ELEVENTH ANNUAL REPORT OF MICHIGAN'S OVERALL HIGHWAY SAFETY IMPROVEMENT PROGRAM

July 1, 1983 - June 30, 1984

MICHIGAN DEPARTMENT OF TRANSPORTATION

August 31, 1984

This report was prepared by the Traffic and Safety Division. The opinions, findings, and conclusions expressed in this publication are those of the Traffic and Safety Division and not necessarily those of the Federal Highway Administration.

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Introduction

This is the Eleventh Annual Report of Michigan's Highway Safety Improvement Program. The report covers the period July 1, 1983 through June 30, 1984.

The Highway Safety Program summary format on page 4, is different this year. We have attempted to differentiate projects which were justified and programmed based on safety factors from those which, although enhancing safety, were justified by other factors or which include some safety work. Examples of work in the latter categories include shoulder paving, resurfacing where coefficients of friction were less than desirable or where the percentage of "wet" accidents were greater than average, the elimination or modification of roadside obstacles incidental to reconstruction projects, additional laneage at intersections, new or modified traffic control devices, utility pole relocations and roadside driveway control. In general, the "safety justified projects" were identified and selected following the Highway Safety Improvement Process outlined in the Appendix of this report. Over $41 million of "safety justified" projects were identified in this years report, in addition to $133.4 million of "safety related" work.

Safety is an important factor in the development of most projects authorized by this department. The shift this past year to 3R/4R type projects and the requirement that such projects incorporate "safety enhancements" witnessed increased emphasis on the review of project design plans, with particular attention to the roadside environment and to locations experiencing documented concentrations of accidents. Where dictated, additional safety enhancements were incorporated into project plans as the result of those reviews.

During the period covered by this report total department expenditures attributed to the Interstate 4R program and the Federal Aid Urban, Primary, and Secondary programs totaled about $209 million. We estimate that approximately $81 million were for safety related items.

Approximately $9 million in justified safety projects were recommended for programming this past year by the Traffic and Safety Division's Safety Programs Unit, which are not included in the categorical program summary. Many of these projects will be funded using other than HES funding sources. It is our intention to develop a monitoring system which better documents projects justified primarily by safety considerations, or other accepted safety criteria, and which are funded by sources other than the categorical programs.

This report includes evaluation of the HES program. The evaluation includes statistical control which assess accident trends and "expected" changes in before-and-after accidents as initiated in last years report and as recommended by the 1984 federal audit of the HES program.

Also in this report is a summary of the current structure and operating practices of the Safety Programs Unit of the Traffic and Safety Division. That group has primary department responsibility for carrying out the Safety Improvement Process on the state trunkline system. A revision of that process is included in the appendix for review and approval by the FHWA.

This report also includes a Special Projects, Studies, and New Developments Section, as has been the custom in recent years.

Highway Safety in Michigan - The Year in Review

Michigan experienced its fifth consecutive highway fatality reduction during 1983. There were 1,331 deaths statewide, six percent fewer than reported in 1982. The total was 36 percent below the 2,076 killed in 1978 and 46 percent less than the 2,487 fatalities recorded in 1969, the highest on record. Total accidents and injuries were also down in 1983 to 300,800 and 135,800 respectively.

The 1983 fatality rate was less than 2.1 per 100 million vehicle miles--the lowest ever. This is substantially less than the 2.6 rate nationwide in 1983 and reflects a sharper fatality rate decrease since 1980 than reported nationally.

It is customary and accurate to credit the reduction of highway accidents, injuries, and fatalities to the combined effects of several factors, notably improved vehicle designs, increased and selectively targeted enforcement activities, educational efforts and, of course, improved highway designs and the implementation of corrective accident countermeasures.

Often these efforts are uncoordinated and even appear to be in conflict with one another. In Michigan, however, the various safety interests have come together in an effective coalition representing highway safety. Major success in recent years of the coalition include passage of one of the nation's first child restraint laws and the adoption of stricter drunk driving laws and establishment of the Michigan Drunk Driving Task Force.

Although a major disappointment was the failure of our legislature to adopt the nation's first mandatory occupant restraint law, we are confident that the recently enacted New York law, legislative initiatives in Congress, and incentives incorporated into the recent passive restraint regulations, will witness an occupant restraint law in Michigan in the near future. Studies indicate that occupant restraint use in Michigan has increased to about 18 percent and that the child restraint law resulted in significant injury reductions in the youngest age groups.

Enforcement efforts in Michigan were increasingly focused on the drunk driver. Arrests for drunk driving increased from 39,000 in 1982 to 46,000 in 1983. It was disappointing, however, that the rate of involvement of drunk drivers in total accidents remained at 56 percent. Efforts to combat this problem, generally recognized as the most serious obstacle to continued highway safety casualty reductions will continue. The Drunk Driving Task Force, in an interim report, defined 17 recommendations covering legislation, education/training, and policy and program evaluation. In addition, the Michigan Office of Highway Safety Planning is actively promoting and funding innovative alcohol enforcement and educational programs directed at younger drivers. One of the most significant new legislative initiatives being discussed in Michigan at this time is sobriety check lanes. This, of course, is a very controversial public issue and will be subjected to substantial debate in the coming months.

Highway safety benefitted, as did most transportation programs, from increased revenues during 1983. Increased user fees authorized by our legislature and by Congress combined with a $135 million state transportation bond issue enabled the department to undertake its biggest highway improvement program in years. The major safety program effort this past year was to insure that all of the many pavement rehabilitation, restoration, and reconstruction projects corrected documented accident concentrations and enhanced the overall safety of the road. Last year 360 sets of road construction plans and 100 bridge improvement project plans were reviewed to insure that enhanced safety was a priority consideration of the design process. All of the bridge projects and 15 of the road projects included review and analysis of reported accident experience.

Tort litigation involving Michigan's state trunkline highways is of growing concern. In spite of the lowest highway death rate ever in Michigan, partly the result of highway safety improvements totaling hundreds of millions of dollars, the number of negligence lawsuits continues to escalate.
The volume of active suits against the department increased from 215 in 1979-80 to more than 400 in 1983. Costs increased at a parallel rate. Judgment and settlement payouts in the last five years totaled approximately $27 million, and it is possible that payouts in Fiscal 1984 alone could exceed $20 million if $7 million in judgments under appeal are upheld.

Some of the causes of the sharp upturn include: progressive loss of governmental immunity, adoption of "no fault" insurance in Michigan, replacement of "contributory" negligence with "comparative" negligence and progressive expansion by the courts of the definition of "the traveled way" portion of the roadway intended for vehicle travel to include the entire right-of-way. Further aggravating the problem are trends in judicial interpretation which assign liability for damages in accordance with ability to pay, rather than degree of negligence, and permitting damage awards to uninjured parties for loss of "companionship and society."

Compliance with the 55 mph speed limit also continues to be of concern. Federal transportation funds are threatened by the slow but steady escalation of speeds in Michigan and in other states. Federal law provides for a penalty of up to 10 percent of funds allocated for primary, secondary, and urban systems highways if more than half of a state's motorists exceed the speed limit on roadways with a 55 mph limit. The official 1983 tally showed 51.5 percent of Michigan drivers stayed within the limit.

In spite of these problems, we continue to be optimistic that further reductions in accidents, injuries, and deaths are possible. With continued federal support, we will work to achieve those reductions.

Highway Safety Program Summary (Obligated)
July 1, 1983 - June 30, 1984

	Safety Justified Projects	Safety Related Projects or Parts of Projects
Federal Categorical		
Hazard Elimination	3,148,993	
Rail Highway	8,191,284	
Pavement Marking	164,326	
Special Bridge		
Local System		46,321,080
State System		2,783,162
Other Federal Funds		
Interstate	7,799,957	16,078,986
Primary	14,114,414	8,073,353
Secondary		8,973,844
Urban		26,344,877
State Funded	1,703,448	
State/Local Match	5,955,188	24,862,443
Total	41,077,610	133,437,745

Federal Funding of Highway Safety Improvements in Michigan

As of June 30, 1984, Michigan had obligated $116 million or 93 percent of its total apportioned combined federal aid safety construction funds. That total includes obligations from the various categorical programs as follows:

Program	Obligated (Millions)	% of Apportionment
Rail Highway Combined		
On System	$51.6	92%
Off System	6.1	99%
HES	33.6	89%
HH, ROS	9.6	100%
Pavement Marking	15.1	99%

From July 1, 1983, to June 30, 1984, $11,504,603 was obligated from the various categorical funds (not including the special bridge replacement program on the state and local systems). Hazard Elimination obligations totaled $3,148,993, Rail/Highway obligations $8,191,284, and Pavement Marking program obligations $164,326. In addition to the Pavement Marking Program funds obligated during this past fiscal year, the department allocated approximately $5 million to maintenance of pavement markings on our state trunkline system.

As noted on the "Highway Safety Program Summary" $7.8 million of Interstate and $14.1 million of Federal Aid Primary funds were obligated for projects primarily justified based on safety. In addition the "summary" documents $108.6 million from the Special Bridge Replacement program, Interstate, and Federal-Aid Primary, Secondary, and Urban funds for safety related projects or for parts of projects which include safety items.

The Pavement Marking and Rail/Highway Crossing programs were evaluated in some detail in previous reports. In response to Federal Highway Administration concerns, additional "before" and "after" project data for rail/highway safety projects was included in last year's report. Since selection of Rail/Highway crossing projects are not based primarily on documented accident data, evaluation of before-and-after accident data on an annual basis is not justified. However evaluation of the Hazard Elimination program is also once again included in this report.

Following is Table 1, (Procedural and Status Information) and Tables 3 and 4, pertinent to the Pavement Marking Demonstration program.

TABLE 1

STATE: Michigan | FIPS CODE (Alpha): M I

HIGHWAY SAFETY IMPROVEMENT PROGRAM
ANNUAL REPORT 1984
PROCEDURAL AND STATUS INFORMATION

Line	Highway System	HIGHWAY LOCATION REFERENCE SYSTEMS: Miles Covered (Percent) (1)	Expected Completion (Year) (2)	Type of Location Reference Method (3)	TRAFFIC RECORDS SYSTEM: Types of Data Collected and Maintained (4)	Automated Correlation of Accident and Highway Data (Percent) (5)	Automated Correlation of Accident and Volume Data (Percent) (6)
101	Interstate	100	N/A	M	AHT	100	0
102	State - F.A.	100	N/A	D-II	AHT	100	100
103	State - Non-F.A.	100	N/A	D-II	AHT	100	100
104	Local - F.A.	100	N/A	D-II	AT	100	0
105	Local - Non-F.A.	100	N/A	D-II	AT	100	0

Line	Highway System	HAZARD ELIMINATIONS: Criteria for Identifying Hazardous Locations, Sections and Elements *(7)	Criteria for Setting Project Priorities *(8)	RAILROAD-HIGHWAY GRADE CROSSINGS: Inventory Update *(9)	Project Priority Selection *(10)	Compliance With MUTCD: Crossings Upgraded **7/1/73-6/30/82 (11)	Not Complying: Number (12)	Not Complying: % (13)	Compliance Target Date (14)
201	Interstate	AEHLRS	CEIPTV						
202	State - F.A.	AEHRS	CEIPTV	B	AHIMPTVW	N/A	0	0	N/A
203	State - Non-F.A.	AEHRS	CEIPTV	B	AHIMPTVW	N/A	0	0	N/A
204	Local - F.A.	AEHRS	CHIPTV	B	AHIMPTVW	N/A	0	0	N/A
205	Local - Non-F.A.	AEHRS	CHIPTV	B	AHIMPTVW	N/A	0	0	N/A

F.A. = Federal-Aid
* = If more than one code applies, show all appropriate codes.
** = See instructions.
Describe "Y" Codes on separate sheet and attach to this table.

Indicate reporting period:
7/1/73-6/30/84 ____
7/1/81-6/30/84 ____

TABLE 3

Michigan — M I — FIPS CODE (Alpha)

PAVEMENT MARKING DEMONSTRATION PROGRAM

ANNUAL REPORT 1984

QUANTITIES AND COST OF MARKINGS PLACED

TYPE OF MARKINGS PLACED	QUANTITIES AND COST ($1,000) OF MARKINGS PLACED, *JULY 1, 1983 TO JUNE 30, 1984										Total Quantities and Cost of Markings Placed July 1, 1983 To June 30, 1984		Cumulative Total Miles and Cost of Markings Placed To June 30, 1984	
	FEDERAL-AID SYSTEM						OFF THE FEDERAL-AID SYSTEM							
	Urban		Primary		Secondary		State Jurisdiction		Local Jurisdiction					
	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost
Centerlines Only			714.2	124.5							714.2	124.5	51,980	6,830
Edgelines Only			395	38.7							395	38.7	41,846	3,922.5
Both Centerlines and Edgelines													17,375	2,852.6
Sub Total	-0-	-0-	1,109.2	163.2	-0-	-0-	-0-	-0-	-0-	-0-	1,109.2	163.2	111,201	13,605
	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost		
Railroad-highway Grade Crossings			12 ea.	1.1							12 ea	1.1		
Pedestrian Crossings 1/														
Other (Describe)														
GRAND TOTAL				164.3								164.3		

*If reporting period is other than July 1, 1983 to June 30, 1984 indicate dates: __________

1/ Show number of intersections in "Quantity" column.

Table 4

PAVEMENT MARKING DEMONSTRATION PROGRAM

ANNUAL REPORT 1984

TOTAL MARKINGS REMAINING TO BE PLACED

State Michigan

M	I

FIPS CODE (Alpha)

TYPE OF MARKINGS TO BE PLACED	QUANTITY BY SYSTEM							GRAND TOTAL
	FEDERAL-AID SYSTEM				OFF THE FEDERAL-AID SYSTEM			
	Urban	Primary	Secondary	Total	State Jurisdiction	Local Jurisdiction	Total	
Centerline Miles Only								
Edgeline Miles Only								
Miles of Both Center and Edge lines								
TOTAL MILES	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Railroad-Highway Grade Crossings								
Pedestrian Crossings (Number of Intersections)								
Other (Describe)								

HES SAFETY PROGRAM EVALUATION DATA

Twenty-nine federally funded HES safety improvement construction projects were evaluated for this year's annual safety report. The projects included lane widenings, realignments, signal upgradings, and various other roadway and roadside safety improvements.

Accident data was collected before-and-after each project and is summarized on Table 2 found on pages 12-14. When possible, three years of before and after data was collected and the average before/after period was 2.36 years. The 29 projects experienced a cumulative total of 3,304 accidents in the "before" period, 1,019 resulting in injuries and 11 in fatalities. In the "after" period, the project locations experienced 2,439 crashes, including 756 involving injuries and 11 involving fatalities. The total cost of the 29 projects was $10.74 million. An annual accident savings of $1.21 million resulted in a project time-of-return (TOR) of 8.9 years. This is less than the 10-year TOR goal for safety projects.

Safety Project Accident Data, Costs, and TOR

Before				After			
Fatal	Injury	PD	Total	Fatal	Injury	PD	Total
11	1019	2274	3304	11	756	1672	2439

Before accident costs $13.59 million   After accident costs $10.73 million

Savings $2.86 million
Annual Savings $1.21 Million (Based on 2.36 Years)
Projects Costs $10.74 million
TOR 8.9 years

Statistical Evaluation of
Federal Funded HES Safety Projects

Project Type	B_{pf}	A_{pf}	A_{cf}/B_{cf}	A_{padt}/B_{padt}	E_f	% Reduc.	Significant?
All Projects (29)	3,304	2,439	0.839	1.023	2,835	13.9	Yes
1A, 1G, 3B (Lane Widening - (12 Projects)	822	557	0.811	1.047	698	20.2	Yes
3B, 3E (Realignment - 4 Projects)	42	12	0.775	1.062	34	64.7	Yes
1F (Upgrade Signals - 4 Projects)	640	511	0.811	1.021	529	3.4	No
18, 1C, 2E, 3F, 3K (Miscellaneous 9 Projects)	1,800	1,359	0.775	1.007	1,405	3.3	No

B_{pf} = Before Period Accident Frequency

A_{pf} = After Period Accident Frequency

A_{cf}/B_{cf} = After Control Group Accident Frequency/Before Control Group Accident Frequency

A_{padt}/B_{padt} = After Period ADT/Before Period ADT

E_f = After Expected Accident Frequency

The "time-of-return" method of analyzing project cost/benefit, while simple and easily understood, does not account for changes in accident experience over time resulting from other factors. As a result, and as utilized last year, evaluation techniques endorsed by the FHWA in Evaluation of Highway Safety Projects (January 1979), were also used to analyze the 29 projects. Specifically, the Poisson technique, 95 percent level of confidence was used. In most cases three years of "before" accident data was compared with three years of "after" data. The expected "after" period accident frequency (E_f) was calculated using the following formula:

$$E_f = B_{pf} \frac{(\text{After Project ADT})\ (A_{cf})\ (\text{Before Control ADT})}{(\text{Before Project ADT})\ (B_{cf})\ (\text{After Control ADT})}$$

Evaluation of "all" projects utilized statewide accident data as the control. Since statewide control ADT decreased only about an average of one percent per year, this term was deleted. Incorporation of this factor would have improved the project results slightly. The expected accident frequency (E_f) was then used to compute the percent reduction, and the statistical significance was determined by using the Poisson curve at the 95 percent confidence level. The total program showed a significant reduction in accidents of 13.9 percent beyond that "expected." The actual reduction was about 26.2 percent.

In addition, certain project types were evaluated where a sufficient sample size was available. the types evaluated, individually and in combination, included lane widenings, realignments, signal upgrading, and other roadway and roadside safety improvements. Project type codes indicated on the following table are those developed by the FHWA. The statistical evaluation of the specific project types utilized, as controls, accident data for state trunkline signalized intersections, nonsignalized intersections, or nonintersection segments.

As indicated in last years evaluation report, although instructions for completing the table indicate that only one project type code should be used, we do not believe that the noted multiple project subgroups can be evaluated independently. For instance, construction of a left-turn lane in conjunction with installation of a new traffic signal cannot (or should not) be evaluated as an individual project since the change in accident experience is a function of both.

As the statistical evaluation indicated, all of the project types evidenced statistically significant accident reductions except two - signal upgrading and "miscellaneous." Both of these project types did, however, reflect actual accident reductions at a level greater than "expected."

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Michigan | M | I |
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TABLE 2
HIGHWAY SAFETY IMPROVEMENT PROGRAM AND
PAVEMENT MARKING DEMONSTRATION PROGRAM
ANNUAL REPORT 198
EVALUATION DATA FOR COMPLETED IMPROVEMENTS

Line	Safety [illegible] Program (1)	Safety Classification Code (2)	Total Cost of Evaluated Improvements ($1000) (3)	Quantity of Improvements (4)	Units (5)	NUMBER OF ACCIDENTS: Before: Mos. (6)	Fat. (7)	Inj. (8)	PDO* (9)	Tot. (10)	After: Mos. (11)	Fat. (12)	Inj. (13)	PDO* (14)	Tot. (15)	Evaluation Status (16)	Exposure Information: Before AADT (17)	After AADT (18)	(19)	Rural or Urban (20)	Number of Lanes (21)	Divided or Undivided (22)
01	HE	1A	9.4	1	X	52	0	7	9	16	32	0	3	3	6	F	6,200	6,800		R	2	U
02	HE	1A3B	344.0	1	X	24	0	7	16	23	24	0	3	9	12	F	6,690	7,000		R	2	U
03	HE	1A3B	225.1	1	X	31	0	19	24	43	31	0	4	27	31	F	13,950	14,700		U	4	D
04	HE	1A3B	1,341.5	1	X	36	0	44	68	112	36	0	33	46	79	F	31,500	31,800		R	4	U
05	HE	1A3B	775.2	1	X	20	0	16	23	39	20	0	5	18	23	F	21,700	22,400		U	4	U
06	HE	1A3B	3,025.2	2.39	M	36	0	97	181	278	36	0	64	121	185	F	15,000	15,800		R U	2 4	U U
07	HH	1A1G3B	38.3	1	X	20	0	4	14	18	20	0	3	10	13	F	5,600	5,900		R	2	U
08	HE	1G3B	72.6	2	X	36	0	8	16	24	36	0	13	27	40	F	9,700	10,900		R	4	U
09	HE	1G3B	906.5	1	X	36	0	14	16	30	36	0	17	27	44	F	29,800	30,900		R	4	U
10	HE	3B	176.4	1	X	31	0	8	48	56	31	0	9	31	40	F	8,600	8,800		U	2	U
11	HE	3B3F	601.2	1		30	0	44	71	115	30	0	28	36	64	F	9,500	9,800		U	4	U
12	HE	1G	15.9	1	X	36	0	29	39	68	28	0	14	6	20	P	8,360	9,425		R	2	U
13																						
14	SUB	TOTALS	7,531.3				0	297	525	822		0	196	361	557							
15																						

*Threshold for reporting PDO accidents that are included in this Table (i.e., minimum dollar value, towaway, etc.) $200

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ANNUAL REPORT 198
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Line	Safety [illegible] Program (1)	Safety Classification Code (2)	Total Cost of Evaluated Improvements ($1000) (3)	Quantity of Improvements (4)	Units (5)	NUMBER OF ACCIDENTS Before Mos. (6)	Before Fat. (7)	Before Inj. (8)	Before PDO* (9)	Before Tot. (10)	After Mos. (11)	After Fat. (12)	After Inj. (13)	After PDO* (14)	After Tot. (15)	Evaluation Status (16)	Exposure Information Before AADT (17)	After AADT (18)	(19)	Rural or Urban (20)	Number of Lanes (21)	Divided or Undivided (22)
01	HE	1F	55.7	1	X	29	0	49	105	154	29	0	37	75	112	F	31,200	31,600		R	5	U
02	HE	1F	55.3	1	X	29	0	70	129	199	29	0	37	88	125	F	31,700	32,000		R	5	U
03	HE	1F	54.9	1	X	29	0	26	68	94	29	0	34	76	110	F	28,400	28,900		R	5	U
04	HE	1F	55.1	1	X	29	1	60	132	193	29	1	47	116	164	F	31,700	33,100		R	5	U
05																						
06	SUB	TOTALS	221				1	205	434	640		1	155	355	511							
07																						
08	HE	3B3E	534.2	0.6	M	26	0	3	4	7	26	0	2	0	2	F	4,200	4,400		R	2	U
09	HE	3E	57.3	1	X	20	0	0	0	0	36	0	0	1	1	F	1,200	1,400		R	2	U
10	HE	3E	243.1	1	X	29	0	8	9	17	29	0	2	4	6	F	1,490	1,580		R	2	U
11	HE	3E	260.5	0.47	M	29	0	6	12	18	20	0	1	2	3	F	1,490	1,520		R	2	U
12																						
13	SUB	TOTALS	1,095.1				0	17	25	42		0	5	7	12							
14																						
15																						

*Threshold for reporting PDO accidents that are included in this Table (i.e., minimum dollar value, towaway, etc.) $200

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Line	Safety Improvement Program (1)	Safety Classification Code (2)	Total Cost of Evaluated Improvements ($1000) (3)	Quantity of Improvements (4)	Units (5)	NUMBER OF ACCIDENTS Before Mos. (6)	Before Fat. (7)	Before Inj. (8)	Before PDO* (9)	Before Tot. (10)	After Mos. (11)	After Fat. (12)	After Inj. (13)	After PDO* (14)	After Tot. (15)	Evaluation Status (16)	Exposure Information Before AADT (17)	Exposure Information After AADT (18)	(19)	Rural or Urban (20)	Number of Lanes (21)	Divided or Undivided (22)
01	RO	1C	363.4	1.5	M	36	4	214	548	766	36	6	134	403	543	F	11,000	11,200		R	4	D
02	HE	1C	817.6	1.0	M	11	2	56	174	232	10	0	63	173	236	F	84,800	84,800		U	6	D
03	HE	Parking Removal	307.9	1.3	M	31	1	104	343	448	31	2	84	183	269	F	44,000	43,900		U	6	D
04	HE	2E	980.3	1	X	29	0	4	24	28	29	2	5	37	44	F	1,300	1,400		R	2	U
05	HE	3A	147.5	0.6	M	23	0	3	2	5	23	0	2	0	2	F	1,100	1,200		R	2	U
06	HE	3F	81.7	1	X	36	0	14	22	36	36	0	11	23	34	F	24,100	24,800		U	4	U
07	HE	3K	63.9	4	X	36	1	4	16	21	27	0	2	10	12	F	9,000	9,150		R	2	U
08	HE	30 3R	229.1	2.06	M	36	2	100	159	261	36	0	98	117	215	F	32,000	32,100		U	6	D
09	HH	1B	160.2	2	X	24	0	1	2	3	24	0	1	3	4	F	15,150	15,300		R	4	D
10																						
11	SUB	TOTALS	5,213.5				10	500	1,290	1,800		10	400	949	1,359							
12																						
13		TOTALS					11	1,015	1,278	3,304		11	756	1,672	2,439							
14																						
15																						

*Threshold for reporting PDO accidents that are included in this Table (i.e., minimum dollar value, towaway, etc.) $200

Safety Program Activities

A Safety Improvement Process was first outlined in our Eighth Annual Report in 1981. This years report includes an updated, revised Safety Improvement Process, located in the Appendix.

As outlined in last years report, engineering evaluation and analysis on the state trunkline system continues to be the primary responsibility of the Traffic and Safety Division's Safety Program Unit. Changes in the organizational structure of the Safety Programs Unit and activities, this past year, of its work groups are discussed below.

Crash Analysis/Roadside Safety Program

This past year we combined our Crash Analysis and Roadside Safety teams into one group in response to personnel reductions which necessitated reassessment of program activities. This eliminated some duplication of effort and resulted in a more efficient operation by merging the identification and evaluation of on road and off road accidents. The Crash Analysis/Roadside Safety group evaluates approximately 1,500 trunkline locations which exceed predetermined threshold numbers of total accidents or accident types (including ran-off-road), in a two-year period. A more detailed discussion of the data analysis/evaluation project selection process is included in the appendix "Safety Improvement Process."

A continuing activity of the Crash Analysis/Roadside Safety group is the systematic improvement of guardrail on the state trunkline system. The Traffic and Safety Division is completing an extensive guardrail inventory which identifies guardrail type, post condition, height, lateral offset, and type of guardrail ending.

The inventory has identified several guardrail elements which warrant upgrading. A plan is being developed to prioritize guardrail upgrading projects based on all of the elements included in the inventory and also traffic volume. This method will ensure that the most cost-effective guardrail improvement projects are selected for implementation.

The Federal Highway Administration now requires a safety analysis on all 4R type projects. Last year approximately 100 accident analyses were conducted for bridge projects and ten to 15 more extensive reviews for road projects. In addition, approximately 460 sets of design plans were reviewed to ensure that they were in accord with safety standards and criteria. Crash Analysis/Roadside Safety personnel also function as consultants to the Design Division and other Traffic and Safety Division personnel on matters involving crash analysis and roadside safety.

In an effort to promote more widespread sensitivity to safety, several slide presentations were presented to Construction, Design, and Traffic and Safety Division personnel. These presentations illustrate potential safety improvements which can result from safety awareness in design and construction.

TOPICS Program

The Traffic Operations Program to Increase Capacity and Safety (TOPICS) is the traffic engineering element of the department's Transportation System Management (TSM) process. The program intent is to provide recommendations for improving traffic safety and operational efficiency on the existing roadway system of Michigan's 13 urbanized areas and 17 "smaller communities" with populations exceeding 10,000.

The program encompasses both state trunklines and local streets in order to assure a comprehensive, integrated effort to identify and solve traffic engineering problems. The local street review is accomplished by our Community Assistance group (discussed elsewhere in this section). This activity is funded by Federal Section 402 funds distributed through the Office of Highway Safety Planning. The TOPICS reviews are closely coordinated with the Metropolitan Planning Organization (MPO) in the 13 urbanized areas and with appropriate local officials in the smaller communities.

Program activities include data collection and analysis, identification of corrective countermeasures, preparation of a written report of the findings and recommendations, identification of funding sources, and before-and-after evaluation of implemented recommendations.

Data analysis focuses on accidents, capacity deficiencies, signal system optimization, and identification of unwarranted signals. As reported last year, one major difficulty in this study phase has been the inability to accurately define capacity deficient roadway segments since the data base for some of the models is out-of-date. The department's Bureau of Transportation Planning is continuing updating efforts and we are hopeful that data for upcoming studies will be available.

The focus of the TOPICS program and the majority of recommended solutions are low-cost operational countermeasures such as parking restrictions, improved signing and/or lane markings, revised signal timing, revised signal placement, and turn prohibitions. However, some construction projects such as pavement friction improvements, radius improvements, and additional laneage are identified and funded with safety improvement monies or integrated into the local MPO Transportation Improvement Program or long range plans.

The structure of our studies has changed somewhat during the past year. As reported last year, TOPICS reviews have culminated in two separate reports, the first dealing with accident concentrations and capacity deficiencies, and the second addressing signal system optimization and unwarranted signals. Currently, our in-house efforts focus on the first. Signal system optimization and review of existing unwarranted signals in the TOPICS areas has been deferred to an upcoming statewide signal system optimization program. The program is to be accomplished on a consultant basis, funded by Amoco Oil overcharge refunds received through the U.S. Department of Energy. More details on this program follows the TOPICS discussion.

During the past year, we completed TOPICS studies in five areas; Bay City, Kalamazoo, Ann Arbor, Ypsilanti, and Mt. Pleasant. A before-after analysis of implemented recommendations resulting from the 1981-82 Muskegon study has been initiated and will be included in next years report.

Following is a brief description of each of the past year's studies and estimated TOR of invested safety monies. Estimates were based on a conservative 10 percent expected reduction in accidents, 1982 National Safety Council figures for the cost of property damage, injury, and fatal accidents, and the May 1981 U.S. Department of Transportation Publication "Energy Saving Traffic Operations Project Guide".

Bay City - In last year's report we documented completion of the accident study portion of this review. We have now completed a review of unwarranted signals which involved 30 locations where the need for existing signalization was considered questionable. Recommendations were made for 10 removals and 19 flash operation schedule changes. Two of the 10 have been removed and the other eight are under study by the city during trial flash periods. Recommended changes are estimated to provide annual savings of $10,000 in maintenance and electrical energy costs, and over $30,000 in fuel consumption.

Kalamazoo - Last years report summarized our review of accident concentrations and unwarranted traffic signals. During the past year we completed a signal system timing optimization plan for the Kalamazoo area. Recommendations for timing changes (splits and resets) and interconnect system changes and/or additions were developed for the area signal system which included three grids (53 locations) and 10 corridors (69 signals). Total implementation is estimated to save 549,000 gallons of fuel ($686,250 @ $1.25/gallon) annually based upon results of the FHWA sponsored "National Signal Timing Optimization Project."

Ann Arbor - The Ann Arbor study addressed 29 locations with accident concentrations, 25 determined as warranting corrective action. Recommendations included 51 low-cost operational improvements and seven capital outlay (construction) projects. The construction recommendations include two widenings to provide a center left-turn lane, two widenings for right-turn lanes, two widenings to provide additional through lanes, and one pavement friction improvement project. Total study implementation costs are estimated to be $670,000 and the annual safety benefit in reduced accidents is estimated to be $274,000, yielding an expected TOR of approximately 2.5 years.

Ypsilanti - The Ypsilanti study involved review of 19 locations based on accidents. Corrective actions were recommended at 14 of the study locations and included 32 low-cost operational improvements and three capital outlay (construction) projects. The construction project recommendations included a widening to provide for a center left-turn lane, a geometric modification to provide for a teed-up intersection, and a pavement friction improvement. Estimated implementation costs for all recommendations totaled $216,000, the annual safety benefit in reduced accidents is expected to be $159,000, yielding an expected TOR of less than 1.5 years.

Mt. Pleasant - Eighteen accident justified locations were reviewed with corrective actions recommended at 14. Recommendations included construction of a "departing from intersection" merge taper and 37 low-cost operational improvements. Total implementation costs were estimated at $84,000 with an annual safety benefit of $70,000, yielding an estimated TOR of just over one year.

We are currently conducting TOPICS studies for the Flint, Traverse City, Adrian, and Owosso areas. In addition to completing these, we plan to initiate studies in the Battle Creek and Marquette areas in the coming year.

Amoco Refund (Signal System Optimization) Program

Between 1970 and 1981 crude oil and petroleum products were under federal price controls. The Economic Regulatory Administration of the U.S. Department of Engergy (DOE) brought charges against a number of oil companies for alleged violations of those controls with many of the charges being settled out of court through consent agreements. On November 16, 1983, DOE officially requested states to submit refund plans on behalf of consumers in the Amoco Stage II refund proceeding. These refunds are restricted in use to programs which make restitution to consumers of motor gasoline and distillate fuel oil.

As part of the Michigan proposal, a plan was submitted for a statewide traffic signal system timing optimization program. In anticipation of receiving a portion of the Amoco overcharge refunds, signal system optimization efforts of the TOPICS program were deferred as noted previously in this report. Michigan received the Amoco funds ($786,344 for signal optimization) in March 1984 and it was appropriated by the legislature in July. Traffic signal systems comprised of approximately 1,100 signalized intersections statewide (including all appropriate TOPICS program areas) have been targeted for action under this program.

The purpose of this program is to provide fuel savings through a more efficient roadway system for the motorists of Michigan resulting from improved traffic signal system timing. The program will be comprised of three parts: (1) Michigan Department of Transportation (MDOT) personnel will identify signal systems in urbanized areas which require timing optimization; (2) MDOT will administer a contract with interested consultant(s) who, utilizing computer models, will develop optimized timing plans and recommend signal equipment needs; and (3) needed equipment and optimized signal timing will be installed as identified by contractors or state or local forces. The project will be carried out over two years.

Traffic Engineering Services Program

Community Assistance

The Community Assistance Program assists in the identification, analysis, and correction of locations experiencing accident concentrations. The program is funded by a Section 402 grant administered by the Michigan Office of Highway Safety Planning.

During this past year we continued to emphasize integration of the Community Assistance Program with our TOPICS program as outlined in last years report. This has resulted in a much higher level of activity and, we believe, a more efficient, cost-effective use of personnel. The Community Assistance Program does, however, continue to respond to any local agency requesting its services.

During fiscal 1983-84, the Community Assistance Program analyzed 116 locations in 15 local jurisdictions. Recommendations included traffic signal installations and modernizations, intersection reconstruction, signing modifications, pavement resurfacing and markings, road realignments, and plans for urban parking. Federal Highway safety funds were utilized to assist local agencies in implementing highway improvements. Much of the project funding was the direct result of Community Assistance involvement in prior years.

TOPICS studies were conducted for the Bay City, Kalamazoo, Ann Arbor, Ypsilanti, and Mt. Pleasant metropolitan areas as discussed previously. The Community Assistance Program evaluated all of the locations on the nontrunkline system in those areas. Low-cost, short-range recommendations included all-red intervals, revised signing and pavement markings, revised signal timing and flasher schedules, pavement friction surface improvements, and parking prohibitions. Higher-cost, longer-range recommendations included revised geometrics and signal modernizations. Signal optimization studies were also performed on specified corridors as part of the TOPICS studies.

For the Bay City, Kalamazoo, Ann Arbor, Ypsilanti, and Mt. Pleasant TOPICS reviews discussed in the TOPICS section of this report, a total of 165 nontrunkline locations were analyzed. The nontrunkline locations included 30 in Bay City, 112 in Kalamazoo, 16 in Ann Arbor, one in Ypsilanti, and six in Mt. Pleasant. The aggregate estimated cost and safety benefits for each urban area is included in the TOPICS section.

In addition, the TOPICS studies initiated in Flint, Traverse City, Adrian, and Owosso include active participation by the Community Assistance group.

The benefits of the Community Assistance Program are detailed in the TOPICS section of this report and in a 1982 evaluation of 20 projects identified or administered by the Community Assistance Program. Those projects witnessed a 31 percent accident reduction, nearly $800,000 in annual accident savings, and a project TOR of about five years. In addition, many of the nontrunkline HES projects evaluated in this and previous reports were identified by the Community Assistance Program. We believe that integration of the Community Assistance and TOPICS programs has furthered the goals of both programs.

Operational Inventories

Since 1969, the Department of Transportation has managed a statewide program to inventory and analyze traffic control devices in counties, cities, and villages. These devices regulate, warn, and guide vehicular and pedestrian traffic on the nontrunkline road system and reduce the likelihood and severity of traffic accidents. This program will be terminated as of September 30, 1984, due primarily to elimination of off-system federal safety funds from the Highway Safety Act, which were used by local governmental units to implement the program's recommendations.

This program was available to all 83 counties and 532 cities and villages in Michigan. Participation was initiated by request from local agencies to either the department's Local Government or Traffic and Safety Divisions. To date, 61 counties and 370 cities and villages requested assistance. As of June 30, 1984, traffic control device inventories have been finalized for:

22,918 miles of county primary roads in 68 counties
21,464 miles of county local roads in 27 counties
12,937 miles of major and local streets in 336 cities and villages

In addition, completed field inventories need to be reviewed for 186 miles of streets in two municipalities and 321 miles of local system roads in one county. From July 1, 1983 to June 30, 1984, department personnel prepared one engineer estimate for a county FAS sign upgrading project. Contracts were awarded for three local agency sign upgrading projects utilizing $147,354 in Safer Off System and Federal Aid Secondary program monies.

In addition to the inventory and analysis assistance, department personnel provided technical assistance to local governmental agencies. This included preparing project cost estimates and programming documents required to obtain federal funds for project implementation. To date, 275 county, city, or village sign upgrading projects totaling $11,415,000 ($9,003,500 in federal funds) have been awarded.

The Operational Inventories program is currently being evaluated by the Department of Civil and Sanitary Engineering, at Michigan State University. The study is funded by a federal grant administered through the Office of Highway Safety Planning. The basic goal of the study is a safety evaluation of the traffic control device upgrading program. However, specific goals being considered include the identification of efficient inventory methods, the identification of the distribution of need for projects, and the development of program guidelines.

Although the Operational Inventories program will soon be terminated, the Michigan Department of Transportation will continue to provide guidance to local agencies upon request. This will be accomplished through routine departmental operations to ensure statewide conformance of traffic control devices.

Special Projects Evaluations,
Cost Controls, and New Developments

Preliminary Evaluation
"Waterwall"
I-375, City of Detroit

The southbound I-375 Chrysler freeway ends with a 15 degree right curve leading to Jefferson Avenue and downtown Detroit. Bridge piers on the outside of the curve had been protected with steel beam guardrail. Numerous accidents had been reported and maintenance of the beam guardrail was considered a problem. The construction of concrete median barrier (CMB), by itself, was not considered feasible due to the expected sharp angles of impact on the 15 degree curve. It was therefore, decided to authorize the "waterwall" attenuating system in conjunction with a concrete median barrier construction project which had been approved for the I-375 freeway.

The waterwall attenuator was designed and developed by Energy Absorption Systems Incorporated (EASI) and installed by Carrier & Gable, Inc. of Farmington Hills, Michigan in August 1982, at a cost of $141,230.30 (398 linear feet at $354.85/ft.).

Prior to installation of the waterwall this location experienced 45 reported accidents in 6.7 years (1976 - August 1982). These accidents resulted in 17 injuries and eight deaths.

The following accident data was compiled for the 22 month period following installation of the waterwall (September 1, 1982 - June 30, 1984):

	Total
Number of impacts (from Maintenance log)	15
Reported Accidents	6
Injuries	8
Fatalities	0

Four of these eight reported injuries were classified as Type A, two Type B, and two Type C. Three of the four Type A injuries occurred in one accident, on October 29, 1984. The waterwall had been damaged on October 27, (two days earlier) and had not yet been repaired by maintenance forces.

The cost for maintaining the waterwall attenuator between March 1, 1983 and June 30, 1984, was $92,332.11. Maintenance records for the first six months were not available due to contractural problems between the contractor, construction forces and County Maintenance Forces. Thirty-one days were recorded for waterwall maintenance by the Wayne County Road Commission between March of 1983 and June 1984.

The total cost of the waterall attenuator, including installation, and maintenance, has been $233,562.41 for the past 22 months. The "cost" of accidents before and after installation of the system are summarized below:

	P	I_A	I_T	F_A	F_T	*Accident Costs ($)
1976	3	5	5	2	2	443,270
1977	1	4	5	0	0	41,090
1978	1	1	1	1	2	409,090
1979	3	3	3	2	2	427,270
1980	7	2	2	0	0	23,630
1981	4	0	0	2	2	404,360
1982 - Aug. 31	3	1	1	0	0	11,270
						$1,759,980 Total

I_A = Injury Accidents F_A = Fatal Accidents P = Property Damage
I_T = Injuries (total) F_T = Fatalities (total)

Accident costs averaged $267,339 annually during the 6.7 years preceding installation of the waterwall attenuating system. The annualized accident costs during the 22 months following the installation were $127,630. This savings of $139,709/year, more than offsets annual maintenance costs, ($70,000 based on 16 months experience) and will amortize construction costs after approximately two years.

In summary, the waterwall impact attenuation system is performing effectively and as expected. Accident severity is less. Particularly noteworthy is the absence of fatalities. If this trend continues, the installation and maintenance costs of the system will be justified.

However, we are continuing to evaluate whether or not the waterwall attenuator will be able to withstand repeated collisions. The front panels have been noted as moving longitudinally from their original position. Though EASI has assured us that this does not affect the overall performance characteristics of the wall, we will continue to monitor the performance and discuss the results in our two year evaluation which will be completed later this year.

MIDAS Expansion

In June 1983, a $250,000 contract using Federal Safety 402 Funds as well as Highway Planning and Research Funds for three years of carefully monitored research into various aspects of accident causation was signed with Michigan State University. Dr. Thomas Maleck, the original developer of MIDAS at the Department of Transportation, and Dr. William Taylor, Chairman of the Civil Engineering Department at Michigan State University, both nationally recognized experts in highway safety, are conducting the research with the assistance of graduate and undergraduate students.

The contract was designed as an "umbrella agreement" within which guidelines are defined for submittal of individual project work plans by the university for approval by the department's Michigan State University Research Steering Committee. Proposals are undertaken at the department's request, but at no cost to the department. Research can be terminated on an individual project at any time during the study if it appears that project results will be of questionable benefit.

Among the projects completed or currently active are: The Relationship of Vehicle Characteristics, Highway Geometry, and Traffic Accidents; Geometric Inventory; No-Passing Zone-Eye Height Investigations; Factors Affecting Accidents in No-Passing Zones; and the Development of a Freeway Interchange Safety Ranking Procedure. The focus of the research continues to be on providing useful tools, models, programs, or predictive equations for use by the department as well as increased knowledge concerning the causative factors and state of the art in traffic safety nationwide.

An example of practical application of this research is the literature review and nationwide questionnaire results concerning trends in driver eye height. Provided by the university, the results suggested that department management not resurvey all 7,000 miles of two lane state trunklines with about 9,500 no-passing zones. The study cost was $4,300. The estimated cost of the survey was more than $250,000.

During the investigation of accidents and accident severity relative to vehicle size, the exposure or relative miles driven by different makes and models of vehicles is significant. The university has developed an exposure estimator. Simply stated, the likelihood of a vehicle being the object of an accident, that is, the second vehicle in a two-vehicle collision, is proportional to its exposure. This approach to measuring exposure appears to be superior to traditional methods that rely on vehicle registration data. It has been determined that small vehicles are more likely to be involved in an accident than large vehicles in the following conditions: single vehicle, overturned, icy or snowy highway surface, and accidents at mid-blocks in rural areas. Large automobiles are more likely to be involved in accidents in the following conditions: with pedestrians, with parked vehicles, and accidents with other vehicles at intersections in urban areas.

Using the second vehicle exposure method, it appears that there is little difference between accident involvement of male and female drivers if exposure is considered.

Continued development of these expansions to MIDAS will improve our surveillance capabilities of the trunkline system to ensure the most cost-effective allocation of safety funds. In turn, safer highways for the motoring public will be possible.

Guardrail Inventory Program

The Michigan Department of Transportation initiated a statewide project to inventory all guardrail located along state trunkline highways. This inventory consists of various types which have evolved over many years as a result of varying roadway classifications and continually upgraded design standards. In consideration of the approximately 1,320 miles of guardrail along our trunkline, a method was developed to monitor the maintenance, performance, and the upgrading of the guardrail system in order to assure a safe roadside environment for the motorist. Representatives from the Traffic and Safety, Maintenance, and Testing and Research Divisions cooperatively established a computer based data file covering the various types of guardrail in place on Michigan trunklines.

During fiscal year 1983-84, the department continued to utilize construction inspectors during the winter months to record and incorporate up-to-date information on the condition of the guardrail and its system components which include guardrail endings, anchorages, and wood and steel support posts. To date, approximately 91 percent of the 21,570 guardrail runs statewide have been field verified for design description accuracy and 68 percent of the guardrail runs have had the guardrail posts inspected for deterioration. A typical page of the inventory is attached.

In addition, the department developed a guardrail data file update procedure and implemented the procedure in the nine district offices. An Operational Instruction (OI 4000.04) "Updating Trunkline Guardrail Inventory" was implemented which outlines the procedures and responsibility for the file maintenance and updating of the guardrail file. Two manuals were prepared for use by the district and Lansing offices to follow in updating the data files. They are:

1. "Guardrail Remote Forms Program" users manual.
2. "Procedural Manual for Recording Maintenance and Construction Activity on Form 424, Guardrail Work Activity Report."

Two output reports are available to provide lists of guardrail data by statewide, district, county, control section, and maintenance route (districtwide only) and control section milepoint order or section rating in descending order formats. The reports are: "A General Use Report" and "Guardrail Section Accident Rating Report."

Initially, the data will assist in the identification and prioritization of any guardrail sections which may require modernization. It will also allow us to more efficiently correlate accident data with precise guardrail information in determining roadside areas which warrant guardrail installation to protect motorists from a roadside obstacle (such as a bridge pier), or warrant reduction or elimination of guardrail by flattening embankment slopes or clearing the roadside of fixed-objects.

In the future, in addition to providing information for accident studies, predetermined criteria such as number of years in service will provide us with an annual list of guardrail segments which warrant inspection for possible deteriorated conditions due to age.

We consider the computerized guardrail inventory as another accomplishment in our continuing effort to provide safe roadways for Michigan's motorists. By maintaining a current, accurate, and readily available computerized information file on guardrail conditions, we can efficiently provide an optimum, properly performing guardrail system to provide motorists with safer roadsides.

Detroit Freeway Rehabilitation

The Michgian Department of Transportation is committed to a comprehensive program of reconstructing, in the next decade, the freeway network in the Metropolitan Detroit Area. Comprehensive studies are underway to identify needs, strategies for minimizing traffic disruption, and alternative designs which will lead to a cost-effective program. A major criterion is the enhancement of highway safety.

The Detroit Metropolitan Area freeway system was developed over a 40-year period. Much of the system is antiquated and deteriorated resulting in capacity and safety deficiencies. There are 135 miles of freeway within the metropolitan area, excluding I-696 and I-275. The Edsel Ford Freeway (I-94) and John Lodge Freeway (US-10) are the two oldest freeways. Consequently, there are most in need of repairs and safety upgrading.

The first stage of the I-94 reconstruction was initiated this summer. It includes resurfacing and/or joint and patch repair to temporarily improve the riding surface. Major reconstruction is planned in three to five years after a comprehensive study of traffic needs, drainage, environmental impacts, and right-of-way requirements have been determined.

The John C. Lodge reconstruction is tentatively scheduled to begin next year. The recycling from I-75 north to Wyoming will cost approximately $25 million. Construction activities will include replacing the existing pavement, construction of 12-foot paved shoulders, extension of acceleration and deceleration lanes, upgrading the Wyoming, Davison, and Livernois interchanges, and eliminating, modifying, or protecting roadside appurtenances to reduce the number of fixed-object accidents.

From 1980 through 1982, 3,266 accidents were reported on the Lodge Freeway and interchanges. The rate of 360 accidents per 100 million vehicle miles is higher than comparable freeway segments except on I-94. Accidents occurring during wet pavement conditions accounted for 37.3 percent of the total reported accidents, well above the district average of 25 percent. The new pavement surface will have improved friction qualities which should reduce the percentage of wet related accidents to the district average. This alone would provide an estimated $900,000 per year benefit from accident reduction. The fixed-object accident rate is also the highest for comparable freeway segments in Detroit with the exception of I-94. All fixed-objects will be eliminated, modified, or protected according to current standards.

Ramp metering will be installed on the Lodge and will provide a smooth flow during peak traffic periods permitting the freeway to operate at maximum efficiency without breakdowns. Ramp metering controls rush-hour traffic entering the freeway, thereby eliminating surges of traffic that create unstable flow and limit the traffic carrying ability of the freeway. Studies have also shown that accident reductions approaching 50 percent on the freeway have been achieved after ramp metering.

In summary, the reconstruction of the Detroit Metropolitan freeway system will provide the motoring public a smoother, safer, and more efficient transportation system.

Interchange Improvement Program

The department is responsible for the operation and maintenance of approximately 677 interchanges on the freeway system in Michigan. In order to monitor and manage the safety and efficient opertion of those interchanges, it is necessary to identify areas warranting attention with respect to accidents, congestion, and geometric configuration.

The Traffic and Safety Division, with the assistance of Michgian State University, is in the process of developing such a program. Interchange geometry is being integrated into the MALI mileage system. Eventually, up-to-date traffic volumes and an inventory of traffic control devices will also be coded into the system. The program will have the capability, using computer accident analysis, to locate and prioritize specific freeway interchange element improvements based on capacity, geometry, safety, and/or traffic operations. Once identified, corrective measures will be provided such as the installation of various traffic control devices including signals, signing, pavement markings, and attenuation devices. Some interchanges may require complete reconstruction while others may require only minor modifications such as obstacle removal, regrading of slopes, or ramp revisions.

Surveillance, Control, and Driver Information (SCANDI)

As detailed in previous annual reports, the Michigan Department of Transportation has undertaken a major effort to improve operations on the existing freeway system in the Detroit metropolitan area. The Surveillance, Control, and Driver Information (SCANDI) system, involves 32.5 miles of freeway within the city.

This past year ramp metering was expanded to include 28 ramps on both eastbound and westbound I-94. A subsequent review of traffic volumes revealed increases during peak periods of approximately eight percent over nonmetered flows. A significant reduction in congestion has also been observed. Furthermore, preliminary accident data indicates a 50 percent reduction in accidents on the freeway mainline.

Ramp metering was operated during construction on I-94 with one lane closed. Analysis of data indicates that 17 percent more traffic was accommodated than would have been expected without ramp meter control.

Ramp metering will be included as part of the proposed reconstruction of US-10 (Lodge Freeway). Further discussion of the SCANDI project is included in the October report to the State Safety Commission, which is included in this report.

Pavement Marking Cost Controls

The department has expanded use of polyester pavement markings. This material ensures year-round line visibility and provides three to four years of service life depending on traffic volumes and weather conditions. Five contracts were awarded in 1984 to install over 4,000 line miles of polyester markings on high volume urban trunklines and six contracts were awarded to install polyester markings on interchange ramps. The new edgeline ramp markings are six inches wide instead of four inches and the gore markings were increased from eight inches to 12 inches. The wider lines on the ramps will improve night visibility and lengthen the time between paintings.

A new program to install preformed thermoplastic special markings was initiated in 1984. The installation of special markings is a labor intensive operation and highly disruptive to traffic flow. The preformed thermoplastic is relatively expensive, but should last a minimum of seven years. the longer life material will reduce the hazard to employees installing the markings and traffic disruption. The cost "breakeven" point is about six years.

A new long life pavement marking material (Epoflex), which dries fast and can be used on both concrete and bituminous surfaced roadways, was installed in the Detroit area for evaluation in 1984. If this material proves cost-effective, it can be used for pavement markings on high volume freeways.

Discussion of a research project evaluating permanent reflective markers can be found in the July 1984 report to the State Safety Commission, elsewhere in this report.

Accident Data Retrieval on all Roadways in Michigan

A computerized system has been developed where traffic accident data can be generated for all roadways in Michigan through an interactive process. This process allows the Department of Transportation and State Police as well as all local agencies to do site specific traffic accident analyses of any location in Michigan. The system is accessible to any terminal connected to the MDOT computer and offers information in six different report formats. Currently the system offers accident data for the years 1982 through 1983, but it will be expanded to include data from 1978 through the current month of 1984.

Impact Attenuators

The Michigan Department of Transportation continues to manage an active roadside safety program. The status of that program is outlined earlier in this report.

Where removal or relocation of fixed-objects is not economically feasible, the installation of impact attenuators is authorized to minimize the consequences of a crash with the object.

As of the end of 1983, approximately 250 impact attenuators were in place on the state trunkline system. "Hi-Dro Cell" units comprised 66 percent of that total, 22 percent were Guardrail Energy Absorption Terminals (GREAT), eight percent were sand barrel installations, and three percent were cell cluster attenuators. The remaining units include one "Hi-Dro Cell" unit and a "Waterwall" attenuation device. At the present time, there are 28 units either proposed or under contract. Since the previous report, 33 units have been installed at an approximate cost of $693,000.

The "Waterwall" attenuation device located on I-375 at Jefferson Avenue has been in place since August 1982. A preliminary report of the effectiveness of that installation follows.

Safety at Construction Sites - Lightweight Trailer Sign Supports

Contractors commonly install construction warning signs on used car axles to facilitate easy relocation of these signs. Some of these car axles include differential housings, which increase the units weight and potential hazard as a signs support. The special provision that allows the use of axles for sign supports has been modified to limit the maximum weight to 350 pounds and prohibits the use of axle assemblies with differential housings. This will provide an increased measure of increased safety for the motorist.

Vehicle Occupant Restraint Use in Michigan

A study "Restraint Usage Among Crash-involved Motor Vehicle Occupants" was recently completed by Alexander C. Wagenaar of the University of Michigan's Transportation Research Institute.

Objectives of this study were to identify recent trends in restraint use in Michgian and assess the effectiveness of mandatory restraint laws in increasing the use of occupant restraint systems and decreasing traffic casualties. A review of studies of mandatory adult restraint laws in other countries revealed that the laws have generally been successful. A review of recent studies of mandatory child restraint laws revealed that such laws have frequently increased use to some extent, but a clearly demonstrable effect on child injuries has not yet been documented. Many past studies have major methodological limiations and should therefore be interpreted with caution.

The Wagenaar study examined all reported crash-involved motor vehicle occupants in Michigan from January 1978 through December 1982. Time-series analyses were used to measure trends in restraint use and injuries in recent years, and to measure the effects of Michigan's mandatory child restraint law, implemented in April 1982.

Major findings of Wagenaar are as follows: the rate of restraint use in Michigan: (1) is higher among young children and lower among teenagers and young adults, (2) is lower among drivers using alcohol or drugs at the time of a crash and higher among drivers not using alcohol or drugs, (3) varies according to seating position, (4) is higher among drivers alone in a vehicle and lower among people in vehicles with multiple occupants, (5) is higher among occupants experiencing no injury and lower among those severely injured or killed, (6) is higher among occupants of vehicles with minor damage and lower among occupants of vehicles experiencing extensive damage, (7) is higher among occupants of small cars and lower among occupants of large cars and pickup trucks, (8) is higher during weekday daytime hours and lower during weekend nighttime hours, (9) is higher on limited-access highways and lower on nonlimited-access highways, and (10) varies considerably across counties in Michigan. Restraint use decreased from 1978 to 1980 and increased from 1980 to 1982. Use is slightly higher during the winter months than during the summer, but this seasonal cycle was of marginal significance. The number of Michigan residents involved in traffic crashes trended downward from 1978 through 1982. These patterns were controlled when evaluating the effects of Michigan's child restraint law through the use of Box-Jenkins intervention analysis methods.

The main effects of the child restraint law were as follows: (1) a 208 percent increase in restraint use among 1-3 year olds, that is, use increased from about 12 percent to 36 percent; (2) a 50 percent reduction in injuries (including all types of reported fatal and nonfatal injuries) to infants under age 1; that is, an estimated 156 infant injuries are prevented per year; and (3) a 17 percent reduction in injuries to children age 1-3, that is, an estimated 302 toddler injuries are prevented per year. The effects of the law were due primarily to reductions in less severe injuries, and occurred primarily among occupants of crash-involved vehicles experiencing low or moderate damage. The number of children riding in the more-dangerous front-seat and cargo-area positions decreased as a result of the law, with children increasingly riding in the safer rear-seat postiion. Finally, the law may have had a slight spillover effect in reducing injuries among 25-54 year olds by about six percent, although this finding must be verified in follow-up research.

Wagenaar concluded that Michigan's mandatory child restraint law has had a significant effect in increasing the proportion of young children who are restrained, and has prevented a substantial number of injuries to young children. Continued public information and enforcement efforts might make the law more effective. Long-term effects of the law should be evaluated in follow-up studies. Given the demonstrated effectiveness of the child restraint law in Michigan, it is recommended that the mandatory restraint law be expanded to motor vehicle occupants of all ages.

Copies of the complete report are available from the Transportation Research Institute.

State Safety Commission Reports

The Michigan State Safety Commission has been involved in safety activities throughout the state since its legislative establishment in 1941. The commission membership is composed of the Governor (Honorary Chairman), Secretary of State, Superintendent of Public Instruction, State Transportation Director, the Executive Director of the Office of Highway Safety Planning, and Director of State Police. The commissions three objectives are to: (1) improve awareness and liaison among persons, affiliated with the commission who have a continuing professional interest in traffic safety, (2) discuss among the commissioners pending or proposed legislation, and (3) monitor monthly crash trends.

Each month the Department of Transportation prepares a report of one of its activities which impacts safety. Copies of recent selected reports follow.

STATE OF MICHIGAN

TRANSPORTATION COMMISSION
WILLIAM C. MARSHALL
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JAMES J. BLANCHARD, GOVERNOR

DEPARTMENT OF TRANSPORTATION

TRANSPORTATION BUILDING, 425 WEST OTTAWA PHONE 517-373-2090
POST OFFICE BOX 30050, LANSING, MICHIGAN 48909

JAMES P. PITZ, DIRECTOR

May 10, 1983

Honorable James J. Blanchard
Governor of the State of Michigan
and
Members of the State Safety Commission
Lansing, Michigan 48909

Gentlemen:

A significant goal of the Department of Transportation is to minimize construction and maintenance zone accidents and casualties on Michigan highways. Construction zone fatal and injury accidents are less than one percent of the statewide total. Efforts are focused on the safety of both motorists and the employees who must work under traffic conditions. Roadway improvements must be accomplished, in most cases, while maintaining existing traffic and pedestrian activities. Maintenance of traffic in construction and maintenance zones demands a high degree of safety with as little disruption of traffic as possible.

Responsibility for the "maintaining traffic control plan" in construction zones rests with our district traffic and safety engineer in each of the nine department district offices. These plans are developed in cooperation with district construction and design offices, with central coordination in Lansing to ensure statewide design uniformity. Responsibility for the "maintaining traffic control plan" for maintenance activities, which are usually short term moving operations, rests with the district maintenance engineer.

The requirements and specifications for traffic control devices and typical plans for maintaining traffic in construction and maintenance zones are detailed in the "Standard Specifications for Construction" and in the "Michigan Manual of Uniform Traffic Control Devices" (MMUTCD). Signs and most other traffic control devices for work zones are orange with black legends or white reflectorized stripes to differentiate from other traffic control devices. That part of the MMUTCD concerned with construction and maintenance has been reprinted and distributed statewide to contractors, utility companies, and governmental agencies to serve as a guide for the uniform application of traffic control devices required for the safe movement of traffic through work zones.

One of the most important safety considerations in work zones is the speed limit. In 1978, a state law was enacted which requires a 45 mph speed limit on freeways where there is a lane closure. The department supports enforcement efforts to promote compliance with the 45 mph construction zone speed limit.

Each year the department and the Federal Highway Administration conduct reviews of typical construction zones. The traffic control plans are reviewed during the day and night and recommendations for future improvements are developed. A review is also conducted during each project by a contractor's representative, and the department's project and district traffic and safety engineers, to ensure that details of the traffic plan are followed and that the plan is responsive to traffic conditions.

The most challenging traffic control plans this summer involve closing one-half of a freeway for reconstruction while maintaining two-way traffic on the other half on I-94 in the Kalamazoo area, on US-23 ten miles north of the Michigan-Ohio state line, and on US-31 north of Muskegon. The department will be testing different configurations of flexible posts, raised pavement markers, and paint used to separate two-way traffic to develop the safest and most economical application.

This department will continue to evaluate the movement of traffic through work zones in order to assure maximum safety for the worker and increased safety and convenience to the motorist.

Sincerely,

James P. Pitz
Director

STATE OF MICHIGAN

JAMES J. BLANCHARD, GOVERNOR
DEPARTMENT OF TRANSPORTATION
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JAMES P. PITZ, DIRECTOR

June 14, 1983

Honorable James J. Blanchard
Governor of the State of Michigan
and
Members of the State Safety Commission
Lansing, Michigan 48909

Gentlemen:

Reducing the number of highway accidents and their severity is a continuing priority of the Michigan Department of Transportation. The department's efforts are often concentrated at intersections, which account for about one-half of all collisions on the trunkline system.

When intersections with correctable accident patterns are identified, potential accident reducing measures are evaluated and implemented. A major consideration in the selection of these accident countermeasures is the comparison of the cost of implementing the countermeasure with the expected accident reduction benefits.

Continuous monitoring of the effect of similar actions on accident experience at previous project sites provides a statistical base which can be used to estimate accident reductions associated with any particular corrective action. National Safety Council estimates of the cost of property damage, injury, and fatal accidents are used to determine the expected accident reduction savings.

Three examples of recent intersection improvement projects in Ottawa County and the results which were achieved are discussed below. The project site selections were based on a minimum of three year's accident experience. The accident reducing measures were chosen based on the results of previous before-and-after accident studies. The reductions outlined are typical; but may not be achieved in all cases. Further evaluation of these selected projects, and other safety projects initiated by this department, includes more rigorous statistical techniques, including assessment of accident trends at similar "control" sites during corresponding time periods.

1. <u>M-21 (Chicago Drive) at Main Street/Byron Road, Zeeland Township</u>. Four-way STOP signs and pavement rumble strips were installed in September 1981 at a cost of $10,500. In the 15 months following these changes, through December 1982, total collisions numbered six, compared to 14 in a similar period before the change was made. This reduction resulted in an

annual safety benefit of over $60,000. Therefore, the project was considered to have "paid" for itself in about two months.

2. US-31 at James Street, Holland Township. Additional laneage for turning vehicles was added and a traffic signal installed at the intersection in November 1980, at a cost of $240,000. Two full years of "after" data documents a safety benefit of $35,000, reflecting an estimated decrease of six accidents annually. Amortization of the safety improvement project is, therefore, estimated to be less than seven years.

3. BL-196 (Chicago Drive) at Waverly Road/120th, Holland Township. Construction improvements at this intersection included additional turning lanes, relocation of an adjacent freeway off ramp, and installation of a traffic signal in June 1982, at a cost of $250,000. Although our evaluation is not yet complete, preliminary data indicates a safety benefit in six months of $43,000. This is the result of collisions being reduced from 30 accidents in the year immediately preceding the change to seven accidents in the six months after. Recovery of project costs is estimated to be about three years.

These three safety projects were implemented at a cost of about $500,000. Annual safety benefits are estimated to be $181,000, resulting in a return of invested safety funds in less than three years.

Safety projects are among the most cost-effective programs administered by the Department of Transportation. We will continue to monitor the safety of our state trunkline system and implement safety improvements of these types, where justified, to ensure that Michigan's highway safety record continues to be among the best in the nation.

Sincerely,

James J. Pitz
Director

STATE OF MICHIGAN

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JAMES P. PITZ, DIRECTOR

July 12, 1983

Honorable James J. Blanchard
Governor of the State of Michigan
and
Members of the State Safety Commission
Lansing, Michigan 48909

Gentlemen:

This month's report to the Michigan State Safety Commission concerns tort liability lawsuits againt the Department of Transportation. The primary objective of our department has been, and will continue to be, providing a safe and efficient transportation system. As previously reported, such efforts have resulted in a continuing decrease in fatalities and injuries on Michigan roadways.

While our highway safety record is among the best in the nation, we have experienced a dramatic increase in tort liability claims. Since the loss of universal governmental immunity in the 1960's, a death or injury caused by an alleged highway defect can produce a tort liability claim. As a result, litigation against the department is increasing at an alarming rate. Currently, there are about 700 tort suits filed or that have given notice of intent to file against the department. The tort caseload is growing, with a net increase of 50 to 60 active cases annually.

Litigation is diverting an ever increasing share of our available engineering and technical staff time. Approximately $500,000 in department engineering activities is devoted annually to litigation defense. Attorney, investigative, and clerical staff efforts cost the department another estimated $1 million annually. In addition, we face the potential loss of hundreds of millions of dollars in judgments. Court awarded judgments and settlements against the department for highway-related accidents have totaled over $8 million to date this fiscal year (1982-1983). This amount is more than twice the currently available federal funds to Michigan on a yearly basis specifically designated for safety construction projects. Judgments are obviously consuming an ever increasing percentage of capital outlay funds that could be used for safety and operational improvement projects on the state highway system.

We have reached a point where the time, effort, and cost of defending lawsuits and paying judgments impairs the department's ability to respond to the needs of our highways. Significant relief can only be provided by the legislature. While the department does not advocate a return to total sovereign immunity, we do support enactment of limitations that specifically define the scope of actions and maximum damages for which we may be found liable.

Legislation has been introduced that would limit department liability to damages resulting from defects in that "portion of the highway designed for vehicular travel." Additional legislation placing a maximum dollar amount on the department's liability would be helpful. Enactment of this legislation will enable the department to continue its contribution toward a safe and efficient highway system to the maximum extent possible.

Sincerely,

James P. Pitz
Director

STATE OF MICHIGAN

JAMES J. BLANCHARD, GOVERNOR

DEPARTMENT OF TRANSPORTATION

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JAMES P. PITZ, DIRECTOR

October 11, 1983

Honorable James J. Blanchard
Governor of the State of Michigan
and
Members of the State Safety Commission
Lansing, Michigan 48909

Gentlemen:

This month's report to the Michigan State Safety Commission focuses upon our Detroit Surveillance, Control, and Driver Information (SCANDI) system. SCANDI is a computerized system designed to monitor the traffic situation and react to incidents by disseminating information and controlling traffic through ramp metering. In addition to improving safety on Detroit's freeway system, it is also designed to improve the environmental air quality by reducing vehicle emissions by way of improved traffic flow.

From a safety standpoint, the prime feature of SCANDI is ramp metering. By smoothing peak hour merging and overall flow, accidents are reduced throughout the metered system. Ramp metering was in operation on six ramps on eastbound I-94 from November 19, 1982 to April 25, 1983. Ramp metering has not functioned since then due to a construction related, permanent lane closure on I-94 upstream of the ramp metered section which has reduced traffic volumes to a level below which ramp metering is necessary. Ramp metering will resume this fall when the third lane of I-94 is reopened.

Comparing accident experience during the operation of ramp metering (November 17, 1982 to April 25, 1983) with a comparable "before" period (November 17, 1981 to April 25, 1982) gives the following results.

	Before	After
Total Accidents	49	25
Injury Accidents	21	6
Persons Injured	31	9
P.D. Accidents	28	19

The comparison is for peak traffic hours when ramp metering was in operation, weekdays from 3 p.m. - 7 p.m.

Experience also verifies that SCANDI can effect a significant reduction in vehicle emissions. By reducing the time needed to detect, react to, and clear an incident, the delay caused by the incident is reduced. Thus each vehicle in the traffic stream spends less time waiting behind the scene of the incident. Also ramp metering, by improvig traffic flow, has allowed the freeway to handle a larger volume of traffic, thus reducing rush hour delay both on the freeway and on surface streets. Based on this experience, annual vehicle emissions have been reduced by the following estimated amounts:

	Reduction From Incident Detection	Reduction From Ramp Metering	Totals
Carbon Monoxide	84.1 Tons	156 Tons	240.1 Tons
Hydrocarbons	5.5 Tons	10.5 Tons	16 Tons
Nitrous Oxides	1.7 Tons	5.5 Tons	7 Tons

In addition, we are in the process of adding ramp metering to 22 ramps on I-94. This will reduce annual emissions by an estimated additional 575 tons of carbon monoxide, 39 tons of hydrocarbons, and 20 tons of nitrous oxides. The total reduction in annual outputs will then be:

Pollutant	Reduction in Annual Output
Carbon Monoxide	815 Tons
Hydrocarbons	55 Tons
Nitrous Oxides	27 Tons

SCANDI has been incorporated into the state's air quality implementation plan. We are relying on the SCANDI project to reduce vehicle emissions and help bring the Detroit area into compliance with National Ambient Air Quality Standards.

As we continue to strive to improve the safety of our roadways. SCANDI is proving to be a means toward that goal. Because the safety benefits are the result of improved traffic flow in this case, we are realizing additional benefits through the reduction of vehicle emissions and therefore improved air quality. It should be a big step toward the Federal Air Quality Control Standards required of the southeast Michigan area.

Sincerely,

James P. Pitz
Director

STATE OF MICHIGAN

TRANSPORTATION COMMISSION
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JAMES P. PITZ, DIRECTOR

January 10, 1984

Honorable James J. Blanchard
Governor of the State of Michigan
and
Members of the State Safety Commission
Lansing, Michigan 48909

Gentlemen:

This month's Department of Transportation report to the State Safety Commission reviews the various types of crash cushions used in our roadside safety program. The goal of this program is to remove or shield fixed-objects along existing highways in an effort to develop a "forgiving roadside environment." Projects include flattening side slopes to eliminate guardrail, extending culverts away from the road edge, improving guardrail endings and connections to bridge structures, and relocating signs onto bridges or breakaway supports. Fixed-objects along a roadway that cannot be relocated or shielded with guardrail or barrier wall are protected with crash cushions. Examples of roadside fixed-objects where crash cushions have been installed include bridge piers, concrete wall endings, railroad crossing warning light and gate structures, and sign trusses.

Michigan uses several types of crash cushions dictated by the roadside environment and the type of roadside obstacle requiring protection. The four types shown on the attached drawing are the most commonly used crash cushions in Michigan.

The inertial barrier system, a group of sand filled barrels, is the most economically installed system, but it can be the most expensive to maintain. This system is usually installed at roadside obstacles too wide to be covered by the more compact units. Because a high-speed impact often destroys 60 percent or more of the system, and results in substantial debris, it is only used where the expected frequency of impacts is low.

The HI-DRO Cell cluster system, a series of water-filled polyvinyl tubes wrapped with a flexible "belt", is designed for use at locations with speeds lower than 45 mph. With this type of system the impact energy is dissipated and absorbed through the controlled release of the water expelled from the polyvinyl tubes. The initial installation cost is relatively high; but when impacted, there is very little crash cushion debris, and quite often, over 90 percent of the unit is reusable.

A more sophisticated system, the HI-DRO cushion (sandwich) system is similar in operation to the hycrocell cluster. This cushion has molded fiberglass side panels in combination with steel cables strung laterally through the unit to provide vehicle redirection capabilities. These units are designed for use on high or low speed roadways, and because of low maintenance costs, are used at locations where frequent impacts are expected to occur.

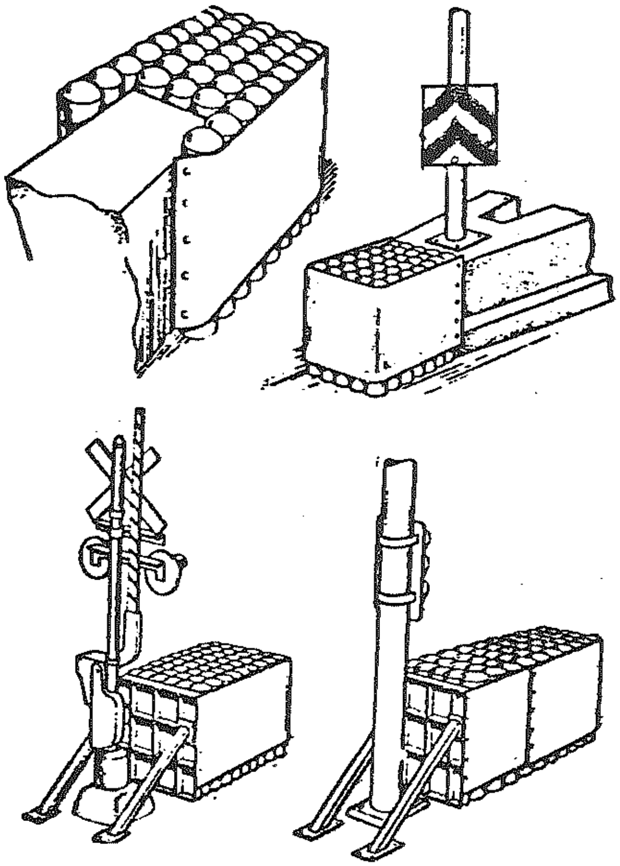
The GREAT system (guardrail energy absorbing terminal) consists of crushable foam cartridges surrounded by a framework of triple corrugated steel guardrail. The impact energy is absorbed by crushing of the foam cartridges. The system also has vehicle redirection capabilities, can be installed on high or low speed roadways, and reacts favorably to smaller vehicles (less than 2,250 pounds) using our highways. An advantage in extremely cold areas is that the foam cells are not susceptible to freezing.

Prior to 1970, most crash cushions were installed in Michigan primarily on an experimental basis. However, the value of crash cushions has been proven and we now have approximately 245 installations on the trunkline system.

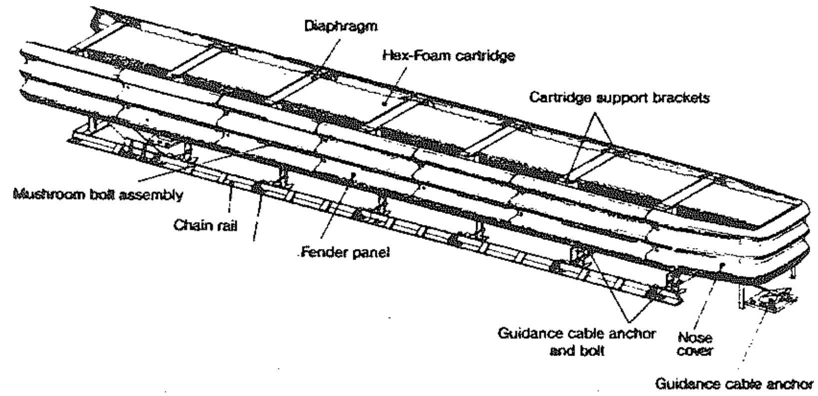
Well over 1,000 vehicle crash cushion impacts have been recorded with only two reported fatalities. It is estimated that crash cushions on Michigan highways have prevented more than a hundred fatalities and have eliminated or reduced the severity of hundreds of injuries.

Sincerely,

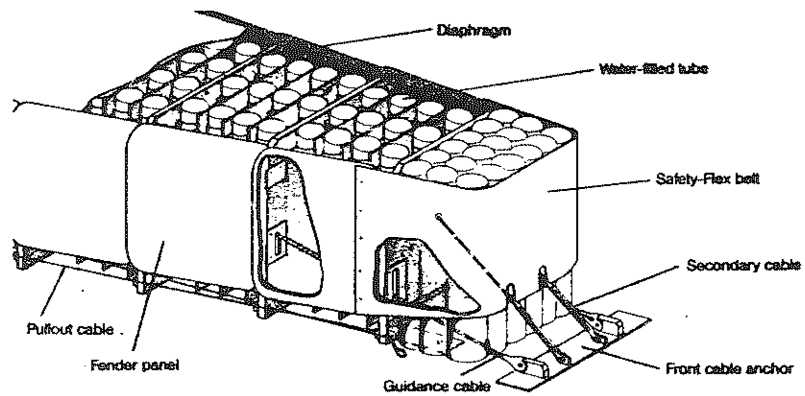
James P. Pitz
Director



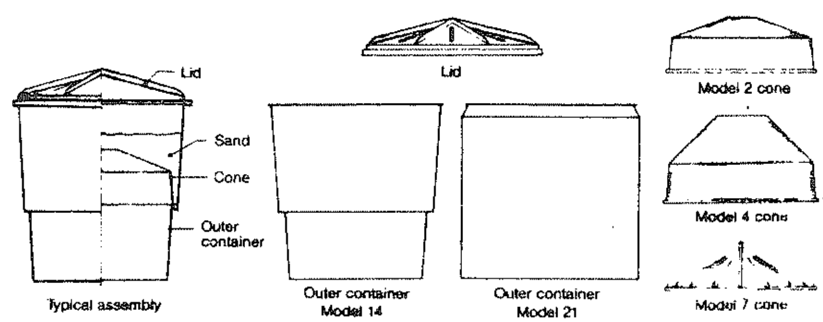
HI-DRO CELL CLUSTER



G.R.E.A.T. SYSTEM



HI-DRO CUSHION (SANDWICH)



INERTIAL BARRIER SYSTEM

STATE OF MICHIGAN

JAMES J. BLANCHARD, GOVERNOR

DEPARTMENT OF TRANSPORTATION

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JAMES P. PITZ, DIRECTOR

March 13, 1984

Honorable James J. Blanchard
Governor of the State of Michigan
and
Members of the State Safety Commission
Lansing, Michigan 48909

Gentlemen:

This month's Department of Transportation report to the State Safety Commission focuses on a program to resurface, restore, and rehabilitate many older sections of Michigan's state highways. The objectives are twofold; to improve the quality of existing road surfaces and extend the facility's service life, and also to enhance safety.

As the nation's highways began deteriorating at an increasing rate in the mid-1970's, many states' maintenance budgets could not keep pace with the projects needed to maintain quality road surfaces. In response, the Federal-Aid Highway Act of 1976 provides federal funds for resurfacing, restoration, and rehabilitation (3R) work, which had previously been the states' financial responsibility. By redefining the term "construction" to include "resurfacing, restoration, and rehabilitation," federal aid construction funds could be used for work that was previously considered heavy maintenance. The federal-aid 3R program does not fund projects considered as "new" construction or "major" reconstruction.

In 1982, general guidelines for 3R projects were established by the Federal Highway Administration which stressed prolonging the facility's service life and safety enhancement. Rather than develop a rigid set of nationwide criteria for 3R projects, the FHWA proposed flexible guidelines which could be tailored to the needs of individual states. The primary objectives of the 3R guidelines adopted in Michigan are to rehabilitate the existing roadway surface to obtain better rideability, improve the operational characteristics of the facility if warranted, and enhance safety. Improvements related to the roadway itself include resurfacing or recycling the pavement, adding shoulders, constructing climbing lanes, and improving intersection radii for truck movements. Other 3R improvements include upgrading signing and pavement markings, upgrading traffic signals, extending drainage culverts, and upgrading guardrail to current standards. In addition, an accident analysis is initiated for each project to determine if any locations within the project area warrant further corrective measures. Typical actions include tree removal, utility pole relocation, additional signing, and other measures designed to reduce a pattern, or potential pattern, of accidents.

Over $83,000,000 of 3R-type projects are scheduled during 1984. These projects range from resurfacing and shoulder work on 8.7 miles of US-41 between Marquette and Escanaba, to resurfacing of a large section of the I-94 freeway in Detroit.

The significant number of 3R projects scheduled in 1984 throughout the state signify the Michigan Department of Transportation's ongoing commitment to provide a safe, efficient, and well maintained highway system.

Sincerely,

James P. Pitz
Director

STATE OF MICHIGAN

JAMES J. BLANCHARD, GOVERNOR
DEPARTMENT OF TRANSPORTATION
TRANSPORTATION BUILDING, 425 WEST OTTAWA PHONE 517-373-2090
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JAMES P. PITZ, DIRECTOR

June 12, 1984

Honorable James J. Blanchard
Governor of the State of Michigan
and
Members of the State Safety Commission
Lansing, Michigan 48909

Gentlemen:

This month's report to the State Safety Commission reviews a unique 15-year-old operational program in Michigan to bring the traffic control devices along nontrunkline roads and streets in conformance with the Michigan Manual of Uniform Traffic Control Devices, thus making the roadway environment safer for motorists and pedestrians.

Since 1969 the Department of Transportation, through a federal grant from the Office of Highway Safety Planning, has been involved in a statewide program to inventory and analyze all traffic control devices in counties, cities, and villages. These control devices are used to regulate, warn, and guide vehicular and pedestrian traffic on the nontrunkline road system to reduce the likelihood and severity of traffic accidents. This program will be terminated as of September 30, 1984, because of the elimination of off-system federal safety funds from the Highway Safety Act which are needed for the local governmental units to implement the program's recommendations.

This program has been available to all 83 counties and 532 cities and villages in Michigan. Participation was initiated by request from local agencies to either the department's Local Government or Traffic and Safety Divisions. To date, 61 counties and 370 cities and villages requested assistance. As of June 1, 1984, recommendations for the upgrading of traffic control devices have been finalized for 61 county and 264 city, and village jurisdictions involving 39,578 miles or 37 percent of the nontrunkline roads and streets. In addition to the department's efforts, seven counties and 70 cities and villages involving 17,405 miles or 16 percent of the statewide mileage were inventoried by outside consulting traffic engineering firms. Overall, this accounts for traffic control devices being inventoried and analyzed along 56,983 miles or 53 percent of the nontrunkline roadway mileage in 68 of the 83 counties and 334 of the 532 cities and villages in Michigan.

In addition to the inventory and analysis assistance, department personnel provided technical assistance to local governmental agencies by preparing the project cost estimates and programming documents required to obtain federal funds for project implementation. To date, 275 county, city, or village sign upgrading projects totaling $11,415,000 ($9,003,500 in federal funds) have been awarded.

This program is currently being evaluated by the Department of Civil and Sanitary Engineering, at Michigan State University. The study is funded by a federal grant administered through the Office of Highway Safety Planning. The basic goal of the study is a safety evaluation of the traffic control device upgrading program. However, specific goals being considered include the identification of efficient inventory methods, the identification of the distribution of need for projects, and the development of program guidelines.

Although the systemwide program will soon be terminated, Michigan Department of Transportation will continue to provide guidance to local agencies for individual locations upon request. This will be accomplished through routine departmental operations to provide statewide conformance in the area of traffic control devices leading to safer roadways.

Sincerely,

James P. Pitz
Director

STATE OF MICHIGAN

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JAMES P. PITZ, DIRECTOR

July 10, 1984

Honorable James J. Blanchard
Governor of the State of Michigan
and
Members of the State Safety Commission
Lansing, Michigan 48909

Gentlemen:

For some time, the Michigan Department of Transportation has experimented with the installation of permanent reflective pavement markers to supplement reflectorized painted lane lines. Installations of permanent raised reflective pavement markers have been made on selected sections of freeway in the Detroit metropolitan area and at a number of curve locations on free access highways in southwestern Michigan. Accident analyses and onsite inspections were conducted at these locations in an effort to assess the value of permanent markers as delineation devices.

Evaluative studies conducted at the locations where raised reflective pavement markers were used have not indicated statistically significant accident reduction nor satisfactory performance of the devices. Most troubling has been their lack of durability during winter maintenance operations. The truck-mounted, underbody scraper blades used extensively for snow removal appear to be responsible for severe damage to the raised markers. In addition to the marker's comparatively initial high cost (currently $15 each, installed), the continual maintenance required to keep the markers operationally effective made this device of questionable value.

Recently, it has been demonstrated that recessing the reflective markers into the pavement may make them practical. Therefore, it was decided to install recessed markers on a project for northbound I-275 between I-96 and I-696. Installation of the reflective markers was completed in June of this year. Markers were used to supplement painted lines at intervals of 100 feet for broken lane lines, at 50 feet for solid lane lines, and at 25 feet for gore markings. Each unit was recessed by grinding a four-inch wide longitudinal groove 46 inches long and one-half inch deep. It is expected that this method of installation will result in less damage to the markers from future snow plowing operations.

Evaluation of the permanent pavement markers will be in terms of nighttime accident reduction, marker durability, and performance of the markers under varying weather conditions. Other items to be considered in the evaluation will include initial installation and follow-up maintenance costs, sign knockdowns in gore areas, the general overall appearance of the devices, and how successful they are for lane and gore area delineation. Reflectivity of the markers will also be checked periodically with equipment furnished and operated by the department's Testing and Research Division.

A preliminary report on the use of recessed permanent pavement markers will be issued after two years of experience. It is anticipated that a final report with recommendations can be published early in 1987.

Sincerely,

for James P. Pitz
Director

APPENDIX
SAFETY IMPROVEMENT PROCESS

Table of Contents

I. Planning

A. Data Collection

1. Accident Data

<u>Michigan Accident Location Index (MALI)</u>

The Michigan Department of Transportation utilizes a computerized crash location reference and analysis system referred to as the MALI. The MALI system generates computerized descriptions of traffic crash locations directly from the information reported by the police officer. The system uses a street index composed of distances between intersections, alternate street names, and accurate city and township boundaries.

The MALI system enables the user to identify locations on all roads and streets with concentrations of correctable accident types.

2. Traffic Volume Data

The department utilizes Permanent (automatic) Traffic Recorders (PTR), portable traffic recorders, and manual recording techniques to collect traffic volume data on the trunkline system. The counting network consists of 110 ATR's 393 portable traffic recorder "A: stations, and 2858 portable traffic recorder "C" stations. ATR data is used to establish seasonal and annual volume trends (refer to Exhibit I). "A" stations are counted for one week three times a year and are used to determine where patterns change. "C" stations (short counts) are counted once a year for 48 to 96 hours and are used to determine volume changes.

Vehicle classification surveys are conducted year-round at all the permanent traffic count stations by manual observation for 8- and 16-hour periods. This data is used to determine the mix of commercial traffic on the trunkline system.

Special intersection traffic surveys are conducted on a request basis primarily for traffic engineering analyses. These surveys usually include 3-hour manual turning movement counts and 24-hour machine counts. Gap-and-delay studies and pedestrian volumes are included when appropriate.

All traffic volume data is stored on magnetic tape in the department's central computer. This information is used to estimate present and future traffic on the state trunkline system, analyze specific locations, and monitor annual and seasonal traffic trends.

Exhibit Ia

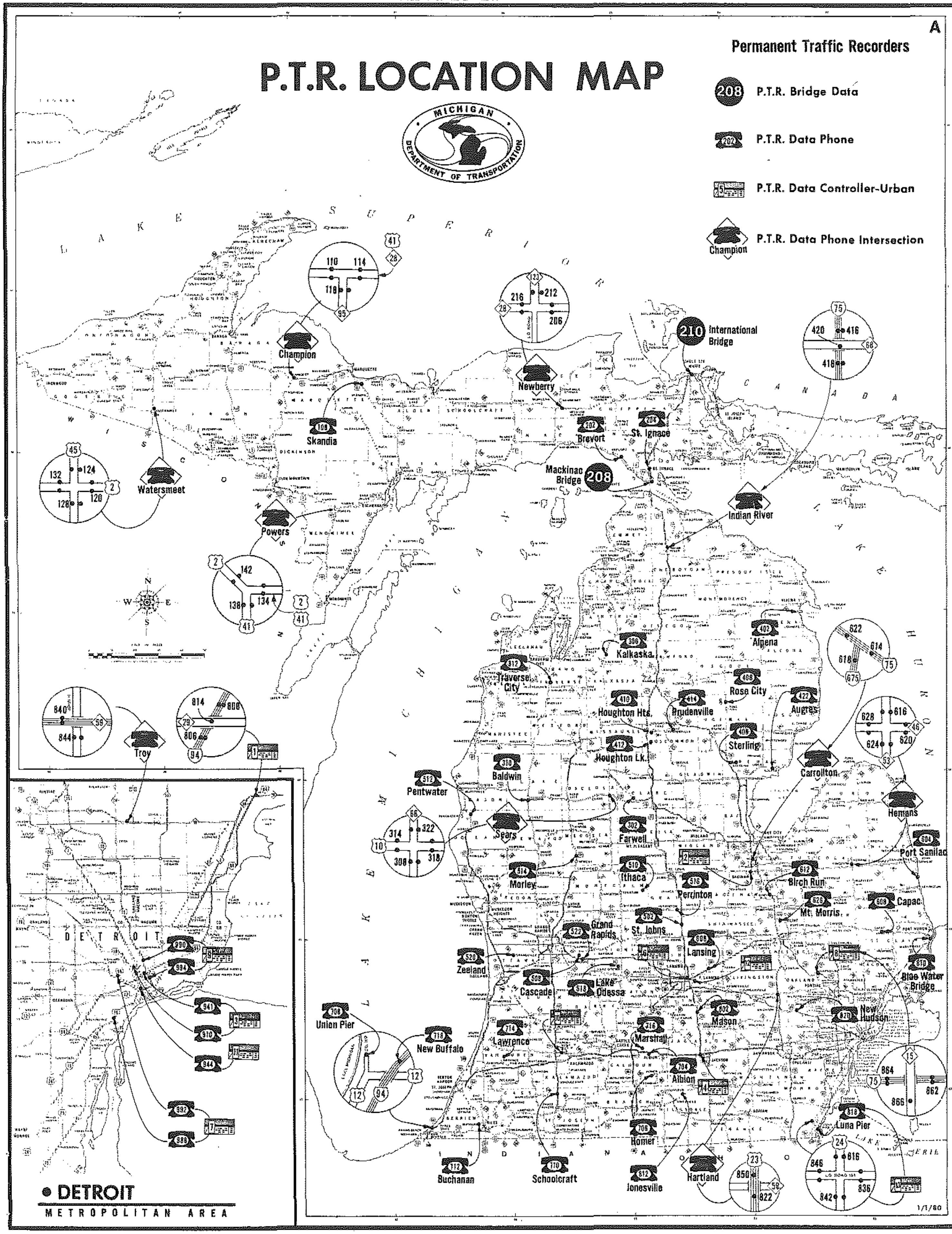
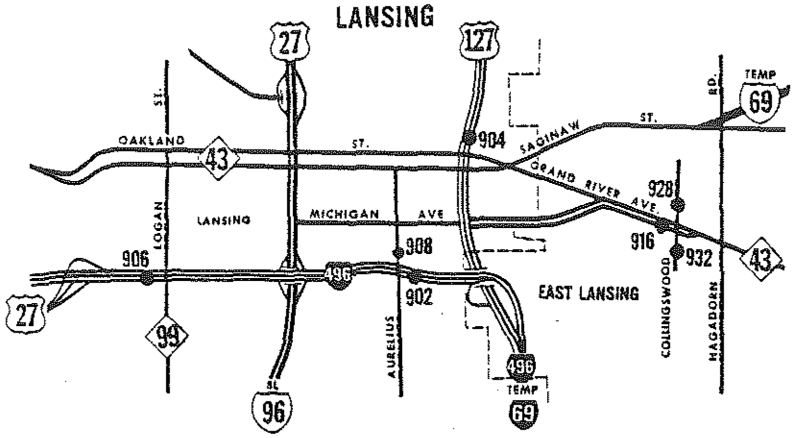

A
P.T.R. LOCATION MAP
MICHIGAN DEPARTMENT OF TRANSPORTATION
Permanent Traffic Recorders
208 P.T.R. Bridge Data
202 P.T.R. Data Phone
P.T.R. Data Controller-Urban
Champion P.T.R. Data Phone Intersection
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ERIE
CANADA
WISCONSIN
INDIANA
OHIO
Champion
Skandia
Watersmeet
Powers
Newberry
Brevort
St. Ignace
International Bridge
Mackinac Bridge
Indian River
Kalkaska
Alpena
Traverse City
Rose City
Houghton Hts.
Prudenville
Augres
Sterling
Houghton Lk.
Carrollton
Baldwin
Pentwater
Sears
Farwell
Hemans
Port Sanilac
Morley
Ithaca
Birch Run
Perrinton
Capac
Mt. Morris
Grand Rapids
St. Johns
Lansing
Zeeland
Cascade
Lake Odessa
Blue Water Bridge
Union Pier
Mason
New Hudson
New Buffalo
Lawrence
Marshall
Albion
Homer
Luna Pier
Buchanan
Schoolcraft
Jonesville
Hartland
Troy
DETROIT
METROPOLITAN AREA
1/1/80

Exhibit Ib

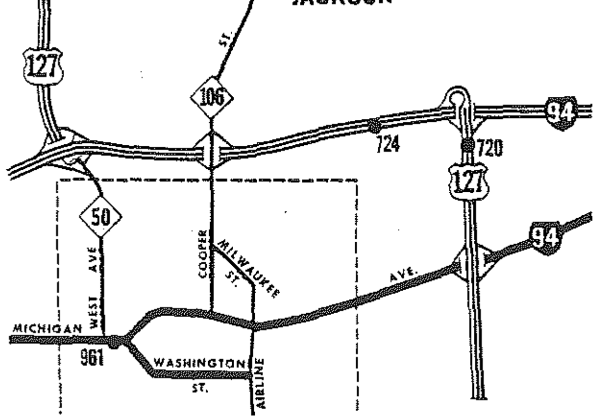
B

P.T.R. URBAN LOCATION MAP

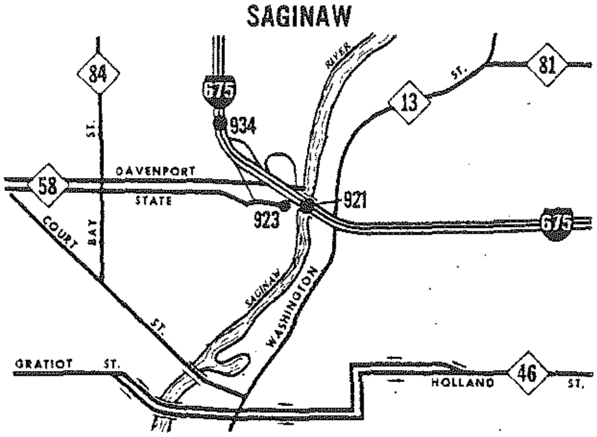
LANSING



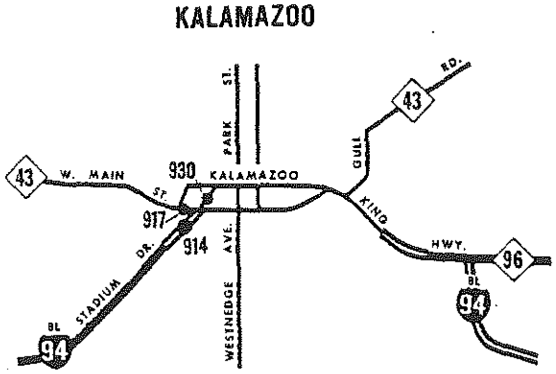
JACKSON



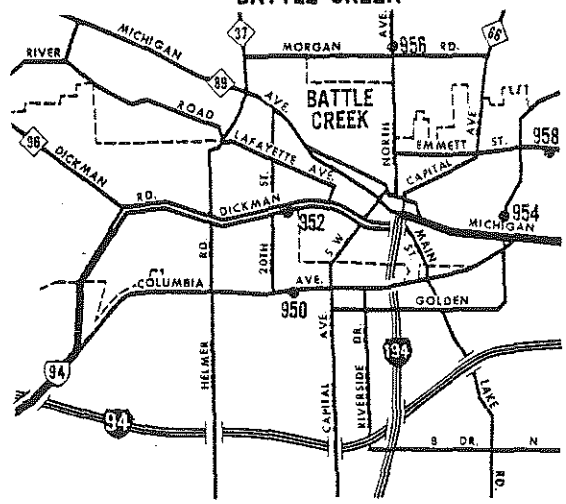
SAGINAW



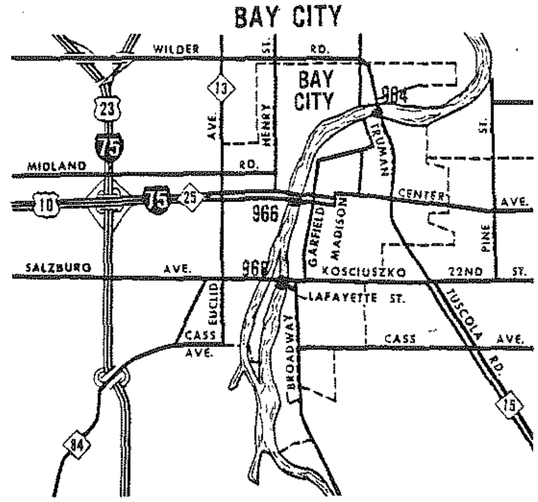
KALAMAZOO



BATTLE CREEK



BAY CITY



Data from the PTR stations are published in a monthly report (MDOT #65) which is available to the public. A magnetic tape of this information is also transmitted to the FHWA Washington D.C., in order to develop national traffic trends.

As a result of the Surface Transportation Act, vehicle speed data is also collected on various highway categories. This speed monitoring information is collected through automatic techniques from 44 stations (see Exhibit II) and is reported on aquarterly and annual basis (MDOT #66). This data is sent to FHWA in Washington D.C. on a quarterly and annual basis as part of Michigan's Annual Certification. This certification is done in conjunction with the Department of State Police and the Office of Highway Safety Planning.

The department also conducts spot speed surveys, primarily to evaluate the need for new or modified speed limits. This data is maintained in a computerized file, tabulations of which are available in the Traffic and Safety Division.

3. Highway Data

Many different inventories are maintained which include highway data. These files can be generally characterized as length or point highway data. Length data includes roadway features and roadway alignment. Examples of roadway features include facility type, tyoe of parking, surface type, and roadside type. Roadway alignment data is not generally available from a single source and is usually collected and stored in response to specific needs.

Point highway data includes traffic control devices (signs and signals), guardrail installations, interchange configuration, intersection geometry, structures, and bridge data, railroad crossing information (see 4 below), and utility placement.

The computerization of the department's highway related data has witnessed several problems which are now the subject of comprehensive study. A task force has been formed and is developing recommendations to ensure the orderly development and accessibility of compatible data systems.

These highway data systems warrant special mention:

Photolog

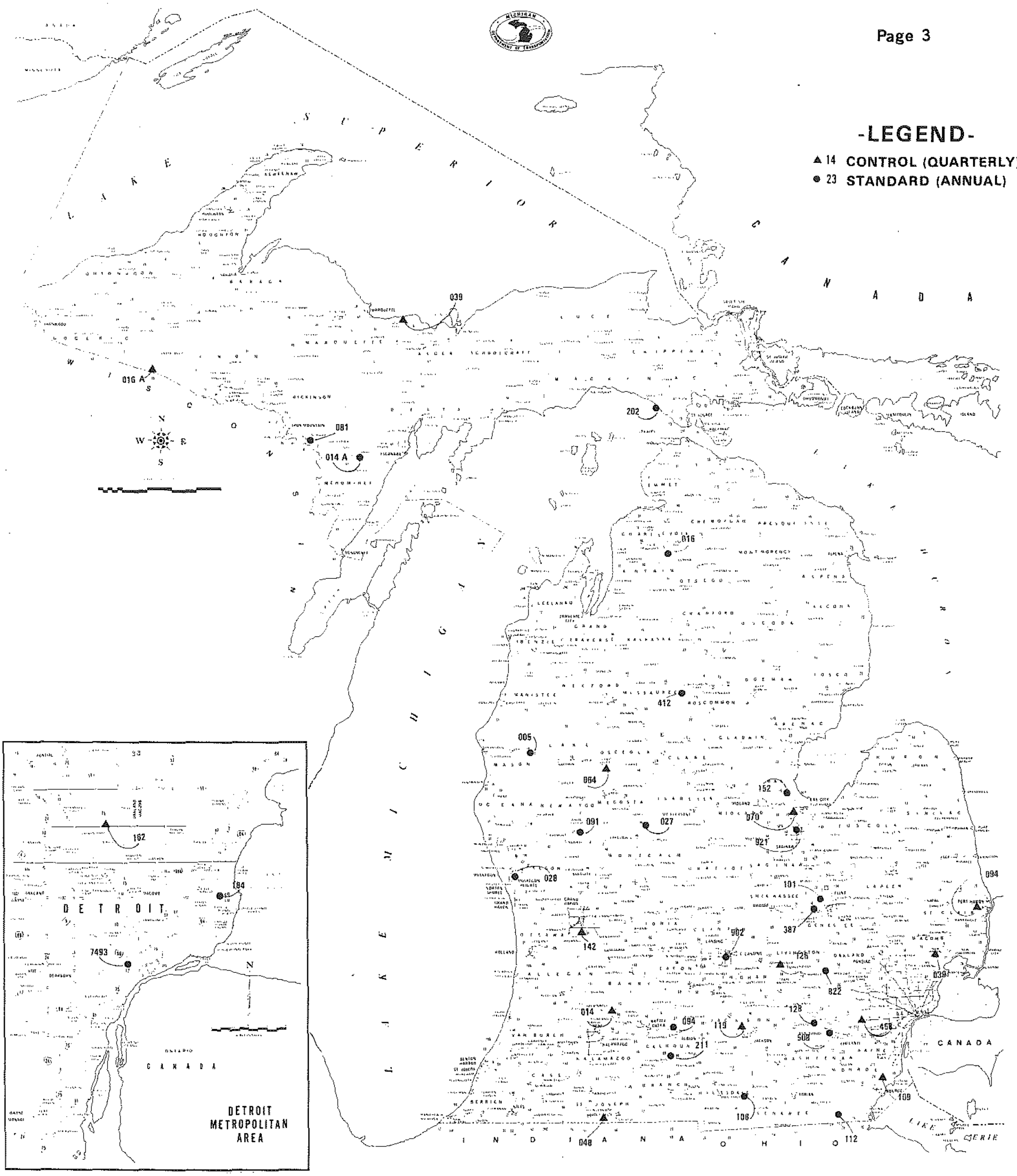
The department maintains a photolog system which provides a 35mm sequential film library of all state trunkline roadways and federal forest highways. The system includes a control section-milepoint reference system which is coordinated with the MALI System.

The photolog and viewing equipment are located in the department's Traffic and Safety Division.

Exhibit II

55 M.P.H. SPEED MONITORING PROGRAM

Station Location Map



6/1/81

The system is used to document and evaluate roadway geometrics traffic control devices.

Sufficiency Rating

MDOT recognizes the need to monitor the condition of its highway system and manage and prioritize improvements based on assessment of several variables including safety, surface and base condition, drainage, alignment, and other deisng factors. A method used by the department to assist in the ranking of deficiencies is the Sufficiency Rating. In the Sufficiency Rating, a completely adequate section of a highway rates 100. All road sections with deficiencies of any kind in their structural condition, effectiveness in serving traffic, or their safety are marked down from 100 according to specified formulae and procedures.

This system helps define which road sections should be given first priority for improvement. The magnitude of the rating also indicates the degree of inadequacy on specific road sections.

The Highway Sufficiency Rating Report is published biennially. A copy of a typical page is shown in Exhibit III.

Railroad Crossing Inventory

The Michigan Department of Transportation, Office of Transportation Safety and Tariffs maintains a highway-railroad crossing inventory. Information for the inventory is obtained through site inspections and contacts with the various agencies involved and is recorded on grade crossing inspection report. The inventory data is computerized to provide flexibility in use, analysis, and updating.

B. Data Analysis

Prior to 1981-1982, data analysis was done using the MIDAS statistical outlier, peer group comparison system. Since the geometric features and traffic control devices were not updated, the "peer group" analysis has been suspended temporarily.

High accident locations are now identified based on a minimum threshold table (Exhibit IV). Those thresholds are used to generate "high accident" lists (Exhibit V). The high-accident list identifies each location for which the number of accidents exceeded its threshold values. The thresholds can, at the analyst's option, be either a previously selected number or a number calculated through statistical analysis. There are threshold values for the total accidents and for 24 accident types for each peer group. The histogram displays the accident counts by number of locations. Accident counts above the threshold are displayed by a change in the symbol used in the plot and the locations that experienced those high counts ("outliers") are identified on an accompanying list.

US- 12 CONTINUED

71.2 TOTAL PAVE. MI.
68.9 TOTAL T.L. MI.
50.1 1ST PRIOR IMP MI

	REC FAF																				
STARTING MILE POST																					
LENGTH																					
YR. OF LATEST IMPROV.																					
URBAN OR RURAL																					
PREDOMINANT WIDTH																					
PARKING																					
30th HIGH HOUR IN 10's																					
A.D.T. IN 100's																					
% COMMERCIAL VEH.																					
% SIGHT RESTRICTION																					
ACC. PER 10⁶ VEH. MI.																					
CAPACITY RATING																					
SURFACE RATING																					
BASE RATING																					
SAFETY RATING																					
SUFFICIENCY RATING																					
REC. 5-YR. PERIOD																					

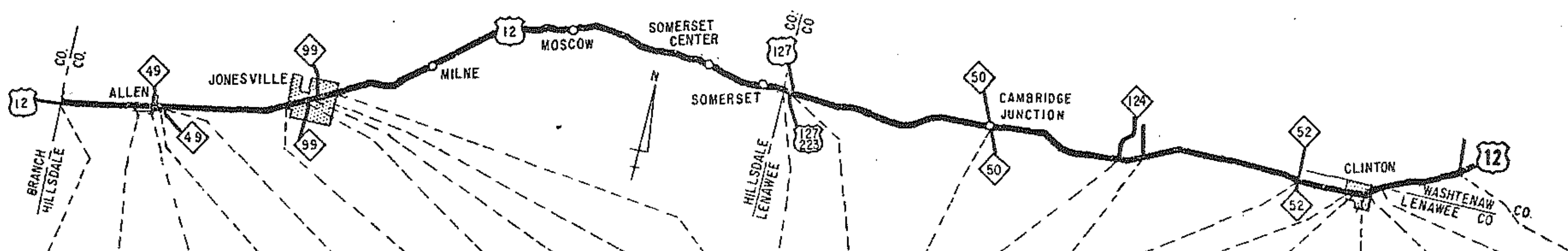


Exhibit III

STARTING MILE POST	0.0	2.5	3.0	3.4	3.5	7.7	8.5	8.7	0.0	0.6	0.0	0.2	7.6	11.8	12.6	18.7	20.3	20.5	21.2	21.4	0.0
LENGTH	2.5	0.5	0.4	0.1	4.2	0.8	0.2	0.1	0.6	16.4	0.2	7.4	4.2	0.8	6.1	1.6	0.2	0.7	0.2	0.3	2.5
YR. OF LATEST IMPROV.	72	72	72	72	72	72	74	74	74	74	74	71	67	67	69	65	63	63	69	69	76
URBAN OR RURAL	R	U	U	R	R	U	U	U	U	R	R	R	R	R	R	R	U	U	U	R	R
PREDOMINANT WIDTH	24	+38	38	+24	24	+24	+44	70	+22	+24	+24	+24	+24	24	+24	+24	24	+48	24	24	24
PARKING	0	2	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0
30th HIGH HOUR IN 10's	52	52	55	55	51	66	130	130	79	54	71	71	77	94	96	105	106	107	109	101	90
A.D.T. IN 100's	40	40	42	42	43	52	110	110	65	45	41	31	49	54	50	83	99	102	105	98	86
% COMMERCIAL VEH.	27	27	26	26	26	28	15	15	22	29	20	23	13	11	12	8	7	7	7	7	11
% SIGHT RESTRICTION	24	0	0	0	21	0	0	0	0	42	0	49	76	63	52	25	0	0	0	67	48
ACC. PER 10⁶ VEH. MI.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPACITY RATING	37	40	40	40	38	21	18	40	11	29	40	21	15	13	14	15	***7**	31	***7**	12	18
SURFACE RATING	7	7	7	7	7	5	6	13	6	8	8	6	***2**	***2**	***3**	***3**	***2**	***2**	***4**	***3**	10
BASE RATING	6	6	***2**	6	6	6	6	6	***1**	6	6	6	***3**	***3**	***3**	***3**	***2**	***2**	***2**	***1**	5
SAFETY RATING	22	18	18	26	14	10	22	18	18	***6**	22	10	***6**	14	***6**	14	18	14	22	18	22
SUFFICIENCY RATING	72	71	67	79	65	42	52	77	36	49	76	43	26	32	26	39	29	49	35	34	55
REC. 5-YR. PERIOD	2	2	1	2	2	2	2	2	1	1	2	85P2	85F1	85F1	85F1	1	1	1	1	1	2
CONTROL SECTION	30061								30062		46101										81031 CONT.

* INDICATES CAPACITY RATING CONTROL DUE TO EXISTING PARKING.

+ = WIDER BY 9' OR MORE

*** ** DENOTES 1ST. PRIORITY FOR IMPROVEMENT

P = PROGRAMMED

Exhibit IV

SAFETY PROGRAM ANNUAL REVIEW DOCUMENTATION

Accident Data Used - 1981, and 1982 Combined
1982 Seperate

Thresholds for Intersections 1981-1982	Thresholds for Intersection 1982 (Only)
Total - 20	14
Injury - 15	10
Fatal - 2	2
Wet - 12	8
Icy - 12	8
Dark - 15	10
Overturned - 3	2
Train - 2	2
Parked Vehicle - 10	7
Multi Vehicle Other - 8	5
Pedestrian - 3	2
Fixed Object - 6	4
On Road Object - 3	2
Animal - 8	5
Bicycle - 3	2
Single Vehicle Other - 10	7
Head-On - 3	2
Side Swipe Meet - 4	3
Side Swipe Pass - 4	3
Right Angle - 10	7
Left Turn - 10	7
Right Turn - 4	3
Rear end - 14	9
Backing - 6	4
Parking - 10	7

Exhibit V

DISTRICT 9

ACC TYPE	# ACC	THRESHOLD NUMBER

82062 00.70 US-12 NOWLIN STREET DEARBORN CY. 20 TOTAL ACCIDENTS
8 Lane Divided/Tangent Urban/Signal 12 ft. Lane/Curb

Total	20	000020

REMARKS:

82062 01.11 US-12 MILITARY STREET DEARBORN CY. 39 TOTAL ACCIDENTS
5 Lane-2 Way/Tangent Urban/Signal 12 ft. Lane/Curb

Total	39	000020
Injury	16	000015
Wet	16	000012
Right Angle	10	000010

REMARKS:

82062 01.29 US-12 HOWARD STREET DEARBORN CY. 34 TOTAL ACCIDENTS
5 Lane-2 Way/Tangent Urban/Signal 12 ft. Lane/Curb

Total	34	000020
Rear-End	22	000014

REMARKS:

82062 01.38 US-12 MASON STREET DEARBORN CY. 65 TOTAL ACCIDENTS
5 Lane-2 Way/Tangent Urban/Signal 12 ft. Lane/Curb

Total	65	000020
Injury	27	000015
Wet	18	000012
Right Turn	4	000004
Rear-End	42	000014

REMARKS:

82062 01.50 US-12 MONROE STREET DEARBORN CY. 58 TOTAL ACCIDENTS
5 Lane-2 Way/Tangent Urban/Signal 12 ft. Lane/Curb

Total	58	000020
Injury	24	000015
Wet	17	000012
Pedestrian	3	000003
Rear-End	38	000014

REMARKS:

82062 01.56 US-12 OAKWOOD BLVD. DEARBORN CY. 54 TOTAL ACCIDENTS
5 Lane-2 Way/Tangent Urban/Signal 10 ft. Lane/Curb

Total	54	000020
Right Angle	16	000010
Rear-End	22	000014

REMARKS:

The threshold table lists each of those outliers for a peer group and shows the number of accidents for each accident type in which the threshold was exceeded.

Current development work underway involves improving those three reports and revising the statistical analysis techniques used. Better techniques will help assure that the high-accident list includes all locations that do in fact have an abnormal number of accidents.

The department is continuing to develop and enhance the MIDAS model. The system being designed will ultimately provide a statistical analysis of abnormal crash patterns and an analysis of all feasible corrective treatments. Integration of the MIDAS and minimum threshold techniques is also being considered.

To conduct an in-depth analysis of any selected segment or intersection, the analyst uses the MIDAS package of reports (Exhibit VI). This package, which can serve as a stand-alone report, provides all available information about a location. It includes a summary of accidents by intersection approach; a one line printout of each specific accident; accident distribution by hour of the day (with volume distribution), by day of week, by month, and by year (using multiyear analysis). The reports in some cases can be used in lieu of a collision diagram. The model also provides before-and-after accident information which is helpful in the evaluation of safety improvements.

Accident information is available for the previous nine years and for a portion of the current year. An accident is added to this file generally within three to four months after it occurs.

The accident predictor routines will allow the analyst test different alternatives by changing one or more of the geometric or operational characteristics, thus putting the segment into a different peer group, and getting an estimate of the number of accidents the segment would experience if it were in that peer group.

The predictor routines, with a small number of predictor equations, are now included in the MIDAS package, for testing purposes. A more complete library of equations is needed to make the routines usable. The department has contracted with Michigan State University, funded in part by a grant from the Office of Highway Safety Planning, to develop the needed equations.

For MIDAS, it is crucial that the roadway geometrics and operational characteristics be correctly described in the files. Otherwise a segment may be placed into the wrong peer group, which would effect the statistical analysis of both peer groups and could incorrectly identify the segment as being or not being an outlier. So the major effort underway for MIDAS is to obtain a revised geometrics file, through a review of the department's photolog and the MARS survey.

INTERSECTION PROFILE

LOCATION: M-100 AT GRAND RIVER AVE

CITY/VILLAGE/TOWNSHIP: EAGLE TWP

COUNTY: CLINTON COUNTY

INTERSECTION TYPE: 4 LEGS - CROSS - FLASHER

DISTRICT	CONTROL SECTION	MILEPOINT MALI	MILEPOINT PHOTOLOG
5	19011	1.92	1.90

DATE REQUESTED: JANUARY 1, 1979 THRU DECEMBER 31, 1983 (5 YEARS, 0 MONTHS, 0 DAYS)

REPORT RUN BY: J. SALLER

REASON FOR RUN: M-100 AT GRAND RIVER AVE.

AUGUST 08, 1984

Exhibit VIa

INTERSECTION PROFILE

DIST 5 CS 19011 MP 1.92 (MALI), 1.90 (PHOTOLOG) M-100 AT GRAND RIVER AVE EAGLE TWP CLINTON COUNTY

INTERSECTION GEOMETRICS

APPROACH DIRECTION	SPEED (MPH)	DAILY VOLUME	LANEAGE BASIC	LANEAGE LEFT	LANEAGE RIGHT	LEFT TURNS PROHIBITED	LEFT TURNS PHASE	DIST	CS	INFLUENCE ZONE MALI MP	INFLUENCE ZONE LENGTH	
NORTH BOUND	55	2,430	1			NO	NONE	5	19011	1.45- 2.00	0.55MI	2904FT
SOUTH BOUND	55	2,430	1			NO	NONE	5	19011	0.00- 0.00	0.00MI	0FT
EAST BOUND						NO	NONE	5	19011			
WEST BOUND						NO	NONE	5	19011			
OTHER						NO	NONE	5	19011			

INTERSECTION ACCIDENTS: 1- 1-79 THRU 12-31-83 (5.00 YEARS)

APPROACH DIRECTION	INJ ACC	FAT. ACC	TOTL ACC	NUMBER OF ACCIDENTS BY TYPE: HEAD ON	SS PASS	SS MEET	ANGL	LEFT TURN	RIGHT TURN	REAR END	BACK UP	PARK	OTHER	PERCENT: WET	ICY	DARK	ACC PER MILLION VEHICLES
NORTH BOUND	2	0	6	0	0	0	2	1	1	2	0	0	0	33.3	33.3	33.3	1.35
SOUTH BOUND	5	0	9	0	0	0	1	6	0	0	0	0	2	22.2	11.1	22.2	2.03
EAST BOUND	9	0	12	0	0	0	9	1	0	1	0	0	1	16.7	33.3	25.0	0.00
WEST BOUND	6	0	12	0	0	0	8	0	0	1	0	0	3	25.0	25.0	16.7	0.00
OTHER	1	0	1	0	0	0	1	0	0	0	0	0	0	0.0	0.0	0.0	0.00
5.00 YEAR TOTAL	23	0	40	0	0	0	21	8	1	4	0	0	6				
AVERAGE PER YEAR	4.6	0.0	8.0	0.0	0.0	0.0	4.2	1.6	0.2	0.8	0.0	0.0	1.2				
PERCENT OF TOTAL	57.5	0.0	100.0	0.0	0.0	0.0	52.5	20.0	2.5	10.0	0.0	0.0	15.0	22.5	25.0	22.5	
EXPECTED ACC.	2.2	0.0	3.5	0.1	0.0	0.2	2.0	0.8	0.3	0.8	0.1	0.3	0.5	2.5	1.4	1.6	
DIFF IN ACCIDNT	2.4	-0.0	4.5	-0.1	-0.0	-0.2	2.2	0.8	-0.1	-0.0	-0.1	-0.3	0.7	-0.7	0.6	0.2	

Exhibit VIb

?????

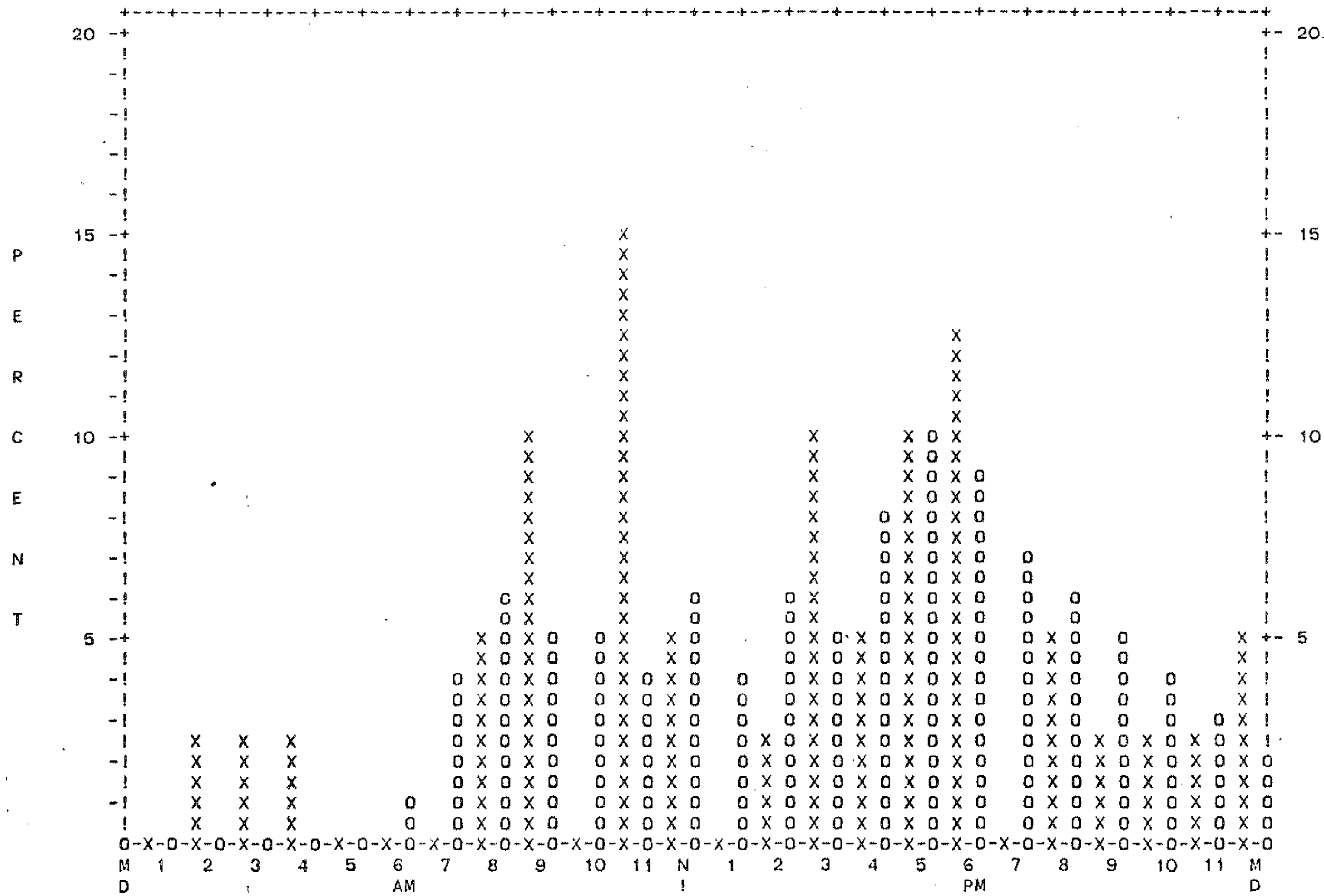
MICHIGAN DEPARTMENT OF TRANSPORTATION
TRAFFIC AND SAFETY DIVISION

08/08/84 MICHIGAN DIMENSIONALIZED ACCIDENT SURVEILANCE SYSTEM (MIDAS)

I N T E R S E C T I O N   P R O F I L E - H I S T O G R A M

DIST CS 19011 MP 1.92(MALI) 1.90(PHOTOLOG) M-100 AT GRAND RIVER AVE EAGLE TWP CLINTON COUNTY

DISTRIBUTION BY HOUR OF DAY



X = ACCIDENT DISTRIBUTION (JANUARY 01, 1979 THRU DECEMBER 31, 1983)
O = VOLUME DISTRIBUTION

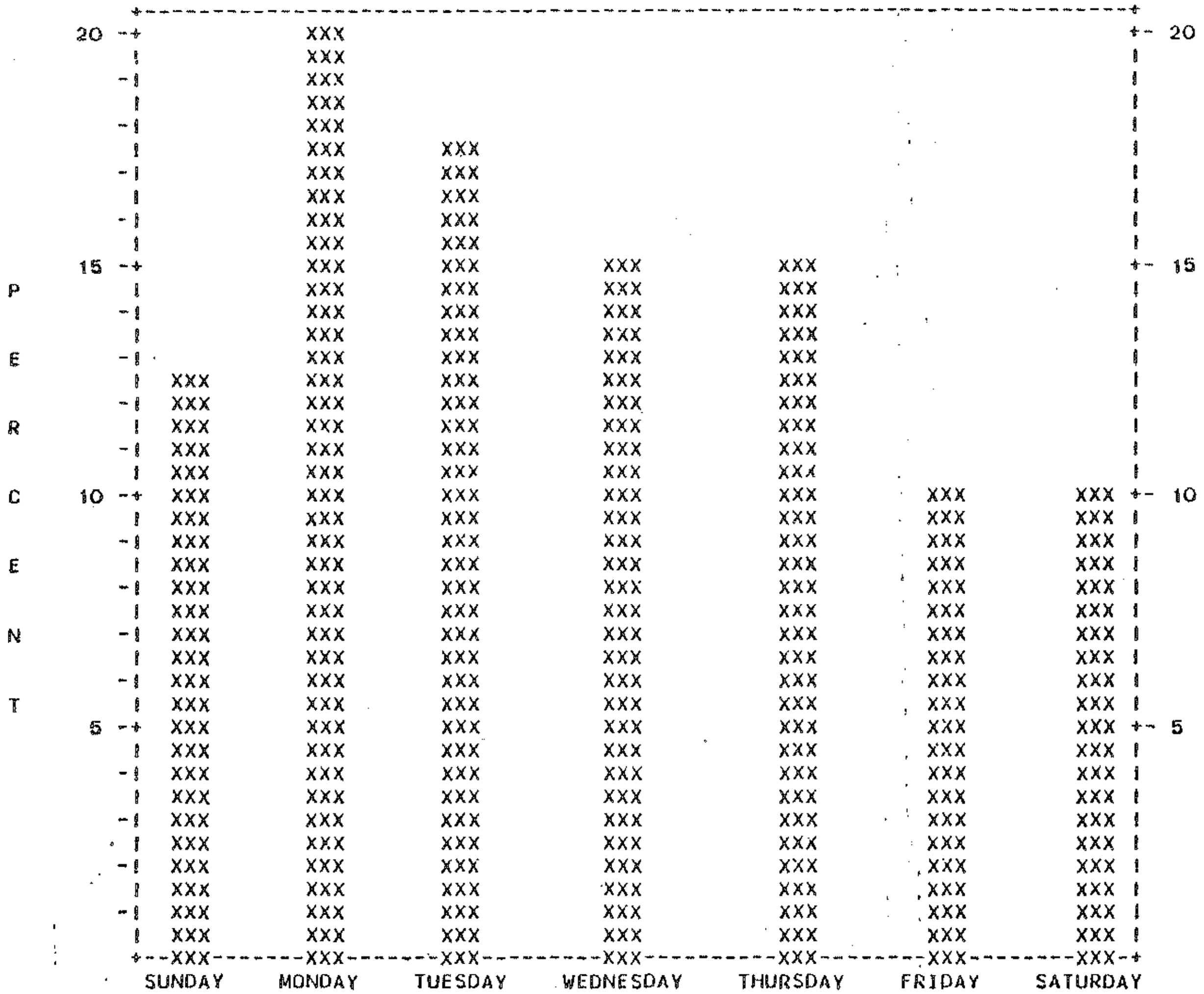
Exhibit VIc

?????

INTERSECTION PROFILE-HISTOGRAM

DIST CS 19011 MP 1.92(MALI) 1.90(PHOTOLOG) M-100 AT GRAND RIVER AVE EAGLE TWP CLINTON COUNTY

DISTRIBUTION BY DAY OF WEEK



X = ACCIDENT DISTRIBUTION (JANUARY 01, 1979 THRU DECEMBER 31, 1983)

Exhibit VIb

MICHIGAN DEPARTMENT OF TRANSPORTATION
TRAFFIC AND SAFETY DIVISION
MICHIGAN DIMENSIONALIZED ACCIDENT SURVEILANCE SYSTEM (MIDAS)

I N T E R S E C T I O N   P R O F I L E - H I S T O G R A M

DIST CS 19011 MP 1.92(MALI) 1.90(PHOTOLOG) M-100 AT GRAND RIVER AVE EAGLE TWP CLINTON COUNTY

DISTRIBUTION BY MONTH OF ALL YEARS

```
       +---------------------------------------------------------------------------+
   40 -+                                                                           +- 40
       !                                                                           !
      -!                                                                           !
       !                                                                           !
      -!                                                                           !
       !                                                                           !
      -!                                                                           !
       !                                                                           !
A     -!                                                                           !
       !                                                                           !
   30 -+                                                                           +- 30
C      !                                                                           !
      -!                                                                           !
       !                                                                           !
C     -!                                                                           !
       !                                                                           !
      -!                                                                           !
I      !                                                                           !
      -!                                                                           !
       !                                                                           !
D  20 -+                                                                           +- 20
       !                                                                           !
      -!                                                                           !
E      !                                                                           !
      -!                                                                           !
       !                                                                           !
N     -!                                                                           !
       !                                                                           !
      -!                                                                           !
T      !                                                                           !
   10 -+                                                                           +- 10
       !                                                                           !
S     -!                                                                           !
       !                                                      XXX                  !
      -!                                                XXX   XXX               XXX!
       !   XXX         XXX                              XXX   XXX               XXX!
      -!   XXX         XXX   XXX                        XXX   XXX         XXX   XXX!
       !   XXX         XXX   XXX                        XXX   XXX         XXX   XXX!
      -!   XXX         XXX   XXX         XXX            XXX   XXX         XXX   XXX!
       !   XXX   XXX   XXX   XXX         XXX            XXX   XXX         XXX   XXX!
       +---XXX---XXX---XXX---XXX---XXX---XXX---XXX---XXX---XXX---XXX---XXX---XXX---+
       !   JAN   FEB   MAR   APR   MAY   JUN   JUL   AUG   SEP   OCT   NOV   DEC   !
```

X = ACCIDENT DISTRIBUTION (JANUARY 01, 1979 THRU DECEMBER 31, 1983)

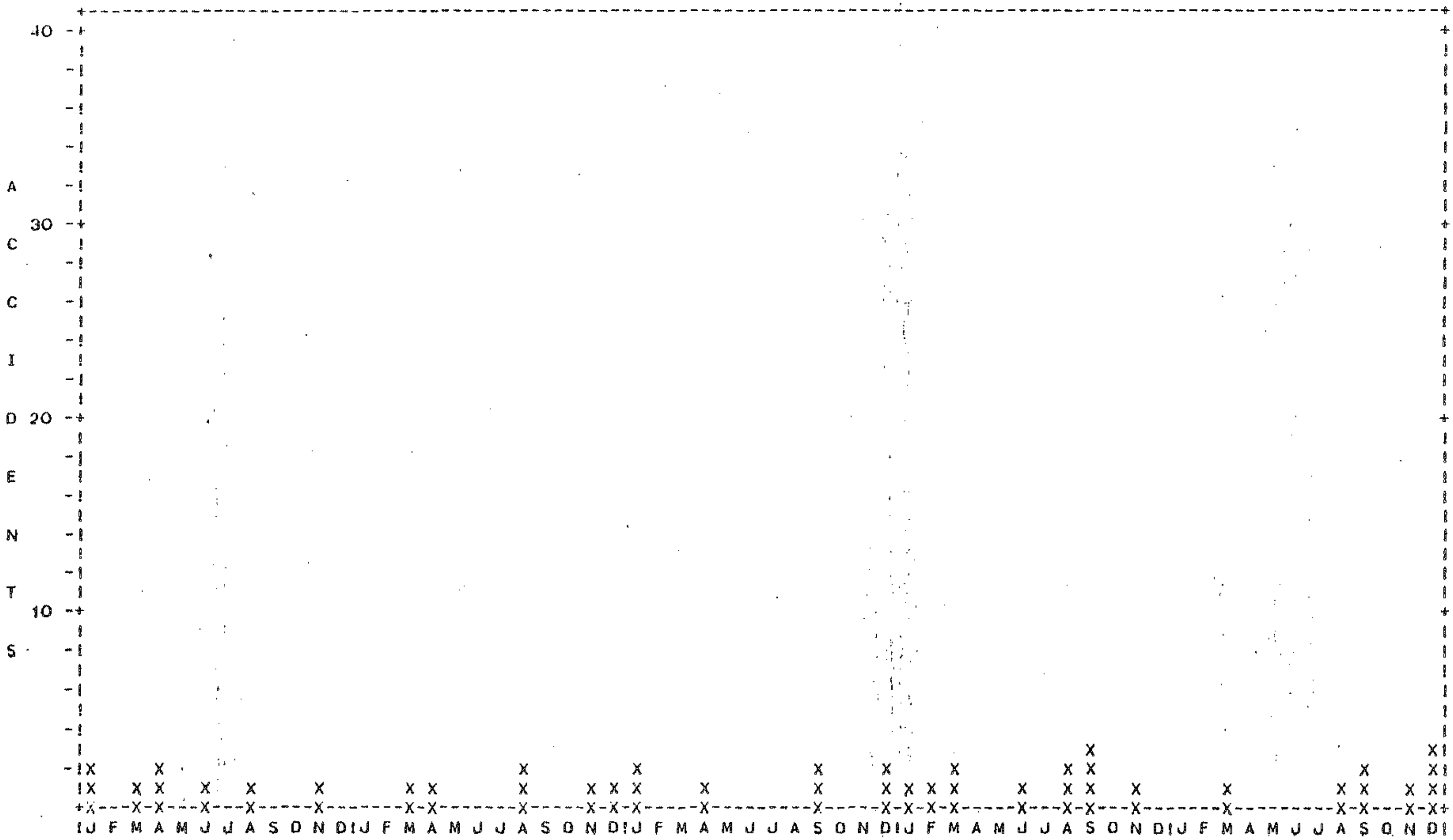
Exhibit VIe

?????

INTERSECTION PROFILE-HISTOGRAM

DIST CS 19011 MP 1.92(MALI) 1.90(PHOTOLOG) M-100 AT GRAND RIVER AVE EAGLE TWP CLINTON COUNTY

DISTRIBUTION BY MONTH



X = ACCIDENT DISTRIBUTION (JANUARY 1, 1979 THRU DECEMBER 31, 1983)

Exhibit VIIf

?????

INTERSECTION PROFILE-HISTOGRAM

DIST CS 19011 MP 1.92(MALI) 1.90(PHOTOLOG) M-100 AT GRAND RIVER AVE EAGLE TWP CLINTON COUNTY

```
                 DISTRIBUTION BY YEAR
      +--------------------------------------+
  40 -+                                      +- 40
      !                                      !
     -!                                      !
      !                                      !
     -!                                      !
      !                                      !
     -!                                      !
      !                                      !
A    -!                                      !
      !                                      !
  30 -+                                      +- 30
C     !                                      !
     -!                                      !
      !                                      !
C    -!                                      !
      !                                      !
     -!                                      !
I     !                                      !
     -!                                      !
      !                                      !
D 20 -+                                      +- 20
      !                                      !
     -!                                      !
E     !                                      !
     -!                                      !
      !                                      !
N    -!                                      !
      !                                      !
     -!                                      !
T     !                          XX          !
  10 -+                          XX          +- 10
      !                          XX          !
S    -!  XX                      XX      XX  !
      !  XX              XX      XX      XX  !
     -!  XX      XX      XX      XX      XX  !
      !  XX      XX      XX      XX      XX  !
     -!  XX      XX      XX      XX      XX  !
      !  XX      XX      XX      XX      XX  !
     -!  XX      XX      XX      XX      XX  !
      !  XX      XX      XX      XX      XX  !
      *--XX--**--XX--**--XX--**--XX--**--XX--*
      * 1979 ** 1980 ** 1981 ** 1982 ** 1983 *
```

X = ACCIDENT DISTRIBUTION (JANUARY 01, 1979 THRU DECEMBER 31, 1983)

Exhibit VI8

INTERSECTION ACCIDENT PROFILE

INTERSECTION TYPE : 2 LANE 2-WAY FLASHER

LOCATION : M-100 AT GRAND RIVER AVE EAGLE TWP , CLINTON COUNTY

DISTRICT 5 CONTROL SECTION 19011 MILEPOINT 1.92

DIST FROM ISCN	ACCIDENT TYPE	VIOLATOR (OR VEH 1) DR	INTENT	IMPACT	HAZRD ACT'N	SECOND VEHICLE DR	INTENT	IMPACT	HAZRD ACT'N	WEATH	SRF CND	LIGHT	VEH/ CIRCUM	F	A	B	C	O	PRP DMG	DATE OF ACCIDENT	ACCDNT REPORT NUMBER
NORTHBOUND APPROACH																					
1.92	2-VEH ANGLE	N	R-TURN	FRNT-L	CLOSE	W	GO STR	SIDE-L	NONE	CLEAR	ICY	DUSK	1/SKID	0	0	0	0	2	X	FRI 1/ 5/79 5PM	9543
1.92	2-VEH ANGLE	N	R-TURN	FRNT-L	FAST	W	GO STR	SIDE-L	NONE	CLEAR	ICY	DAY		0	0	0	0	2	X	THU 1/ 4/79 8AM	5234
1.92	2-VEH L-TRN	N	L-TURN	FRNT-L	TURN	S	GO STR	FRNT-L	NONE	CLEAR	DRY	DAY		0	0	1	0	1		TUE 8/26/80 10AM	155325
1.92	2-VEH R-TRN	N	GO STR	SIDE-R	NONE	N	R-TURN	SIDE-R	NONE	RAIN	WET	DARK		0	0	0	0	4	X	THU 9/ 3/81 9PM	178718
1.92	2-VEH R-END	N	GO STR	FRONT	CLOSE	N	L-TURN	REAR	NONE	CLEAR	DRY	DAY		0	0	0	3	4		SAT 9/24/83 10AM	167156
1.96	2-VEH R-END	N	GO STR	REAR-L	NONE	N	GO STR	FRNT-R	NONE	RAIN	WET	DARK		0	0	0	0	3	X	TUE 4/24/79 7PM	98032
SOUTHBOUND APPROACH																					
1.89	1-VEH FX OB	S	AV VEH	FRNT-R	NONE		DITCH			CLEAR	WET	DAY		0	0	0	0	2	X	MON 12/ 5/83 5PM	234460
1.92	2-VEH L-TRN	S	L-TURN	REAR-R	TURN	N	GO STR	FRNT-R	NONE	CLEAR	DRY	DARK		0	1	0	1	2		FRI 11/16/79 11PM	261711
1.92	1-VEH ROLL	S	L-TURN	OTHER	TURN					CLEAR	DRY	DARK	1/RECK	0	0	1	0	1		SAT 8/11/79 2AM	191301
1.92	2-VEH L-TRN	S	L-TURN	SIDE-R	TURN	N	GO STR	FRONT	NONE	CLEAR	DRY	DAY		0	0	0	2	1		WED 4/30/80 2PM	80954
1.92	2-VEH ANGLE	S	GO STR	SIDE-R	NONE	E	GO STR	FRNT-L	NONE	CLEAR	DRY	DAY		0	0	0	0	4	X	SUN 9/12/82 1PM	214775
1.92	2-VEH L-TRN	S	L-TURN	FRONT	TURN	N	GO STR	FRNT-L	NONE	CLEAR	DRY	DAY		0	0	0	1	2		MON 8/30/82 10AM	170973
1.92	3-VEH L-TRN	S	L-TURN	FRNT-R	F YLD	N	GO STR	FRNT-R	NONE	CLEAR	WET	DAY		0	0	1	0	3		SAT 1/30/82 2PM	26211
1.92	2-VEH L-TRN	S	L-TURN	SIDE-R	F YLD	N	GO STR	FRNT-R	NONE	SNOW	ICY	DUSK		0	0	0	0	2	X	TUE 12/ 6/83 5PM	234457
1.92	2-VEH L-TRN	S	L-TURN	SIDE-R	TURN	N	GO STR	FRONT	NONE	CLEAR	DRY	DAY		0	0	0	0	4	X	SUN 8/ 7/83 11AM	158006
EASTBOUND APPROACH																					
1.92	2-VEH ANGLE	E	GO STR	FRONT	F YLD	N	GO STR	SIDE-L	NONE	CLEAR	DRY	DAY	1/OB V	0	3	0	2	1		MON 6/18/79 5PM	139429
1.92	2-VEH ANGLE	E	GO STR	SIDE-R	F YLD	N	GO STR	FRONT	NONE	SNOW	WET	DAY		0	0	1	0	1		MON 3/31/80 11AM	53547
1.92	2-VEH R-END	E	GO STR	FRONT	FAST	E	STOPPD	REAR	NONE	CLEAR	ICY	DAY		0	0	0	5	1		WED 12/16/81 4PM	250146
1.92	1-VEH FX OB	E	GO STR	FRNT-L	CLOSE		SIGN			CLEAR	ICY	DARK	1/SKID	0	0	0	0	1	X	WED 12/16/81 11PM	261718
1.92	2-VEH ANGLE	E	GO STR	FRNT-R	F YLD	N	GO STR	FRONT	NONE	CLEAR	DRY	DAY		0	1	0	0	2		SUN 9/12/82 3PM	173014
1.92	2-VEH ANGLE	E	GO STR	REAR-L	F YLD	S	GO STR	FRONT	NONE	CLEAR	DRY	DAY		0	0	1	0	2		THU 8/ 5/82 10AM	152413
1.92	2-VEH ANGLE	E	GO STR	FRNT-L	CLOSE	S	GO STR	FRNT-R	NONE	CLEAR	ICY	DAY		0	0	0	0	3	X	WED 2/ 3/82 10AM	46280
1.92	3-VEH ANGLE	E	GO STR	REAR-R	F YLD	N	GO STR	FRONT	NONE	CLEAR	WET	DAY		0	0	0	1	2		MON 12/ 5/83 4PM	234445
1.92	2-VEH L-TRN	E	GO STR	FRNT-R	CLOSE	W	L-TURN	SIDE-R	NONE	CLEAR	DRY	DARK		0	0	0	0	2	X	TUE 9/27/83 10PM	169179
1.92	2-VEH ANGLE	E	GO STR	SIDE-R	F YLD	N	GO STR	FRONT	NONE	CLEAR	DRY	DARK		0	0	1	0	1		THU 3/17/83 8PM	46714
1.97	2-VEH ANGLE	E	GO STR	FRNT-L	F YLD	S	GO STR	FRNT-R	NONE	CLEAR	DRY	DAY		0	0	0	1	1		TUE 3/23/82 4PM	56163
1.98	2-VEH ANGLE	E	GO STR	FRNT-L	F YLD	S	GO STR	FRONT	NONE	CLEAR	ICY	DAY		0	0	1	1	3		WED 12/24/80 2PM	244651
WESTBOUND APPROACH																					
1.92	2-VEH ANGLE	W	L-TURN	FRONT	F YLD	N	GO STR	FRONT	NONE	CLEAR	WET	DAY		0	0	0	0	2	X	MON 4/30/79 8AM	98038
1.92	3-VEH R-END	W	GO STR	FRONT	CLOSE	W	STOPPD	FRONT	NONE	CLEAR	ICY	DAY		0	0	0	0	3	X	TUE 3/ 6/79 7AM	72528
1.92	2-VEH ANGLE	W	GO STR	FRNT-L	F YLD	S	L-TURN	REAR-L	NONE	CLEAR	DRY	DAY		0	0	0	0	2	X	MON 11/ 3/80 8AM	218815
1.92	2-VEH ANGLE	W	L-TURN	FRNT-R	F YLD	N	GO STR	FRNT-R	NONE	CLEAR	DRY	DAY		0	0	0	1	5		FRI 4/10/81 10AM	77623

Exhibit VIh

INTERSECTION ACCIDENT PROFILE

INTERSECTION TYPE : 2 LANE 2-WAY FLASHER

LOCATION : M-100 AT GRAND RIVER AVE EAGLE TWP , CLINTON COUNTY

DISTRICT 5 CONTROL SECTION 19011 MILEPOINT 1.92

DIST FROM ISCN	ACCIDENT TYPE	VIOLATOR (OR VEH 1) DR	INTENT	IMPACT	HAZRD ACT'N	SECOND VEHICLE DR	INTENT	IMPACT	HAZRD ACT'N	WEATH	SRF CND	LIGHT	VEH/ CIRCUM	NUMBER OF INJURIES INJURY CLASS F	A	B	C	O	PRP DMG	DATE OF ACCIDENT			ACCDNT REPORT NUMBER
1.92	1-VEH FX OB	W	GO STR	SIDE-L	CLOSE		ON RD			FOG	WET	DAY	1/SKID	0	0	0	1	0		MON	9/14/81	7AM	168677
1.92	2-VEH ANGLE	W	GO STR	FRONT	F YLD	S	L-TURN	SIDE-L	NONE	SNOW	ICY	DAY		0	0	0	0	2	X	THU	1/15/81	3PM	7620
1.92	1-VEH FX OB	W	GO STR	SIDE-R	FAST		SIGN			CLEAR	DRY	DARK		0	0	0	0	1	X	SAT	1/10/81	3AM	7730
1.92	2-VEH ANGLE	W	GO STR	FRNT-L	F YLD	N	AV VEH	FRNT-R	NONE	CLEAR	DRY	DAY		0	0	0	1	3		WED	9/ 1/82	2PM	173015
1.92	2-VEH ANGLE	N	GO STR	SIDE-R	NONE	W	GO STR	FRONT	UNKN	RAIN	WET	DARK		0	1	0	0	1		SUN	6/13/82	1AM	124175
1.92	2-VEH ANGLE	W	GO STR	FRNT-L	F YLD	N	GO STR	FRONT	NONE	CLEAR	DRY	DAY		0	1	0	2	2		THU	11/ 3/83	4PM	201928
1.94	2-VEH ANGLE	W	GO STR	FRONT	FAST	S	GO STR	FRNT-L	NONE	RAIN	ICY	DAY		0	5	0	1	1		SUN	11/28/82	8AM	226050
1.96	1-VEH PARKD	W	L-TURN	FRNT-R	CLOSE					CLEAR	DRY	DAY		0	0	0	0	1	X	TUE	3/23/82	5PM	56169
OTHER																							
1.92	2-VEH ANGLE	NW	GO STR	FRNT-R	F YLD	N	GO STR	SIDE-R	NONE	CLEAR	DRY	DAY		0	0	1	0	3		FRI	8/15/80	7PM	155297

Exhibit VII

The need for MIDAS to obtain information available in a variety of department files has rekindled departmentwide efforts to develop a complete data base, so that information can be transferred easily.

In the future, MIDAS will be expanded to include the approximately 40 percent of the local roads which experience about 80 to 90 percent of the accidents. The model will then be made available to local agencies. Eventually MIDAS will incorporate optimization processes to assist in setting priorities for roadway improvements.

C. Engineering Studies

Primary responsibility for accident surveillance on the state trunkline system is assigned to the Spot Safety Improvement Program managed by the Traffic and Safety Division's Safety Programs Unit. This surveillance/analysis effort is accomplished annually using the most recent two years of accident data as a basis.

In addition, a TOPICS Program (Traffic Operations Program to Improve Capacity and Safety), managed by the Safety Programs Unit, is responsible for a more intensive review on a 3-year cycle in 13 large urbanized areas and 17 smaller cities with population greater than 10,000. That effort includes coordinated identification and analysis of deficiencies on the local system by staff in the Safety Programs Unit funded by a Section 402 grant. The TOPICS studies are very comprehensive, including the identification of operational and capacity deficiencies and review of system and signal timing. The program emphasizes lower cost corrective countermeasures such as improved signs, signals or pavement markings, parking prohibitions, traffic signal modifications such as longer yellows, all reds, or special turn phases, and minor construction projects.

The process followed by these two programs to carry out accident surveillance differs somewhat. The annual Spot Safety reviews are completed as follows:

1. Location Review List

   a. Computer listings of all locations exceeding minimum thresholds of accidents or exceeding a minimum threshold for any of 24 accident types. The listing can also be generated using statistical deviations; of accidents or accident types in similar "peer groups." Present effort is being directed toward integrating the peer group generation of locations with benchmark minimum levels for each accident type.

   b. Traffic and Safety engineerings located in the department's Lansing and district offices are very familiar with all state trunkline highways in their area. They are aware of new and tentative development which will impact safety and other conditions which will influence accident experience.

c. Citizen Input

The department regularly receives requests from motorists, developing police agencies, local governmental officials, and others calling attention to locations where accident concentrations are, or may be, developing.

2. Preliminary Analysis

The accident data developed in conjunction with the location review list is preliminarily reviewed in the office. That effort may include review of the department photolog, traffic signal inventory and timing permits, intersection drawing, and other information included in Traffic and Safety Division files. The purpose of this preliminary review is to determine if the identified accident concentration is unusual and warrants further review. If not, the reasons are documenbted on the accident location list. If an accident concentration appears to warrant further analysis, that concentration is isolated and possible corrective countermeasures identified.

The entire list and those locations noted for further review are then sent to the district traffic and safety engineers and affected units in the Traffic and Safety Division for further review and comment.

3. Final Analysis and Identification of Corrective Countermeasures

After review of the preliminary analysis, the district traffic and safety engineer and/or implementing unit indicate the recommended countermeasure, an agreed on alternate, or proposes that no action is justified because of previous or already proposed project or because corrective action is not cost justified or otherwise warranted. A field review may be scheduled if indicated including Safety Programs Unit representative, the district traffic and safety engineer, and other affected staff and local interests. Final action is documented in return correspondence to the Safety Programs Unit.

If the proposed corrective countermeasure requires construction, the following process is followed:

a. The Geometrics Coordination Unit develops proposed alternate geometric schemes with cost estimates and transmits a recommended plan to the Safety Programs Unit. (Solutions are developed with district, local, and private developer's input if required.)

b. Funding may be recommended by the Safety Programs Unit based on cost-effectiveness. Candidate projects are generally recommended when the expected return in safety benefits is realized in approximately five to eight years. If approved, the Safety Programs Unit requests a job number and project programming.

c. "Intent to Study Forms" are processed which provide documentation of alternatives considered in developing safety improvement projects in order to fulfill state and federal environmental requirements. Necessary impact reviews of the proposed projects are initiated.

d. The recommended functional layout is transmitted to the district for their review and for the district traffic and safety engineer to discuss with local officials. The district traffic and safety engineer obtains unofficial written concurrence from local agencies required to participate in the project.

e. The Geometrics Coordination Unit makes necessary changes resulting from the district review and transmits the plan to the Design Division for completion and letting.

The TOPICS Program reviews follow basically the same procedures, except that they review accident data at lower threshold levels on both the state trunkline and nontrunkline systems. The resultant review is more comprehensive and detailed identifying less significant accident concentrations and operational deficiencies. The TOPICS reviews are conducted within the framework of local Metro Planning Organizations (MPOs) responsible for managing and coordinating transportation activities in the urbanized areas. The final TOPICS reports are offered as the traffic engineering element of the TSM process.

D. Establishing Priorities

1. Potential Accident Reduction Factors (Number, Severity, and/or Pattern of Accidents).

a. Current Practice - Analysis of Anticipated Benefits for Safety Projects.

The analysis technique used by the Traffic and Safety Division of the Michigan Department of Transportation at the present time is to determine the cost-benefit of short-term safety improvement projects and subsequently the time-of-return (T.O.R.) or the number of years to amortization. If the anticipated TOR is less than ten years, programming of the project is requested.

The anticipated probable reduction in accidents due to a particular treatment at a given location is estimated. We use data collected from previous before-and-after accident studies to determine expected reductions. Attached is a copy of a worksheet (Exhibit VII) used by the Michigan DOT to evaluate accident costs, determine expected accident reductions, and anticipated benefits.

Exhibit VII

COMPUTED BENEFITS DERIVED THROUGH ACCIDENT REDUCTION

Location ______________________ City/Twp. ____________ County ____________

The method of evaluating accident costs, used below, is given on page 67 of Roy Jorgensen's report of Highway Safety Improvement Criteria, 1966 edition. This same method is given in the Bureau of Public Roads IM21-3-67.

In the following analysis the costs provided by the National Safety Council are: 1983 values

Death - $210,000

Nonfatal Injury - $8,600

Property Damage Accident - $1,150

$$B = \frac{ADT_a}{ADT_b} \times (Q\ R_1 + 1150\ R_2)$$

where

B = Benefit in dollars

ADT_a = Average traffic volume after the improvement ____________________

ADT_b = Average traffic volume before the improvement ____________________

R_1 = Reduction in fatalities and injuries combined ____________________

R_2 = Reduction in property damage accidents ____________________

Q = 8,600 if no fatal accidents occurred, and

$$Q = \frac{210{,}000 + (I/F \times 8{,}600)}{1 + I/F} = 10{,}570 \text{ if at least 1 fatality occurred.}$$

where

I/F = Ratio of injuries to fatalities that occurred statewide during the year 1983

$$= \frac{135{,}996}{1{,}343} = 101.26$$

Time of Return (T.O.R.) based on _____ years of data.

B = ________ [(8,600 or 10,570) __________ + (1,150) __________] ÷ ______ yrs.

B = ________ [(__________) + (__________)] ÷ __________ yrs. = __________

Annual B = ______________ dollars

C = Total cost of project

$$T.O.R. = \frac{C}{B} = \text{\_\_\_\_\_\_\_\_\_\_} = \quad \text{years}$$

8-31-84
MAF:nkg(Form 3-219)-2
Safety Programs Unit

The estimated cost of each improvement can then be compared to the anticipated yearly benefit. To accomplish this, a modified T.O.R. approach is used which can be computed by merely dividing the estimated initial cost by the anticipated yearly benefit neglecting interest, maintenance, and salvage factors. This system provides a reasonable comparative index since most typical safety projects have a similar design life. Presently, most safety related projects programmed yield a return in safety benefits in approximately five to eight years. In general, a TOR of less than ten years is sufficient to justify a safety improvement project.

b. Future Methodology

Using the MIDAS Program, it is our intent to evaluate potential corrective countermeasures by assessing the real life performance of similar designs on our state trunkline system. When complete accurate geometry and traffic control device data has been incorporated into the department's data base, such evaluations will be possible by integrating that data base with the existing accident data base.

2. Cost and Resources

The ability of the department to program the recommended safety projects is, or course, limited by their cost and by available funds. All designated categorical funds (HES and R.R. Safety) are earmarked for safety projects. Other state and federal aid funds are used for safety projects as described in "Implementation" (II, below).

3. Grade Crossings (RR Crossings) Improvement Program

The Grade Crossing Improvement Program utilizes the Hazard Index Rating (H.I.R.) to initiate grade inspections by a diagnostic team. Inspectors from the department's diagnostic team. Inspectors from the department's Railroad Safety Section are the team leaders and are responsible for completing the Grade Inspection Report form (Exhibit VIII). The remarks section of the form would include data relative to people, factors, and hazardous materials. The H.I.R. is then again utilized to determine the order in which improvement projects are submitted with one exception. Flexibility in the program is maintained by being able to take advantage of a scheduled highway improvement to include an improvement in a rail-highway crossing. The crossing improved may not appear near the top of the project listing but by incorporating the two projects a lower cost can be utilized.

a. Hazard Index from State Inventory Program

Exhibit VIII

1704 (N9/79)

GRADE CROSSING INSPECTION REPORT

File No.______ N.I. No. ______ Inspector______ Date ______

Railroad(s):______ Road Authority ______

Location ______

Intersecting Roadway(s) Nearby ______

Direction of Roadway ______ Direction of Tracks ______ Angle ______

No. of Traffic Lanes ______ Roadway Width ______ Shoulder Width ______ Surface of Roadway ______

______ Approaches ______ Electricity Nearby ______

No. of Tracks ______ Materials in Crossing ______ Crossing Length ______

Site Distances (Approx.)	NE Quadrant	NW Quadrant	SE Quadrant	SW Quadrant
100 Feet				
200 Feet				
300 Feet				

PHYSICAL CROSSING	CONDITION	RECOMMENDATIONS	QUANDRANTS	LOCATION	RECOMMENDATIONS
1. Existing Crossing			8. Vegetation		
2. Proposed Crossing			9. Structures		
3. Trackage			10. Embankments		
4. Road Approaches			11. Vehicle Parking		
5. Devil Strip			12. RR Car Storage		
6. Drainage			13. Other		
7. Other					

STATIC SIGNING	REMARKS	RECOMMENDATIONS	AUTO. PROTECTION	REMARKS	RECOMMENDATIONS
14. Crossbucks			21. Flashing Lights		
15. Adv. Warning Signs			22. Side Lights		
16. Pavement Markings			23. Signals on Cants		
17. Overhead Lighting			24. Gates		
18. Stop Signs			25. Other		
19. Stop Ahead Signs					
20. Other					

RECOMM. CODES: 1 - Repair 3 - Extend 5 - Close 7 - Modernize 9 - Approve 11 - Restrict 13 - Add 15 -
2 - Rebuild 4 - Remove 6 - Relocate 8 - Install 10 - Deny 12 - Paint 14 - Adequate

PARTY RESPONSIBLE FOR WORK CODES: RR - Railroad RD - Road Authority Identify Other: ______

Traffic Count ______ Posted Speed Limit ______ No. School Buses Using Crossing ______

Accident Record ______

Train Movements: Thru ______ Switching ______

Speed ______ Main Tracks ______ Sidings/Spurs ______ Simultaneous Occupancy ______

Exposure Factor ______ Priority ______ Other ______

REMARKS ______

A. Existing situation adequate.

B. More information required.

C. Will draft supplemental report and mail to the involved parties at a later date.

D. Items ______ are considered seasonal and/or normal maintenance and should be accomplished within ____ days from this inspection and written confirmation provided to the Railroad Safety Section.

E. Items ______ are considered construction improvements, and a Commission Order will be issued. Objections to the recommendations must be received within 45 days from this inspection and must be based upon specific safety concerns.

REPORT PREPARED BY: ______

REPORT RECEIVED BY: Railroad Representative ______

Road Authority Representative ______

______ Representative ______

Signature Title

Hazard Index Rating (HIR) = Average Daily Traffic (A.D.T.) x Average 24-hour Train Movements x Protection Factor

Protection Factors

1.00 - Reflectorized Crossbuck Sign
0.30 - Flashing Light Signals
0.27 - Flashing Light Signals with Cantilever Arms
0.24 - Flashing Light Signals with Cantilever Arms and Half-Roadway Gates
0.11 - Flashing Light Signals with Half-Roadway Gates
0.08 - Flashing Light Signals with Cantilever Arms and Half-Roadway Gates
0.05 - Flashing Light Signals with Cantilever Arms, Half-Roadway Gates, and Traffic Signal Interconnection

Note: Railroad Safety does not account for interconnected traffic lights in their inventory data.

We have now scheduled 103 inspections based on the new rail-highway crossing process. The annual target is to complete 200 inspections.

b. Diagnostic Team Inspection

Grade Crossing Inspection Report
People Factor
Hazardous Materials Factor

II. Implementation

The Department of Transportation schedules and implements safety projects through its Programming Section of the Bureau of Highways. The process is in accord with criteria outlined in the Federal-Aid Highway Program Manual, Volume 6, Chapter 3, Section 2, Subsection 2. The safety project identification/evaluation/selection process is described in Section I (Planning) of the Safety Improvement Process.

Hazard Elimination Funds are used to implement safety justified projects on all state roads, except Interstate. Approximately 50 percent of the HES funds are allocated to the state trunkline and 50 percent to the local system. State trunkline projects are primarily recommended by the Traffic and Safety Division and projects on local roads are administered by the Local Government Division.

Rail Highway Crossing funds are selected based on the criteria outlined in I, D., 3 of the Sfaety Improvement Process. The projects are identified as selected based primarily on evaluation by the Railroad Safety Section. The Railroad Section administers state trunkline projects and the Local Government Division those on the local system.

Section 144 of Title 23 of the United States Code provides financial assistance for replacing bridges over significant waterways or other topo-graphical barriers which are unsafe because of structural deficiencies, physical deterioration, or functional obsolescence. The program in Michigan is administered by the department's Local Government Division.

Bridges under local jurisdiction have been surveyed for structural adequacy and are ranked for priority of replacement in accordance with critical need based on the local agency's financial resources, importance of the bridge to the area, and the structural condition of the existing bridge. Other highway safety projects are funded with Federal-Aid Urban, Primary, and Secondary funds. Interstate safety projects are funded with interstate funds.

Contracts for highway safety improvements are awarded in accord with criteria and requirements outlined in FHPM 6-4-1-14.

III. Evaluation and Reporting

Evaluation of highway safety improvements are done in accord with reporting requirements outlined in the Federal Aid Highway Program Manual, Volume 8, Chapter 2, Section 3, Paragraph 8. Results of these evaluations are included in Michigan's annual report to the Federal Highway Administration of its overall highway safety improvement program.

The basic element of the evaluation process is completion of the "Table 2" form for the federal categorical Hazard Elimination Safety (H.E.S.) programs. In addition, that form has been, and is, used to tabulate before-and-after data for previous federally funded safety programs as well as safety projects funded by state and other federal highway funds. Since Rail Highway Safety Program projects are not justified primarily by accident data, other "program" analysis methods are used (see C).

The "Table 2" includes the following information:

- Funding Source (Column 1)
- Improvement Type (Column 2)kk
- Cost (Column 3)
- Before-and-After Accident Data, Including Severity (Columns 7-15)
- Traffic Volume (Columns 17 and 18)

The data summarized in the "Table 2's" is assessed in different ways.

A. Time of return

The time of return analysis computes before-and-after accident costs, considering fatalities, injuries, and property damage only crashes. Comparing the reduction of these costs (the "benefit") to project costs yields the time to recover the investment.

B. Statistical Analysis

Long term accident data is subject to increasing and decreasing trends, resulting from some well known factors, such as safer vehicle designs, the lower national speed limit, changes in the minimum drinking age, and also other less well understood factors which seem to affect crash and crash severity data. MDOt therefore utilizes statistically valid "control" groups to assess the expected impact of the "no build" alternative. This affords a more accurate assessment of the benefits of safety projects. "Controls" are usually groups of locations with characteristics similar to the project location. When entire ssafety programs are evaluated, statewide or system classification made data may be used as a control.

C. Program Analysis

After several years of experience with one or more safety programs directed at specific road systems, type of projects or locations, a program analysis is undertaken. Examples of such analyses included in previous annual safety reports are the Pavement Marking Demonstration Program (1981), the Railroad Safety Programs (1982), and the Roadside Safety Improvement Program on the Interstate System (1983). These types of analysis yield a broad perspective overview of the long term effect of various safety programs on the targeted roadway systems.

D. Type of Improvement Analysis

MDOT regularly analyzes the impact of various types of roadside "hardware" and operational improvements. Examples include concrete median barrier walls, paved shoulders, traffic signal systems, 4-way stops in rural areas, and 2-way center left-turn lanes. These studies allow us to assess new "state of the art" traffic control devices and new or unique uses of existing devices.

The body of knowledge accumulated through these evaluations allows MDOT to assess the cost-effectiveness of specific safety programs, their impact on specific roadway classifications, and the impact of new or modified traffic control devices, highway appurtenance, or design techniques. This data assists us in future decisions as to what countermeasures will be most effective in alleviating accidents or reducing their severity.