EVALUATION OF HIGHWAY SAFETY IMPROVEMENT PROJECTS IN LOUISIANA (1975 - 1978)

ZAHIR BOLOURCHI
SPECIAL STUDIES RESEARCH ENGINEER,

SARAH F. KEMP
ENGINEERING RESEARCH AIDE

and

WILLIAM C. WALTERS
RESEARCH & DEVELOPMENT GEOLOGIST

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FOREWORD

The authors of this report were requested by the Traffic and Planning Division of the Department and the Federal Highway Administration to analyze the data contained within. All data was furnished for this evaluation by the Traffic and Planning Division. The procedures for analysis were prepared for F.H.W.A. by Goodwell-Grivas, Inc., and were followed closely, with a few exceptions, by the authors. Thus, the writers can only claim credit for the arrangement of the accident data into various categories gleaned from the reports furnished and computing benefit/cost ratios, accident reduction factors, the tests for statistical significance, etc., and for the reporting of the work.

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ABSTRACT

The purpose of this study was to evaluate the effectiveness of Highway Safety Improvement Projects constructed by the Department during 1975 through 1978. The projects included crossover improvement, passing lane construction, drainage improvements, shoulder reconstruction, intersection improvements, and skid resistant overlays. Evaluation consisted of statistical and economic assessment of the projects goal of reducing the number and severity of accidents. The goal of this study was to improve the Department's ability in making future decisions with regard to all components of the Highway Safety Program so that scarce safety funds can be properly allocated to high payoff projects and diverted from marginal or ineffective ones.

An accident based "before" and "after" evaluation procedure was used throughout the study. Project effectiveness was also examined with respect to the relationship between the benefits and the costs for each project.

Accident reduction factors for intersection improvements were found to be 12%, 3%, 26%, and 67% (decrease) for total, PDO, injury, and fatal accidents, respectively. The benefit-cost ratio for this category was 6.25, indicating that the benefits derived outweighed the incurred costs on the order of 525%.

For the skid resistant overlays, the accident reduction factors were found to be 12%, 9%, and 20% (increase) for the total, PDO, and injury accidents, and 50% decrease for fatality accidents. The benefit cost ratio for the overlay projects was 0.58.

It was recommended that the findings of this study be implemented by the Department's Traffic Safety Section so that funds may be properly allocated to derive the maximum benefit.

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IMPLEMENTATION

The findings of this study can be immediately implemented by the Traffic Safety Section to improve the Department's ability in making future decisions with regard to the Highway Safety Improvement Program so that scarce safety funds may be properly allocated to high payoff projects and diverted from those which are ineffective. The Research and Development Section has already initiated the phase II of this study to evaluate all safety projects constructed during the years 1978 - 1980.

INTRODUCTION

As described in the Federal-Aid Highway Program Manual (FHPM) directive 8-2-3, the Highway Safety Improvement Program (HSIP) consists of three components: planning, implementation and evaluation. The planning component consists of four processes, namely: collecting and maintaining data, identifying hazardous locations, conducting engineering studies and establishing priorities. The implementation component contains one process, that is, scheduling and implementing safety improvement projects. The evaluation component also consists of one process and that involves the determination of the effectiveness of the highway safety projects in reducing the number and severity of accidents.

FHPM 8-2-3 recommends that processes for planning, implementing, and evaluating highway safety projects be instituted on a statewide basis. Its stated objective is that each state "develop and implement, on a continuing basis, a highway safety improvement program which has the overall objective of reducing the number and severity of accidents and decreasing the potential for accidents on all highways."

Accordingly, in 1975, the Department began the statewide task of collecting data, identifying hazardous locations, conducting engineering studies, establishing priorities and scheduling and implementing the State's Highway Safety Improvement Program.

By 1978, the program included fifty-nine (59) completed safety projects which were implemented under thirty-three (33) different construction contracts costing a total of $8,577,363. The projects included widening of one crossover at a cost of $35,630, construction of two (2) passing lanes at a cost of $1,302,218, drainage improvements at three (3) locations costing $1,556,475, shoulder reconstruction at four (4) sites costing $1,436,918, turn lane construction at thirty (30) locations at a cost of $1,413,738

and skid resistant overlays at nineteen (19) locations costing a sum of $2,832,384.

It is the objective of this report to summarize the researcher's findings with regard to the value or the effectiveness of the aforementioned completed safety projects as measured by the observed changes in the number, rate, and severity of traffic accidents resulting from the implementation of the projects; and also, to summarize the results obtained by examining the relationships between the costs and the benefits of the implemented projects.

PURPOSE

The purpose of this study was to evaluate the safety effectiveness of fifty-nine (59) Highway Safety Improvement Projects (HSIP) constructed by the Department during the years 1975 - 1978. Effectiveness evaluation consisted of statistical and economic assessment of the extent to which the projects achieved their safety goal of reducing the number and severity of accidents. The ultimate goal of this study was to improve the Department's ability in making future decisions with regard to all components of the Highway Safety Program so that scarce safety funds can be properly allocated to high payoff projects and diverted from those which are found to be marginal or ineffective.

SCOPE

The scope of this study was limited to an accident-based "before" and "after" evaluation study of the fifty-nine (59) safety projects which were constructed by the Department during the years 1975-1978. Evaluation time frame included a two-year "before" and a two-year "after" period, during which time the changes in accident experience were used as the primary measure of safety effectiveness. The scope also included examination of project effectiveness with respect to the relationship between the benefits and the costs (benefit-cost ratio).

METHODOLOGY

Throughout this study, the March 1981 edition of "Highway Safety Evaluation Procedural Guide" prepared for Federal Highway Administration (FHWA) by Goodell-Grivas, Inc. was utilized as a general guide in evaluating the fifty-nine (59) safety projects completed during the period 1975 - 1978. However, the authors did not attempt to follow the Procedural Guide every step of the way due to manpower and fiscal constraints. Additionally, to have followed the Procedural Guide step-by-step would have required an individual evaluation report for each project, resulting in tremendous duplication of forms and worksheets and a voluminous final report of approximately 1200 pages.

Faced with the above constraints, the authors decided to group the projects into six (6) distinct categories, namely: Widening of Existing Crossovers, Construction of Passing Lanes, Drainage Improvements, Shoulder Reconstruction, Intersection Modifications and Skid Resistant Overlays. Table 1, page 13, is a summary of project identification, construction date, type of modification implemented, length of each project, construction cost and project location and description.

METHOD OF EVALUATION:

The accident-based "before" and "after" evaluation procedure which utilizes the changes in accident experience as the primary measure of project effectiveness has been used throughout this report. This procedure measures the project effectiveness in terms of observed changes in the number, rate and severity of traffic accidents resulting from the implementation of a safety modification designed and constructed to alleviate specific safety problems. Project effectiveness has also been examined with respect to the relationship between the benefits and the costs of each project. Since Skid Resistant Overlays are intended to reduce wet weather accidents alone, the wet weather accidents, rather than total accidents were used in computing the effectiveness of these safety projects.

EVALUATION PERIOD:

The evaluation period for each project consisted of a two-year "before" and a two-year "after" period. It was felt that this time frame was sufficiently long enough to provide adequate accident data and, at the same time, short enough to minimize the introduction of factors other than the implemented countermeasures which might have influenced the accident experience. Accidents within the project limits, occuring during a time period beginning with approximately one month before the start of construction and ending approximately one month after the completion of the project, were not included in the "before" and "after" evaluation periods. This allowed sufficient time not only for actual construction but also for installation and removal of construction signs and barricades. The one-month transition period after completion allowed the motoring public to adjust to the new modifications and also provided time for the traffic to return to a steady-state pattern. Additionally, the starting and ending date of each evaluation period was rounded off to the nearest month to make traffic and accident rate calculations as simple as possible.

DATA RETRIEVAL:

For spot improvement projects (Intersections), the accident data was manually extracted from the accident report forms, whereas for extended roadway projects (Passing Lanes, Skid Resistant Overlays, etc.) the data was retrieved directly from the computer files which listed the accidents by route number and reference point to the nearest 0.1 of a mile (see Appendix, page 57 for sample accident printout.)

Actual number of accidents for each project may be found on Table 2, page 16. Table 3 on page 20 compares the actual number of accidents vs number of injuries and fatalities for each project. The number of injuries and fatalities will be used in benefit-cost ratio

calculations as explained later on. Table 3 A on page 23 is a summary of total number of PDO involvements, injuries and fatalities for each category.

TRAFFIC EXPOSURE AND ACCIDENT RATES:

To determine the effectiveness of each safety project, the following four (4) fundamental and primary objectives were selected for evaluation purposes:

1) Total Accidents (TOT)
2) Property Damage Accidents (PDO)
3) Personal Injury Accidents (INJ)
4) Fatal Accidents (FAT)

Three additional objectives which were felt to be specific to most of the projects being evaluated were also chosen and evaluated by severity. They are:

1) Wet Weather Accidents (WET)
2) Night Time Accidents (NIGHT)
3) Run-off-the-road Accidents (ROR)

Traffic volume or average daily traffic (ADT) for each site and for the entire duration of the evaluation period was obtained from the Department's Traffic and Planning Division. Appreciable changes in the accidents were used as measure of effectiveness rather than simply comparing frequency of accidents for the "before" and "after" periods. Consequently, accidents in this report are expressed as the number of accidents or severity of occurrences per unit of exposure.

For spot improvement projects (intersections), the exposure unit is expressed as millions of vehicles (MV) utilizing major and minor approaches to the intersection during the "before" or the "after"

evaluation period, that is:

$$\text{EXPOSURE} = MV = ADT \times 365 \times 2/1{,}000{,}000$$

The two-year accident rates were then calculated as the total number of accidents occurring during the two-year period divided by the exposure (MV).

For extended projects (passing lanes, skid resistant overlays, etc.) the exposure unit is expressed as million vehicle-miles (MVM) of travel for the duration of the evaluation period (two years), that is:

$$MVM = ADT \times 365 \times 2 \times L/1{,}000{,}000$$

where L is defined as the length of the roadway section in miles. For these projects, the accident rates were calculated as the total number of accidents occurring during the two-year evaluation period divided by the exposure (MVM). It should be noted that the ADT in the above formulas refers to average daily traffic averaged over the two-year evaluation span.

The "before" and "after" traffic exposures (MV or MVM) and accident rates (No. of Acc./MV or MVM) for all projects are listed in Table 4 on page 24.

WEIGHTED ACCIDENT RATES:

Table 5 on page 28 shows a summary of weighted accident rates in which a factor of one (1) was assigned to property damage accidents (PDO), a factor of three (3) to personal injury accidents (INJ) and a factor of eight (8) to fatal accidents (FAT). The comparison of "before" and "after" weighted accident rates for each project gives a good indication as to the degree to which the project was

effective in reducing the number and/or the severity of accidents. (For sample calculation refer to the Appendix, page 59.)

TEST FOR STATISTICAL SIGNIFICANCE:

Table 6 on page 31 is a summary of statistical significance tests using Poisson Distribution Curves for 80%, 90%, 95%, and 99% probabilities. These tests were conducted in order to measure the statistical significance of the effectiveness of the safety projects to better understand whether the observed changes in accident rates were attributable to the implementation of the safety project or due to some other factors unrelated to the project. The inputs required for statistical testing were the percent change in accident frequency resulting from project implementation and the expected accident frequency had the safety project not been implemented. Assuming that without the implementation of the safety countermeasure the accident rate would have remained constant during the "before" and "after" periods, the expected accident frequency was calculated as the product of the "before" accident rate and the "after" exposure (MV) or (MVM) as the case may be. See Appendix, page 60 and 61 for sample calculations and Poisson Distribution Curves.

ECONOMIC ANALYSIS:

For the purpose of this study the benefit-cost-ratio (B/C) technique was chosen to determine the relationship between costs and benefits resulting from the implementation of safety improvement projects. The benefit-cost ratio was calculated as the ratio of equivalent uniform annual benefit (EUAB) and the equivalent uniform annual cost (EUAC). That is:

$$(B/C) = (EUAB)/(EUAC)$$

The equivalent uniform annual benefit is the dollars saved due to reduction in the number of accidents associated with each type of severity (PDO involvement, injury, fatality). This was calculated as the difference between the cost of annualized expected number of accidents had the safety project not been implemented and the cost of annualized number of accidents during the "after" period. In this study, the expected accident rates were assumed to be equal to the "before" rates and the number of PDO involvements were determined by multiplying the number of PDO accidents by 1.5 for non-intersection locations and by 2.0 for intersections as recommended by the Department's Traffic Safety Section.

The accident cost for each type of severity was derived from the National Highway Traffic Safety Administration publication entitled "1975 Societal Cost of Motor Vehicle Accidents". The following updated dollar values were used to determine accident costs:

$430,763 per fatality
$ 4,778 per injury
$ 780 per PDO involvement

The equivalent uniform annual cost (EUAC) was determined by using the following equations:

$$EUAC = I(CR_n^i) + K - T(SF_n^i)$$

where:

I = Project cost ($)
CR_n^i = Capital Recovery Factor for n years at interest rate i
i = interest rate (%)
n = estimated service life of the project (years)
T = net salvage value ($)
K = annual cost of operation and maintenance ($)
SF_n^i = sinking fund factor for n years at interest rate i.

The cost of construction (I) for each project was obtained from Form 675 kept in file by the Construction Audit Section. Capital Recovery Factor (CR_n^i) was obtained from standard interest table included in the Appendix. For 8% interest rate, the value of CR_n^i is as follows:

$$CR_n^i = 0.1490 \text{ for } n = 10 \text{ years}; \quad CR_n^i = 0.1019 \text{ for } n = 20 \text{ years}$$

Service life (n) was assumed to be ten years for Intersections and Skid Resistant Overlays and twenty years for other projects evaluated in this study. Salvage value (T) and the net annual cost of operation and maintenance were assumed to be zero.

It should be noted that for the purpose of benefit-cost ratio analysis, if there were any fatal accidents during the evaluation period, the first fatality was considered as an injury to eliminate isolated cases which might have skewed the data. For sample calculations the reader is advised to refer to the Appendix, page 60.

Summary of accident statistics including benefit-cost ratio for each project is shown on Table 7, page 34. Summary of Construction Cost, Annual Cost (EUAC), Annual Benefit (EUAB) and Benefit-cost Ratio (B/C) for each category of evaluated safety projects is shown on Table 8, page 37.

ACCIDENT REDUCTION FACTORS:

Accident reduction factor (AR) is an estimate of the project effectiveness, expressed as a percent reduction in accident experience. In this study AR Factors were computed for each category of highway safety improvement projects as shown on Table 9, page 38. This table includes reduction factors for total accidents, PDO, Injury, and fatal accidents. The following equation was used to compute the AR Factors:

$$\text{AR Factor} = 100 \left(1 - \frac{\sum A}{\sum E_F}\right)$$

A = Total number of accidents for the "after" period.

E_F = Total expected number of accidents.

Sample calculations may be found in the Appendix, page 63.

TABLE 1

PROJECT LOCATION, IDENTIFICATION AND COST

PROJ. NO.	Const. Date	Type of Modification	Length of Project	Const. Cost	Project Location and Description	Parish
CROSSOVER						
283-09-43	76	Widening of the Existing Crossover	Spot Modification	$ 35,630	US 90 (W. Bank Expressway) at Manhatten Blvd. in Harvey	Jefferson
PASSING LANE						
25-02-14	75	Const of Passing Lane	5.3 Mi.	$799,640	US 171 from Fisher to Many	Sabine
25-03-16	75	Const of Passing Lane	2.7 Mi.	$502,578	US 171 from Many to Zwolle	Sabine
DRAINAGE IMPROVEMENT						
7-09-71	75	Drainage at Intersection		$ 34,564	Jct US 61 & McClelland Dr. in Baton Rouge	E. Baton Rouge
7-05-20	78	Drainage Structure and Safety Work	8.8 Mi.	$480,680	US 61, Ascension Parish Line to St. John Parish Line	St. James
7-04-32	79	Drainage Structures	14.1 Mi.	$1,041,230	US 61, St. James Parish Line to St. Charles Parish Line	St. John the Baptist
SHOULDER RECONSTRUCTION						
15-08-21	75	Asphalt Conc. Shoulders	9.9 Mi.	$417,301	US 165 from Caldwell Parish Line to Rilla	Ouachita
7-09-70	76	Asphalt Conc. Shoulders	3.8 Mi.	$211,592	US 61 in Baton Rouge from Florida Blvd to Nesser Overpass	E. Baton
7-04-31	78	Base Widening & Asph. Conc. Sh.	5.6 Mi.	$326,037	US 61 thru LaPlace	St. John the Baptist
7-03-32	79	Asphalt Conc. Shoulders	11.0 Mi.	$481,987	US 61, St. John Parish Line to Kenner Highway in Norco	St. Charles
INTERSECTIONS						
6-90-38	76	Left Turn Lane	Spot Imp.	$ 28,878	Jct US 90 & Hickerson in New Orleans	Orleans
7-04-27	76	Turn Lane	Spot Imp.	$ 28,419	Jct US 61 & LA 54 in Garyville	St. John
7-04-28	76	3 Left Turn Lanes	Spot Imp.	$412,764	Jct US 61 & 3 streets in Reserve	St. John
7-04-29	76	Left Turn Lane	Spot Imp.	$ 68,132	Jct US 61 & LA 3179 in Garyville	St. John
7-04-30	76	Left Turn Lane	Spot Imp.	$255,142	Jct US 61 & Magnolia St in LaPlace	St. John
7-05-18	76	Turn Lane	Spot Imp.	$ 28,419	Jct US 61 & LA 54 at Blind River	St. James
7-09-72(A)	76	Left Turn Lane	Spot Imp.	$ 25,050	Jct US 61 & Foster Dr in Baton Rouge	E. Baton Rouge

TABLE 1 (Continued)

PROJECT LOCATION, IDENTIFICATION AND COST

PROJ. NO.	Const. Date	Type of Modification	Length of Project	Const. Cost	Project Location and Description	Parish
7-09-72(B)	76	Left Turn Lane	Spot Imp.	$ 25,050	Jct US 61 & Tom Dr. in Baton Rouge	E. Baton Rouge
8-01-32	77	Left Turn Lane	Spot Imp.	$ 25,998	Jct US 190 & LA 413 in Erwinville	W. Baton Rouge
8-03-38	77	Left Turn Lane	Spot Imp.	$ 25,998	Jct US 190 & LA 81 in Lottie	Point Coupee
420-01-19(A)	77	Left Turn Lane	Spot Imp.	$ 22,286	Jct LA 3032 & Knight St, Shreveport	Caddo
420-01-19(B)	77	Left Turn Lane	Spot Imp.	$ 22,286	Jct LA 3032 & Weyman Dr, Shreveport	Caddo
7-07-29(A)	78	Left Turn Lane	Spot Imp.	$ 26,512	Jct US 61 & LA 431 & LA 30	Ascension
7-07-29(B)	78	Left Turn Lane	Spot Imp.	$ 26,512	Jct US 61 & LA 939	Ascension
7-07-29(C)	78	Left Turn Lane	Spot Imp.	$ 26,512	Jct US 61 & LA 3038	Ascension
7-07-29(D)	78	Left Turn Lane	Spot Imp.	$ 26,512	Jct US 61 & LA 938	Ascension
7-07-29(E)	78	Right Turn Lane	Spot Imp.	$ 26,512	Jct US 61 & LA 74	Ascension
7-07-29(F)	78	Left Turn Lane	Spot Imp.	$ 26,512	Jct US 61 & LA 934	Ascension
7-07-29(G)	78	Left Turn Lane	Spot Imp.	$ 26,512	Jct US 61 & LA 621	Ascension
7-07-29(H)	78	Left Turn Lane	Spot Imp.	$ 26,512	Jct US 61 & LA 929	Ascension
7-07-29(I)	78	Left Turn Lane	Spot Imp.	$ 26,512	Jct US 61 & LA 73	Ascension
7-07-29(J)	78	Left Turn Lane	Spot Imp.	$ 26,512	Jct US 61 & LA 427	Ascension
7-07-29(K)	78	Left Turn Lane	Spot Imp.	$ 26,512	Jct US 61 & Wayside Park	Ascension
24-01-28	78	Left Turn Lane	Spot Imp.	$ 25,615	Jct US 171 & LA 3059 outside Lake Charles	Calcasieu
26-02-30	78	Left Turn Lane	Spot Imp.	$ 46,210	Jct US 65 & US 84 in Ferriday	Concordia
193-06-17(A)	78	Left Turn Lane	Spot Imp.	$ 27,286	Jct LA 14 & Progressive, Lake Charles	Calcasieu
193-06-17(B)	78	Left Turn Lane	Spot Imp.	$ 27,286	Jct LA 14 & 11th St, Lake Charles	Calcasieu
193-06-17(C)	78	Left Turn Lane	Spot Imp.	$ 27,286	Jct LA 14 & 12th St, Lake Charles	Calcasieu
SKID RESISTANT OVERLAY						
65-30-14	75	Slag Overlay	0.46 Mi. 4 Lane, Conc	$ 26,209	Intercostal Canal Tunnel (LA 3040) in Houma	Terrebonne
737-03-67	76	Expanded Clay Overlay	0.9 Mi. 2 Lane, Asph	$ 57,140	LA 14 between LA 338 & LA 14 Bypass in Abbeville	Vermillion
737-03-74(A)	76	Crushed Gravel Overlay	4.9 Mi. 2 Lane, Asph	$181,588	LA 468 between LA 8 & UA 171 near Leesville	Vernon
737-03-74(B)	76	Crushed Gravel Overlay	4.0 Mi. 2 Lane, Asph	$148,235	LA 1214 between LA 28 & LA 8 near Slagle	Vernon

TABLE 1 (Continued)

PROJECT LOCATION, IDENTIFICATION AND COST

PROJ. NO.	Const. Date	Type of Modification	Length of Project	Const. Cost	Project Location and Description	Parish
19-01-24 & 817-20-17	77	Slag Overlay	3.4 Mi. 4 Lane, Conc	$201,661	Scenic Highway between LA 67 & US 61/190 in Baton Rouge	E. Baton Rouge
737-03-66(A)	77	Slag Overlay	2.5 Mi. 2 Lane, Asph	$ 92,044	LA 3017 along Harvey Canal north from Plaquemine Parish Line	Jefferson
737-03-66(B)	77	Slag Overlay	1.0 Mi. 2 Lane, Asph	$ 36,818	LA 3151 on Grande Isle	Jefferson
737-03-66(C)	77	Slag Overlay	0.5 Mi. City Hwy.	$ 18,409	LA 541 in Harvey	Jefferson
737-03-66(D)	77	Slag Overlay	0.5 Mi. City Hwy.	$ 18,409	LA 611-2, Central Ave in New Orleans	Orleans
737-03-66(E)	77	Slag Overlay	4.8 Mi. 2 Lane, Asph	$176,724	LA 309, north from LA 20 outside Thibodeaux	Terrebonne & Lafourche
737-03-66(F)	77	Slag Overlay	4.2 Mi. 2 Lane, Asph	$154,634	LA 3107 between LA 309 & LA 20 outside Thibodeaux	Lafourche
737-03-66(G)	77	Slag Overlay	1.6 Mi. 2 Lane, Asph	$ 58,909	LA 3011 spur from LA 57 at Duloc	Terrebonne
737-03-68(A)	77	Crushed Gravel Overlay	0.5 Mi. 2 Lane, Asph	$ 14,693	LA 767 between LA 169 & LA 538 in Mooringsport	Caddo
737-03-68(B)	77	Crushed Gravel Overlay	0.6 Mi. 2 Lane, Asph	$ 17,632	LA 3014 between LA 106 & LA 7 in Cotton Valley	Webster
737-03-68(C)	77	Crushed Gravel Overlay	8.2 Mi. 2 Lane, Asph	$241,027	LA 537 between LA 2 & LA 3 near Plain Dealing	Bossier
737-03-69	77	Crushed Gravel Overlay	10.6 Mi. 2 Lane, Asph	$296,857	LA 133 between Girard & Oak Ridge	Richland & Morehouse
737-03-70(A)	77	Expanded Clay Overlay	8.0 Mi. 2 Lane, Asph	$244,617	LA 578 between LA 4 & Crowville	Franklin
737-03-70(B)	77	Expanded Clay Overlay	1.2 Mi. 2 Lane, Asph	$ 36,693	LA 865 outside Winnsboro, north of LA 863	Franklin
7-03-31 & 7-03-34	78	Slag Overlay	11.9 Mi. 4 Lane, Conc	$810,087	US 61 between Jefferson Parish Line & St. John Parish Line	St. Charles

NOTE: Letters in parenthesis refer to different sites constructed under the same contract number.

TABLE 2

ADT AND ACTUAL NUMBER OF ACCIDENTS DURING EVALUATION PERIOD

PROJ #		ADT	TOTAL TOT	TOTAL PDO	TOTAL INJ	TOTAL FAT	WET TOT	WET PDO	WET INJ	WET FAT	NIGHT TOT	NIGHT PDO	NIGHT INJ	NIGHT FAT	RUN OFF ROAD TOT	RUN OFF ROAD PDO	RUN OFF ROAD INJ	RUN OFF ROAD FAT
CROSSOVER																		
283-09-43	B	53,603	254	198	56	0	46	41	5	0	70	55	15	0	5	2	3	0
	A	52,004	310	228	82	0	67	47	20	0	94	63	31	0	2	1	1	0
PASSING LANE																		
25-02-14	B	4,830	19	13	6	0	3	3	0	0	4	2	2	0	7	5	2	0
	A	4,695	22	15	7	0	6	4	2	0	1	1	0	0	3	3	0	0
25-03-16	B	2,316	13	9	4	0	2	1	1	0	5	4	1	0	4	3	1	0
	A	2,810	13	8	5	0	6	4	2	0	7	4	3	0	3	2	1	0
DRAINAGE IMPROVEMENT																		
7-09-71	B	29,322	26	13	12	1	8	3	5	0	9	5	4	0	1	0	1	0
	A	28,699	46	35	11	0	17	14	3	0	21	14	7	0	2	1	1	0
7-05-20	B	4,345	21	12	8	1	6	5	0	1	9	2	6	1	5	2	2	1
	A	5,197	44	28	15	1	7	3	4	0	19	10	8	1	10	5	4	1
7-04-32	B	7,859	258	139	113	6	50	31	19	0	92	41	46	5	17	9	8	0
	A	10,206	277	149	119	9	57	30	27	0	94	38	50	6	19	8	10	1
SHOULDER RECONSTRUCTION																		
15-08-21	B	3,894	38	20	16	2	10	6	4	0	8	3	3	2	11	8	3	0
	A	4,302	22	7	14	1	2	1	1	0	3	1	2	0	7	0	7	0
7-09-70	B	28,274	432	295	135	2	100	71	29	0	116	70	45	1	12	8	4	0
	A	33,752	672	496	174	2	174	134	40	0	182	125	57	0	16	14	2	0
7-04-31	B	7,586	225	121	101	3	34	22	12	0	75	32	41	2	11	5	6	0
	A	8,725	234	130	100	4	53	29	24	0	61	29	30	2	7	3	4	0
7-03-32	B	10,434	251	130	117	4	67	36	29	2	91	40	49	2	23	11	12	0
	A	14,818	369	209	153	7	76	45	29	2	98	46	47	5	29	21	8	0
INTERSECTIONS																		
6-90-38	B	21,496	20	8	12	0	4	1	3	0	3	1	2	0	0	0	0	0
	A	23,791	20	10	10	0	8	2	6	0	7	5	2	0	0	0	0	0
7-04-27	B	11,045	3	2	1	0	1	1	0	0	2	1	1	0	1	0	1	0
	A	7,724	3	2	0	1	0	0	0	0	1	0	0	1	0	0	0	0
7-04-28	B	11,445	47	20	26	1	4	3	1	0	18	7	11	0	10	6	4	0
	A	9,968	13	9	4	0	1	1	0	0	4	3	1	0	4	1	3	0
7-04-29	B	9,892	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A	7,878	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

NOTE: Letter "A" refers to "After" evaluation period.
Letter "B" refers to "Before" evaluation period.

TABLE 2 (Continued)

ADT AND ACTUAL NUMBER OF ACCIDENTS DURING EVALUATION PERIOD

PROJ #		ADT	TOTAL				WET				NIGHT				RUN OFF ROAD			
			TOT	PDO	INJ	FAT	TOT	PDO	INJ	FAT	TOT	PDO	INJ	FAT	TOT	PDO	INJ	FAT
7-04-30	B	24,665	3	1	2	0	0	0	0	0	1	1	0	0	3	1	2	0
	A	23,125	2	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0
7-05-18	B	10,838	7	4	2	1	2	0	2	0	3	0	2	1	3	2	1	0
	A	4,641	3	0	3	0	0	0	0	0	2	0	2	0	2	0	2	0
7-09-72(A)	B	36,037	54	41	13	0	17	13	4	0	19	18	1	0	0	0	0	0
	A	34,936	62	41	21	0	18	13	5	0	19	10	9	0	0	0	0	0
7-09-72(B)	B	36,967	95	59	35	1	33	20	13	0	23	15	8	0	4	0	3	1
	A	37,701	67	50	17	0	12	9	3	0	13	8	5	0	0	0	0	0
8-01-32	B	10,791	19	12	6	1	2	2	0	0	14	8	5	1	1	0	0	1
	A	12,121	25	17	7	1	2	2	0	0	9	5	4	0	2	2	0	0
8-03-38	B	7,113	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A	7,800	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
420-01-19(A)	B	22,756	71	53	18	0	10	9	1	0	19	13	6	0	0	0	0	0
	A	21,369	72	63	9	0	7	6	1	0	14	11	3	0	0	0	0	0
420-01-19(B)	B	22,756	53	42	11	0	6	5	1	0	14	11	3	0	0	0	0	0
	A	21,369	23	19	4	0	5	4	1	0	7	6	1	0	0	0	0	0
7-07-29(A)	B	22,307	31	18	13	0	5	3	2	0	8	5	3	0	3	1	2	0
	A	14,334	22	10	12	0	3	2	1	0	5	5	0	0	3	1	2	0
7-07-29(B)	B	14,767	35	19	16	0	6	4	2	0	5	5	0	0	1	1	0	0
	A	13,074	27	15	12	0	3	1	2	0	4	2	2	0	2	1	1	0
7-07-29(C)	B	13,058	12	7	5	0	0	0	0	0	0	0	0	0	2	1	1	0
	A	10,993	7	7	0	0	2	2	0	0	1	1	0	0	0	0	0	0
7-07-29(D)	B	17,761	11	10	1	0	4	4	0	0	5	4	1	0	1	1	0	0
	A	12,538	25	16	9	0	10	8	2	0	13	7	6	0	0	0	0	0
7-07-29(E)	B	13,301	4	2	2	0	0	0	0	0	3	2	1	0	0	0	0	0
	A	11,178	5	3	2	0	0	0	0	0	2	1	1	0	0	0	0	0
7-07-29(F)	B	12,989	6	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0
	A	11,037	2	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0
7-07-29(G)	B	16,385	5	3	2	0	0	0	0	0	0	0	0	0	1	1	0	0
	A	15,350	10	5	5	0	0	0	0	0	4	3	1	0	0	0	0	0
7-07-29(H)	B	14,665	5	4	1	0	3	2	1	0	2	1	1	0	1	1	0	0
	A	13,218	3	2	1	0	1	1	0	0	1	0	1	0	1	1	0	0
7-07-29(I)	B	14,849	5	3	2	0	1	0	1	0	2	2	0	0	0	0	0	0
	A	13,460	7	6	1	0	3	3	0	0	1	0	1	0	0	0	0	0
7-07-29(J)	B	15,766	7	1	6	0	1	0	1	0	4	0	4	0	2	0	2	0
	A	14,919	8	4	4	0	0	0	0	0	4	1	3	0	1	1	0	0
7-07-29(K)	B	14,059	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A	13,040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 2 (Continued)

ADT AND ACTUAL NUMBER OF ACCIDENTS DURING EVALUATION PERIOD

PROJ #		ADT	TOTAL TOT	TOTAL PDO	TOTAL INJ	TOTAL FAT	WET TOT	WET PDO	WET INJ	WET FAT	NIGHT TOT	NIGHT PDO	NIGHT INJ	NIGHT FAT	RUN OFF ROAD TOT	RUN OFF ROAD PDO	RUN OFF ROAD INJ	RUN OFF ROAD FAT
24-01-28	B	13,934	27	13	13	1	10	4	6	0	2	1	1	0	3	3	0	0
	A	15,752	29	23	6	0	6	6	0	0	10	8	2	0	4	3	1	0
26-02-30	B	13,693	2	1	1	0	0	0	0	0	1	0	1	0	0	0	0	0
	A	13,507	3	3	0	0	0	0	0	0	2	2	0	0	0	0	0	0
193-06-17(A)	B	19,423	28	23	5	0	11	7	4	0	17	13	4	0	1	1	0	0
	A	14,523	9	7	2	0	3	3	0	0	7	5	2	0	1	0	1	0
193-06-17(B)	B	19,423	12	9	3	0	1	1	0	0	1	1	0	0	1	0	1	0
	A	14,523	3	2	1	0	1	1	0	0	0	0	0	0	1	0	1	0
193-06-17(C)	B	20,566	53	32	21	0	13	8	5	0	15	8	7	0	4	2	2	0
	A	15,728	41	25	16	0	12	7	5	0	14	8	6	0	3	1	2	0
SKID RESISTANT OVERLAY																		
65-30-14	B	29,454	125	92	33	0	39	27	12	0	23	15	8	0	15*	10*	5*	0*
	A	30,215	191	143	47	1	44	34	10	0	37	23	14	0	5*	4*	1*	0*
737-03-67	B	6,445	84	53	31	0	22	11	11	0	16	9	7	0	2	1	1	0
	A	7,766	97	64	33	0	17	11	6	0	20	14	6	0	5	3	2	0
737-03-74(A)	B	2,362	30	17	13	0	16	10	6	0	9	4	5	0	18	10	8	0
	A	3,140	75	32	41	2	25	13	12	0	48	21	26	1	44	18	26	0
737-03-74(B)	B	1,500	5	3	2	0	2	1	1	0	2	1	1	0	2	1	1	0
	A	2,338	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-01-24 &	B	15,678	533	395	137	1	147	121	26	0	146	88	57	1	13	8	5	0
817-20-17	A	12,730	420	284	135	1	114	75	39	0	104	63	40	1	10	5	5	0
737-03-66(A)	B	5,354	157	110	46	1	47	34	12	1	24	14	10	0	7	4	3	0
	A	5,499	146	105	40	1	48	35	13	0	18	15	3	0	11	8	3	0
737-03-66(B)	B	1,109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A	1,107	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
737-03-66(C)	B	520	8	5	2	1	1	1	0	0	4	3	0	1	0	0	0	0
	A	499	14	12	2	0	3	3	0	0	2	1	1	0	1	1	0	0
737-03-66(D)	B	2,826	10	4	6	0	3	1	2	0	4	3	1	0	1	0	1	0
	A	3,560	19	12	7	0	9	6	3	0	2	1	1	0	0	0	0	0
737-03-66(E)	B	1,000	13	9	4	0	2	1	1	0	3	2	1	0	7	6	1	0
	A	882	10	5	5	0	0	0	0	0	4	0	4	0	4	2	2	0
737-03-66(F)	B	2,427	41	19	21	1	4	3	1	0	18	6	12	0	16	7	9	0
	A	2,742	88	44	43	1	22	14	8	0	32	17	14	1	26	12	13	1
737-03-66(G)	B	1,605	10	7	3	0	1	1	0	0	5	2	3	0	5	2	3	0
	A	2,136	13	10	2	1	2	2	0	0	6	3	2	1	5	4	0	1

* Collision with tunnel walls

TABLE 2 (Continued)

ADT AND ACTUAL NUMBER OF ACCIDENTS DURING EVALUATION PERIOD

PROJ. #		ADT	TOTAL				WET				NIGHT				RUN OFF ROAD			
			TOT	PDO	INJ	FAT	TOT	PDO	INJ	FAT	TOT	PDO	INJ	FAT	TOT	PDO	INJ	FAT
737-03-68(A)	B	1,185	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A	1,264	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
737-03-68(B)	B	1,270	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A	1,085	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
737-03-68(C)	B	207	5	2	3	0	2	0	2	0	2	1	1	0	3	1	2	0
	A	237	2	1	1	0	0	0	0	0	2	1	1	0	1	1	0	0
737-03-69	B	1,710	3	0	3	0	1	0	1	0	1	0	1	0	1	0	1	0
	A	1,625	8	1	7	0	0	0	0	0	8	1	7	0	6	0	6	0
737-03-70(A)	B	658	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0
	A	757	4	2	2	0	0	0	0	0	1	0	1	0	1	0	1	0
737-03-70(B)	B	835	4	2	2	0	0	0	0	0	1	0	1	0	0	0	0	0
	A	915	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7-03-31 &	B	9,626	223	120	100	3	51	27	22	2	87	46	40	1	27	14	13	0
7-03-34	A	13,277	414	216	195	3	95	57	36	2	99	43	55	1	20	12	8	0

TABLE 3

COMPARISON OF ACTUAL NUMBER OF ACCIDENTS VS. NOS. OF INJURIES AND FATALITIES DURING EVALUATION PERIOD

PROJ #	Total # Acc		# PDO Acc		# Inj Acc		# Injuries		# Fatal Acc		# Fatalities	
	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft
CROSSOVER												
283-09-43	254	310	198	228	56	82	106	132	0	0	0	0
PASSING LANE												
25-02-14	19	22	13	15	6	7	9	11	0	0	0	0
25-03-16	13	13	9	8	4	5	9	6	0	0	0	0
DRAINAGE IMPROVEMENT												
7-09-71	26	46	13	35	12	11	21	18	1	0	1	0
7-05-20	21	44	12	28	8	15	16	26	1	1	1	2
7-04-32	258	277	139	149	113	119	280	237	6	9	9	11
SHOULDER RECONSTRUCTION												
15-08-21	38	22	20	7	16	14	38	26	2	1	2	1
7-09-70	432	672	295	496	135	174	206	256	2	2	2	2
7-04-31	225	234	121	130	101	100	196	203	3	4	5	4
7-03-32	251	369	130	209	117	153	235	267	4	7	5	10
Intersections												
6-90-38	20	20	8	10	12	10	19	16	0	0	0	0
7-04-27	3	3	2	2	1	0	1	0	0	1	0	2
7-04-28	47	13	20	9	26	4	53	4	1	0	1	0
7-04-29	0	0	0	0	0	0	0	0	0	0	0	0
7-04-30	3	2	1	1	2	1	3	1	0	0	0	0
7-05-18	7	3	4	0	2	3	3	8	1	0	1	0
7-09-72(A)	54	62	41	41	13	21	21	32	0	0	0	0
7-09-72(B	95	67	59	50	35	17	69	23	1	0	1	0

TABLE 3 (Continued)

COMPARISON OF ACTUAL NUMBER OF ACCIDENTS VS. NOS. OF INJURIES AND FATALITIES DURING EVALUATION PERIOD

PROJ #	Total # Acc		# PDO Acc		# Inj Acc		# Injuries		# Fatal Acc		# Fatalities	
	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.
8-01-32	19	25	12	17	6	7	15	10	1	1	2	1
8-03-38	1	3	1	3	0	0	0	0	0	0	0	0
420-01-19(A)	71	72	53	63	18	9	29	10	0	0	0	0
420-01-19(B)	53	23	42	19	11	4	16	7	0	0	0	0
7-07-29(A)	31	22	18	10	13	12	27	25	0	0	0	0
7-07-29(B)	35	27	19	15	16	12	24	16	0	0	0	0
7-07-29(C)	12	7	7	7	5	0	7	0	0	0	0	0
7-07-29(D)	11	25	10	16	1	9	1	18	0	0	0	0
7-07-29(E)	4	5	2	3	2	2	2	3	0	0	0	0
7-07-29(F)	6	2	3	1	1	1	3	3	2	0	3	0
7-07-29(G)	5	10	3	5	2	5	3	11	0	0	0	0
7-07-29(H)	5	3	4	2	1	1	2	2	0	0	0	0
7-07-29(I)	5	7	3	6	2	1	2	4	0	0	0	0
7-07-29(J)	7	8	1	4	6	4	16	7	0	0	0	0
7-07-29(K)	0	0	0	0	0	0	0	0	0	0	0	0
24-01-28	27	29	13	23	13	6	22	19	1	0	1	0
26-02-30	2	3	1	3	1	0	2	0	0	0	0	0
193-06-17(A)	28	9	23	7	5	2	6	6	0	0	0	0
193-06-17(B)	12	3	9	2	3	1	5	1	0	0	0	0
193-06-17(C)	53	41	32	25	21	16	34	23	0	0	0	0
SKID RESISTAN[illegible]ERLAY (WET WEATHER ACCIDENTS ONLY)												
65-30-14	39	44	27	34	12	10	24	17	0	0	0	0
737-03-67	22	17	11	11	11	6	17	8	0	0	0	0
737-03-74(A	16	25	10	13	6	12	9	17	0	0	0	0

TABLE 3 (Continued)

COMPARISON OF ACTUAL NUMBER OF ACCIDENTS VS. NOS. OF INJURIES AND FATALITIES DURING EVALUATION PERIOD

PROJ #	Total # Acc		# PDO Acc		# Inj Acc		# Injuries		# Fatal Acc		# Fatalities	
	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.
737-03-74(B)	2	0	1	0	1	0	1	0	0	0	0	0
19-01-24 & 817-20-17	147	114	121	75	26	39	49	59	0	0	1	0
737-03-66(A)	47	48	34	35	12	13	2	17	1	0	1	0
737-03-66(B)	0	0	0	0	0	0	0	0	0	0	0	0
737-03-66(C)	1	3	1	3	0	0	0	0	0	0	0	0
737-03-66(D)	3	9	1	6	2	3	2	3	0	0	0	0
737-03-66(E)	2	0	1	0	1	0	2	0	0	0	0	0
737-03-66(F)	4	22	3	14	1	8	1	11	0	0	0	0
737-03-66(G)	1	2	1	2	0	0	0	0	0	0	0	0
737-03-68(A)	0	0	0	0	0	0	0	0	0	0	0	0
737-03-68(B)	0	0	0	0	0	0	0	0	0	0	0	0
737-03-68(C)	2	0	0	0	2	0	3	0	0	0	0	0
737-03-69	1	0	0	0	1	0	1	0	0	0	0	0
737-03-70(A)	0	0	0	0	0	0	0	0	0	0	0	0
737-03-70(B)	0	0	0	0	0	0	0	0	0	0	0	0
7-03-31 & 7-03-34	44	87	23	55	20	31	41	71	1	1	1	2

NOTE: Letters in parenthesis refer to different sites constructed under the same contract number. Project 7-03-31 and 7-03-34 numbers reflect reduction for concrete structure 1.2 miles long within project limits.

TABLE 3A

ACCUMULATIVE NO. OF PDO INVOLVEMENTS, INJURIES AND FATALITIES
FOR EACH CATEGORY OF HIGHWAY SAFETY IMPROVEMENT PROJECTS

Type of Modification	# PDO Involvements		# Injury Acc.		# Injuries		# Fatal Acc.		# Fatalities	
	Before	After	Before	After	Before	After	Before	After	Before	After
Crossover	396	456	56	82	106	132	0	0	0	0
Passing Lane Construction	33	34	10	12	18	17	0	0	0	0
Drainage Improvement	246	318	133	145	317	281	8	10	11	13
Shoulder Reconstruction	849	1263	369	441	675	752	11	14	14	17
Intersection Improvement	782	688	218	148	385	254	7	2	9	3
Skid Resistant Overlay*	351	372	95	122	152	203	2	1	2	2
Total for all projects	2657	3131	881	950	1653	1639	28	27	36	35

*Wet Weather Accidents Only

TABLE 4

TRAFFIC EXPOSURE & ACCIDENT RATES (NO. OF ACCIDENTS PER MV OR MVM)

PROJ #	EXPOSURE MV/MVM	TOTAL TOT	TOTAL PDO	TOTAL INJ	TOTAL FAT	WET TOT	WET PDO	WET INJ	WET FAT	NIGHT TOT	NIGHT PDO	NIGHT INJ	NIGHT FAT	RUN OFF ROAD TOT	RUN OFF ROAD PDO	RUN OFF ROAD INJ	RUN OFF ROAD FAT
CROSSOVER																	
283-09-43	B 39.13	6.49	5.06	1.43	0.00	1.18	1.05	0.13	0.00	1.79	1.41	0.38	0.00	0.13	0.05	0.08	0.00
	A 37.96	8.17	6.01	2.16	0.00	1.77	1.24	0.53	0.00	2.48	1.66	0.82	0.00	0.05	0.03	0.03	0.00
PASSING LANE																	
25-02-14	B 18.69	1.02	0.70	0.32	0.00	0.16	0.16	0.00	0.00	0.21	0.11	0.11	0.00	0.37	0.27	0.11	0.00
	A 18.16	1.21	0.83	0.39	0.00	0.33	0.22	0.11	0.00	0.06	0.06	0.00	0.00	0.17	0.17	0.00	0.00
25-03-16	B 4.56	2.85	1.97	0.88	0.00	0.44	0.22	0.22	0.00	1.10	0.88	0.22	0.00	0.88	0.66	0.22	0.00
	A 5.54	2.35	1.44	0.90	0.00	1.08	0.72	0.36	0.00	1.26	0.72	0.54	0.00	0.54	0.36	0.18	0.00
DRAINAGE IMPROVEMENT																	
7-09-71	B 21.40	1.21	0.61	0.56	0.05	0.37	0.14	0.23	0.00	0.42	0.23	0.19	0.00	0.05	0.00	0.05	0.00
	A 20.94	2.20	1.67	0.53	0.00	0.81	0.67	0.14	0.00	1.00	0.67	0.33	0.00	0.10	0.05	0.05	0.00
7-05-20	B 27.91	0.75	0.43	0.29	0.04	0.21	0.18	0.00	0.04	0.32	0.07	0.21	0.04	0.18	0.07	0.07	0.04
	A 33.38	1.32	0.84	0.45	0.03	0.21	0.09	0.12	0.00	0.57	0.30	0.24	0.03	0.30	0.15	0.12	0.03
7-04-32	B 80.90	3.19	1.72	1.40	0.07	0.62	0.38	0.23	0.00	1.14	0.51	0.57	0.06	0.21	0.11	0.10	0.00
	A 105.06	2.64	1.42	1.13	0.09	0.54	0.29	0.26	0.00	0.89	0.36	0.48	0.06	0.18	0.08	0.10	0.01
SHOULDER RECONSTRUCTION																	
15-08-21	B 28.14	1.35	0.71	0.57	0.07	0.36	0.21	0.14	0.00	0.28	0.11	0.11	0.07	0.39	0.28	0.11	0.00
	A 31.10	0.71	0.23	0.45	0.03	0.06	0.03	0.03	0.00	0.10	0.03	0.06	0.00	0.23	0.00	0.23	0.00
7-09-70	B 78.44	5.51	3.76	1.72	0.03	1.27	0.91	0.37	0.00	1.48	0.89	0.57	0.01	0.15	0.10	0.05	0.00
	A 93.62	7.18	5.30	1.86	0.02	1.86	1.43	0.43	0.00	1.94	1.34	0.61	0.00	0.17	0.15	0.02	0.00
7-04-31	B 31.02	7.25	3.90	3.26	0.10	1.10	0.71	0.39	0.00	2.42	1.03	1.32	0.06	0.35	0.16	0.19	0.00
	A 35.66	6.56	3.65	2.80	0.11	1.49	0.81	0.67	0.00	1.71	0.81	0.84	0.06	0.20	0.08	0.11	0.00
7-03-32	B 83.78	3.00	1.55	1.40	0.05	0.80	0.43	0.35	0.02	1.09	0.48	0.58	0.02	0.27	0.13	0.14	0.00
	A 118.98	3.10	1.76	1.29	0.06	0.64	0.38	0.24	0.02	0.82	0.39	0.40	0.04	0.24	0.18	0.07	0.00
INTERSECTIONS																	
6-90-38	B 15.70	1.27	0.51	0.76	0.00	0.25	0.06	0.19	0.00	0.19	0.06	0.13	0.00	0.00	0.00	0.00	0.00
	A 17.36	1.15	0.58	0.58	0.00	0.46	0.12	0.35	0.00	0.40	0.29	0.12	0.00	0.00	0.00	0.00	0.00
7-04-27	B 8.06	0.37	0.25	0.12	0.00	0.12	0.12	0.00	0.00	0.25	0.12	0.12	0.00	0.12	0.00	0.12	0.00
	A 5.64	0.53	0.35	0.00	0.18	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.18	0.00	0.00	0.00	0.00
7-04-28	B 8.36	5.62	2.39	3.11	0.12	0.48	0.36	0.12	0.00	2.15	0.84	1.32	0.00	1.20	0.72	0.48	0.00
	A 7.28	1.79	1.24	0.55	0.00	0.14	0.14	0.00	0.00	0.55	0.41	0.14	0.00	0.55	0.14	0.41	0.00

NOTE: Letter "A" refers to "After" evaluation period. Letter "B" refers to "Before" evaluation period.

TABLE 4 (Continued)

TRAFFIC EXPOSURE & ACCIDENT RATES (NO. OF ACCIDENTS PER MV OR MVM)

PROJ #	EXPOSURE MV/MVM		TOTAL				WET				NIGHT				RUN OFF ROAD			
			TOT	PDO	INJ	FAT	TOT	PDO	INJ	FAT	TOT	PDO	INJ	FAT	TOT	PDO	INJ	FAT
7-04-29	B	7.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A	5.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7-04-30	B	18.00	0.17	0.06	0.11	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.00	0.00	0.17	0.06	0.11	0.00
	A	16.88	0.12	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00
7-05-18	B	7.92	0.88	0.51	0.25	0.13	0.25	0.00	0.25	0.00	0.38	0.00	0.25	0.13	0.38	0.25	0.13	0.00
	A	3.38	0.89	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.59	0.00	0.59	0.00	0.59	0.00	0.59	0.00
7-09-72(A)	B	26.31	2.05	1.56	0.49	0.00	0.65	0.49	0.15	0.00	0.72	0.68	0.04	0.00	0.00	0.00	0.00	0.00
	A	25.50	2.43	1.61	0.82	0.00	0.71	0.51	0.20	0.00	0.75	0.39	0.35	0.00	0.00	0.00	0.00	0.00
7-09-72(B)	B	26.98	3.52	2.19	1.30	0.04	1.22	0.74	0.48	0.00	0.85	0.56	0.30	0.00	0.15	0.00	0.11	0.04
	A	27.52	2.43	1.82	0.62	0.00	0.44	0.33	0.11	0.00	0.47	0.29	0.18	0.00	0.00	0.00	0.00	0.00
8-01-32	B	7.88	2.41	1.52	0.76	0.13	0.25	0.25	0.00	0.00	1.78	1.02	0.63	0.13	0.13	0.00	0.00	0.13
	A	8.84	2.83	1.92	0.79	0.11	0.23	0.23	0.00	0.00	1.02	0.57	0.45	0.00	0.23	0.23	0.00	0.00
8-03-38	B	5.20	0.19	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A	5.70	0.53	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
420-01-19(A)	B	16.62	4.27	3.19	1.08	0.00	0.60	0.54	0.06	0.00	1.14	0.78	0.36	0.00	0.00	0.00	0.00	0.00
	A	15.60	4.62	4.04	0.58	0.00	0.45	0.38	0.06	0.00	0.90	0.71	0.19	0.00	0.00	0.00	0.00	0.00
420-01-19(B)	B	16.62	3.19	2.53	0.66	0.00	0.36	0.30	0.06	0.00	0.84	0.66	0.18	0.00	0.00	0.00	0.00	0.00
	A	15.60	1.47	1.22	0.26	0.00	0.32	0.26	0.06	0.00	0.45	0.38	0.06	0.00	0.00	0.00	0.00	0.00
7-07-29(A)	B	16.28	1.90	1.11	0.80	0.00	0.31	0.18	0.12	0.00	0.49	0.31	0.18	0.00	0.18	0.06	0.12	0.00
	A	10.46	2.10	0.96	1.15	0.00	0.29	0.19	0.10	0.00	0.48	0.48	0.00	0.00	0.29	0.10	0.19	0.00
7-07-29(B)	B	10.78	3.25	1.76	1.48	0.00	0.56	0.37	0.19	0.00	0.46	0.46	0.00	0.00	0.09	0.09	0.00	0.00
	A	9.54	2.83	1.57	1.26	0.00	0.31	0.10	0.21	0.00	0.42	0.21	0.21	0.00	0.21	0.10	0.10	0.00
7-07-29(C)	B	9.54	1.26	0.73	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.10	0.10	0.00
	A	8.02	0.87	0.87	0.00	0.00	0.25	0.25	0.00	0.00	0.12	0.12	0.00	0.00	0.00	0.00	0.00	0.00
7-07-29(D)	B	12.96	0.85	0.77	0.08	0.00	0.31	0.31	0.00	0.00	0.39	0.31	0.08	0.00	0.08	0.08	0.00	0.00
	A	9.16	2.73	1.75	0.98	0.00	1.09	0.87	0.22	0.00	1.42	0.76	0.66	0.00	0.00	0.00	0.00	0.00
7-07-29(E)	B	9.70	0.41	0.21	0.21	0.00	0.00	0.00	0.00	0.00	0.31	0.21	0.10	0.00	0.00	0.00	0.00	0.00
	A	8.16	0.61	0.37	0.25	0.00	0.00	0.00	0.00	0.00	0.25	0.12	0.12	0.00	0.00	0.00	0.00	0.00
7-07-29(F)	B	9.48	0.63	0.32	0.11	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A	8.06	0.25	0.12	0.12	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 4 (Continued)

TRAFFIC EXPOSURE & ACCIDENT RATES (NO. OF ACCIDENTS PER MV OR MVM)

PROJ #		EXPOSURE MV/MVM	TOTAL TOT	TOTAL PDO	TOTAL INJ	TOTAL FAT	WET TOT	WET PDO	WET INJ	WET FAT	NIGHT TOT	NIGHT PDO	NIGHT INJ	NIGHT FAT	ROR TOT	ROR PDO	ROR INJ	ROR FAT
7-07-29(G)	B	11.96	0.42	0.25	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.00	0.00
	A	11.20	0.89	0.45	0.45	0.00	0.00	0.00	0.00	0.00	0.36	0.27	0.09	0.00	0.00	0.00	0.00	0.00
7-07-29(H)	B	10.70	0.47	0.37	0.09	0.00	0.28	0.19	0.09	0.00	0.19	0.09	0.09	0.00	0.09	0.09	0.00	0.00
	A	9.64	0.31	0.21	0.10	0.00	0.10	0.10	0.00	0.00	0.10	0.00	0.10	0.00	0.10	0.10	0.00	0.00
7-07-29(I)	B	10.84	0.46	0.28	0.18	0.00	0.09	0.00	0.09	0.00	0.18	0.18	0.00	0.00	0.00	0.00	0.00	0.00
	A	9.82	0.71	0.61	0.10	0.00	0.31	0.31	0.00	0.00	0.10	0.00	0.10	0.00	0.00	0.00	0.00	0.00
7-07-29(J)	B	11.50	0.61	0.09	0.52	0.00	0.09	0.00	0.09	0.00	0.35	0.00	0.35	0.00	0.17	0.00	0.17	0.00
	A	10.90	0.73	0.37	0.37	0.00	0.00	0.00	0.00	0.00	0.37	0.09	0.28	0.00	0.09	0.09	0.00	0.00
7-07-29(K)	B	10.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A	9.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24-01-28	B	10.18	2.65	1.28	1.28	0.10	0.98	0.39	0.59	0.00	0.20	0.10	0.10	0.00	0.29	0.29	0.00	0.00
	A	11.50	2.52	2.00	0.52	0.00	0.52	0.52	0.00	0.00	0.87	0.70	0.17	0.00	0.35	0.26	0.09	0.00
26-02-30	B	10.00	0.20	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.10	0.00	0.00	0.00	0.00	0.00
	A	9.86	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.00	0.00	0.00	0.00	0.00	0.00
193-06-17(A)	B	14.18	1.97	1.62	0.35	0.00	0.78	0.49	0.28	0.00	1.20	0.92	0.28	0.00	0.07	0.07	0.00	0.00
	A	10.60	0.85	0.66	0.19	0.00	0.28	0.28	0.00	0.00	0.66	0.47	0.19	0.00	0.09	0.00	0.09	0.00
193-06-17(B)	B	14.18	0.85	0.63	0.21	0.00	0.07	0.07	0.00	0.00	0.07	0.07	0.00	0.00	0.07	0.00	0.07	0.00
	A	10.60	0.28	0.19	0.09	0.00	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.09	0.00
193-06-17(C)	B	15.02	3.53	2.13	1.40	0.00	0.87	0.53	0.33	0.00	1.00	0.53	0.47	0.00	0.27	0.13	0.13	0.00
	A	11.48	3.57	2.18	1.39	0.00	1.05	0.61	0.44	0.00	1.22	0.70	0.52	0.00	0.26	0.09	0.17	0.00
SKID RESISTANT OVERLAY																		
65-30-14	B	9.90	12.63	9.29	3.33	0.00	3.94	2.73	1.21	0.00	2.32	1.52	0.81	0.00	*1.52	*1.01	*0.51	*0.00
	A	10.14	18.84	14.10	4.64	0.10	4.34	3.35	0.99	0.00	3.65	2.27	1.38	0.00	*0.49	*0.39	*0.10	*0.00
737-03-67	B	4.24	19.81	12.50	7.31	0.00	5.19	2.59	2.59	0.00	3.77	2.12	1.65	0.00	0.47	0.24	0.24	0.00
	A	5.10	19.02	12.55	6.47	0.00	3.33	2.16	1.18	0.00	3.92	2.75	1.18	0.00	0.98	0.59	0.39	0.00
737-03-74(A)	B	8.44	3.55	2.01	1.54	0.00	1.90	1.18	0.72	0.00	1.07	0.47	0.59	0.00	2.13	1.18	0.95	0.00
	A	11.24	6.67	2.85	3.65	0.18	2.22	1.16	1.07	0.00	4.27	1.87	2.31	0.09	3.91	1.60	2.31	0.00
737-03-74(B)	B	4.38	1.14	0.68	0.46	0.00	0.46	0.23	0.23	0.00	0.46	0.23	0.23	0.00	0.46	0.23	0.23	0.00
	A	6.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* Collision with tunnel walls

TABLE 4 (Continued)

TRAFFIC EXPOSURE & ACCIDENT RATES (NO. OF ACCIDENTS PER MV OR MVM)

PROJ #		EXPOSURE MV/MVM	TOTAL TOT	TOTAL PDO	TOTAL INJ	TOTAL FAT	WET TOT	WET PDO	WET INJ	WET FAT	NIGHT TOT	NIGHT PDO	NIGHT INJ	NIGHT FAT	ROR TOT	ROR PDO	ROR INJ	ROR FAT
19-01-24 &	B	38.92	13.69	10.15	3.52	0.03	3.78	3.11	0.67	0.00	3.75	2.26	1.46	0.03	0.33	0.21	0.13	0.00
817-20-17	A	31.60	13.29	8.99	4.27	0.03	3.61	2.37	1.23	0.00	3.29	1.99	1.27	0.03	0.32	0.16	0.16	0.00
737-03-66(A)	B	9.78	16.05	11.25	4.70	0.10	4.81	3.48	1.23	0.10	2.45	1.43	1.02	0.00	0.72	0.41	0.31	0.00
	A	10.04	14.54	10.46	3.98	0.10	4.78	3.49	1.29	0.00	1.79	1.49	0.30	0.00	1.10	0.80	0.30	0.00
737-03-66(B)	B	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
*737-03-66(C)	B	0.18	44.44	27.78	11.11	5.56	5.56	5.56	0.00	0.00	22.22	16.67	0.00	5.56	0.00	0.00	0.00	0.00
	A	0.18	77.78	66.67	11.11	0.00	16.67	16.67	0.00	0.00	11.11	5.56	5.56	0.00	5.56	5.56	0.00	0.00
737-03-66(D)	B	1.04	9.62	3.85	5.77	0.00	2.88	0.96	1.92	0.00	3.85	2.88	0.96	0.00	0.96	0.00	0.96	0.00
	A	1.30	14.62	9.23	5.38	0.00	6.92	4.62	2.31	0.00	1.54	0.77	0.77	0.00	0.00	0.00	0.00	0.00
737-03-66(E)	B	3.50	3.71	2.57	1.14	0.00	0.57	0.29	0.29	0.00	0.86	0.57	0.29	0.00	2.00	1.71	0.29	0.00
	A	3.10	3.23	1.61	1.61	0.00	0.00	0.00	0.00	0.00	1.29	0.00	1.29	0.00	1.29	0.65	0.65	0.00
737-03-66(F)	B	7.44	5.51	2.55	2.82	0.13	0.54	0.40	0.13	0.00	2.42	0.81	1.61	0.00	2.15	0.94	1.21	0.00
	A	8.40	10.48	5.24	5.12	0.12	2.62	1.67	0.95	0.00	3.81	2.02	1.67	0.12	3.10	1.43	1.55	0.12
737-03-66(G)	B	1.88	5.32	3.72	1.60	0.00	0.53	0.53	0.00	0.00	2.66	1.06	1.60	0.00	2.66	1.06	1.60	0.00
	A	2.50	5.20	4.00	0.80	0.40	0.80	0.80	0.00	0.00	2.40	1.20	0.80	0.40	2.00	1.60	0.00	0.40
737-03-68(A)	B	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A	0.46	2.17	2.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
737-03-68(B)	B	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
737-03-68(C)	B	1.24	4.03	1.61	2.42	0.00	1.61	0.00	1.61	0.00	1.61	0.81	0.81	0.00	2.42	0.81	1.61	0.00
	A	1.42	1.41	0.70	0.70	0.00	0.00	0.00	0.00	0.00	1.41	0.70	0.70	0.00	0.70	0.70	0.00	0.00
737-03-69	B	13.24	0.23	0.00	0.23	0.00	0.08	0.00	0.08	0.00	0.08	0.00	0.08	0.00	0.08	0.00	0.08	0.00
	A	12.58	0.64	0.08	0.56	0.00	0.00	0.00	0.00	0.00	0.64	0.08	0.56	0.00	0.48	0.00	0.48	0.00
737-03-70(A)	B	3.84	0.26	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.26	0.00	0.00	0.00	0.00	0.00	0.00
	A	4.42	0.90	0.45	0.45	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.23	0.00	0.23	0.00	0.23	0.00
737-03-70(B)	B	0.74	5.41	2.70	2.70	0.00	0.00	0.00	0.00	0.00	1.35	0.00	1.35	0.00	0.00	0.00	0.00	0.00
	A	0.80	2.50	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7-03-31 &	B	83.62	2.67	1.44	1.20	0.04	0.61	0.32	0.26	0.02	1.04	0.55	0.48	0.01	0.32	0.17	0.16	0.00
7-03-34	A	115.34	3.59	1.87	1.69	0.03	0.82	0.49	0.31	0.02	0.86	0.37	0.48	0.01	0.17	0.10	0.07	0.00

* Rates are not valid - data skew due to extremely low ADT counts.

TABLE 5

WEIGHTED ACCIDENT RATES (NO. OF WEIGHTED ACCIDENTS PER MV OR MVM)

PROJ #	TOTAL		WET		[illegible]		ON OFF ROAD	
	Before	After	Before	After	Before	After	Before	After
CROSSOVER								
283-09-43	9.35	12.49	1.44	2.83	2.55	4.12	0.29	0.12
PASSING LANE								
25-02-14	1.66	2.00	0.16	0.55	0.44	0.06	0.60	0.17
25-03-16	4.61	4.14	0.88	1.80	1.54	2.34	1.32	0.90
DRAINAGE IMPROVEMENT								
7-09-71	2.69	3.26	0.83	1.09	0.80	1.66	0.15	0.20
7-05-20	1.62	2.43	0.50	0.45	1.02	1.26	0.60	0.75
7-04-32	6.48	5.73	1.07	1.07	2.70	2.28	0.41	0.46
SHOULDER RECONSTRUCTION								
15-08-21	2.98	1.82	0.63	0.12	1.00	0.21	0.61	0.69
7-09-70	9.16	11.04	2.02	2.72	2.68	3.17	0.25	0.21
7-04-31	14.48	12.93	1.88	2.82	5.47	3.81	0.73	0.41
7-03-32	6.15	6.11	1.64	1.26	2.38	1.91	0.55	0.39
INTERSECTIONS								
6-90-38	2.79	2.32	0.63	1.17	0.45	0.65	0.00	0.00
7-04-27	0.61	1.79	0.12	0.00	0.48	1.62	0.36	0.00
7-04-28	12.68	2.89	0.72	0.14	4.80	0.83	2.16	1.37
7-04-29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7-04-30	0.39	0.24	0.00	0.00	0.06	0.06	0.39	0.00
7-05-18	2.30	2.67	0.75	0.00	1.79	1.77	0.64	1.77
7-09-72(A)	3.03	4.07	0.94	1.11	0.80	1.44	0.00	0.00
7-09-72(B)	6.41	3.68	2.18	0.66	1.46	0.83	0.65	0.00
8-01-32	4.84	5.17	0.25	0.23	3.95	1.92	1.04	0.23

TABLE 5 (Continued)

WEIGHTED ACCIDENT RATES (NO. OF WEIGHTED ACCIDENTS PER MV OR MVM)

PROJ #	TOTAL		WET		NIGHT		RUN OFF ROAD	
	Before	After	Before	After	Before	After	Before	After
8-03-38	0.19	0.53	0.00	0.00	0.00	0.00	0.00	0.00
420-01-19(A)	6.43	5.78	0.72	0.56	1.86	1.28	0.00	0.00
420-01-19(B)	4.51	2.00	0.48	0.44	1.20	0.56	0.00	0.00
7-07-29(A)	3.51	4.41	0.54	0.49	0.85	0.48	0.42	0.67
7-07-29(B)	6.20	5.35	0.94	0.73	0.46	0.84	0.09	0.40
7-07-29(C)	2.29	0.87	0.00	0.25	0.00	0.12	0.40	0.00
7-07-29(D)	1.01	4.69	0.31	1.53	0.55	2.74	0.08	0.00
7-07-29(E)	0.84	1.12	0.00	0.00	0.51	0.48	0.00	0.00
7-07-29(F)	2.33	0.48	0.00	0.00	0.00	0.12	0.00	0.00
7-07-29(G)	0.76	1.80	0.00	0.00	0.00	0.54	0.08	0.00
7-07-29(H)	0.64	0.51	0.46	0.10	0.36	0.30	0.09	0.10
7-07-29(I)	0.82	0.91	0.27	0.31	0.18	0.30	0.00	0.00
7-07-29(J)	1.65	1.48	0.27	0.00	1.05	0.93	0.51	0.09
7-07-29(K)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24-01-28	5.92	3.56	2.16	0.52	0.40	1.21	0.29	0.53
26-02-30	0.40	0.30	0.00	0.00	0.30	0.20	0.00	0.00
193-06-17(A)	2.67	1.23	1.33	0.28	1.76	1.04	0.07	0.27
193-06-17(B)	1.26	0.46	0.07	0.09	0.07	0.00	0.21	0.27
193-06-17(C)	6.33	6.35	1.52	1.93	1.94	2.26	0.52	0.60
SKID RESISTANT OVERLAY								
65-30-14	19.28	28.82	6.36	6.32	3.95	6.41	*2.54	*0.69
737-03-67	34.43	31.96	10.36	5.70	7.07	6.29	0.96	1.76

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TABLE 5 (Continued)

WEIGHTED ACCIDENT RATES (NO. OF WEIGHTED ACCIDENTS PER MV OR MVM)

PROJ #	TOTAL		WET		NIGHT		RUN OFF ROAD	
	Before	After	Before	After	Before	After	Before	After
737-03-74(A)	6.63	15.24	3.34	4.37	2.24	9.52	4.03	8.53
737-03-74(B)	2.06	0.00	0.92	0.00	0.92	0.00	0.92	0.00
19-01-24 & 817-20-17	20.95	22.04	5.12	6.06	6.88	6.04	0.60	0.64
737-03-66(A)	26.15	23.20	7.97	7.36	4.49	2.39	1.34	1.70
737-03-66(B)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
737-03-66(C)	105.59	100.00	5.56	16.67	61.15	22.24	0.00	5.56
737-03-66(D)	21.16	25.37	6.72	11.55	5.76	3.08	2.88	0.00
737-03-66(E)	5.99	6.44	1.16	0.00	1.44	3.87	2.58	2.60
737-03-66(F)	12.05	21.56	0.79	4.52	5.64	7.99	4.57	7.04
737-03-66(G)	8.52	9.60	0.53	0.80	5.86	6.80	5.86	9.60
737-03-68(A)	0.00	1.09	0.00	0.00	0.00	0.00	0.00	0.00
737-03-68(B)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
737-03-68(C)	8.87	2.80	4.83	0.00	3.24	2.80	5.64	0.70
737-03-69	0.69	1.76	0.24	0.00	0.24	1.76	0.24	1.44
737-03-70(A)	0.26	1.80	0.00	0.00	0.26	0.69	0.00	0.69
737-03-70(B)	10.80	2.50	0.00	0.00	4.05	0.00	0.00	0.00
7-03-31 & 7-03-34	5.33	7.48	1.16	1.57	2.09	1.81	0.67	0.35

TABLE 6

TEST FOR STATISTICAL SIGNIFICANCE BY
POISSON DISTRIBUTION

PROJ #	Total # of Accidents in 'Before' Period	Total Expected # of Accidents (Without Treatment)	Total # of Accidents in 'After' Period	% Change in Accident Frequency	Probability 80%	90%	95%	99%
CROSSOVER								
283-09-43	254	246	310	26	yes	yes	yes	yes
PASSING LANE								
25-02-14	19	19	22	16	yes	no	no	no
25-03-16	13	16	13	-19	no	no	no	no
TOTAL	32	35	35	0	no	no	no	no
DRAINAGE IMPROVEMENT								
7-09-71	26	25	46	84	yes	yes	yes	yes
7-05-20	21	25	44	76	yes	yes	yes	yes
7-04-32	258	335	277	-17	yes	yes	yes	yes
TOTAL	305	385	367	-5	no	no	no	no
SHOULDER RECONSTRUCTION								
15-08-21	38	42	22	-48	yes	yes	yes	yes
7-09-70	432	516	672	30	yes	yes	yes	yes
7-04-31	225	259	234	-9	yes	yes	no	no
7-03-32	251	357	369	3	no	no	no	no
TOTAL	946	1174	1297	10	yes	yes	no	no
INTERSECTION IMPROVEMENT								
6-90-38	20	22	20	-9	no	no	no	no
7-04-27	3	2	3	50	no	no	no	no
7-04-28	47	41	13	-68	yes	yes	yes	yes
7-04-29	0	0	0	0	no	no	no	no
7-04-30	3	3	2	-33	no	no	no	no

TABLE 6 (Continued)

TEST FOR STATISTICAL SIGNIFICANCE BY POISSON DISTRIBUTION

PROJ #	Total # of Accidents in 'Before' Period	Total Expected # of Accidents (Without Treatment)	Total # of Accidents in 'After' Period	% Change in Accident Frequency	Probability 80%	90%	95%	99%
7-05-18	7	3	3	0	no	no	no	no
7-09-72(A)	54	52	62	19	yes	yes	no	no
7-09-72(B)	95	97	67	-31	yes	yes	yes	yes
8-01-32	19	21	25	19	yes	no	no	no
8-03-38	1	1	3	200	no	no	no	no
420-01-19(A)	71	67	72	7	no	no	no	no
420-01-19(B)	53	50	23	-54	yes	yes	yes	yes
7-07-29(A)	31	20	22	10	no	no	no	no
7-07-29(B)	35	31	27	-13	no	no	no	no
7-07-29(C)	12	10	7	-30	yes	no	no	no
7-07-29(D)	11	8	25	212	yes	yes	yes	yes
7-07-29(E)	4	3	5	67	no	no	no	no
7-07-29(F)	6	5	2	-60	no	no	no	no
7-07-29(G)	5	5	10	100	yes	yes	no	no
7-07-29(H)	5	5	3	-40	yes	no	no	no
7-07-29(I)	5	5	7	40	yes	no	no	no
7-07-29(J)	7	7	8	14	no	no	no	no
7-07-29(K)	0	0	0	0	no	no	no	no
24-01-28	27	30	29	- 3	no	no	no	no
26-02-30	2	2	3	50	no	no	no	no
193-06-17(A)	28	21	9	-57	yes	yes	yes	yes
193-06-17(B)	12	9	3	-67	yes	yes	yes	no
193-06-17(C)	53	41	41	+ 0	no	no	no	no
TOTAL	616	561	494	-12	yes	yes	yes	no
SKID RESISTANT OVERLAY (WET WEATHER ACCIDENTS ONLY)								
65-30-14	39	40	44	+10	no	no	no	no
736-03-67	22	26	17	-34.6	yes	yes	yes	no
737-03-74(A)	16	21	25	+19.0	yes	no	no	no
737-03-74(B)	2	3	0	-100	no	no	no	no
19-01-24 & 817-20-17	147	119	114	- 4.2	no	no	no	no

TABLE 6 (Continued)

TEST FOR STATISTICAL SIGNIFICANCE BY POISSON DISTRIBUTION

PROJ #	Total # of Accidents in 'Before' Period	Total Expected # of Accidents (Without Treatment)	Total # of Accidents in 'After' Period	% Change in Accident Frequency	Probability 80%	90%	95%	99%
737-03-66(A)	47	48	48	0	no	no	no	no
737-03-66(B)	0	0	0	0	no	no	no	no
737-03-66(C)	1	1	3	+200	no	no	no	no
737-03-66(D)	3	4	9	+125	no	no	no	no
737-03-66(E)	2	2	0	-100	no	no	no	no
737-03-66(F)	4	5	22	+340	yes	no	no	no
737-03-66(G)	1	1	2	+100	no	no	no	no
737-03-68(A)	0	0	0	0	no	no	no	no
737-03-68(B)	0	0	0	0	no	no	no	no
737-03-68(C)	2	2	0	-100	no	no	no	no
737-03-69	1	1	0	-100	no	no	no	no
737-03-70(A)	0	0	0	0	no	no	no	no
737-03-70(B)	0	0	0	0	no	no	no	no
7-03-31 & 7-03-34	44	61	87	+ 42.6	yes	yes	yes	yes
TOTAL	331	334	371	+ 12	no	no	no	no
GRAND TOTAL	2484	2735	2874	5	no	no	no	no

TABLE 7

SUMMARY OF ACCIDENT STATISTICS AND BENEFIT-COST RATIOS

PROJ #	Total No. of Accidents Before	Total No. of Accidents After	Accident Rate # Acc/MV-MVM Before	Accident Rate # Acc/MV-MVM After	Weighted Accident Rate # Acc/MV-MVM Before	Weighted Accident Rate # Acc/MV-MVM After	Benefit/ Cost Ratio
CROSSOVER							
283-09-43	254	310	6.49	8.17	9.35	12.49	-26.92
PASSING LANE							
25-02-14	19	22	1.02	1.21	1.66	2.00	- 0.08
25-03-16	13	13	2.85	2.35	4.61	4.14	0.26
DRAINAGE IMPROVEMENT							
7-09-71	26	46	1.21	2.20	2.69	3.26	- 2.54
7-05-20	21	44	0.75	1.32	1.62	2.43	- 0.54
7-04-32	258	277	3.19	2.64	6.48	5.73	3.82
SHOULDER RECONSTRUCTION							
15-08-21	38	22	1.35	0.71	2.98	1.82	6.71
7-09-70	432	672	5.51	7.18	9.16	11.04	- 3.07
7-04-31	225	234	7.25	6.56	14.48	12.93	12.14
7-03-32	251	369	3.00	3.10	6.15	6.11	- 2.91
TURN LANE CONSTRUCTION							
6-90-38	20	20	1.27	1.15	2.79	2.32	2.57
7-04-27	3	3	0.37	0.53	0.61	1.79	- 0.84
7-04-28	47	13	5.62	1.79	12.68	2.89	1.78
7-04-29	0	0	0.00	0.00	0.00	0.00	0.00
7-04-30	3	2	0.17	0.12	0.39	0.24	0.11
7-05-18	7	3	0.88	0.89	2.30	2.67	- 3.24

TABLE 7 (Continued)

SUMMARY OF ACCIDENT STATISTICS AND BENEFIT-COST RATIOS

PROJ #	Total No. of Accidents Before	Total No. of Accidents After	Accident Rate # Acc/MV-MVM Before	Accident Rate # Acc/MV-MVM After	Weighted Accident Rate # Acc/MV-MVM Before	Weighted Accident Rate # Acc/MV-MVM After	Benefit/ Cost Ratio
7-09-72(A)	54	62	2.05	2.43	3.03	4.07	- 7.72
7-09-72(B)	95	67	3.52	2.43	6.41	3.68	29.90
8-01-32	19	25	2.41	2.83	4.84	5.17	4.27
8-03-38	1	3	0.19	0.53	0.19	0.53	- 0.38
420-01-19(A)	71	72	4.27	4.62	6.43	5.78	9.28
420-01-19(B)	53	23	3.19	1.47	4.51	2.00	10.57
7-07-29(A)	31	22	1.90	2.10	3.51	4.41	- 4.32
7-07-29(B)	35	27	3.25	2.83	6.20	5.35	3.53
7-07-29(C)	12	7	1.26	0.87	2.29	0.87	3.34
7-07-29(D)	11	25	0.85	2.73	1.01	4.69	-12.22
7-07-29(E)	4	5	0.41	0.61	0.84	1.12	- 1.06
7-07-29(F)	6	2	0.63	0.25	2.33	0.48	47.42
7-07-29(G)	5	10	0.42	0.89	0.76	1.80	- 5.39
7-07-29(H)	5	3	0.47	0.31	0.64	0.51	0.20
7-07-29(I)	5	7	0.46	0.71	0.82	0.91	- 1.97
7-07-29(J)	7	8	0.61	0.73	1.65	1.48	4.34
7-07-29(K)	0	0	0.00	0.00	0.00	0.00	0.00
24-01-28	27	29	2.65	2.52	5.92	3.56	2.67
26-02-30	2	3	0.20	0.30	0.40	0.30	0.46
193-06-17(A)	28	9	1.97	0.85	2.67	1.23	1.07
193-06-17(B)	12	3	0.85	0.28	1.26	0.46	2.52
193-06-17(C)	53	41	3.53	3.57	6.33	6.35	1.65

TABLE 7 (Continued)

SUMMARY OF ACCIDENT STATISTICS AND BENEFIT-COST RATIOS

PROJ #	Total No. of Accidents Before	After	Accident Rate # Acc/MV-MVM Before	After	Weighted Accident Rate # Acc/MV-MVM Before	After	Benefit/ Cost Ratio
SKID RESISTANT OVERLAY *							
65-30-14	39	44	3.94	4.34	6.36	6.32	3.69
737-03-67	22	17	5.19	3.33	10.36	5.70	3.65
737-03-74(A)	16	25	1.90	2.22	3.34	4.37	-0.44
737-03-74(B)	2	0	0.46	0.00	0.92	0.00	0.21
19-01-24 & 817-20-17	147	114	3.78	3.61	5.12	6.06	-1.08
737-03-66(A)	47	48	4.81	4.78	7.97	7.36	0.79
737-03-66(B)	0	0	0.00	0.00	0.00	0.00	0.00
737-03-66(C)	1	3	5.56	16.67	5.56	16.67	-0.43
737-03-66(D)	3	9	2.88	6.92	6.72	11.55	1.45
737-03-66(E)	2	0	0.57	0.00	1.16	0.00	-0.18
737-03-66(F)	4	22	0.54	2.62	0.79	4.52	1.29
737-03-66(G)	1	2	0.53	0.80	0.53	0.80	-0.04
737-03-68(A)	0	0	0.00	0.00	0.00	0.00	0.00
737-03-68(B)	0	0	0.00	0.00	0.00	0.00	0.00
737-03-68(C)	2	0	1.61	0.00	4.83	0.00	0.23
737-03-69	1	0	0.08	0.00	0.24	0.00	-0.05
737-03-70(A)	0	0	0.00	0.00	0.00	0.00	0.00
737-03-70(B)	0	0	0.00	0.00	0.00	0.00	0.00
7-03-31 & 7-03-34	44	87	0.58	0.83	1.16	1.51	-0.41

*Wet Weather Accidents Only

TABLE 8

SUMMARY OF COST, BENEFIT, AND BENEFIT/COST RATIO
FOR EACH CATEGORY OF HIGHWAY SAFETY IMPROVEMENT PROJECTS

Type of Modification	Construction Cost	Annual Cost (EUAC)	Annual Benefit (EUAB)	Benefit-Cost Ratio (B/C)
Crossover	$ 35,630	$ 3,630	$ -97,709	-26.92*
Passing Lane Construction	$1,302,218	$ 132,696	$ 2,886	0.02
Drainage Improvement	$1,556,475	$ 158,605	$ 346,883	2.19
Shoulder Reconstruction	$1,436,918	$ 146,422	$ 251,438	1.72
Intersection Improvement	$1,413,738	$ 210,647	$1,316,707	6.25
Skid Resistant Overlays	$2,832,384	$ 422,025	$ 245,315	0.58
Total for all projects	$8,577,363	$1,074,026	$2,065,520	1.92

*Based on one single isolated project only. The data is probably skewed.

TABLE 9

ACCIDENT REDUCTION FACTORS

Type of Modification	Type of Accident	Reduction Factor
CROSSOVER	Total	26% Increase
	PDO	19% Increase
	Injury	52% Increase
	Fatal	None on Record
PASSING LANE	Total	3% Increase
	PDO	4% Decrease
	Injury	9% Increase
	Fatal	None on Record
DRAINAGE IMPROVEMENT	Total	5% Decrease
	PDO	2% Increase
	Injury	14% Decrease
	Fatal	11% Increase
SHOULDER RECONSTRUCTION	Total	10% Increase
	PDO	21% Increase
	Injury	5% Decrease
	Fatal	7% Decrease
INTERSECTION IMPROVEMENT	Total	12% Decrease
	PDO	3% Decrease
	Injury	26% Decrease
	Fatal	67% Decrease

TABLE 9 (Continued)

ACCIDENT REDUCTION FACTORS

Type of Modification	Type of Accident	Reduction Factor
SKID RESISTANT OVERLAY *	Total	12% Increase
	PDO	9% Increase
	Injury	20% Increase
	Fatal	50% Decrease
TOTAL OF ALL CONSTRUCTION	Total	5% Increase
	PDO	10% Increase
	Injury	5% Decrease
	Fatal	16% Decrease

* Wet Weather Accidents

SUMMARY OF EVALUATIONS

A review of the preceding accident-based effectiveness evaluation of fifty-nine (59) safety projects constructed during the years 1975 - 1978, under the Highway Safety Improvement Program indicates the following:

I. WIDENING OF EXISTING CROSSOVERS

This category included only one minor project constructed at a cost of $35,630.00. Accident statistics indicated that there were a total of 254 recorded accidents during the "before" period. For the "after" period, the expected number of accidents without safety treatment was estimated to be 246. The actual number of accidents during the "after" period was 310 or a 26% increase over the expected frequency. During the same period, total accident rate increased from 6.49 accidents per million vehicle (ACC/MV) to 8.17 ACC/MV. The weighted accident rate also increased from 9.35 ACC/MV to 12.49 ACC/MV. The increase in total number of accidents was found to be statistically significant for all probability levels (80% to 99%), using Poisson Distribution Curves for testing.

Accident reduction factors (AR) for this category were calculated to be 26% (increase) for total accidents, 19% for property damage (PDO) accidents and 52% for injury accidents. There were no fatal accidents reported during the evaluation period. The benefit-cost (B/C) ratio for this project was found to be negative in the order of -26.92 to 1. It is hypothesized that factors other than the implemented countermeasure have caused the increase in frequency and the severity of accidents during the "after" period, which resulted in an excessively high negative B/C ratio. Identification of factors which might have influenced the effectiveness of this safety project was beyond the scope of this study.

II. CONSTRUCTION OF PASSING LANES

This category included two (2) projects constructed at a total cost of $1,302,218.00. Accident-based effectiveness evaluation of this group of safety improvement projects indicated that the total number of recorded accidents during the "before" period was thirty-two (32) as compared to thirty-five (35) for the estimated frequency of accidents expected to occur without the implementation of the safety treatments. The actual number of accidents during the "after" period amounted to thirty-five (35), which equals the expected frequency.

Accident reduction factors for this category were found to be 0% and 4% (decrease) for the total and the PDO accidents, respectively, and 9% (increase) for the injury accidents. Economic analysis indicated a B/C ratio of 0.02. It should be noted that when B/C ratio is less than unity, the benefits derived from the project are less than the incurred cost.

III. DRAINAGE IMPROVEMENTS

This group of highway safety improvements included three (3) projects, constructed at a total cost of $1,556,474.00. Accident statistics indicated that there were a total of 305 recorded accidents during the "before" period. For the "after" period, the expected number of accidents without safety treatment was estimated to be 385. The actual number of accidents during the "after" period was 367, or a decrease of 5% over the expected frequency. The decrease in accident frequency was found to be statistically not significant. Accident reduction factors for this group of safety projects were determined to be 20% (increase) for the total; 42% (increase) for the PDO;

14% (decrease) for the injury; and 11% (increase) for the fatal accidents. The benefit-cost ratio for these projects was 2.19, which indicates that the benefit derived from this group of projects outweighed the incurred costs on the order of 119%. This benefit was primarily due to the decrease in accident severity.

IV. SHOULDER RECONSTRUCTION

This category included four (4) projects constructed at a total cost of $1,436,918.00. The actual number of accidents for the "before" period was 946 as compared to 1174 for the estimated frequency of accidents expected to occur without the implementation of the safety treatments. The actual number of accidents during the "after" period amounted to 1297 or a 10% increase over the expected frequency. This increase was statistically significant at the 90% probability level.

Accident reduction factors were found to be 10% (increase) for the total accidents; 21% (increase) for the PDO; 5% (decrease) for the injury; and 7% (decrease) for the fatal accidents. The benefit cost ratio for this group was found to be 1.72. The benefits were primarily due to decrease in accident severity.

V. INTERSECTIONS

This category consisted of constructing left and/or right turning lanes at thirty (30) sites at a total cost of $1,413,738.00. Accident statistics indicated that there were a total of 616 recorded accidents for the "before" period. For the "after" period, the expected number of accidents without safety treatments was estimated to be 561. The actual number of accidents during the "after" period was 489 or a decrease of 12% compared to the expected frequency.

This decrease was found to be statistically significant at 95% probability level.

Accident reduction factors for intersection improvements were found to be 12%, 3%, 26%, and 67% (decrease) for total, PDO, injury, and fatal accidents, respectively. The benefit-cost ratio for this category was calculated to be 6.25 which indicates that the benefit derived from construction of turning lanes outweighed the incurred costs on the order of 525%. This benefit was primarily due to the decrease in the frequency of fatal and injury accidents.

VI. SKID RESISTANT OVERLAYS

The skid resistant overlay projects evaluated under this study consisted of ten (10) slag, three (3) expanded clay, and six (6) crushed gravel overlays constructed at a total cost of $2,832,384.00. Accident statistics indicated that there were a total of 331 wet weather recorded accidents for the "before" period. For the "after" period, the expected number of wet weather accidents without safety treatments was estimated to be 334. The actual number of wet weather accidents during the "after" period was 371 or an increase of 12% over the expected frequency. This increase was found to be statistically significant at the 95% probability level.

For the skid resistant overlays, the accident reduction factors were found to be 12%, 9%, and 20% (increase) for the total, PDO, and injury accidents, respectively, and 50% decrease for the fatal accidents. The benefit-cost ratio for the overlay projects was determined to be 0.58.

VII. ALL PROJECTS (1975 - 1978)

The above-categorized safety projects which were implemented by the Department between the years 1975 and 1978, at a total cost of $8,577,363.00, covered fifty-nine (59) projects under thirty-three (33) different construction contracts. During the two-year "before" evaluation period, there were 2,484 recorded accidents, whereas during the two-year "after" evaluation period, there were 2,874 recorded accidents of all types and severities. Assuming that the safety improvement projects were not constructed and also assuming that the average accident rates during the two-year "after" period would have continued at the same rate as the two-year "before" period, the number of accidents which were expected to occur during the two-year "after" period was estimated to be 2,725 or approximately 5% increase in total number of accidents over the four-year period. This increase was found to be statistically significant at the 80% probability level.

For the safety projects, as a whole, the accident reduction factors for total and PDO accidents were found to be 5% and 10% (increase) respectively, while for injury and fatal accidents, the reduction factors were 5% and 16% decrease.

Economic analysis indicated a benefit-cost ratio of 1.92 for all projects considered.

It should be noted that these evaluations, in many cases, represent a very small sample of similar construction projects. For instance, the total number of lane miles of asphaltic concrete friction course (skid resistant overlays) laid as a part of construction projects in response to the Department's "Skid Resistant Program" is estimated at 3800. This research evaluated only 169 lane miles and it is

doubtful that 81 of these 169 miles should have been overlaid in the first place. They had less than four (4) wet weather accidents in the two (2) years before treatment. Other problems exist with the skid resistant overlay portion of the research which, in the interest of brevity, will not be discussed in detail. However, one project which had an adverse influence on the final benefit-cost ratio was 7-03-31 and 7-03-34. The expected number of wet weather accidents without treatment was sixty-one (61), but the actual number was eighty-seven (87) - a 43% increase. If one looks at the number of dry accidents, he will find that the percentage increased by the same amount. This then causes one to suspect that there is some factor other than the skid resistant overlay that caused the accident increase.

RECOMMENDATIONS

1. It is recommended that the findings of this study be utilized by the Traffic and Planning Division to improve the Department's ability in making future decisions with regard to all components of the highway safety program so that scarce safety funds can be properly allocated to high pay-off projects (e.g. intersections) and diverted from those which are found to be marginal or ineffective.

2. Effectiveness evaluation of those safety improvement projects which were constructed during the years 1978 - 1980 should be initiated as phase II of this study. A new set of accident reduction factors should then be developed to include all safety projects constructed and evaluated during the 1975 - 1980 period.

3. Selection of future sites for implementation of highway safety improvement projects should be based on comprehensive accident studies to identify safety hazards and then design and implement specific countermeasures to alleviate or reduce the identified deficiencies.

4. In order to reduce the influence of variables other than the specified countermeasure on the evaluation results, it is recommended that the evaluation plan, "Before and After Study With Control Sites", be considered for use on some future projects.

LIST OF REFERENCES

1. Federal Highway Administration. Federal-Aid Highway Program Manual (FHPM). 1979.

2. Goodell - Grivas, Inc. for the Federal Highway Administration. Highway Safety Evaluation Procedural Guide. 1980.

APPENDIX

Case Study - Evaluation Procedure: Passing Lane Project

The following information was extracted from the Estimate Section's form 675 (See page 54).

State Project #	25-03-16
FAP #:	HHS-03-04(002)
Type of Project:	Passing Lane
Location:	US 171 from Many to Zwolle
Parish:	Sabine
Route:	La US 171
Length:	2.7 mile
Contractor:	L. H. Bossier, Inc.
Project Engineer:	T. G. Watts
Contract Estimate:	$498,800.60
Final Cost:	$502,578.11
Cost Per Mile:	$186,140.02
Date Accepted:	11-21-75
Cont. Date:	8-19-75
Final Est. Received:	1-3-76
Passed:	3-26-76

Construction is assumed to have taken place between the contract date of 8-19-75 and the acceptance date of 11-21-75.

Inspection of milepost and Project Maps (See Page 54) indicated that the Passing Lane Project was located between MP 108.2 and MP 111.0.

The "before" period covered from 8-1-73 to 8-1-75, and the "after" period was indicated between 1-1-76 and 1-1-78.

FORM 675

FORM 675 (REV. 4/66)

STATE PROJECT NUMBER 25-03-16 FAP NO: HHS-03-04(002)

Type: ASPHALTIC CONCRETE OVERLAY Checker(s) BARZARE, JOHNSON, DICHARRY

Highway(s) MANY - ZWOLLE (PASSING LANES) Parish(es) SABINE

Route(s) LA-US 171 Length in Miles: Net 2.700 Gross 2.700

Contractor L. H. BOSSIER, INC. Project Engineer T. G. WATTS

Contract Estimate $ 498,800.60 Final Cost $ 502,578.11 Cost Per Mile $ 186,140.04

ACCEPTED: 11-21-75 CONT. DATE: 8-19-75 FINAL EST. RC'D: 1-13-76 PASSED: 3-22-

Final Est. Books: 125-221 Asphalt Record: 123-683

Final X-Sect.:

Final Align.: 123-682 Pipe Record:

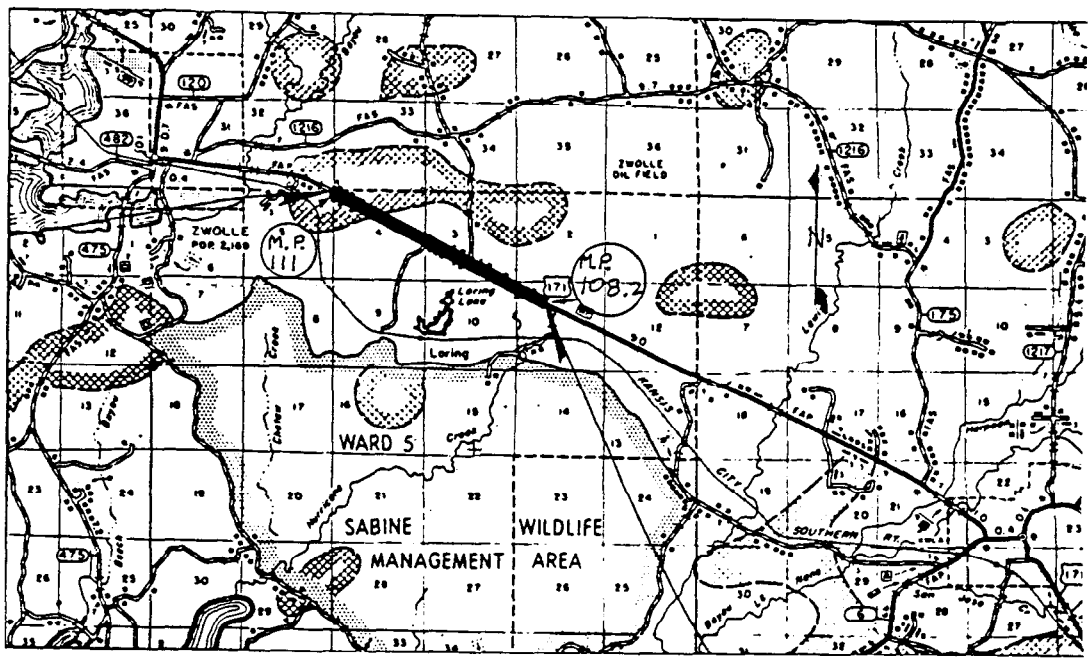
Grade: Truck Bed Measr.: 124-199 & L.L. IN FOLDER

Orig. X-Sect.: Levels:

Diary: 122-832, 123-608

Loc. X-Sect.: Loc. Align:

Misc.: 124-199 (119-382 MASTER LOG)



PROJECT MAP

ADT data obtained from Traffic & Planning were as follows:

1973	Not Available
1974	Not Available
1975	2316
1976	2813
1977	2808

Since only one year of ADT data for the "before" period was available, and no great variation was noted in the three years of available data, 2316 was designated to be the average ADT for the "before" period.

ADT for the after period was calculated as follows:

$$\frac{(365 \times 2813) + (365 \times 2808)}{365 \times 2} = 2810$$

The million vehicle miles (MVM) for two-year periods were calculated as follows:

$$\text{"before"} = \frac{(2316 \text{ veh/day})\ (365 \text{ day/year})\ (2)\ (2.7 \text{ miles})}{1{,}000{,}000} = 4.56 \text{ MVM}$$

$$\text{"after"} = \frac{(2810 \text{ veh/day})\ (365 \text{ days/year})\ (2)\ (2.7 \text{ miles})}{1{,}000{,}000} = 5.54 \text{ MVM}$$

Accident data for the two-year evaluation periods extracted from the attached computer printouts (Page 57 & 58) are as follows:

	"Before"	"After"
Total # of Accidents	13	13
# PDO Accidents	9	8
# Injury Accidents	4	5
# Injuries	9	6
# Fatal Accidents	0	0
# Fatalities	0	0
Total # of Wet Weather Accidents	2	6
# of PDO Wet Weather Accidents	1	4
# of Injury Wet Weather Accidents	1	2
# Injuries	1	3
Total # of Night Accidents	5	7
# PDO Night Accidents	4	4
# Injury Night Accidents	1	3
# Injuries	1	3
Total # of Run off Road Accidents	4	3
# PDO ROR Accidents	3	2
# Injury ROR Accidents	1	1
# Injuries	1	1

It should be noted that the number of PDO involvements (to be used for B/C Ratio computation) is determined by multiplying the number of PDO accidents by a factor of 2.0 for spot improvements (Intersections) and by a factor of 1.5 for roadway section improvements (Skid Resistant Overlay, etc.). These factors have been developed by the Department's Traffic Safety Section.

8/19/81

TRAFFIC ACCIDENTS
SECTIONS 6-10
BEFORE DATA

REF POINT	ROUTE	TOTAL ACCIDENTS	PDO	F A	F	I A	I	DATE PRT	TYPE COLL	ROAD SURFACE	AC RPT NO	PR	TIME	TP AC	SEC
0965	0171	1	1					05/09/5	RT ANGLE	DRY	1522358	43	09 55	COL WT VEH	08
0965	0171	1	1					02/17/5	R END	DRY	1519624	43	NIGHT	COL WT VEH	08
0968	0171	1	1					01/31/5	OTHER	DRY	0792744	43	31 55	NON COL ON RD	08
SECT TOTAL		19	13			6	9								
1084	0171	1	1					11/17/3	R END	DRY	1064656	43	17 60	COL WT VEH	09
1107	0171	1	1					09/18/3	NON COLL	DRY	0794476	43	18 60	RUN OFF RD	09
1085	0171	1	1					04/08/4	OTHER	DRY	0673036	43	NIGHT	COL WT ANIMAL	09
1089	0171	1				1	4	04/13/4	S SWIPE(OD)	DRY	1073114	43	13055	COL WT VEH	09
1091	0171	1	1					11/17/4	OTHER	DRY	1519905	43	NIGHT	COL WT ANIMAL	09
1106	0171	1				1	1	02/11/4	R END	DRY	1063751	43	11 60	COL WT VEH	09
1108	0171	1				1	3	02/09/4	S SWIPE(SD)	DRY	1063748	43	09555	COL WT VEH	09
1108	0171	1	1					01/19/4	NON COLL	WET	1063801	43	19 60	RUN OFF RD	09
1109	0171	1	1					06/28/4	S SWIPE(SD)	DRY	1336310	43	28055	COL WT VEH	09
1083	0171	1	1					04/15/5	NON COLL	DRY	1518601	43	NIGHT	RUN OFF RD	09
1083	0171	1				1	1	02/03/5	NON COLL	WET	1521709	43	NIGHT	RUN OFF RD	09
1091	0171	1	1					04/11/5	R END	DRY	1520938	43	11055	COL WT VEH	09
1092	0171	1	1					06/25/5	OTHER	DRY	1335127	43	NIGHT	COL WT ANIMAL	09
SECT TOTAL		13	9			4	9								
0027	3040	1	1					12/19/3	R END	DRY	1186291	55	NIGHT	COL WT VEH	10
0027	3040	1	1					07/13/3	RT ANGLE	DRY	0658619	55	13 35	COL WT VEH	10
0028	3040	1	1					12/27/3	R END	DRY	1101039	55	27 35	COL WT VEH	10
0028	3040	1				1	1	11/29/3	S SWIPE(OD)	DRY	0983450	55	29 35	COL WT VEH	10
0028	3040	1				1	2	09/11/3	R END	DRY	0632663	55	11 35	COL WT VEH	10
0028	3040	1	1					08/16/3	OTHER	WET	0659462	55	NIGHT	COL WT FIX OBJ	10
0028	3040	1	1					08/14/3	R END	WET	0658671	55	14035	COL WT VEH	10
0028	3040	1				1	1	08/18/3	OTHER	DRY	1183892	55	NIGHT	COL WT FIX OBJ	10
0028	3040	1	1					08/15/3	R END	DRY	1184475	55	15 30	COL WT VEH	10
0028	3040	1				1	1	09/13/3	S SWIPE(OD)	DRY	1185081	55	NIGHT	COL WT VEH	10
0028	3040	1	1					12/01/3	R END	DRY	1190466	55	01 35	COL WT VEH	10
0029	3040	1				1	1	07/23/3	OTHER	DRY	1185531	55	NIGHT	COL WT FIX OBJ	10
0029	3040	1	1					10/27/3	R END	DRY	1185883	55	NIGHT	COL WT VEH	10
0029	3040	1	1					11/17/3	R END	DRY	1190355	55	17 35	COL WT VEH	10
0029	3040	1	1					11/01/3	R END	DRY	1190403	55	01 35	COL WT VEH	10
0029	3040	1				1	1	08/02/3	R END	DRY	0658863	55	02 35	COL WT VEH	10
0029	3040	1	1					07/16/3	R END	DRY	0658807	55	NIGHT	COL WT VEH	10
0030	3040	1				1	1	11/28/3	R END	DRY	0983446	55	28 35	COL WT VEH	10
0031	3040	1				1	2	11/16/3	R END	DRY	1185938	55	16 35	COL WT VEH	10
0031	3040	1	1					07/31/3	R END	DRY	1184338	55	31 35	COL WT VEH	10
0032	3040	1				1	1	07/13/3	R END	DRY	0658616	55	13 25	COL WT VEH	10
0032	3040	1	1					09/20/3	OTHER	DRY	0632927	55	20 35	COL WT OTHER OB	10

8/31/81

TRAFFIC ACCIDENTS
SECTIONS 06,08,09,11,12,13
AFTER DATA

REF POINT	ROUTE	TOTAL ACCIDENTS	PDO	F	A	F	I	A	I	DATE	TYPE COLL	ROAD SURFACE	AC RPT NO	PR	TIME	TYPE ACC	WT	SEC
0969	0171	1	1							70327	OTHER	WET	7030280	43	NIGHT	COL WT OTHER OB	C	08
0982	0171	1	1							70302	S SWIPE(SD)	WET	7023326	43	02555	COL WT VEH	C	08
0985	0171	1	1							70808	S SWIPE(SD)	DRY	7093392	43	08055	COL WT VEH	A	08
0987	0171	1	1							71031	NON COLL	DRY	7131883	43	31 55	RUN OFF RD	A	08
0988	0171	1	1							70928	R END	DRY	7116405	43	28 55	COL WT VEH	A	08
0997	0171	1					1		1	70622	R END	DRY	7075281	43	22055	COL WT VEH	A	08
0997	0171	1	1							70909	S SWIPE(SD)	WET	7114713	43	09055	COL WT VEH	C	08
0999	0171	1	1							70312	S SWIPE(SD)	DRY	7030286	43	12555	COL WT VEH	A	08
1000	0171	1					1		1	70816	R END	DRY	7095306	43	16555	COL WT VEH	A	08
1004	0171	1	1							71001	R END	DRY	7132358	43	01045	COL WT VEH	A	08
SECT TOTAL		22	15				7		11									
1091	0171	1	1							61125	S SWIPE(SD)	WET	6137068	43	NIGHT	COL WT VEH	C	09
1092	0171	1	1							61022	R END	DRY	6122410	43	NIGHT	COL WT VEH	A	09
1094	0171	1					1		1	60922	NON COLL	DRY	6107048	43	NIGHT	RUN OFF RD	A	09
1096	0171	1	1							60307	OTHER	WET	6033993	43	NIGHT	COL WT ANIMAL	C	09
1108	0171	1					1		2	60625	R END	WET	6069826	43	25055	COL WT VEH	B	09
1109	0171	1					1		1	60925	S SWIPE(OD)	DRY	6107046	43	NIGHT	COL WT VEH	A	09
1083	0171	1	1							70504	R END	DRY	7051472	43	04055	COL WT VEH	A	09
1085	0171	1	1							70902	S SWIPE(SD)	DRY	7114711	43	02555	COL WT VEH	A	09
1093	0171	1					1		1	70816	RT ANGLE	DRY	7095312	43	NIGHT	COL WT VEH	A	09
1093	0171	1	1							70903	NON COLL	DRY	7114708	43	NIGHT	RUN OFF RD	A	09
1096	0171	1	1							70113	OTHER	WET	7007372	43	13555	COL WT FIX OBJ	C	09
1103	0171	1					1		1	71010	R END	WET	7124808	43	10055	COL WT VEH	C	09
1111	0171	1	1							70416	NON COLL	WET	7043720	43	16 55	RUN OFF RD	C	09
SECT TOTAL		13	8				5		6									
0806	0014	1	1							61203	S SWIPE(SD)	DRY	6147239	57	NIGHT	COL WT VEH	A	11
0806	0014	1					1		2	61220	H ON	WET	6151493	57	20540	COL WT VEH	C	11
0807	0014	1	1							61219	S SWIPE(SD)	DRY	6147250	57	19040	COL WT VEH	B	11
0803	0014	1	1							70412	S SWIPE(SD)	DRY	7045880	57	12040	COL WT VEH	A	11
0803	0014	1	1							70528	RT ANGLE	DRY	7055754	57	28 40	COL WT VEH	A	11
0803	0014	1	1							70625	S SWIPE(SD)	DRY	7070332	57	25545	COL WT VEH	A	11
0803	0014	1	1							70706	S SWIPE(SD)	DRY	7086899	57	06045	COL WT VEH	A	11
0803	0014	1					1		2	70901	S SWIPE(SD)	DRY	7126598	57	NIGHT	COL WT VEH	A	11
0804	0014	1	1							70927	RT ANGLE	DRY	7121550	57	27 45	COL WT VEH	A	11
0806	0014	1					1		4	70225	H ON	DRY	7022833	57	25050	COL WT VEH	A	11
0806	0014	1	1							70328	S SWIPE(SD)	DRY	7033747	57	28050	COL WT VEH	A	11
0806	0014	1	1							70518	R END	DRY	7055736	57	188	COL WT VEH	B	11
0806	0014	1	1							70518	OTHER	DRY	7055737	57	NIGHT	COL WT FIX OBJ	A	11

Accident rates were determined by dividing the # of accidents for the two-year evaluation periods by the exposure (MVM).

	"Before"	"After"
Total Accident Rate	2.85	2.35
PDO Accident Rate	1.97	1.44
Injury Accident Rate	0.88	0.90
Fatal Accident Rate	0.00	0.00
Wet Weather Rate	0.44	1.08
Wet Weather PDO Rate	0.22	0.72
Wet Weather Injury Rate	0.22	0.36
Wet Weather Fat Rate	0.00	0.00
Night Rate	1.10	1.26
Night PDO Rate	0.88	0.72
Night Injury Rate	0.22	0.54
Night Fat Rate	0.00	0.00
Run Off Road Rate	0.88	0.54
ROR PDO Rate	0.66	0.36
ROR Injury Rate	0.22	0.18
ROR Fat Rate	0.00	0.00

Weighted accident rates are expressed as # of weighted accidents/MVM and were calculated for each category based on a factor of one for PDO, three for injury and eight for fatal accidents. For example:

$$\text{"Before" Rate} = \frac{9(1) + 4(3) + 0(8)}{4.56} = 4.61$$

Total Weighted Accident Rate	4.61	4.14
Wet Weather Weighted Accident Rate	0.88	1.80
Night Weighted Accident Rate	1.54	2.34
ROR Weighted Accident Rate	1.32	0.90

The test for statistical significance was made using the attached Poisson Distribution curves. (See page 61)

$$\% \text{ change in accident rate} = \frac{\text{before rate - after rate}}{\text{before rate}} (100\%)$$

$$= \frac{2.85 - 2.35}{2.85} (100) = 18\% \text{ (decrease)}$$

Expected Frequency = 2.85 x 5.54 = 16

Using the Poisson Curves with 18 as percent change in accident rate and 16 as the expected accident frequency (without treatment) it is evident that the change in accident rate was not statistically significant.

BENEFIT-COST RATIO CALCULATIONS:

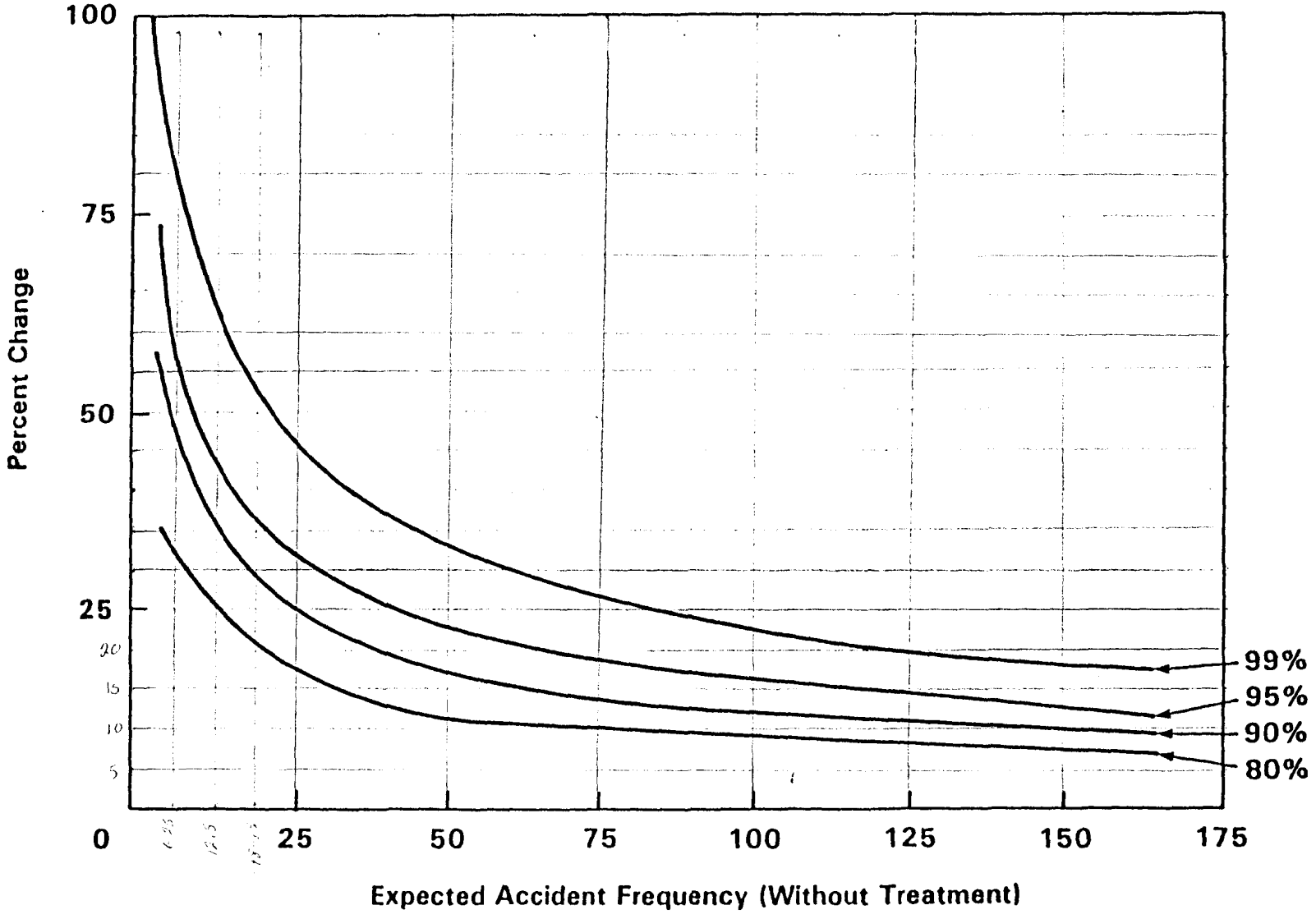
$$B/C = (EUAB) / (EUAC) = \frac{\text{Equal Uniform Annual Benefit}}{\text{Equal Uniform Annual Cost}}$$

Accident data for two year evaluation periods are:

	"Before"	"After"
Total Number of Accidents	13	13
Number PDO Accidents	9	8
Number PDO Involvements	9 x 1.5 = 14	8 x 1.5 = 12
Number Injury Accidents	4	5
Number Injuries	9	6
Number Fatal Accidents	0	0
Number Fatalities	0	0
Exposure (MVM)	4.56	5.54

Dollar Values assigned to each type of severity are:

$430,763 per fatality
$ 4,778 per injury
$ 780 per PDO involvement


100
75
50
25
20
15
10
5
0
25
50
75
100
125
150
175
Percent Change
Expected Accident Frequency (Without Treatment)
99%
95%
90%
80%

Accident costs per unit of exposure (MVM) were determined as follows:

$$\text{"Before"} = \frac{(13.5 \times 780) + (9 \times 4{,}778) + (0 \times 430{,}763)}{4.56} = \$11{,}739.47$$

$$\text{"After"} = \frac{(12 \times 780) + (6 \times 4{,}778) + (0 \times 430{,}763)}{5.54} = \$\ 6{,}864.26$$

NOTE: If there were any fatal accidents, the first fatality would have been considered as an injury to eliminate isolated cases which would have skewed the data.

Benefit per unit exposure (MVM) for the two-year "after" period is equal to:

$$11{,}739.47 - 6{,}864.26 = \$\ 4{,}875.21$$

$$EUAB = \frac{(4{,}875.21)\ (5.54)}{2} = \$13{,}504.33$$

$$EUAC = I(CR_n^i) + K - T(SF_n^i)$$

I = Construction cost = $502,578.11 (See attached Form 675)

CR_n^i = Capital Recovery Factor (See Page 64)

i = interest rate = 8%

n = estimated service life = 20 years (See Page 65)

K = net annual cost of operation and maintenance = 0

T = net salvage value = 0

From the attached table, with i = 8 and n = 20, $CR_n^i = 0.1019$

$$EUAC = (502{,}578.11)\ (0.1019) = \$51{,}212.71$$

$$B/C = (EUAB)/(EUAC) = \frac{13{,}504.33}{51{,}212.71} = 0.26$$

A B/C ratio of 0.26 indicates a 26 cent benefit for every dollar of safety fund spent.

ACCIDENT REDUCTION FACTOR CALCULATIONS:

There were two (2) projects in the passing lane category (See table 1, page 13). The AR Factor for this category was calculated as follows:

$$\text{AR Factor} = 100\left(1 - \frac{\sum A}{\sum E_F}\right)$$

$$\text{AR (Total)} = 100\left(1 - \frac{35}{35}\right) = 0\ \%$$

$$\text{AR (PDO)} = 100\left(1 - \frac{23}{24}\right) = 4\%\ \text{(decrease)}$$

$$\text{AR (INJ)} = 100\left(1 - \frac{12}{11}\right) = 9\%\ \text{(increase)}$$

AR (FAT) : No fatal accidents on record.

Note: "Before" and "After" accident rates were extracted from Table 4, page 24.

Based on the above calculations, it may be concluded that the estimated accident reduction for future passing lane installations will average no change for the total number of accidents, 4% (decrease) for PDO accidents and 9% (increase) for injury accidents.

8% INTEREST FACTORS FOR ANNUAL COMPOUNDING INTEREST

	SINGLE PAYMENT		EQUAL PAYMENT SERIES			
YEAR	COMPOUND AMOUNT FACTOR	PRESENT WORTH FACTOR	COMPOUND AMOUNT FACTOR	SINKING FUND FACTOR	PRESENT WORTH FACTOR	CAPITAL RECOVERY FACTOR
1	1.080	0.9259	1.000	1.0000	0.9259	1.0800
2	1.166	0.8573	2.080	0.4808	1.7833	0.5608
3	1.260	0.7938	3.246	0.3080	2.5771	0.3880
4	1.360	0.7350	4.506	0.2219	3.3121	0.3019
5	1.469	0.6806	5.867	0.1705	3.9927	0.2505
6	1.587	0.6302	7.336	0.1363	4.6229	0.2163
7	1.714	0.5835	8.923	0.1121	5.2064	0.1921
8	1.851	0.5403	10.637	0.0940	5.7466	0.1740
9	1.999	0.5002	12.488	0.0801	6.2469	0.1601
10	2.159	0.4632	14.487	0.0690	6.7101	0.1490
11	2.332	0.4289	16.645	0.0601	7.1390	0.1401
12	2.518	0.3971	18.977	0.0527	7.5361	0.1327
13	2.720	0.3677	21.495	0.0465	7.9038	0.1265
14	2.937	0.3405	24.215	0.0413	8.2442	0.1213
15	3.172	0.3152	27.152	0.0368	8.5595	0.1168
16	3.426	0.2919	30.324	0.0330	8.8514	0.1130
17	3.700	0.2703	33.750	0.0296	9.1216	0.1096
18	3.996	0.2502	37.450	0.0267	9.3719	0.1067
19	4.316	0.2317	41.446	0.0241	9.6036	0.1041
20	4.661	0.2145	45.762	0.0219	9.8181	0.1019
21	5.034	0.1987	50.423	0.0198	10.0168	0.0998
22	5.437	0.1839	55.457	0.0180	10.2007	0.0980
23	5.871	0.1703	60.893	0.0164	10.3711	0.0964
24	6.341	0.1577	66.765	0.0150	10.5288	0.0950
25	6.848	0.1460	73.106	0.0137	10.6748	0.0937
26	7.396	0.1352	79.954	0.0125	10.8100	0.0925
27	7.988	0.1252	87.351	0.0114	10.9352	0.0914
28	8.627	0.1159	95.339	0.0105	11.0511	0.0905
29	9.317	0.1073	103.966	0.0096	11.1584	0.0896
30	10.063	0.0994	113.283	0.0088	11.2578	0.0888
31	10.868	0.0920	123.346	0.0081	11.3498	0.0881
32	11.737	0.0852	134.214	0.0075	11.4350	0.0875
33	12.676	0.0789	145.951	0.0069	11.5139	0.0869
34	13.690	0.0730	158.627	0.0063	11.5869	0.0863
35	14.785	0.0676	172.317	0.0058	11.6546	0.0858
36	15.968	0.0626	187.102	0.0053	11.7172	0.0853
37	17.246	0.0580	203.070	0.0049	11.7752	0.0849
38	18.625	0.0537	220.316	0.0045	11.8289	0.0845
39	20.115	0.0497	238.941	0.0042	11.8786	0.0842
40	21.725	0.0460	259.057	0.0039	11.9246	0.0839
41	23.462	0.0426	280.781	0.0036	11.9672	0.0836
42	25.339	0.0395	304.244	0.0033	12.0067	0.0833
43	27.367	0.0365	329.583	0.0030	12.0432	0.0830
44	29.556	0.0338	356.950	0.0028	12.0771	0.0828
45	31.920	0.0313	386.506	0.0026	12.1084	0.0826
46	34.474	0.0290	418.426	0.0024	12.1374	0.0824
47	37.232	0.0269	452.900	0.0022	12.1643	0.0822
48	40.211	0.0249	490.132	0.0020	12.1891	0.0820
49	43.427	0.0230	530.343	0.0019	12.2122	0.0819
50	46.902	0.0213	573.770	0.0017	12.2335	0.0817

SAFETY IMPROVEMENT PROJECT CODES, DESCRIPTIONS, AND SERVICE LIVES USED IN EFFECTIVENESS EVALUATION

Code	Description	Service Life (Years)
	Intersection Projects	
10	Channelization, left-turn bay	10
11	Traffic signals	10
12	Combination of 10 and 11	10
13	Sight distance improved	10
19	Other intersection, except structures	10
	Cross Section Projects	
20	Pavement widening, no lanes added	20
21	Lanes added without new median	20
22	Highway divided, new median added	20
23	Shoulder widening or improvement	20
24	Combination of 20-23	20
25	Skid treatment - grooving	10
26	Skid treatment - overlay	10
27	Flattening, clearing side slopes	20
29	Other cross section or combinations of 20-27	20
	Structures	
30	Widening bridge or major structure	20
31	Replace bridge or major structure	30
32	New bridge or major structure (except 34 and 51)	30
33	Minor structure	20
34	Pedestrian over- or under-crossing	30
39	Other structure	20
	Alignment Projects	
40	Horizontal alignment changes (except 52)	20
41	Vertical alignment changes	20
42	Combination of 40 and 41	20
49	Other alignment	20
	Railroad Grade Crossing Projects	
50	Flashing lights replacing signs	10
51	Elimination by new or reconstructed grade separation	30
52	Elimination by relocation of highway or railroad	30
53	Illumination	10
54	Flashing lights replacing active devices	10
55	Automatic gates replacing signs	10
56	Automatic gates replacing active devices	10
57	Signing, marking	10
58	Crossing surface improvement	10
59	Other RR grade crossing	10
5A	Any combination of 50, 53, 54, 55, 56, 57, 58	10
	Roadside Appurtenances	
60	Traffic signs	6
61	Breakaway sign or luminaire supports	10
62	Road edge guardrail	10
63	Median barrier	15
64	Markings, delineators	2
65	Lighting	15
66	Improve drainage structures	20
67	Fencing	20
68	Impact attenuators	10
69	Other roadside	10
6A	Combination of 60-64	10
6C	Combination of 60 and 62	8
6D	Combination of 60 and 64	4
	Other Safety Improvements	
90	Safety provisions for roadside features and appurtenances	20
99	All projects not otherwise classifiable	20

Source: Manual on Identification, Analysis and Correction of High Accident Location, FHWA, 1976.