a Previously Reported Incident (3)_____
Call Back by the Trooper (4)_____
Call with no Answer (Failure) (5)_____
Testing only (6)_____

Figure D-1
I-80 MOTORIST AID COMMUNICATION SYSTEM
ACTIVATIONS REPORT FORM

APPENDIX E

USAGE OF MOTORIST AID PHONE SYSTEM

1. Request for Vehicle Service - Script
2. Notification of Accident - Script

REQUEST FOR VEHICLE SERVICE

Police: State Police, can I help you?

Person: Yes, I had a flat tire on I-80 going eastbound at milepost 90 and need help because of no spare or jack.

Police: Is the number on the telephone you are calling from, 97.2E?

Person: Yes

Police: I can call a service truck out to help you if you want. You understand this is a private service truck.

Person: That would be fine.

Police: Do you have any preference?

Person: Yes, I have a Standard credit card.

Police: OK, there is a Standard service station at the next exit; I'll send him out. What kind of vehicle do you have?

Person: I have a blue 1968 Chevy station wagon.

Police: What state is the car licensed and what is the number?

Person: It has an Illinois license with the number 765 432. Do you have any idea how long it will take them to get out here?

Police: No, but I will call him right away and then it depends how busy he is. If he can't make it, will it be alright if I call another service station?

Person: Yes, I have money on me.

Police: OK, go back to your car and wait for the service truck.

Person: Thank you.

NOTIFICATION OF ACCIDENT

Police: State Police

Lady: Yes, there has been an accident on I-80. There is a car flipped over in the median about -

Police: 5 miles East of 55

Lady: Yea

Police: Is anyone injured?

Lady: I am not sure, we just passed by and went to the next phone.

Police: Alright, we'll get a car out there right away.

Lady: I think there is somebody hurt though.

Police: Alright, we'll get a car out there right away.

Lady: OK, thank you, bye.

DUPLICATE CALL

Police: State Police

Man: Hello

Police: Yes

Man: Uh yes, I'm on Route 80

Police: Yes, the accident we have a squad car and ambulance enroute.

Man: You do, I didn't know if anybody had called.

Police: Yea, right, these motorist aid phones are a godsend.

Man: Yea, thank you very much.

Police: Thank you for calling.