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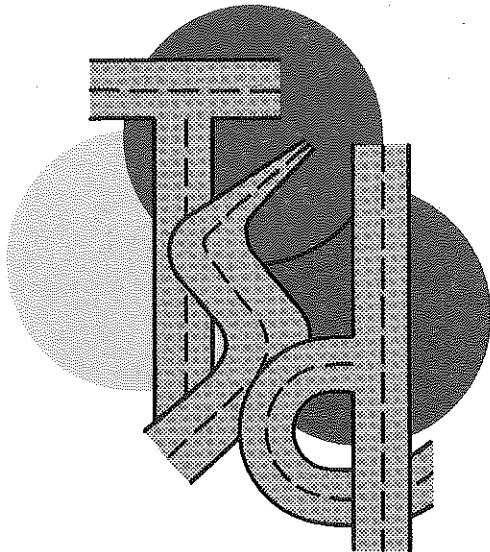
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Evaluation of a Safety Project
Replacement of bi-directional crossover
with pair of directional crossovers

TSD-SS-116-69



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MICHIGAN DEPARTMENT OF STATE HIGHWAYS

Evaluation of a Safety Project

Replacement of bi-directional crossover
with pair of directional crossovers

TSD-SS-116-69

Intersection of US-10 (Woodward Avenue)
at Opdyke Road, City of Bloomfield Hills, Oakland County
Project Ms 63051-029
(Inventory of Highway Safety Improvement Projects, Item #201)

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ACKNOWLEDGEMENTS

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SYNOPSIS

This report is an evaluation of accidents resulting from the closing of the median crossover on a trunkline, US-10 (Woodward Ave.) at a tee intersection of a minor road, Opdyke Rd., and the construction of two directional crossovers, one northwest and one southeast of the intersection. The roadway at the approaches to each crossover was widened on the median side to provide for protected left-turn lanes.

This \$67,000 safety project contributed to the reduction in the total number of accidents from 34 to 13 (62%) in a one-year period. This reduction, according to National Safety Council criteria, amounted to a savings of \$47,300 to the motoring public in the first year.

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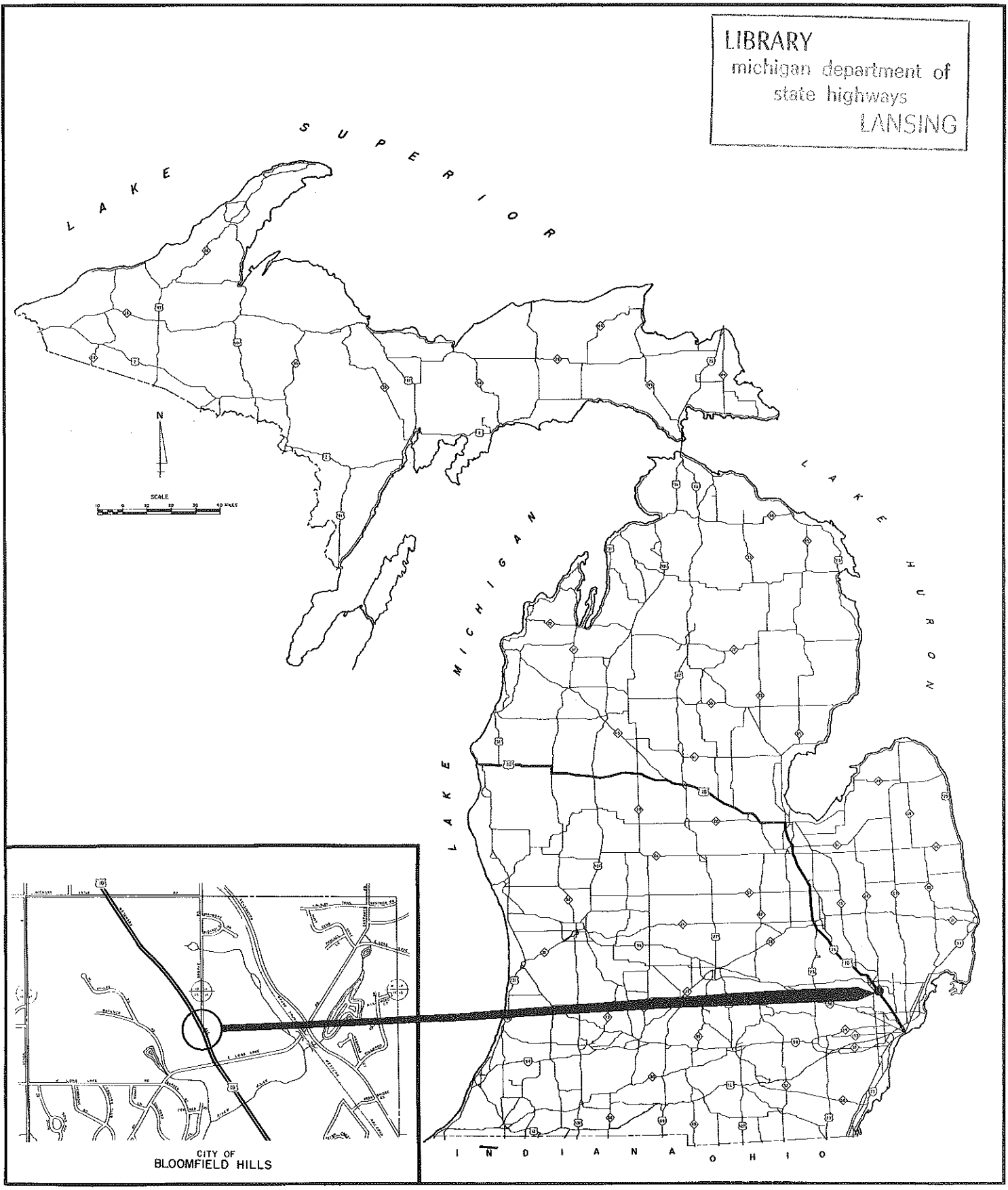


FIGURE I

Location

US-10 is a major route in Michigan beginning in downtown Detroit and extending northwesterly to the city of Ludington on Lake Michigan (See Figure 1).

Opdyke Road is a north-south county road extending southerly from BL-75 (Perry Road) to the subject intersection in the city of Bloomfield Hills. Development along Opdyke Road (a two-lane, two-way roadway with a speed limit of 35 mph) is mostly residential with scattered commercial establishments.

At the intersection, US-10 is 128 feet wide with four lanes in each direction separated by a 40 foot median. The speed limit on US-10 at this location is 50 mph.

Figure 2 is an aerial photograph of the intersection before the improvement. Opdyke Road enters the photograph from the lower left corner.

Problem

During a one-year period (May 1, 1966 to April 30, 1967) preceding the improvement, 34 accidents occurred at this intersection, 13 involving injuries, with a total of 20 persons injured (See Figure 5).

The southbound left-turn movement from Opdyke Road to US-10 was a factor in 28 of the accidents (82% of the total).

The traffic volume on US-10 at Opdyke Road is very high and increasing.

<u>Year</u>	<u>ADT</u>
1966	35,800
1967	37,900
1968	39,000

Consequently, it was difficult for southbound Opdyke Road traffic to cross the four lanes of traffic on northbound US-10, find a temporary place to wait in the median, and then an acceptable gap to safely merge with southbound US-10 traffic. This last movement appeared to be the biggest problem, since the majority of accidents occurred after southbound Opdyke Road traffic had crossed northbound US-10 and was trying to merge with southbound US-10 traffic (See Figure 5).



FIGURE 2

Site location before the improvement.
(Looking Southerly)

Improvement

The improvement between May 1, 1967 and September 1, 1967 involved (See Figures 5 and 6):

1. The closure of the existing bi-directional median crossover which was aligned with Opdyke Road.
2. The construction of two directional median crossovers northwest and southeast of the intersection.
3. The construction of median deceleration lanes for northbound US-10 traffic at both crossovers.
4. Providing an additional lane for northbound US-10 traffic exiting at Opdyke Road and channelizing the intersection.

Figures 3 and 4 show ground photographs taken after the improvement.

	BEFORE	AFTER
	May 1, 1966 to April 30, 1967	Sept. 2, 1967 to Sept. 1, 1968
TOTAL ACCIDENTS	34	13
Property Damage	21	10
Injury	13(20)	3(6)
<hr/>		
TYPE OF ACCIDENTS		
NB US-10 at Opdyke	5	4
SB US-10 at Opdyke	13	4 (N. Crossover) 5 (S. Crossover)
Median Crossover	10	0
Other	6	0

() Number of persons injured.

TABLE 1. Accident patterns before and after the improvement.



FIGURE 3

Northbound US-10 at Opdyke Road
(Looking Northerly)

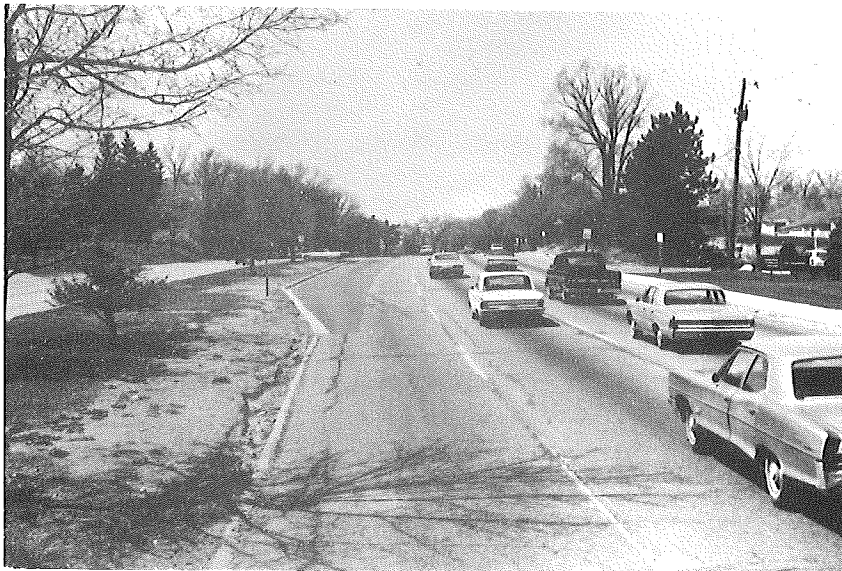


FIGURE 4

Northbound US-10 south of Opdyke Road
(Looking Northerly)

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Results

Before the improvement, the greatest number of accidents (See Table 1) were occurring in the median and on the far side of US-10 (See Figure 5). The median is 40 feet wide, too narrow to easily store two cars one behind the other.

The median accidents, which can be attributed to the concern the motorist had for safely and quickly crossing the near side traffic stream (northbound US-10) to temporarily wait in the median, were divided into two types: rear-end and sideswipe. These types of accidents apparently result when a motorist misjudges a gap in the near side traffic stream and is required to force his way into the median, or when a trailing motorist does not expect the leading motorist to stop abruptly in the median, or when vehicles waiting in the median leave simultaneously to enter the southbound traffic stream.

Many right-angle accidents occurred when vehicles waiting side by side in the median, especially at the adverse angle, often restricted the vision of the first, second and third motorist, causing them to hazardously enter the traffic stream without adequate vision.

The improvement eliminated the median storage problem by providing a deceleration lane for left turns in the median, and also eliminated the adverse angle of storage with a properly designed crossover tied into the left-turn lane (See Figure 6).

Median accidents were completely eliminated. There were no far-side, right-angle accidents at the north crossover and only two right-angle accidents at the south crossover.

Total accidents decreased 62% (34 to 13) and more importantly, injuries decreased 70% (20 to 6).

Conclusion

This safety project has achieved its primary purpose of reducing the accident hazard, especially the median and far-side patterns. It also increased the efficiency of lane usage on northbound US-10 since the motorist in the left through lane no longer needed to reduce speed or avoid left-turning vehicles at the crossover. This crossover was also used by northbound motorists to gain access to the parking lot on the west side of US-10 and these motorists now use the southerly directional crossover which has a deceleration lane. An analysis of the accident reduction indicates that the improvement is statistically significant in reducing accidents (See Appendix A).

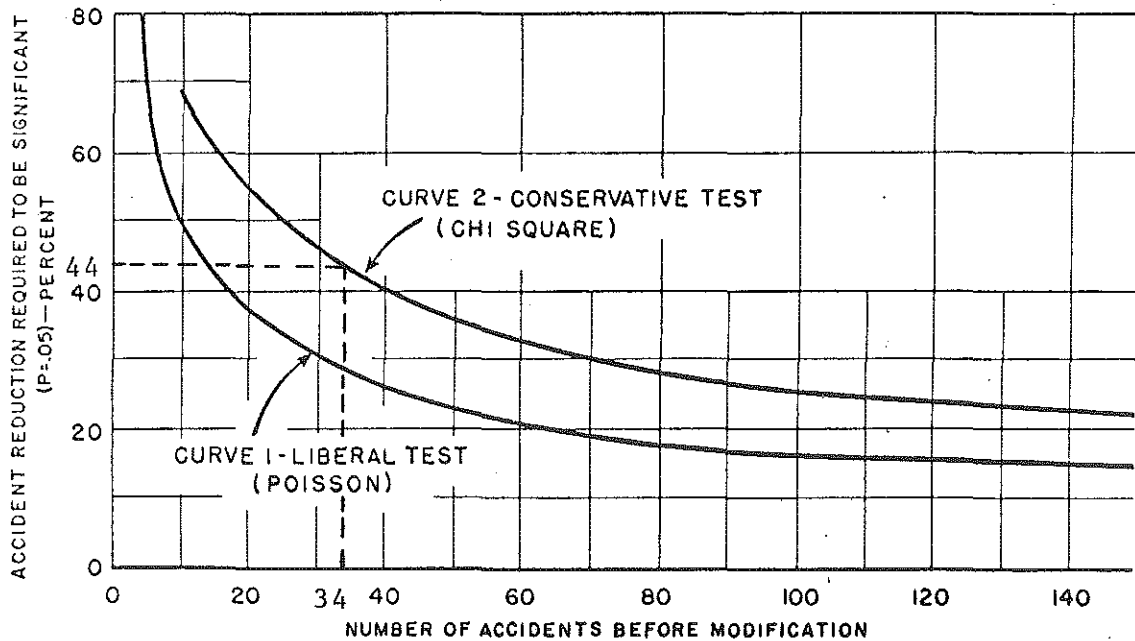
The computed annual benefit for the first year after the completion of this project, as determined by a National Safety Council criteria, is \$47,300 (See Appendix B). The cost of the improvement was \$67,000. This improvement should pay for itself in less than two years.

The intersection of US-10 (Woodward Avenue) and Long Lake Road is approximately one-quarter mile south of Opdyke Road, and the effect of the southerly bi-directional crossover on accidents at Long Lake Road will be covered in a subsequent report.

APPENDIX A

The Significance of the Accident Reduction

The graph below appeared in an article entitled "Two Simple Techniques for Determining the Significance of Accident Reducing Measures" by Richard H. Michaels in the September, 1966 issue of "Traffic Engineering" magazine.



Curves for determining the statistical significance of accident-reducing techniques.

Curve 1 is the liberal curve and may be used where more than minimum accident records are available such as two years before and two years after. Curve 2 should be used where data may only be available one year before and one year after, as in this case.

During the one year period (May 1, 1966 to April 30, 1967) before reconstruction, 34 accidents occurred at this location. Using Curve 2, the percentage of reduction required to be significant is 44%. There was a 62% reduction at the subject location studied in this report.

Therefore, the accident reduction at this location after the improvement is statistically significant.

APPENDIX "B"

Annual Benefit

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

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

Death - \$34,400

Non-fatal Injury - \$1,800

Property Damage Accident - \$310

$$B = \frac{ADT_a}{ADT_b} \times (Q \times A_{fi} \times P_{fi} + 310 \times A_{pd} \times P_{pd})$$

where

B = annual benefit in dollars

ADT_a = average traffic volume after the improvement
 $4/12 \times 37,900 + 8/12 \times 39,000 = 38,600$

ADT_b = average traffic volume before the improvement
 $8/12 \times 35,800 + 4/12 \times 37,900 = 36,500$

A_{fi} = annual average number of fatalities and injuries combined at the locations in the year before (20)

P_{fi} = percentage reduction in fatalities and injuries
 $\frac{20-6}{20} \times 100 = 70.0\%$

A_{pd} = property damage accidents in the year before (21)

P_{pd} = percentage of reduction in property damage accidents
 $\frac{21-10}{21} \times 100 = 52\%$

and $Q = \frac{34,400 + I/F \times 1,800}{1+I/F}$

where

I/F = ratio of injuries to fatalities that occurred statewide during 1967 in cities with a population of under 2,500.

$$I/F = \frac{32,366}{1,182} = 27.3$$

therefore

$$Q = \frac{34,400 + (27.3 \times 1,800)}{1 + 27.3} = 2,950$$

Then the computed year benefit in dollars for a one year after the completion of this project is:

$$B = \frac{38,600}{36,500} \left(2,950 \times 20 \times \frac{70.0}{100} + 310 \times 21 \times \frac{52}{100} \right) = \$47,300$$

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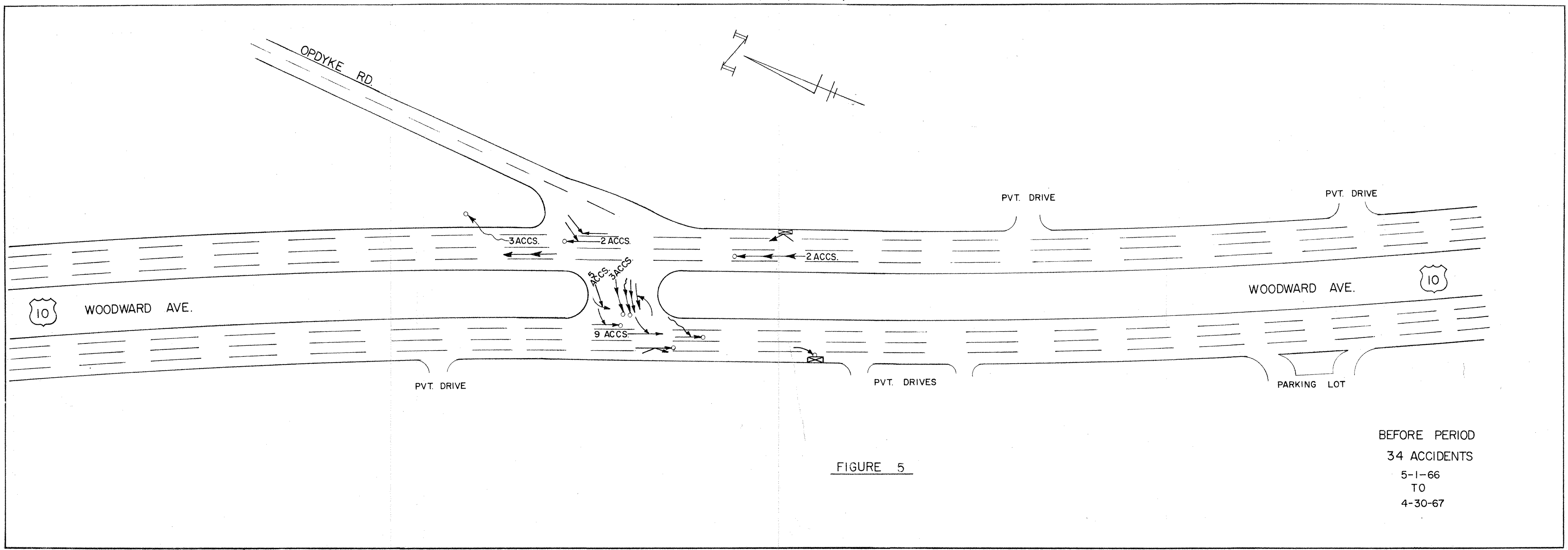


FIGURE 5

BEFORE PERIOD
 34 ACCIDENTS
 5-1-66
 TO
 4-30-67

98
 5-30-69

953069

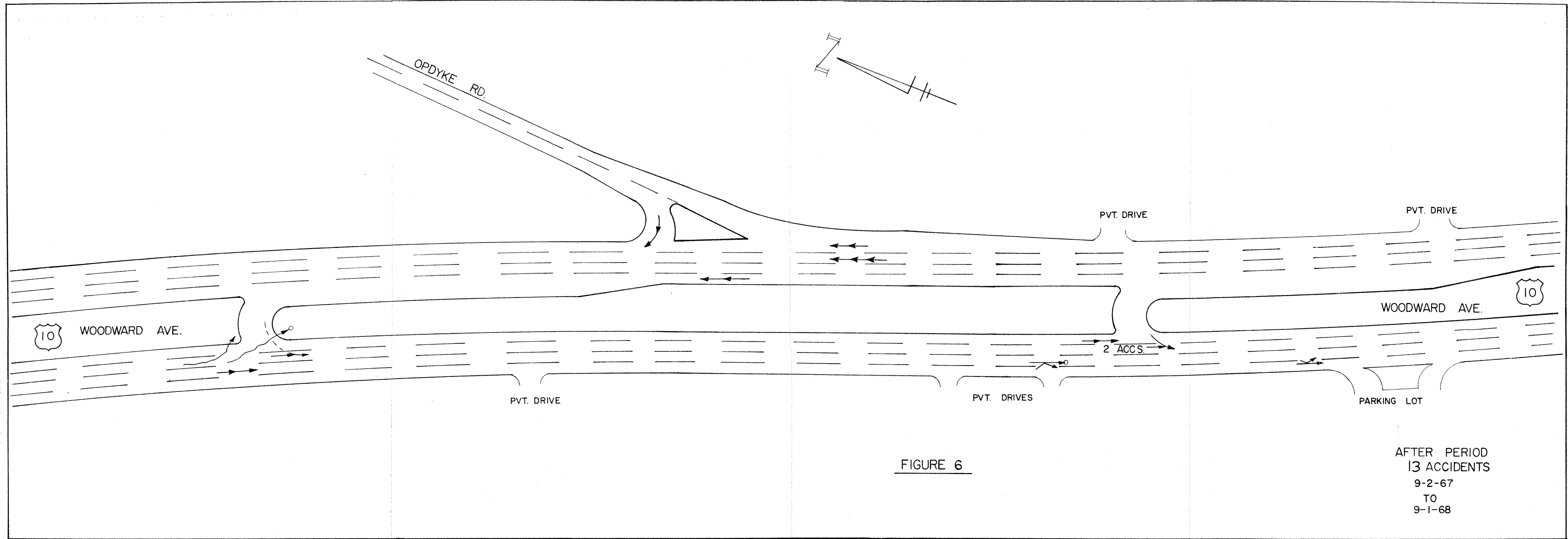


FIGURE 6

AFTER PERIOD
13 ACCIDENTS
9-2-67
TO
9-1-68