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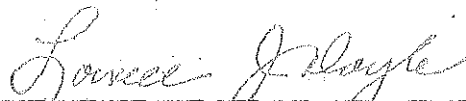
January 18, 1974

District Traffic and Safety Engineers

L. J. Doyle
Assistant Engineer of Traffic and Safety

An Evaluation of the 1965-66, 1966-67 Tree
Removal Program

Attached is a supplement to our TSD-SS-149-70 report (An Evaluation of the 1965-66, 1966-67 Tree Removal Program). The accident record table in this supplement shows a comparison between a year before the tree removal and the calendar years of 1971 and 1972. The reduction of car-tree fatalities was 31% (13 to 9) for 1971 and 77% (13 to 3) for 1972. The total car-tree accidents were reduced by 35% (144 to 93) during 1971 and 11% (144 to 128) during 1972.


Assistant Engineer of
Traffic & Safety

LJD:NAA:nn

Attachment

cc: J. E. Hobria
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M. R. Hoffman
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Michigan Department
of
State Highways and Transportation

SUPPLEMENT TO TSD-SS-149-70 REPORT
AN EVALUATION OF THE 1965-66, 1966-67
TREE REMOVAL PROGRAMS

DECEMBER, 1973

Prepared by the
SURVEILLANCE UNIT
GEOMETRICS SECTION
TRAFFIC & SAFETY DIVISION

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SUPPLEMENT TO TSD-SS-149-70

TSD-SS-149-70 is an evaluation of the "before" and "after" accident experience on scattered sections of state trunkline where trees were removed during the 1965-66 and 1966-67 fiscal years.

Car-tree accidents were analyzed for the 1971 and 1972 calendar years and compared with the car-tree accidents in the "before" period of the original report. The reduction of car-tree fatalities was 31% (13 to 9) for 1971 and 77% (13 to 3) for 1972, while the personal injuries were reduced by 27% (118 to 86) for 1971 and 15% (118 to 100) for 1972*. Total car-tree accidents were reduced by 35% (144 to 93) during 1971 and 11% (144 to 128) during 1972. Appendix A shows that the reduction in the accident severity resulted in a savings of \$357,000 for 1971 and \$943,000 for 1972, a total of \$1,300,000 for both years. Appendix B shows that the reductions in the car-tree accidents during 1971 and 1972 are statistically significant.

The following is a comparison of car-tree accidents during the first year "after" with the accidents occurring in 1971 and 1972:

- 1) In 1971, the total injuries (86) were about the same as the first year "after" (85).

* On page 7 of the original report (TSD-SS-149-70), in the "CAR-TREE ACCIDENTS-RECORD TABLE"- the correct number of persons injured in fatal accidents should be 2 instead of 4.

The fatal accidents in 1971 numbered 8 with 9 killed, compared to 4 fatal accidents with 4 killed in the first year "after". The total number of car-tree accidents was 93 in 1971 compared to 123 in the first year after (see page 7 of the original report).

- 2) In 1972, the total number of persons injured was 100 compared to 85 in the first year after. In 1972, the fatal accidents numbered 3, with 3 killed compared to 4 fatal accidents with 4 killed the first year after. The total number of car-tree accidents was 128 in 1972 and 123 in the first year "after".

All accidents occurring on the studied sections of highway numbered 4,052 in 1971 and 4,463 in 1972 compared to 3,006 during the first year "after" and 3,054 the year "before".

The Average 1971 Daily Traffic increased by 16.5 percent over the year "before" period.

The data of 1971 and 1972 reflects a continuing record of fewer fatalities and injuries involving car-tree accidents compared with the year "before" in spite of an increase in total accidents, and an increase in traffic volumes.

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SUMMARY

CAR-TREE ACCIDENTS - RECORD TABLE

1971 and 1972 Compared With "BEFORE" Record

(Compare with Table on page 7 in the original report)

B E F O R E (Car-Tree Accidents) 1965-66 and 1966-67 Fiscal Years			A F T E R (Car-Tree Accidents) 1971 Calendar Year			A F T E R (Car-Tree Accidents) 1972 Calendar Year			
	Inj. Accs.	Fatal Accs.	Total Accs.	Inj. Accs.	Fatal Accs.	Total Accs.	Inj. Accs.	Fatal Accs.	Total Accs.
Total (both programs)	86(116)	9(13*, 2)	144	52(81)	8(9*, 5)	93	61(98)	3(3*, 2)	128

ALL ACCIDENT RECORD TABLE

B E F O R E (All Accidents) 1965-66 and 1966-67 Fiscal Years			A F T E R (All Accidents) 1971 Calendar Year			A F T E R (All Accidents) 1972 Calendar Year			
	Inj. Accs.	Fatal Accs.	Total Accs.	Inj. Accs.	Fatal Accs.	Total Accs.	Inj. Accs.	Fatal Accs.	Total Accs.
Total (both programs)	1165(2092)	55(83*, 81)	3054	1278(2060)	62(76*, 89)	4052	1376(2349)	66(74*, 80)	4463

() Number of persons injured

(*) Number of persons killed

CAR-TREE ACCIDENTS-RECORD TABLE

Individual Project Record
1971 and 1972 Compared With "BEFORE" Record

(Compare with Table on page 8 in the original report)

Contract No. 88600	BEFORE 1965-66 Fiscal Year			AFTER 1971 Calendar Year			AFTER 1972 Calendar Year		
	Inj. Accs.	Fatal Accs.	Total Accs.	Inj. Accs.	Fatal Accs.	Total Accs.	Inj. Accs.	Fatal Accs.	Total Accs.
C1 & C2	15(22)	2(5*,0)	24	7(8)	1(2*,2)	12	5(9)	0(0,0)	15
C3	7(9)	1(1*,0)	12	3(6)	1(1*,1)	6	6(10)	0(0,0)	10
C4	3(7)	0(0,0)	4	1(1)	0(0,0)	2	3(3)	0(0,0)	3
C5	2(3)	0(0,0)	6	0(0)	0(0,0)	0	7(9)	0(0,0)	12
C6	1(2)	0(0,0)	1	2(2)	0(0,0)	4	2(2)	0(0,0)	4
C7	5(5)	0(0,0)	5	1(1)	1(1*,1)	3	1(1)	0(0,0)	3
C8	2(3)	0(0,0)	2	1(1)	1(1*,0)	2	2(2)	1(1*,0)	3
C9	10(11)	2(3*,0)	18	6(8)	2(2*,0)	14	10(17)	0(0,0)	15
C10	1(1)	0(0,0)	1	4(5)	0(0,0)	4	0(0)	0(0,0)	1
C11	2(2)	0(0,0)	4	0(0)	0(0,0)	0	4(4)	0(0,0)	6
C12	2(2)	0(0,0)	2	4(4)	0(0,0)	4	2(2)	0(0,0)	7
C13	0(0)	0(0,0)	1	1(4)	0(0,0)	2	0(0)	0(0,0)	6
C14	3(3)	1(1*,1)	10	6(12)	0(0,0)	12	1(1)	1(1*,1)	4
Totals	53(70)	6(10*,1)	90	36(52)	6(7*,4)	65	43(60)	2(2*,1)	89

() Number of persons injured

(*) Number of persons killed

CAR-TREE ACCIDENTS-RECORD TABLE

Individual Project Record
1971 and 1972 Compared With "BEFORE" Record

(Compare with Table on page 9 in the original report)

Contract No. 88600	BEFORE 1966-67 Fiscal Year			AFTER 1971 Calendar Year			AFTER 1972 Calendar Year		
	Inj. Accs.	Fatal Accs.	Total Accs.	Inj. Accs.	Fatal Accs.	Total Accs.	Inj. Accs.	Fatal Accs.	Total Accs.
C15&16	53(86)	3(10*,3)	167	49(76)	3(3*,4)	198	68(123)	2(3*,2)	235
C17	76(140)	1(1*,5)	179	71(102)	3(3*,1)	221	63(95)	2(2*,1)	255
C18 & C19	71(124)	5(5*,14)	255	57(94)	4(5*,5)	213	35(90)	4(5*,6)	249
C20 & C21	73(120)	0(0,0)	160	79(131)	1(1*,0)	198	57(97)	3(3*,3)	168
C22	160(287)	8(18*,12)	371	150(261)	12(13*,19)	446	211(375)	12(12*,18)	514
Totals	433(757)	17(34*,34)	1132	406(664)	23(25*,29)	1276	434(780)	23(25*,30)	1421

() Number of persons injured
(*). Number of persons killed

ALL ACCIDENT-RECORD TABLE

Individual Project Record
1971 and 1972 Compared with "BEFORE" Record

(Compare with Table on page 10 in the original report)

Contract No. 88600	BEFORE 1965-66 Fiscal Year			AFTER 1971 Calendar Year			AFTER 1972 Calendar Year		
	Inj. Accs.	Fatal Accs.	Total Accs.	Inj. Accs.	Fatal Accs.	Total Accs.	Inj. Accs.	Fatal Accs.	Total Accs.
C1&C2	145(255)	8(11*,8)	374	172(276)	11(18*,16)	530	139(227)	6(6*,4)	552
C3	61(95)	6(9*,7)	143	57(89)	1(3*,3)	204	143(237)	2(2*,1)	412
C4	48(107)	3(5*,2)	131	43(60)	2(2*,7)	175	40(59)	3(3*,3)	145
C5	51(93)	2(2*,3)	119	65(111)	2(2*,3)	248	90(144)	4(4*,3)	277
C6	52(90)	2(3*,9)	132	98(178)	3(3*,2)	229	132(209)	5(6*,10)	325
C7	72(144)	2(2*,0)	158	81(134)	5(6*,15)	237	25(41)	1(1*,0)	72
C8	40(65)	3(3*,4)	87	33(43)	2(2*,2)	81	39(67)	3(3*,1)	88
C9	134(234)	2(3*,0)	368	156(268)	6(7*,2)	550	155(276)	7(10*,15)	561
C10	9(17)	0(0,0)	26	15(26)	0(0,0)	47	11(25)	1(1*,0)	42
C11	14(18)	0(0,0)	38	10(11)	1(2*,2)	13	15(21)	0(0,0)	48
C12	67(144)	6(7*,11)	166	86(104)	6(6*,8)	219	84(146)	5(6*,8)	256
C13	14(21)	4(4*,3)	68	17(31)	0(0,0)	78	24(36)	0(0,0)	93
C14	25(42)	0(0,0)	112	39(65)	0(0,0)	165	45(81)	6(7*,5)	171
Totals	732(1335)	38(49*,47)	1922	872(1396)	39(51*,60)	2776	942(1569)	43(49*,50)	3042

() Number of persons injured
(*). Number of persons killed

ALL ACCIDENT-RECORD TABLE

Individual Project Record
1971 and 1972 Compared With "BEFORE" Record

(Compare with Table on page 11 in the original report)

Contract No. 88600	BEFORE 1966-67 Fiscal Year			AFTER 1971 Calendar Year			AFTER 1972 Calendar Year		
	Inj. Accs.	Fatal Accs.	Total Accs.	Inj. Accs.	Fatal Accs.	Total Accs.	Inj. Accs.	Fatal Accs.	Total Accs.
C15 & 16	8(12)	0(0,0)	10	0(0)	2(2*,1)	5	7(14)	1(1*,1)	14
C17	6(8)	0(0,0)	9	7(8)	0(0,0)	9	1(2)	0(0,0)	5
C18 & 19	4(5)	1(1*,1)	6	4(7)	0(0,0)	8	4(7)	0(0,0)	8
C20 & 21	4(6)	0(0,0)	5	3(8)	0(0,0)	3	0(0)	0(0,0)	3
C22	11(15)	2(2*,0)	14	2(6)	0(0,0)	3	6(15)	0(0,0)	9
Totals	33(46)	3(3*,1)	54	16(29)	2(2*,1)	28	18(38)	1(1*,1)	39

() Number of persons injured

(*) Number of persons killed

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APPENDIX A

Computed Benefits Derived Through Car-Tree Accident
Reductions - Cost Analysis

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. The same method is given in the Federal Highway Administration PPM 21-16 (March 7, 1969).

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

	Y E A R	
	<u>1971</u>	<u>1972</u>
Death	52,000	82,000
Non-fatal injury	3,100	3,400
Property Damage Accident	440	480
$B = \frac{ADT_a}{ADT_b} \times (52,000 \times R_1^* + 3,100 \times R_2^* + 440 R_3^*) \text{ for } 1971$		

Where

B = annual benefit in dollars

ADT_a = average traffic volume after the improvement

ADT_b = average traffic volume before the improvement

$$\frac{ADT_a}{ADT_b} = \frac{585,000}{502,132} = 1.165$$

	<u>1971</u>	<u>1972</u>
R_1 = reduction in fatalities	(13 - 9 = 4)	(13 - 3 = 10)
R_2 = reduction in injuries	(118 - 86 = 32)	(118 - 100 = 18)
R_3 = reduction in property damage accidents	(49 - 33 = 16)	(49 - 64 = -15)

The computed benefits to the motoring public accrued during the year "after" period is then:

$$B = 1.165 \times (52,000 \times 4 + 3,100 \times 32 + 440 \times 16 + 82,000 \times 10 + 3,400 \times 18 - 480 \times 15) = \$1,300,000.$$

*In the above noted reference, R_1 is listed as $A_f \times P_f$. It is evident upon inspection that $P_f = \frac{R_1}{A_f}$ (see definition above) so that $A_f \times P_f = A_f \times \frac{R_1}{A_f} = R_1$. Similarly R_2 replaces $A_{fi} \times P_{fi}$ and replaces $A_{pd} \times P_{pd}$.

APPENDIX B

The Significance of Accident Reduction

To test the aggregate accident reduction for statistical "significance" reference is made to the "Null Hypothesis" (H_0)* stating that there is no change in "before" and "after" accident numbers.

Where	<u>"Before"</u>	<u>"After"</u>
Number of vehicles not involved in accidents	A	B
Number of vehicles involved in accidents	C	D

Assume

$$A/B = C/D \quad (H_0)$$

Using Chi-square statistics

$$\chi^2 = \frac{(AD - BC)^2}{(A + B)(C + D)(A + C)(B + D)} N$$

Where $N = A + B + C + D$

From Chi-square Table II

$$\chi^2_{.95,1} \quad (\text{read Chi-square at the 95\% confidence level, with 1 degree of freedom}) = 3.84$$

and using for 1971

$$\begin{aligned} A &= (502,132 \times 365) - 144 = 183,278,036 \\ B &= (585,000 \times 365) - 93 = 213,524,907 \\ C &= 144 \\ D &= 93 \end{aligned}$$

Then

$$\chi^2 = 20.24 > 3.84$$

for 1972

$$\begin{aligned} A &= 183,278,036 \\ B &= (585,000 \times 365) - 128 = 213,524,872 \\ C &= 144 \\ D &= 128 \end{aligned}$$

$$\text{Then } \chi^2 = 4.98 > 3.84$$

* Reference is made to "Statistical Inference" by Helen M. Walker, page 100.