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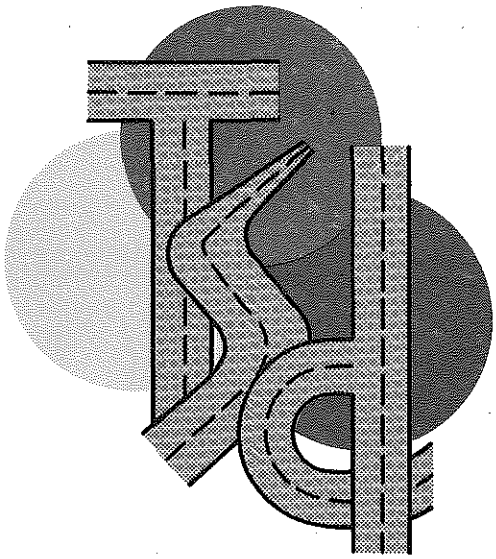
A TRAFFIC ACCIDENT ANALYSIS OF HIGH ACCIDENT LOCATIONS IN MASON COUNTY

Report TSD-SS-135-70



TRAFFIC and SAFETY DIVISION

DEPARTMENT OF STATE HIGHWAYS
STATE OF MICHIGAN

65-7867

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A TRAFFIC ACCIDENT ANALYSIS OF HIGH ACCIDENT LOCATIONS IN MASON COUNTY

Report TSD-SS-135-70

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by

ROBERT G. LARIVIERE

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Department of State Highways
State Highways Building - P.O. Drawer K
Lansing, Michigan 48904

February, 1971

STUDY CONDUCTED BY THE

Safety & Surveillance Section
Traffic & Safety Division
Bureau of Operations
Michigan Department of State Highways

in cooperation with

National Highway Traffic Safety Administration
Department of Transportation

"The opinions, findings and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration."

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Mason County Sheriff Department

Wallace N. Bentz - County Sheriff

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NHSB PROJECT #IS-69-3-001

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INTRODUCTION

The Highway Safety Act of 1966 was enacted by the Congress of the United States in order to promote highway safety programs. Subsequently, various highway safety standards were developed to assure the orderly implementation of the Act.

Highway Safety Standard 4.4.9, Identification and Surveillance of Accident Locations, is one of those standards. The purpose of Standard 4.4.9 is to identify specific locations or sections of streets and highways which have high or potentially high accident experience as a basis for establishing priorities for improvement, selective enforcement, or other operational practices that will eliminate or reduce the hazards at the location so identified.

The State of Michigan carries out a program of this type on the state trunkline system; however, many of the State's city and county agencies lack the financial and technical prerequisites necessary to pursue similar programs with similarly defined objectives. To insure that this additional Highway Safety Standard is met and to improve the overall evaluation of the accident picture in Michigan, the Michigan Department of State Highways requested and received through the Office of Highway Safety Planning in the Executive Office of the Governor a federally funded project entitled, "Traffic Accident Analysis for Cities and

Counties". The intent of this new project is to provide a special traffic engineering field service for cities and counties. In cooperation with participating cities and counties, the proposed service under the direction of Department personnel will make a traffic engineering evaluation of the factors causing traffic accidents and will recommend corrections to those conditions which may be contributing to accidents.

SCOPE

The intent of this program is to improve traffic safety on all Michigan streets and roads by expanding the traffic engineering evaluation of factors causing accidents. This should be accomplished by conducting traffic accident analyses of locations which experience high accident frequencies and summarizing recommendations for corrective action.

STUDY PROCEDURES

The study procedures for the subject project involve several distinct phases. They may be described as follows: basic data collection, identifying and locating high accident locations, an accident analysis of these high accident locations, technical evaluation of previously compiled facts and consequent remedial recommendations.

Since a portion of the data collection phase involves

accident records and reports and since the Michigan Department of State Police is responsible for keeping all accident records in Michigan, the task of identifying and locating high accident locations in Mason County (and providing an inventory of those locations) was designated as State Police responsibility. Because of the fact that a modern or automatic system of locating accidents on the county road system is not yet established, the high accident locations for Mason County were determined by manually extracting and compiling those locations with the highest number of accidents from the 1966 to 1968 county accident reports. From this list, the 15 highest accident locations were selected. Once the problem locations were identified, additional accident information for the year 1969 was compiled in order to expand the accident data to the most recent year. Upon completion of this portion of the data collection, the Department of State Police documented and transmitted to the Traffic and Safety Division of the Department of State Highways a list, along with the accident reports, of the high accident locations for Mason County.

The second portion of the data collection phase, which is the responsibility of the Department of State Highways, involves data collection utilizing the following basic steps: 1) preparation of collision diagrams, and, if necessary, physical condition diagrams for each selected location and 2) obtaining traffic counts where necessary.

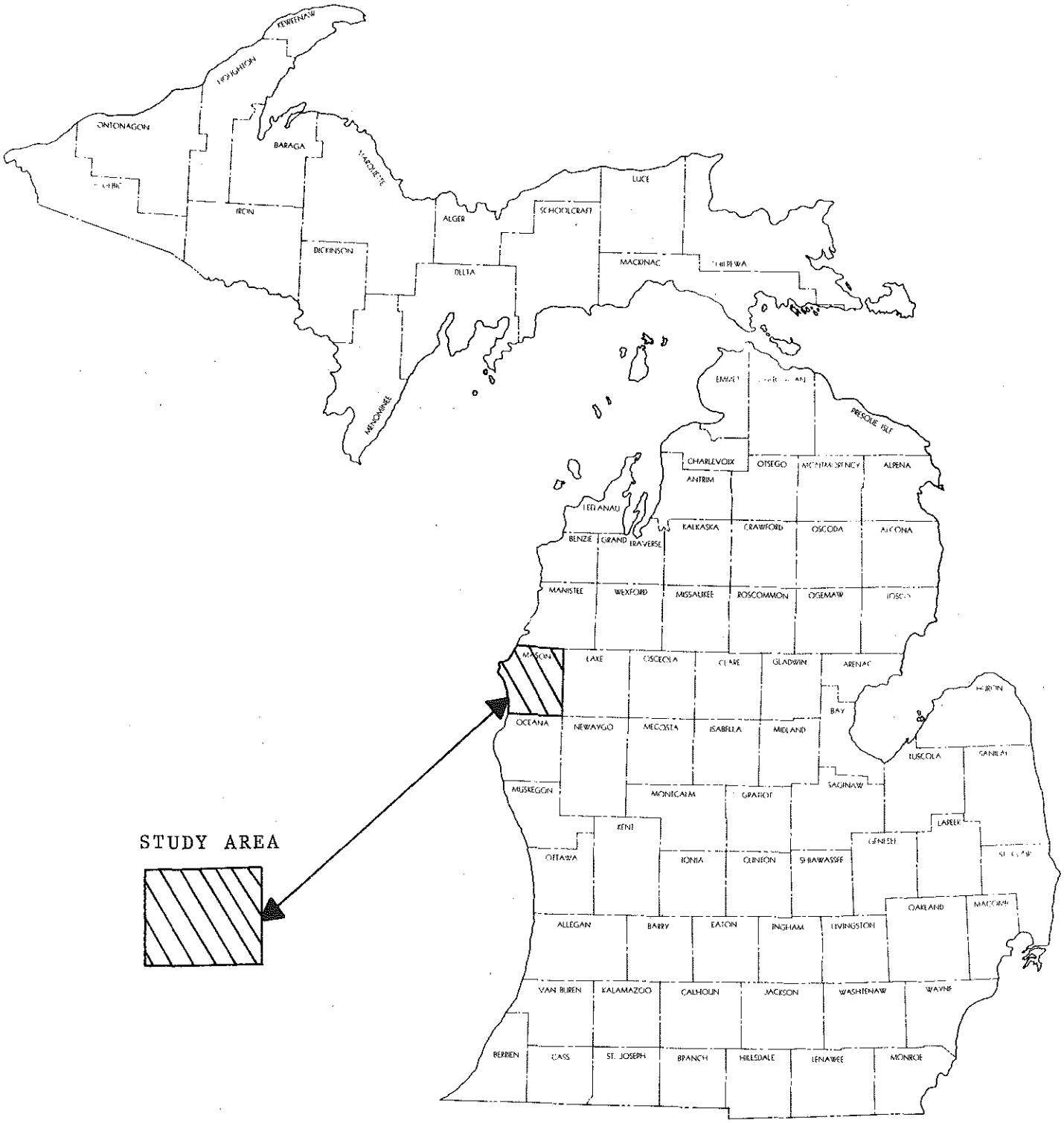
The accident analysis phase involves the analysis of the summarized facts and field data from the viewpoint of a highway traffic engineer with special attention focused on the effect which the highway environment may have had on the accident. Thus, at each high accident location, individual accident reports were reviewed in detail and the accident factors were tabulated and grouped in various tables. Collision diagrams were prepared for each location in order to identify accident patterns and to locate the accident in relation to the intersection or approaches to the intersection.

The traffic engineering analysis phase involves evaluating the summarized facts and field data and prescribing the proper remedial treatment.

STUDY AREA

Mason County is located in the northwestern part of Michigan and is bordered by Oceana County on the south, Lake County on the east, Manistee County on the north and Lake Michigan on the west (see Figure 1 on the following page). Mason County has a land area of 493 sq. miles, an inland water area of 12 sq. miles and a 1965 population of 44.2 people per sq. mile. Ludington is the largest city in Mason County and is also the center of the greatest population increase. About 2/3 of the population increase between 1950 and 1960 took place in the three townships surrounding Ludington. The present trend appears to be a stable population

FIGURE 1


KEWEENAW
HOUGHTON
ONTONAGON
BARAGA
GOGEBIC
IRON
MARQUETTE
ALGER
SCHOOLCRAFT
LUCE
DICKINSON
DELTA
MACKINAC
CHIPPEWA
MENOMINEE
EMMET
PRESQUE ISLE
CHARLEVOIX
OTSEGO
MONTMORENCY
ALPENA
ANTRIM
LEELANAU
BENZIE
GRAND TRAVERSE
KALKASKA
CRAWFORD
OSCODA
ALCONA
MANISTEE
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
IOSCO
MASON
LAKE
OSCEOLA
CLARE
GLADWIN
ARENAC
HURON
BAY
OCEANA
NEWAYGO
MECOSTA
ISABELLA
MIDLAND
TUSCOLA
GENESEE
MUSKEGON
MONTCALM
GRATIOT
SAGINAW
KENT
LAPEER
OTTAWA
IONIA
CLINTON
SHIAWASSEE
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EATON
INGHAM
LIVINGSTON
VAN BUREN
KALAMAZOO
CALHOUN
JACKSON
WASHTENAW
WAYNE
BERRIEN
CASS
ST. JOSEPH
BRANCH
HILLSDALE
LENAWEE
MONROE
STUDY AREA

in Ludington and a growing population in the fringe areas around Lundington.

As one can see from the population projection (see Figure 2 on p. 7), Mason County didn't begin to grow consistently until around 1932. Mason County's population figures decreased for the 20-year period from 1912 to 1932. Even though the population projection shows an increase up to 1980, Mason County can still be called, in general, a sparsely settled recreation area. The general pattern for the past 20 years shows that more people have been attracted away from Mason County than to it for job opportunities. Even though a greater potential working force is born in the county each year, the present working force is finding it necessary to move out of the county. Thus, the outlook for the future is a moderately growing county population whose percentage increase will continue to be substantially less than that of the state as a whole.

Mason County is characterized by sound industries, established arterial commerce, productive farm and fruit lands and unlimited natural resources such as petroleum, bromine, sand, gravel and natural gas. Resort business, which is quite apparent, is welcome but not essential. Statistics compiled by the Office of Economic Expansion, Michigan Department of Commerce, indicate a decrease in farm acreage in Mason County. The percentage of land area devoted to farms decreased from 54.1 percent in 1954, to 44.9 percent

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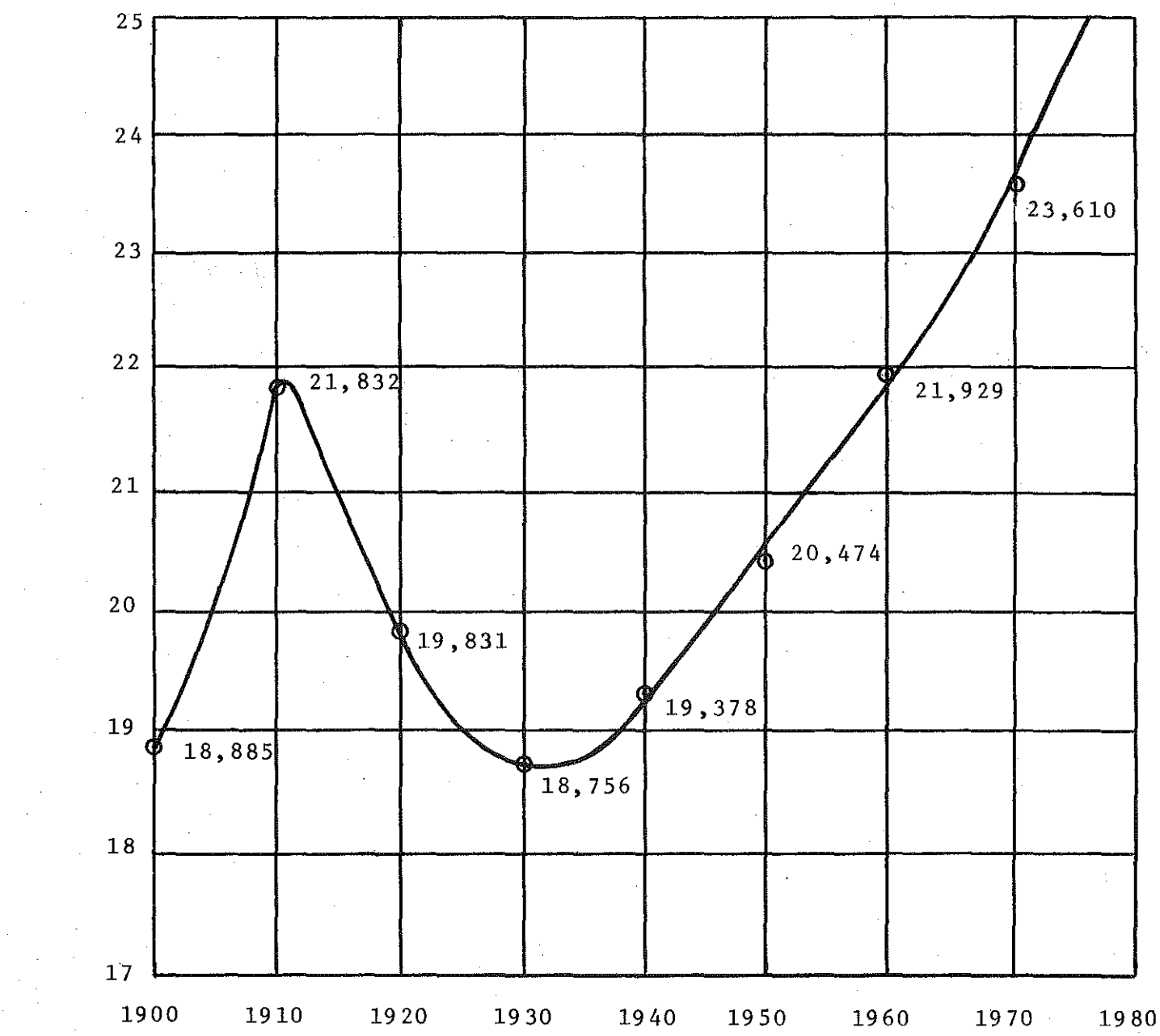
FIGURE 2

POPULATION PROJECTION

Mason County: 1900 to 1970



Source: Institute for Community Development, Continuing Education Service, Michigan State University, Technical Bulletin B-24, Population of Michigan Counties, Projections to 1970, March, 1962

in 1959 and to 37.4 percent in 1964. This trend is following the national pattern as the amount of farm land decreases. Despite the relatively large percentage of agricultural land, only 14 percent of the total work force was engaged in agriculture in 1960 compared to 31.2 percent employed in manufacturing industry. Agricultural land in Mason County is devoted to fruit farms as evidenced by their total fruit production and number of fruit trees. This indicates the importance of agricultural land to the economy of Mason County and reflects land values in its area.

Manufacturing statistics went up from 1954 to 1963 in number of establishments, number of employees, annual payroll, value added by manufacturer and new capital expenditures. Even with this increase, however, industrial development in Mason County still has a great capacity for expansion. Thus, the trend for the future indicates that Mason County will show a decrease in farm land plus a gradual increase in population and industry.

According to the Eighteenth Annual Progress Report, as compiled by the Local Government Division of the Michigan Department of State Highways, Mason County has 989.34 miles of highways. This figure does not include city and incorporated village streets and roads. It does include, however, 48.29 miles of state trunkline, 180.78 miles of county primary roads and 760.27 miles of local roads. Only about 1/4 of the miles of county roads are hard surfaced while

the remaining mileage is either gravel or unimproved dirt roads (see Figure 3 on the following page). Mason County's vehicle registrations have increased 16.2% over the past three years while the total number of accidents in the county have increased only 2.8% for the same time period.

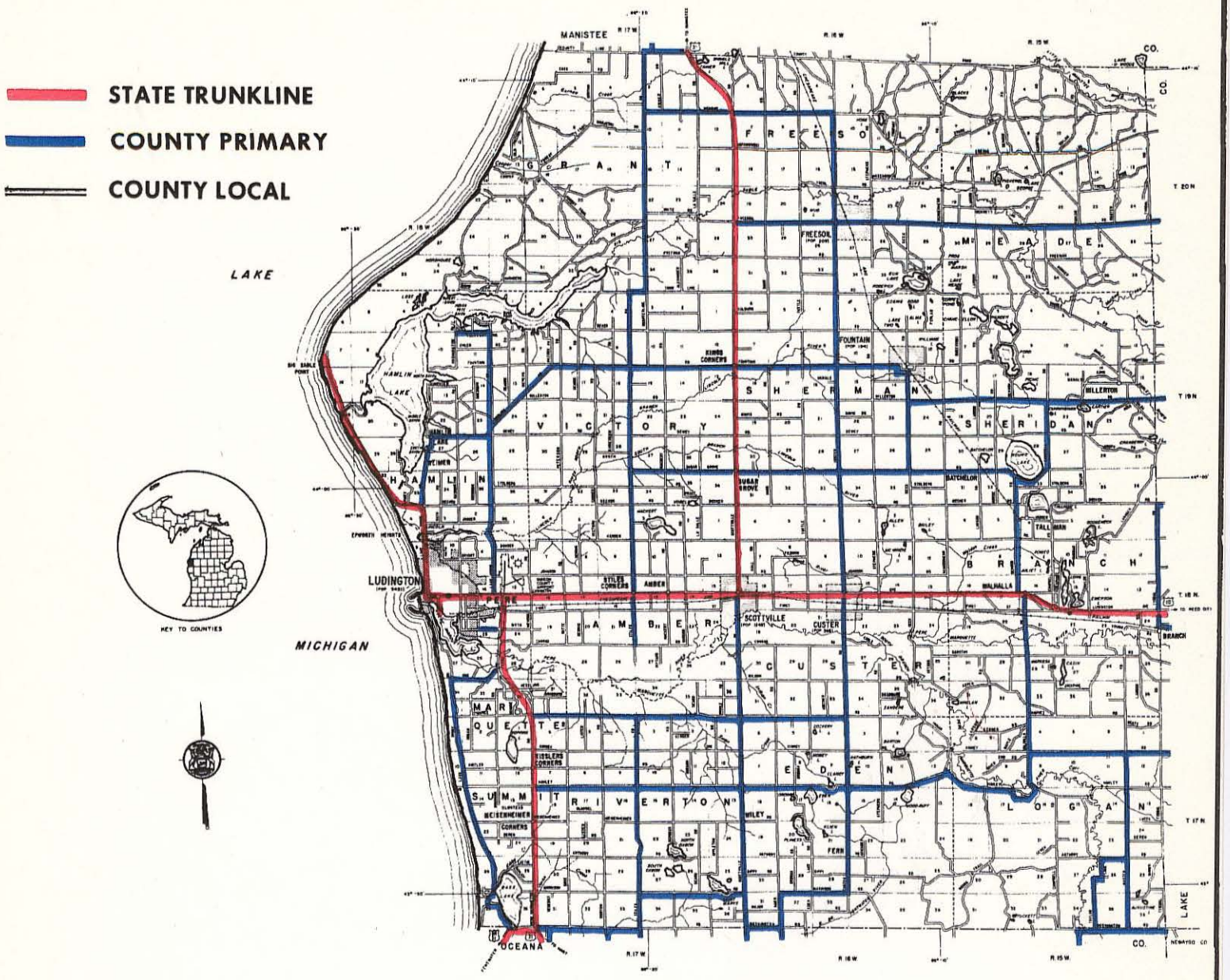


FIGURE 3

MASON COUNTY

MICHIGAN
STATE HIGHWAY COMMISSION
DEPARTMENT OF STATE HIGHWAYS

DATA OBTAINED FROM
HIGHWAY PLANNING SURVEY
CONDUCTED IN COOPERATION WITH
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS

1" = 2.75 MILES
POLYCONIC PROJECTION

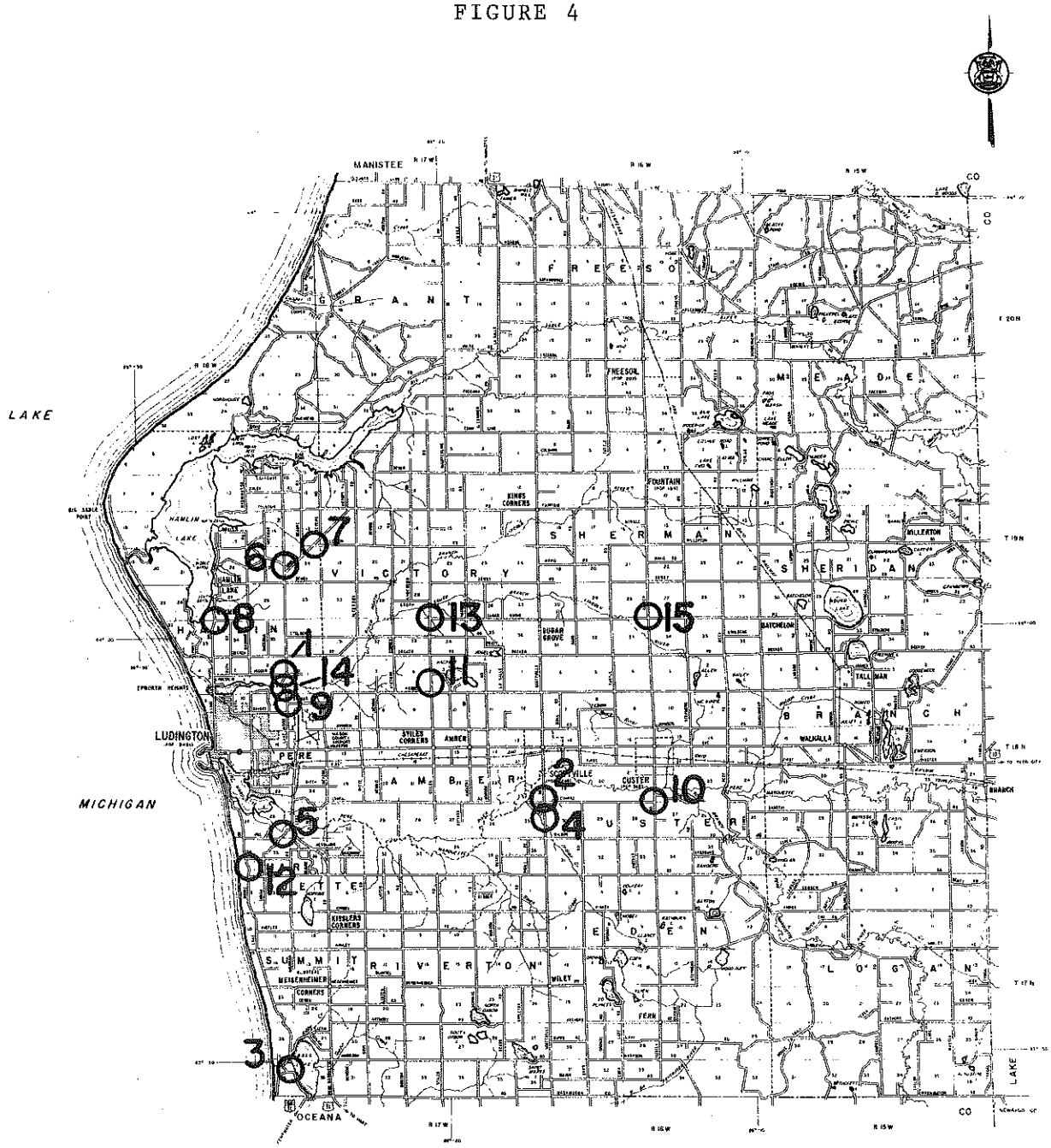
MASON COUNTY MICHIGAN

TRAFFIC ENGINEERING ANALYSIS

The traffic engineering analysis phase of our study involves evaluating the summarized facts and field data and prescribing the proper remedial treatment. One of the basic tools used in this type of analysis is a graphic representation of accidents, either on a spot collision diagram or strip map, which is used to locate the accident and determine accident patterns. This is one of the engineering techniques we use in trying to determine the reason for the accident. Accident causes, however, are numerous and often difficult to determine. An accident pattern does not always exist. In this case the collisions may involve one or more serious driving hazards such as slippery pavement, snow or fog, drinking drivers, defective equipment, excessive speed and inadequate traffic control. In many cases these hazards may be eliminated or at best controlled. In some cases the accident causes may lie in factors outside the jurisdiction of the traffic engineer, such as enforcement. In this instance, he can offer specific information to the police or other responsible agencies and request their cooperation.

In Mason County the traffic engineering analysis began when the State Police, after compiling the accident data for Mason County, transmitted to the Michigan Department of State

Highways 15 high accident locations (see spot map on the following page). After our analysis, it was apparent that no recommendations would be feasible for three of these locations. There were no accident patterns at these three locations, no present serious driving hazards that could be eliminated or controlled and no potential hazards or trouble areas that could be eliminated before accident occurrence. Consequently, this report will discuss in detail only the remaining 12 locations. The collision diagrams and pictures for each of these will be found on the page following the discussion. The collision diagrams and pictures for the remaining three locations are found in Appendix I.



SPOT MAP

FOR

HIGH ACCIDENT

LOCATIONS

MASON COUNTY

MICHIGAN

STATE HIGHWAY COMMISSION

DEPARTMENT OF STATE HIGHWAYS

DATA OBTAINED FROM

HIGHWAY PLANNING SURVEY

CONDUCTED IN COOPERATION WITH

U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

BUREAU OF PUBLIC ROADS

1 0 1 2 3 MILES

PLANIMETRIC PROJECTION

LOCATIONS

1-9-14 North Jebavy Drive, (F.A.S. 139), at Jagger Road, the Lincoln River Bridge and Rasmussen Road, Pere Marquette and Hamlin Townships

These three locations were studied together because of their close proximity to each other. The area begins at the intersection of Jebavy Road and Jagger Road and runs south approximately 0.5 of a mile to the Lincoln River Bridge and then continues southerly for approximately 0.5 of a mile to the intersection of Jebavy Road and Rasmussen Road. The traffic accidents were grouped at the Jebavy Road, Jagger Road intersection, at the Lincoln River Bridge and at a point just north of the Jebavy Road, Rasmussen Road intersection.

The intersection of Jebavy Road and Jagger Road is offset. One leg is offset to the north and the other to the south. Jebavy Road in this area is 22 ft bituminous. It is in excellent condition. The west leg of Jagger Road is 22 ft bituminous and the east leg 20 ft. The east leg of Jagger Road deadends a short distance from Jebavy Road. Jagger Road in this area generates very little traffic. Sight distance to the north from both legs of Jagger Road is very poor due to the horizontal and vertical alignment of Jebavy Road (see photos following pages). However, there was only one accident during the four-year study period that could be attributed to the poor alignment.

The existing traffic controls at this intersection are a 30 in. blind intersection warning sign located on southbound Jebavy Road about a quarter of a mile from the intersection and a target arrow (W1-6-48, Appendix II, p. 82) located on southbound Jebavy Road at the tangent to the first curve. There is also a 36 in. reverse curve sign with an accompanying 35 mph advisory speed panel for southbound Jebavy Road traffic. Passing is prohibited on Jebavy Road in this area and is so indicated by painted no passing zones. There is a 24 in. stop sign (R1-1-24, Appendix II, p. 75) for east and westbound Jagger Road.

The Lincoln River Bridge area was the scene of eight ran-off roadway accidents and one car-deer accident from 1966 to 1969. The Lincoln River Bridge is 20 ft wide and has no centerline markings. There are 30 in. "narrow bridge" warning signs for both directions of traffic on Jebavy Road. Also, reflectorized obstruction panels have been placed on each side of the bridge for north and southbound traffic. Three of the ran-off roadway accidents were caused by vehicles driving in the center of the bridge thus forcing another vehicle off the highway. While visually inspecting the area, we noticed that the majority of the vehicles going across the bridge were driven in the center of the roadway. This practice can be accounted for by the narrowness of the bridge

surface and the fact that the bridge railing abuts the edge of the pavement. Thus, the drivers instinctively shy away from the bridge railing and drive down the center.

Four of the six accidents at the Jebavy Road, Rasmussen Road intersection actually occurred at the beginning of the curve just north of Rasmussen Road. Jebavy Road is a 22 ft wide bituminous surface in good condition. The curve has a double yellow centerline, a curve warning sign (W1-2-24, Appendix II, p. 79) for southbound traffic and a 36 in. "winding road" sign with an accompanying 35 mile per hour advisory speed panel for northbound traffic.

Recommendations:

We recommend that a 24 in. x 48 in. reflectorized bi-directional target arrow (see Part I, Section C, p. 89, Warning Signs - Michigan Manual of Uniform Traffic Control Devices, Appendix II, p. 83) be placed at the end of east-bound Jagger Road. Also, a 35 mile per hour advisory speed panel (see Part I, Section C, p. 132 of the Manual - Appendix II, p. 87) should accompany the curve sign located south of the Lincoln River Bridge. This curve sign should also be increased in size from a 24 in. sign to a 30 in. sign (see Part I, Section C, p. 82 of the Manual - Appendix II, p. 79) to meet the minimum standards of the Michigan Manual of Uniform Traffic Control Devices.

Also, we recommend that a 24 in. x 48 in. target arrow (see Part I, Section C, p. 88 of the Manual - Appendix II, p. 82) be placed at the tangent to the curve that begins just north of the Lincoln River Bridge. Northbound traffic can also benefit from a curve sign (see Part I, Section C, p. 82 of the Manual - Appendix II, p. 79) that we recommend be placed north of the Lincoln River Bridge just before Jagger Road.

Lastly, we recommend that the centerline be marked on the Lincoln River Bridge (see Part III, Section B, Markings, pps. 278-279 of the Manual - Appendix II, p. 90). This should help keep the drivers from driving through the center of the bridge. During our discussion with Mr. Robert Lunde, Mason County Engineer, he indicated that consideration is being given to replacing the Lincoln River Bridge in about two years.

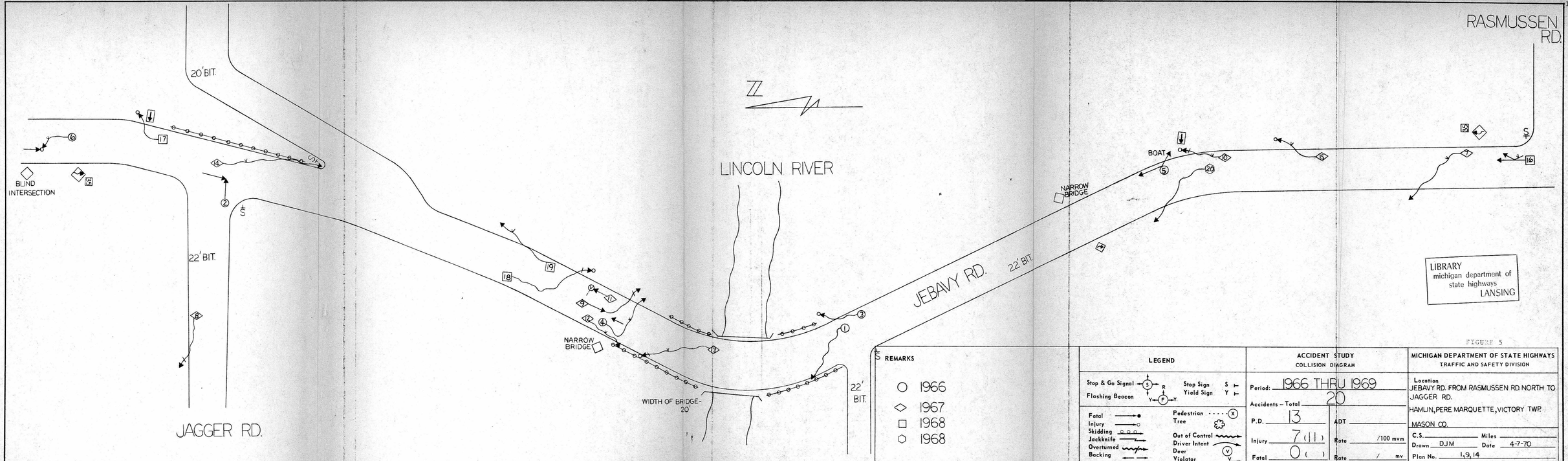


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FIGURE 5

REMARKS

- ○ 1966
- ◇ 1967
- □ 1968
- ⬡ 1968

LEGEND

Stop & Go Signal — Stop Sign S
Flashing Beacon — Yield Sign Y
Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
Accidents – Total 20
P.D. 13
Injury 7 (11)
Fatal 0 ( )
ADT
Rate /100 mvm
Rate / mv

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location
JEBAVY RD. FROM RASMUSSEN RD. NORTH TO JAGGER RD.
HAMLIN, PERE MARQUETTE, VICTORY TWP.
MASON CO.
C.S. Miles
Drawn DJM Date 4-7-70
Plan No. 1, 9, 14

Form 1547 A (Rev. 6/69) Sheet 1 of 1

EASTBOUND

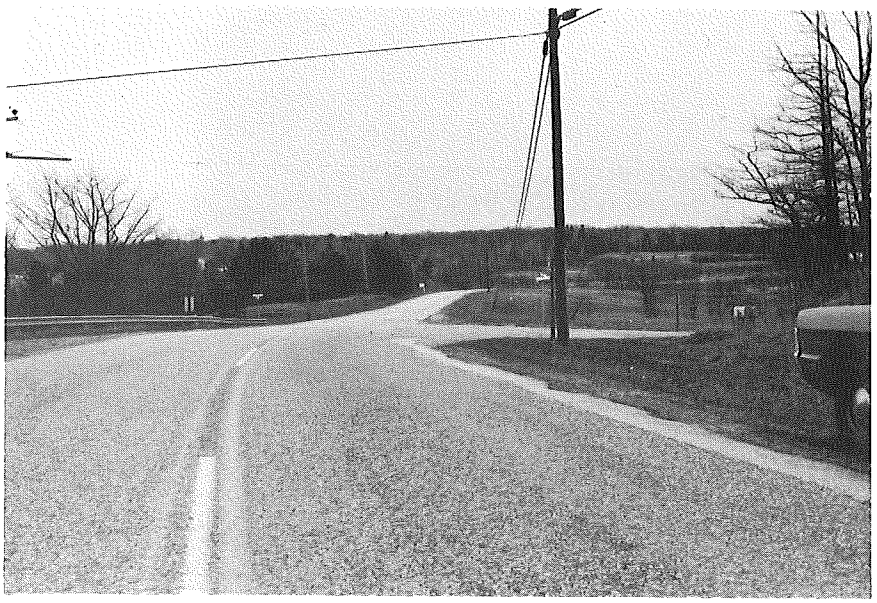
JAGGER ROAD

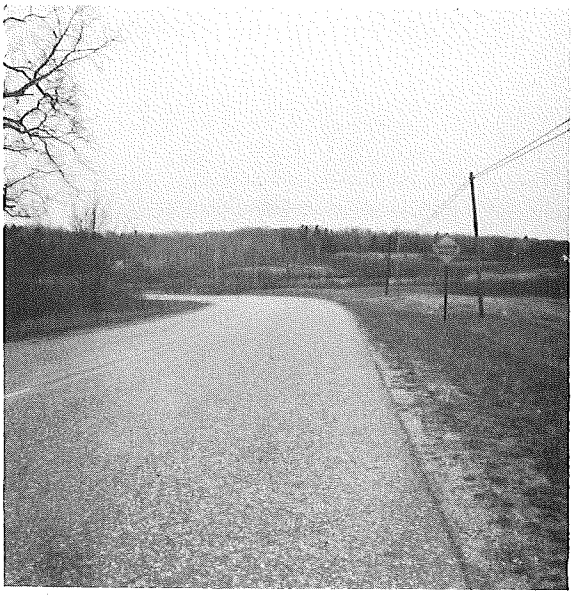
AT JEBAVY ROAD

SOUTHBOUND

JEBAVY ROAD

AT JAGGER ROAD





SOUTHBOUND

JEBAVY ROAD

BETWEEN JAGGER ROAD AND

THE LINCOLN RIVER BRIDGE

FIGURE 5a

NORTHBOUND JEBAVY ROAD

BETWEEN THE LINCOLN RIVER BRIDGE

AND JAGGER ROAD

NORTHBOUND JEBAVY ROAD

AT JAGGER ROAD

FIGURE 5b

NORTHBOUND
JEBAVY ROAD
NORTH OF RASMUSSEN ROAD

NORTHBOUND
JEBAVY ROAD
BETWEEN RASMUSSEN ROAD AND
THE LINCOLN RIVER BRIDGE

NORTHBOUND
JEBAVY ROAD
AT THE LINCOLN
RIVER BRIDGE

FIGURE 5c

SOUTHBOUND

JEBAVY ROAD

AT THE LINCOLN RIVER BRIDGE

SOUTHBOUND

JEBAVY ROAD

BETWEEN THE LINCOLN RIVER BRIDGE

AND RASMUSSEN ROAD

NORTHBOUND

JEBAVY ROAD

NORTH OF RASMUSSEN ROAD

FIGURE 5d

LOCATIONS

2-4 Scottville Road, (F.A.S. 449), 0.1 mile north and 0.3 mile south of Conrad Road, Amber and Custer Townships

Since these two locations are only 0.2 of a mile apart, we have decided to combine them and discuss them as one location. Scottville Road has a 22 ft bituminous surface with sand shoulders. The road surface, which is in excellent condition, has a vertical alignment with a plus gradient in the southerly direction. Conrad Road east of Scottville Road has a 20 ft bituminous surface that is in good condition. There is a stop sign (R1-1-24, Appendix II, p. 75) on Conrad Road for westbound traffic. Conrad Road west of Scottville Road is a single lane unimproved earth trail that carries a negligible amount of traffic.

The accident experience at these locations shows 12 accidents during the four-year study period. Seven of these were car-deer accidents, four were ran-off roadway and there was one rear-end. Two of the ran-off roadway accidents happened in 1966 during reconstruction of Scottville Road.

Recommendations:

It seems from the accident data that deer area warning signs (see Part I, Section C, p. 139 of the Manual, Appendix II, p. 89) should be placed on Scottville Road north and

south of Locations 2 and 4. However, a joint investigation must be made by representatives of the Michigan Department of Conservation and the Mason County Road Commission, which is the agency having jurisdiction over the highway, before this sign may be installed. We recommend that such an investigation be conducted in this area.

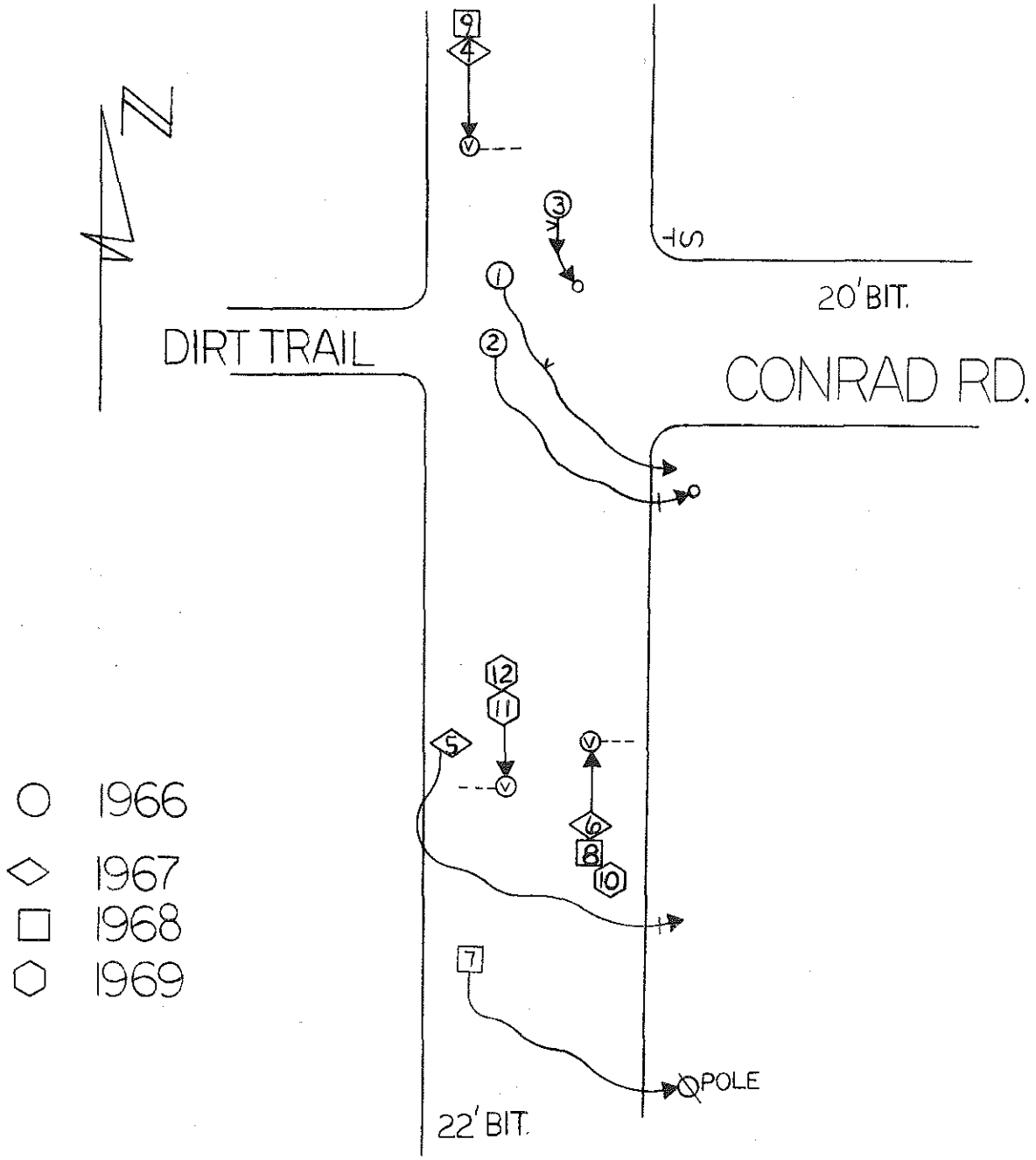


FIGURE 6

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

Stop & Go Signal — Stop Sign S
Flashing Beacon — Yield Sign Y

Fatal — Overturned — Out of Control
Injury — Backing — Driver Intent
Skidding — Pedestrian — Deer
Jackknife — Tree — Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
CUSTER & AMBER TWP Description MASON CO.
SCOTTVILLE RD. FROM CONRAD RD. TO 0.3 MI. SOUTH
Accidents — Total 12
P.D. 10 Injury 2 (3)
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm
C.S. Miles
Drawn DVW Date 4-14 Rev.
Plan No. # 2,4

WESTBOUND

CONRAD ROAD

SOUTHBOUND

SCOTTVILLE ROAD

NORTHBOUND

SCOTTVILLE ROAD

FIGURE 6a

3. Lakeshore Drive, (F.A.S. 1528), at Sunset Lane, Summit Township

This location is composed of two 90° turns with a short tangent in between. The roadway is a two lane bituminous pavement 18 ft wide. Shoulders as such are non-existent. The pavement edges are uneven and cracked in spots, and there are no centerline markings.

The speed limit for Lakeshore Drive is 25 miles per hour. The first turn as you travel north is marked with 90° turn warning signs (W1-1-30, Appendix II, p. 78) for both directions of traffic. The second turn as you travel north is marked with a 90° turn warning sign (W1-1-30, Appendix II, p. 78) for westbound Lakeshore Drive traffic only.

Of the six accidents during the four-year study period, there were two right angle accidents, one head-on, one side-swipe, one rear-end and one ran-off roadway. Even though there is no pattern as far as accident types are concerned, all six of the accidents can still be attributed to the narrowness of the roadway and the sharpness of the turns.

Recommendations:

We recommend that 15 mile per hour advisory speed panels (see Part I, Section C, p. 132 of the Manual - Appendix II, p. 87) accompany the turn warning signs for the first curve in the northerly direction. The 15 mile per hour speed was

determined by using a devil level in accordance with the tables on pps. 132-133 of the Michigan Manual of Uniform Traffic Control Devices. The readings on the devil level were as follows:

Speed	Readings
25	25°
20	20°
15	12°

Devil level readings were also taken on the second curve which intersects at the west junction of Lakeshore Drive and Sunset Lane. The results showed that no special speed panel would be necessary. The 25 mile per hour posted speed for Lakeshore Drive is adequate. The following readings were recorded:

Speed	Readings
25	10°
20	5°
15	3°

We do feel, however, that this second curve should have a 90° turn sign (see Part I, Section C, p.81 of the Manual - Appendix II, p. 78) erected for southbound Lakeshore Drive traffic. Also, we recommend that 24 in. x 48 in. target arrows (see Part I, Section C, p. 88 of the Manual - Appendix II, p. 82) be placed at the tangents for both curves so that

there will be a target arrow for each direction of traffic.

Since three out of the six accidents involved vehicles crossing the middle of the road into the path of opposing traffic, we recommend that the two curves and the short section between them be centerline marked (see Part III, Section B, pps. 278-279 of the Manual - Appendix II, p. 90).

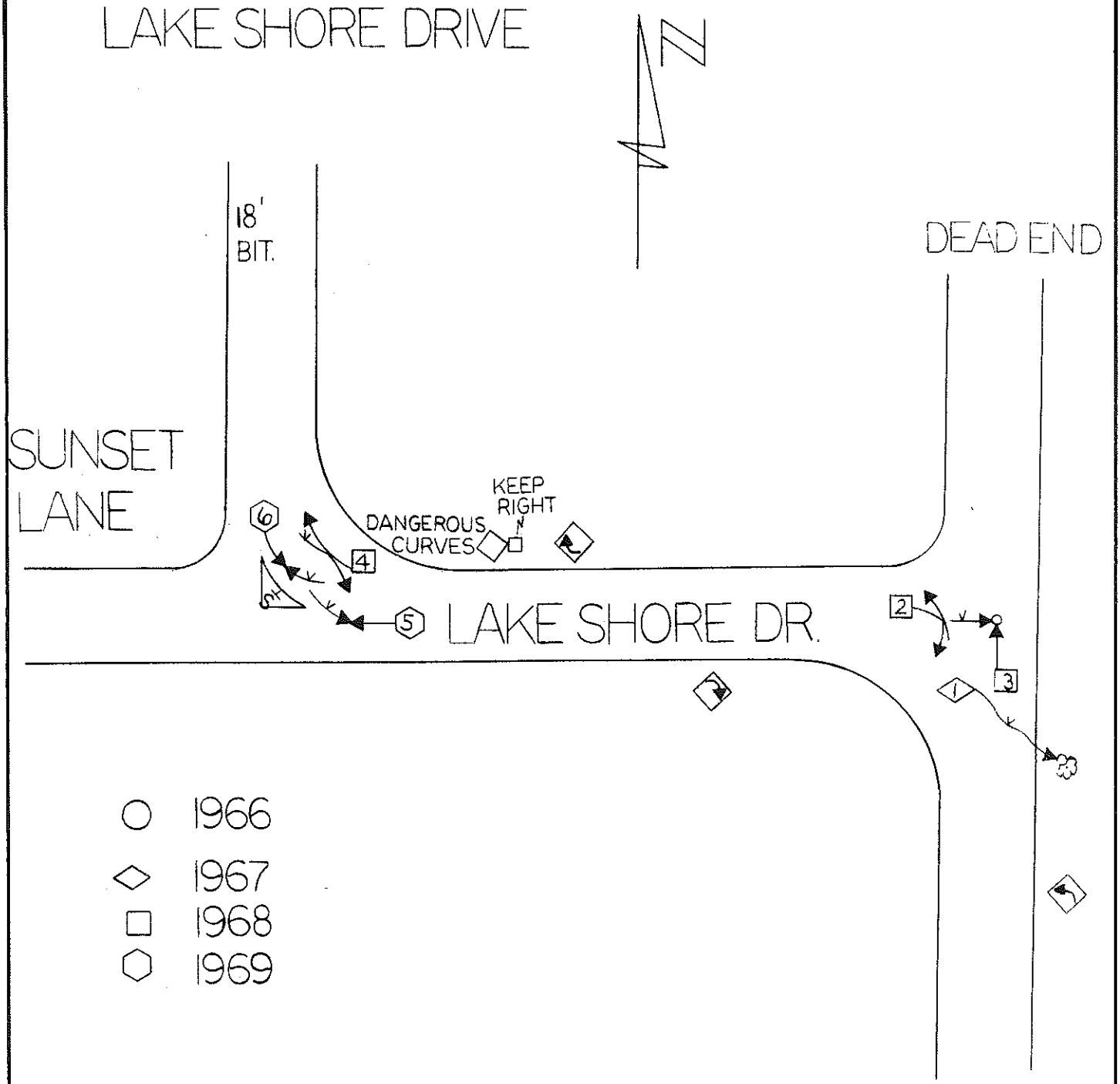


FIGURE 7

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

Stop & Go Signal — Flashing Beacon — Stop Sign S — Yield Sign Y

Fatal — Injury — Skidding — Jackknife — Overturned — Backing — Pedestrian — Tree — Out of Control — Driver Intent — Deer — Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969

SUMMIT TWP. Description MASON CO.
LAKESHORE DRIVE at SUNSET LANE

Accidents – Total 6
P.D. 4 Injury 2 (2)
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm

C.S. Miles
Drawn DJM Date 4-8-70 Rev.
Plan No. #3

SOUTHBOUND

LAKESHORE DRIVE

EASTBOUND

LAKESHORE DRIVE

NORTHBOUND

LAKESHORE DRIVE

FIGURE 7a

NORTHBOUND

LAKESHORE DRIVE

WESTBOUND

LAKESHORE DRIVE

EASTBOUND

SUNSET LANE

FIGURE 7b

4. Scottville Road, (F.A.S. 499), 0.3 miles south of Conrad Road (combined with Location 2, see p. 23)

5. Iris Road, (F.A.S. 1528), 0.25 miles south of US-31, Pere Marquette Township

In 1969 paving was completed for the Iris Road reconstruction project. The new roadway consists of a 22 ft bituminous surface with five foot sand shoulders. The actual accident location consists of a reverse curve. The curves drive easily at the posted speed limit of 35 miles per hour and could be driven safely at a higher speed. Consequently, we feel that the posted speed limit should be investigated for consideration of an increase. The present speed limit was probably essential because of the adverse alignment of the old roadway. Now that the new roadway is completed an increase appears warranted to maintain driver confidence in posted speed limits.

There were five accidents at this location during the study period, all occurring in 1966 and 1967. Four of these accidents were the ran-off roadway type and the fifth was a sideswipe.

Recommendations:

Since there were no curve signs at this location at the time of our field investigation, we recommend that reverse curve signs (see Part I, Section C, p. 86 of the

Manual - Appendix II, p. 80) be erected for both eastbound and westbound traffic. Furthermore, to complement the curve signs, we recommend that 24 in. x 48 in. target arrows (see Part I, Section C, p. 88 of the Manual - Appendix II, p. 82) be placed in target position for both eastbound and westbound traffic. We feel that the new construction has eliminated the problems in alignment that existed at this location, since there has been no reported accidents since 1967. We recommended the curve signs and target arrows to complement the new construction. We suggest that future accident records be checked to determine the continued effectiveness of the improvements at this location.

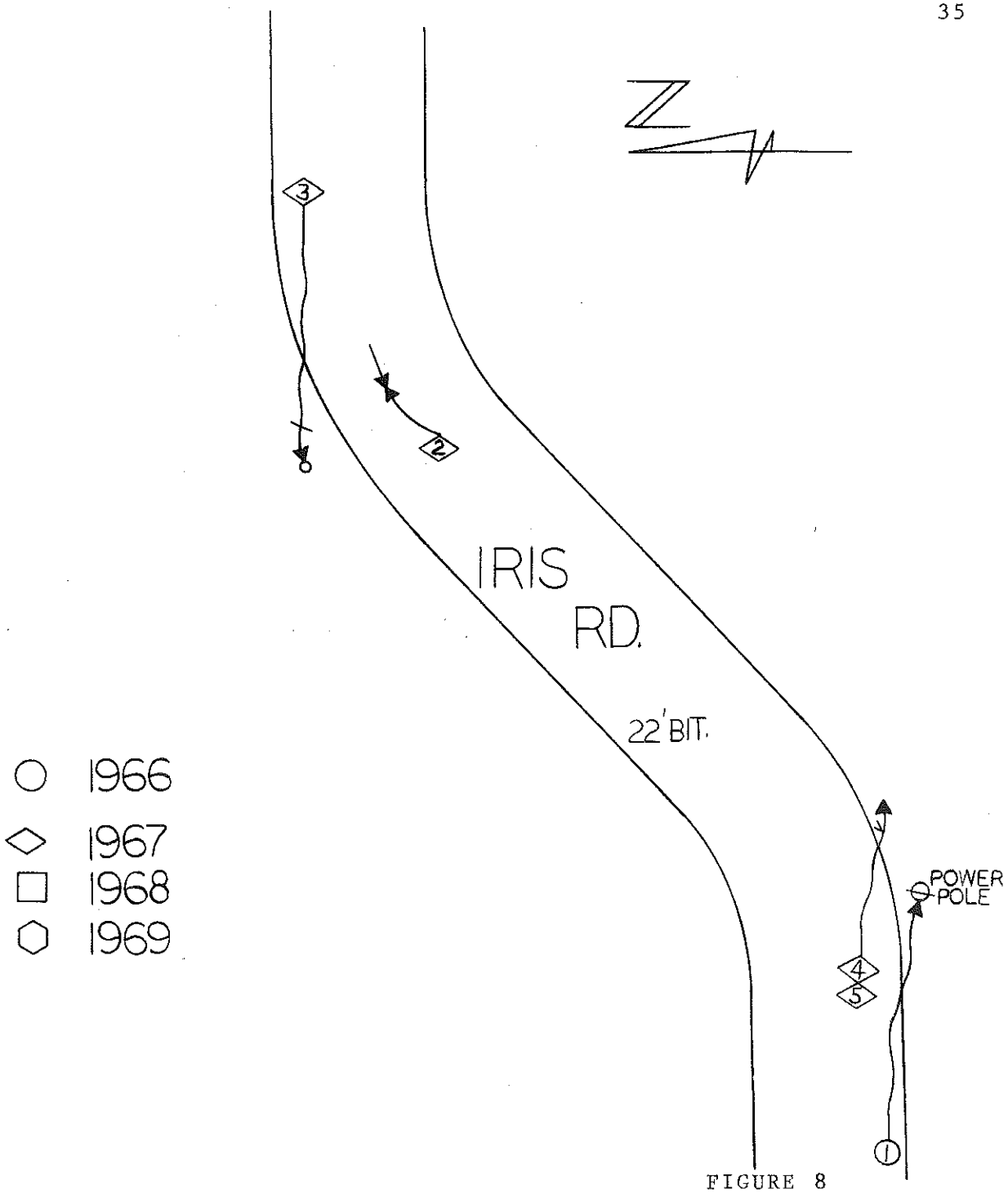


FIGURE 8

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

Stop & Go Signal — Stop Sign
Flashing Beacon — Yield Sign

Fatal — Overturned — Out of Control
Injury — Backing — Driver Intent
Skidding — Pedestrian — Deer
Jackknife — Tree — Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969

Description PERE MARQUETTE TWP. MASON CO.
IRIS RD., 0.25 MI. SOUTHWEST OF US-31

Accidents – Total 5
P.D. 4 Injury 1 (1)
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm

C.S. Miles
Drawn DJM Date 4-9-70 Rev.
Plan No. #5

EASTBOUND

IRIS ROAD

WESTBOUND

IRIS ROAD

WESTBOUND

IRIS ROAD

FIGURE 8a

6. Angling Road, (F.A.S. 139), at Jebavy Road, (F.A.S. 1526), Hamlin Township

Angling Road at Jebavy Road is a "Y" intersection. Jebavy Road and Angling Road both have 22 ft bituminous pavements with sand shoulders. Angling Road is in good condition while Jebavy Road is in fair condition.

The traffic control on Angling Road consists of a stop sign (R1-1-36, Appendix II, p. 75) at its intersection with Jebavy Road which gives northbound and southbound Jebavy Road traffic the right of way.

There were five reported accidents at this location between 1966 and 1969. There were three ran-off roadway accidents, one rear-end and one accident with a parked vehicle. The sight distance from Angling Road looking north on Jebavy Road is very poor. The driver's view is blocked by the roof line of his vehicle. However, there was only one reported accident in the four years that could be attributed to the poor sight distance.

Recommendation:

We recommend that side road symbol signs be placed before Angling Road on northbound and southbound Jebavy Road (see Part I, Section C, p. 91 of the Manual - Appendix II, p. 84). The intersection is not apparent to the driver while traveling in either direction of Jebavy Road. The "Y" inter-

section signs will give drivers advance warning of the approaching intersection.

During our discussion with Mr. Lunde, he indicated that Mason County was studying this location for the feasibility of a channelized right turn lane off Angling Road. This improvement would eliminate the sight distance problem for traffic stopped on Angling Road.

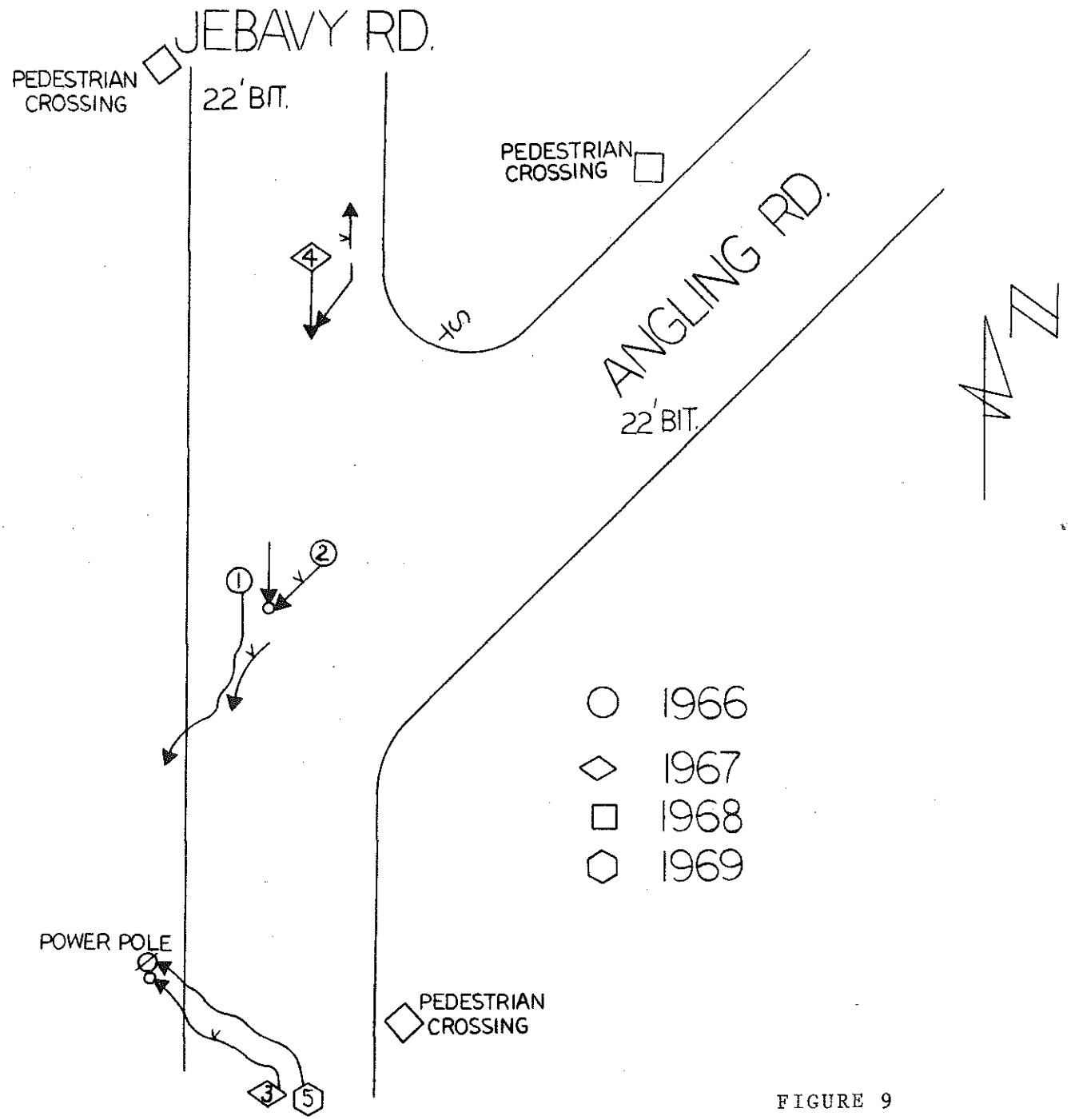


FIGURE 9

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

Stop & Go Signal — Flashing Beacon — Stop Sign — Yield Sign

Fatal — Injury — Skidding — Jackknife — Overturned — Backing — Pedestrian — Tree — Out of Control — Driver Intent — Deer — Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
HAMLIN TWP. Description MASON CO.
JEBAVY RD. at ANGLING RD.

Accidents — Total 5 (2)
P.D. 3 Injury 2
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm
C.S. Miles
Drawn DJM Date 4-13-70 Rev.
Plan No. #6

SOUTHWESTBOUND

ANGLING ROAD

SOUTHBOUND

JEBAVY ROAD

NORTHBOUND

JEBAVY ROAD

FIGURE 9a

7. Angling Road, (F.A.S. 139), at Victory Drive, Victory Township (see Appendix I, p. 66)

Total	P.D.	Inj.	Fatal
5	2	2	1

8. North Lakeshore Drive, (F.A.S. 1338), at Sugar Grove Road, (F.A.S. 1529), Hamlin Township (see Appendix I, p. 68)

Total	P.D.	Inj.	Fatal
5	3	2	0

9. Jebavy Road, (F.A.S. 139), north of Rasmussen Road (combined with Location 1, see p. 14)

10. Custer Road, (F.A.S. 452), at Conrad Road, Custer Township

Custer Road at Conrad Road is a "T" intersection. Custer Road has a two lane bituminous pavement and Conrad Road has a two lane gravel surface.

There were five accidents at this location during the four-year study period. Ran-off roadway accidents accounted for three of the five accidents. There was also one rear-end accident and one turning accident.

This area is under reconstruction at the present time. The roadway has been elevated and a new surface will be constructed. This project should be finished later this year.

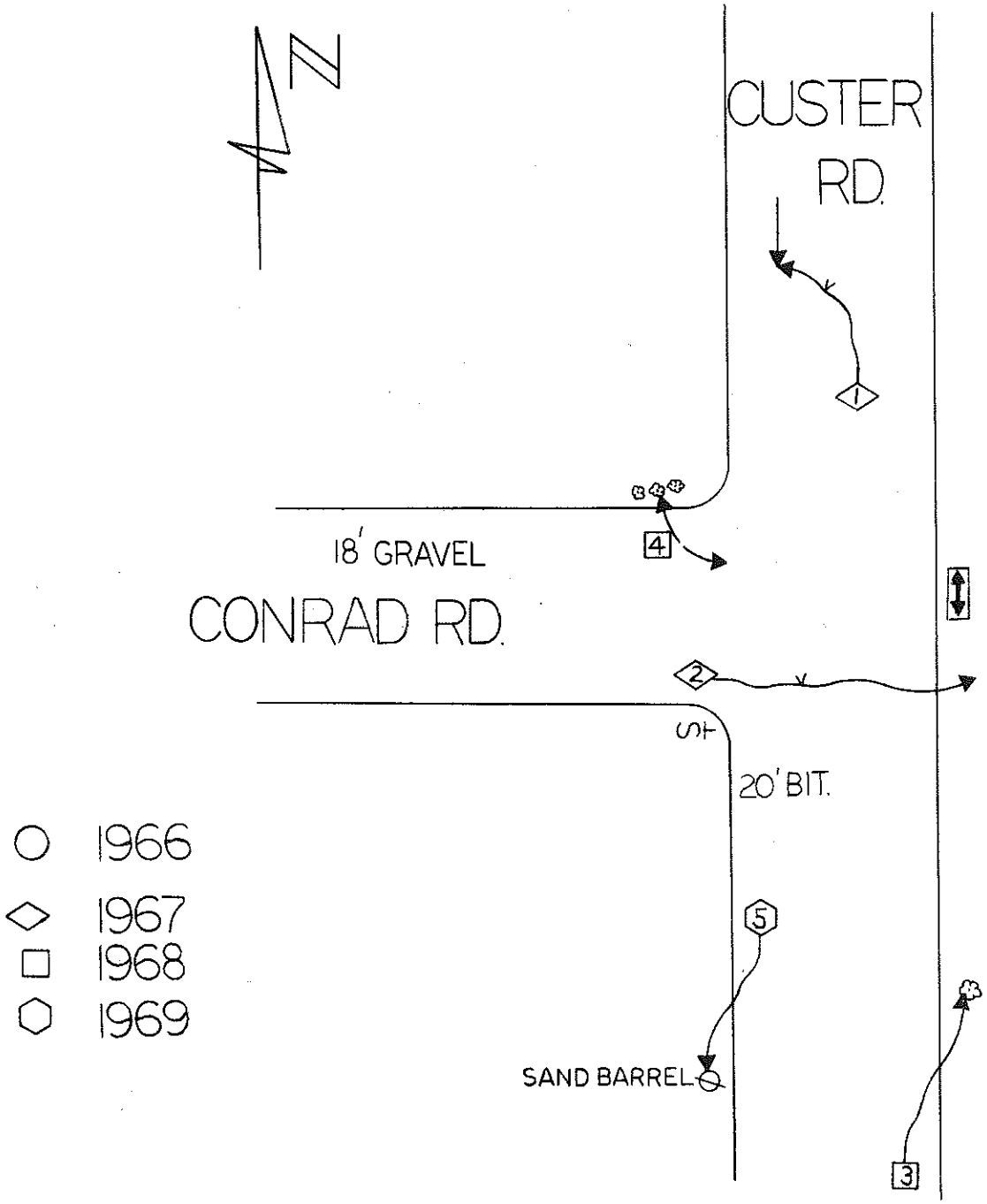


FIGURE 10

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

Stop & Go Signal — Stop Sign S
Flashing Beacon — Yield Sign Y

Fatal — Overturned — Out of Control
Injury — Backing — Driver Intent
Skidding — Pedestrian — Deer
Jackknife — Tree — Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
CUSTER TWP. Description MASON CO.
CUSTER RD. at CONRAD RD.

Accidents — Total 5 ( )
P.D. 5 Injury 0
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm
C.S. Miles
Drawn DJM Date 4-14-70 Rev.
Plan No. #10

EASTBOUND

CONRAD ROAD

SOUTHBOUND

CUSTER ROAD

NORTHBOUND

CUSTER ROAD

FIGURE 10a

11. Stiles Road, (F.A.S. 451), 0.225 to 0.3 miles north of Hansen Road

Stiles Road has a two lane 20 ft wide bituminous pavement. The accident location is a straight stretch of roadway with a speed limit of 65 miles per hour. This location has been the scene of five accidents during the four-year study period. Four of the five accidents occurred on wet pavement and involved vehicles running off the roadway. Numerous wet pavement accidents in this area prompted Mason County into covering the slick pavement with an asphalt cap. They used a hot mix with 85-10 asphalt and sand. This new pavement should eliminate the slick pavement conditions at this location. We suggest that the 1970 accident reports be checked to determine its effectiveness.

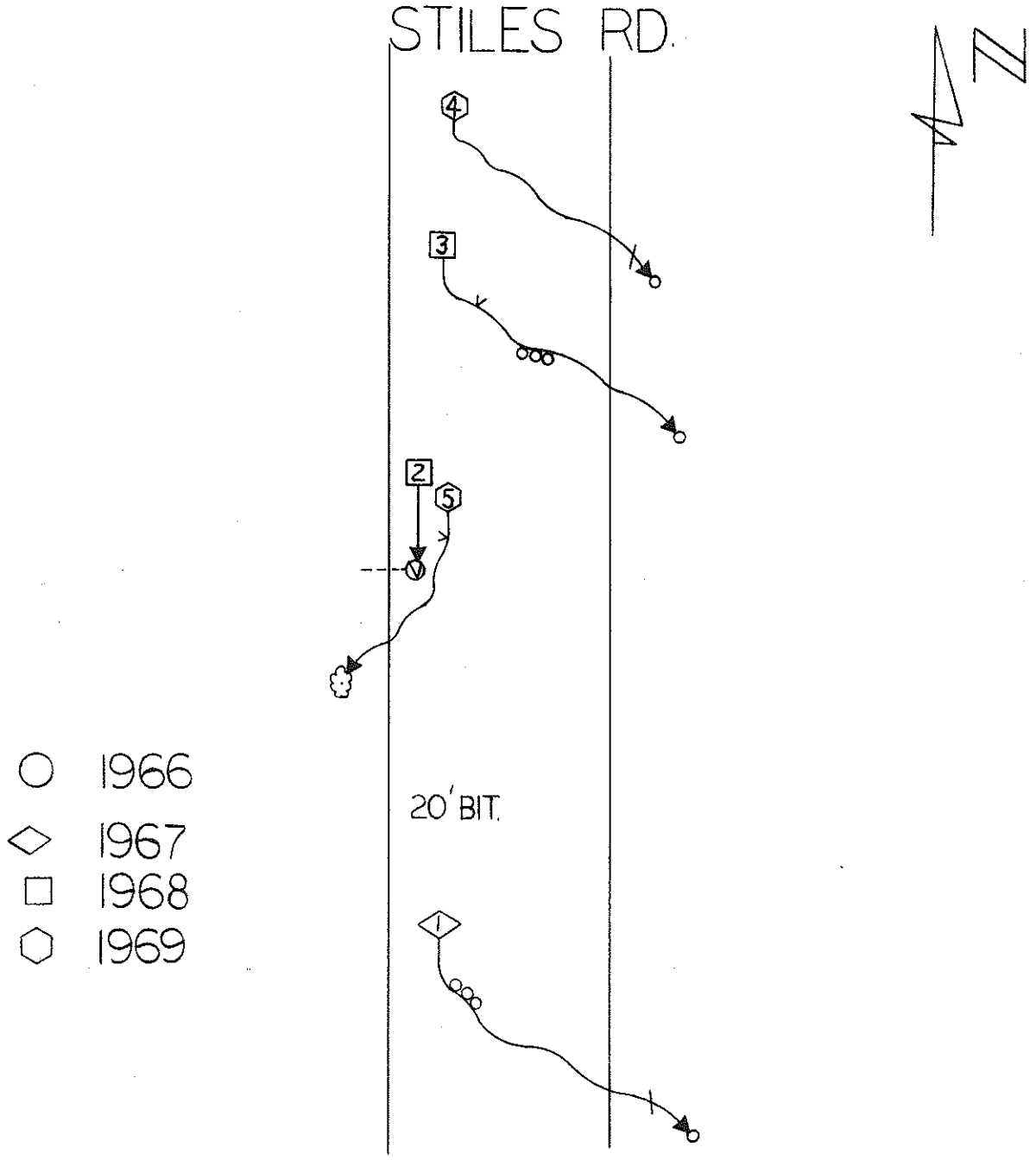


FIGURE 11

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

Stop & Go Signal — Flashing Beacon — Stop Sign — Yield Sign

Fatal — Injury — Skidding — Jackknife — Overturned — Backing — Pedestrian — Tree — Out of Control — Driver Intent — Deer — Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969

AMBER TWP. Description MASON CO.

STILES RD., 0.225 TO 0.3 MI. NORTH OF HANSEN RD.

Accidents – Total 5

P.D. 2 Injury 3 (4)

Fatal 0 ( )

Acc. Rate/mv

Acc. Rate/mvm

C.S. Miles

Drawn DJM Date 4-14-70 Rev.

Plan No. # 11

SOUTHBOUND

STILES ROAD

NORTHBOUND

STILES ROAD

FIGURE 11a

12. Lakeshore Drive, (F.A.S. 1528), 0.25 miles north of Chauvez, Pere Marquette Township

Lakeshore Drive is a two lane 20 ft wide bituminous roadway. The roadway is in good condition except for the road edges which are cracked and patched in some spots and the shoulders which are narrow and uneven.

The horizontal alignment at this location consists of three consecutive curves. The area is centerline marked and also includes yellow no passing lines. Only the first curve in the northerly direction has a curve warning sign (W1-2-24, Appendix II, p. 79). The posted speed limit for Lakeshore Drive is 25 miles per hour.

There were four reported accidents during the four-year study period. All of these accidents were of the ran-off roadway type. Two accidents involved excessive speed for the curves while the other two accidents involved vehicles forced off the roadway by other vehicles traveling to the left of the centerline (probably because of excessive speed).

Recommendations:

We recommend that a winding road sign be placed at the beginning of the series of curves for both northbound and southbound traffic (see Part I, Section C, p. 87 of the Manual - Appendix II, p. 81). Also, we recommend

that target arrows (see Part I, Section C, p. 88 of the Manual - Appendix II, p. 82) be used in conjunction with the winding road signs in target position at each curve. Furthermore, we feel that the speed limit for Lakeshore Drive could be increased. Thus, we suggest that an investigation be conducted into the feasibility of increasing the speed limit along Lakeshore Drive. Our reasoning behind making such a suggestion lies in the desirability of maintaining driver confidence in posted speed limits. If a change in the posted speed limit is deemed necessary, then we would recommend that 25 mile per hour advisory speed panels (see Part I, Section C, pps. 132-133 of the Manual - Appendix II, p. 87) accompany the winding road signs.

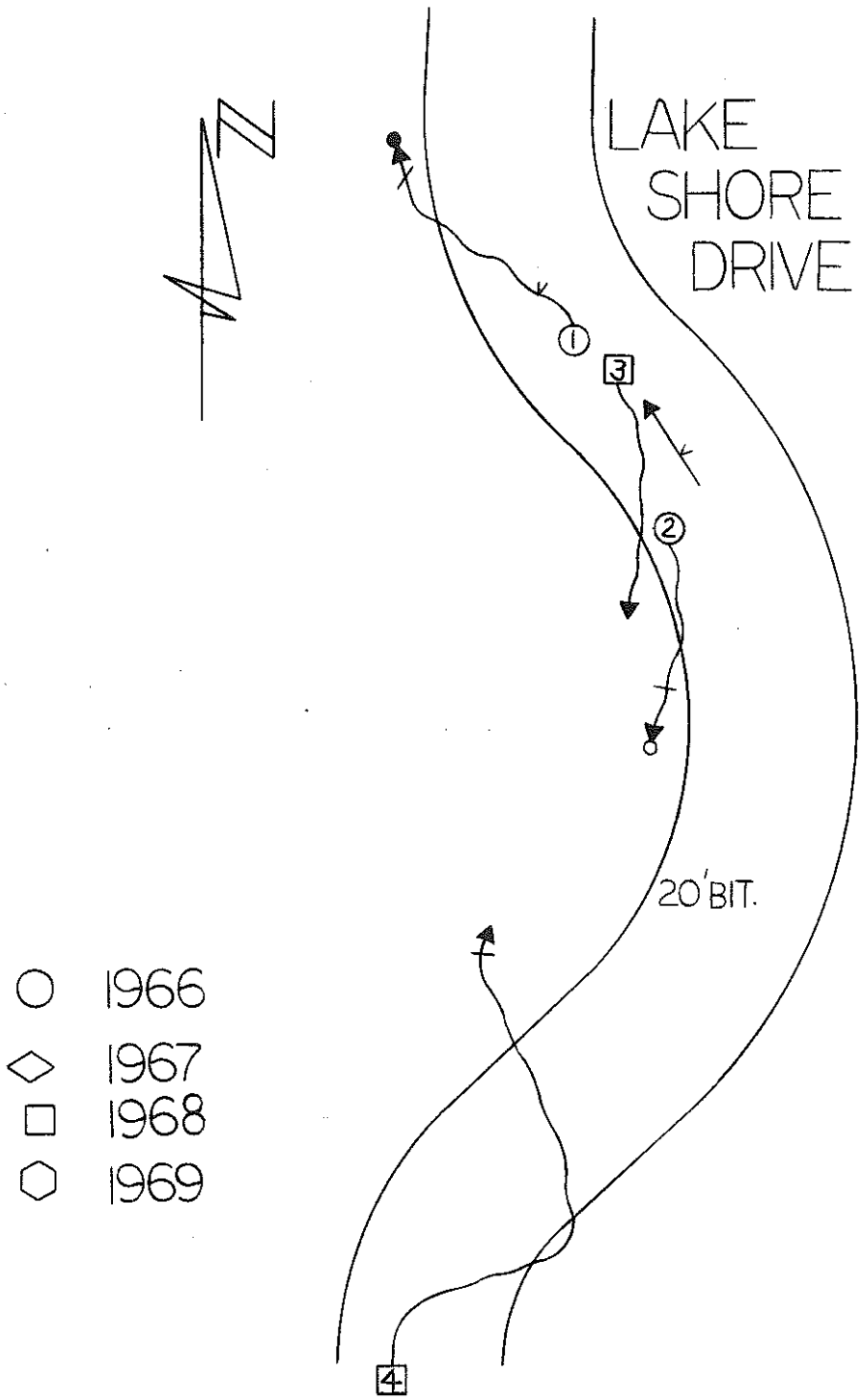


FIGURE 12

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

Stop & Go Signal — S — R — Y — F — Y
Flashing Beacon
Stop Sign S
Yield Sign Y

Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
Description PERE MARQUETTE TWP. MASON CO.
LAKE SHORE DRIVE, 0.25 MI. NORTH OF CHAUVEZ RD.
Accidents – Total 4
P.D. 2 Injury 1 (3)
Fatal 1 (1)
Acc. Rate/mv
Acc. Rate/mvm
C.S. Miles
Drawn DJM Date 4-10-70 Rev.
Plan No. #12

NORTHBOUND

LAKESHORE DRIVE

NORTHBOUND

LAKESHORE DRIVE

NORTHBOUND

LAKESHORE DRIVE

FIGURE 12a

SOUTHBOUND

LAKESHORE DRIVE

SOUTHBOUND

LAKESHORE DRIVE

SOUTHBOUND

LAKESHORE DRIVE

FIGURE 12b

13. Sugar Grove Road, (F.A.S. 1529), at North Stiles Road, (F.A.S. 451), Victory Township

Sugar Grove Road at North Stiles Road is a "T" intersection. Sugar Grove Road has a 22 ft bituminous surface that has centerline markings and narrow grass shoulders. Stiles Road has a 20 ft bituminous pavement south of Sugar Grove and a 22 ft bituminous pavement north of Sugar Grove Road. The 20 ft pavement which is in good condition has narrow sand shoulders. The 22 ft pavement has been recently paved and consequently is in excellent condition. This new construction project was initiated because of the erection of Westshore Community College located in the southeast quadrant.

The existing traffic control on Sugar Grove Road, as you approach North Stiles Road, consists of a stop ahead warning sign (W3-1-30, Appendix II, p. 86), followed by a "T" intersection sign (W2-4-30, Appendix II, p. 85) and then a stop sign (R1-1-24, Appendix II, p. 75) at the intersection. Also, there is a bi-directional target arrow (W1-7-48, Appendix II, p. 83) located at the end of Sugar Grove Road.

There were four accidents during the four-year study period. There was one right angle, one fixed object and two ran-off roadway accidents. The two ran-off roadway accidents occurred at the end of Sugar Grove Road. Both vehicles went through the stop sign on Sugar Grove Road,

across Stiles Road and into the trees located a few feet west of the shoulder area. Each accident involved serious injury to the occupants.

Recommendation:

We recommend that the two trees located at the end of Sugar Grove Road be removed. Increased traffic due to the opening of Westshore Community College will increase the probability of a vehicle running off the end of Sugar Grove Road and into the trees. Removal of the trees would be an important step in preventing serious injury to the occupants of vehicles leaving the roadway in this area.

Mr. Robert Lunde, Mason County Engineer, informed us that street lighting will be installed at this location and that the feasibility of a flashing signal for this intersection is being studied.

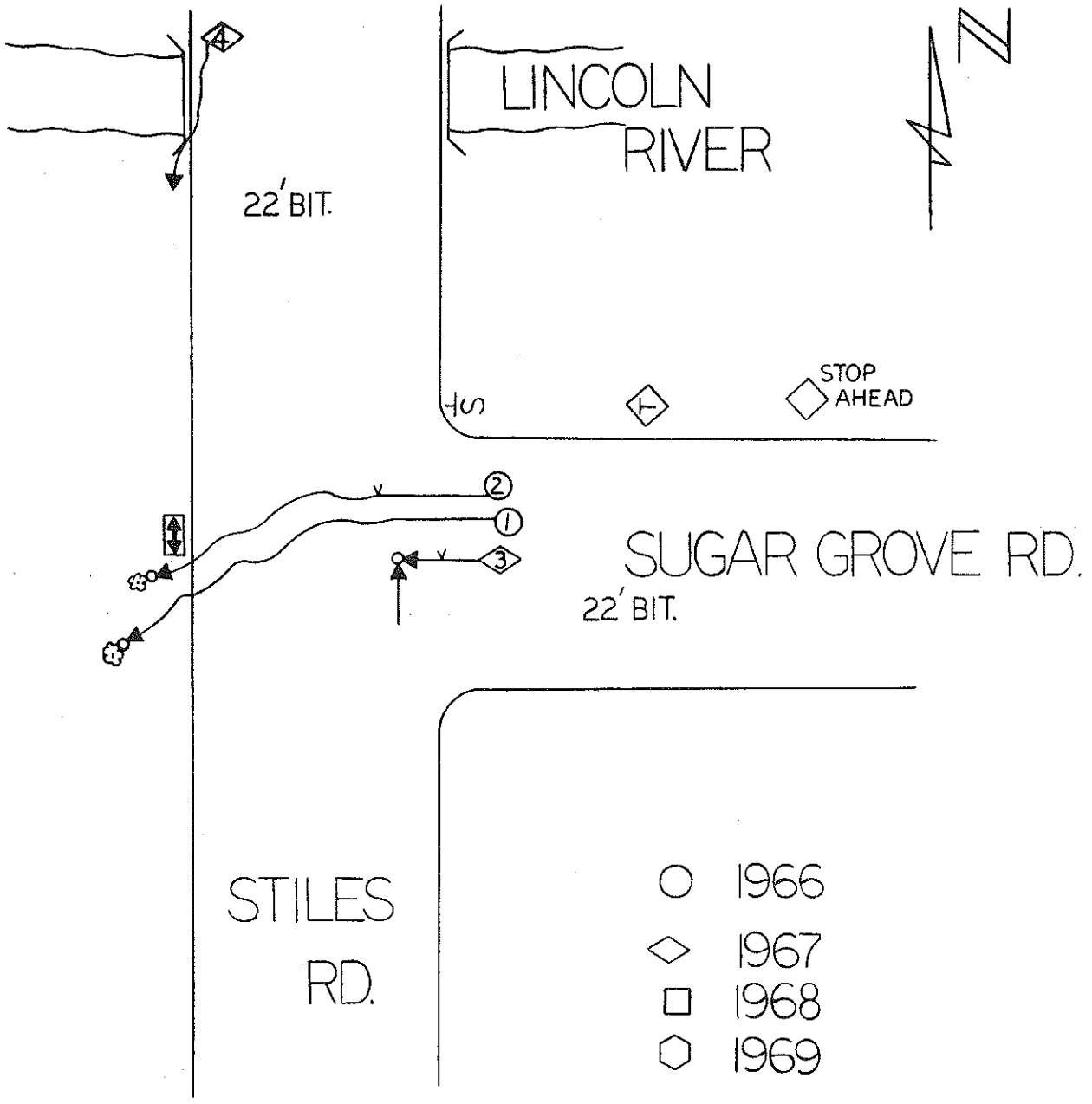


FIGURE 13

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

Stop & Go Signal — Flashing Beacon — Stop Sign — Yield Sign

Fatal — Injury — Skidding — Jackknife — Overturned — Backing — Pedestrian — Tree — Out of Control — Driver Intent — Deer — Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
VICTORY TWP. Description MASON CO.
STILES RD. at SUGAR GROVE RD.

Accidents – Total 4 (7)
P.D. 1 Injury 3
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm
C.S. Miles
Drawn DJM Date 4-10-70 Rev.
Plan No. # 13

WESTBOUND

SUGAR GROVE ROAD

SOUTHBOUND

STILES ROAD

NORTHBOUND

STILES ROAD

FIGURE 13a

14. Jebavy Road, (F.A.S. 139), at the Lincoln River Bridge (combined with Location 1, see p. 14)

15. Sugar Grove Road, (F.A.S. 1529), at Custer Road, (F.A.S. 452, Sherman Township (see Appendix I, p. 70)

Total	P.D.	Inj.	Fatal
3	1	2	0

SUMMARY

There was a total of 695 reported accidents on Mason County roads during the study period 1966 through 1969 for an average of 174 accidents per year. The 15 high accident locations accounted for 79 of the total reported accidents in the county during the four-year study period. This figure is 11.4% of the reported accidents. Table 1, found on the following page, contains some interesting data on the reported traffic accidents in Mason County and on the vehicle registrations. Reported traffic accidents in Mason County increased each year until 1969 when the number of reported accidents remained, for all practical purposes, the same as 1968. This same trend is reflected in the 15 high accident locations as there were only 12 reported accidents in 1969 compared to 67 reported accidents the three previous years.

To further document the various facts present at the fifteen high accident locations, the following tables were prepared to tabulate and chart specific data.

2. Monthly and Daily Accident Occurrence
3. Annual Accident Summary
4. Daily and Hourly Accident Occurrence
5. Age of Drivers Involved in Accidents
6. Residence of Drivers Involved in Accidents

TABLE 1

REPORTED TRAFFIC ACCIDENTS IN MASON COUNTY

Year	Property Damage	Injury	Fatal	Total	County Road	State Route	Inter-State	Persons Injured	Persons Killed
1966	560	257	10	827	132	414	0	436	10
1967	582	236	4	822	167	365	0	384	6
1968	602	242	6	850	199	399	0	397	7
1969	590	175	7	772	197	379	0	276	11

COMPARISON OF ACCIDENT FREQUENCY

	Mason County Roads	Total Accidents State of Mich.
1966	132	302,880
1967	167	299,004
1968	199	305,495
1969	197	331,223

PERCENTAGE OF CHANGE FOR THE ABOVE TOTALS

1966-67	26.5	-1.3
1967-68	19.2	2.2
1968-69	-1.0	8.4

VEHICLE REGISTRATIONS IN MASON COUNTY

Year	Pass.	Comm.	Farm Vehicle	Trailer	Trailer Coach	Motor Cycles	Muni-cipal	Total Plates
1966	-	-	-	-	-	-	-	13,465
1967	9,243	1,708	188	1,580	167	204	12	13,102
1968	9,276	1,905	198	1,732	199	248	22	13,580
1969	9,428	2,163	-	2,148	-	296	12	14,047

7. Weather Conditions at Scene of Accidents

8. Pavement Conditions at Scene of Accidents

Table 2 shows that the peak accident months were June and November and the peak accident day was Sunday. June, October and November together comprise 40% of the total accidents while almost 40% of the accidents occurred on Saturday or Sunday.

The information summarized in Table 3 shows that of the 79 accidents at the 15 high accident locations during the study period, 29 resulted in personal injury while 48 resulted in property damage. There were also two fatal accidents during the four-year study period.

Table 4 shows the peak accident hour as 2:00 p.m. to 3:00 p.m. Tables 5 and 6 contain the age and residence of the drivers involved in the accidents while Tables 7 and 8 show the weather conditions and pavement conditions at the scene of the accidents. These tables could be used by agencies interested in highway safety from the standpoint of driver education and law enforcement.

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ACCIDENT ANALYSIS

Table 2

MONTHLY AND DAILY ACCIDENT OCCURRENCE

FIFTEEN HIGH ACCIDENT LOCATIONS IN MASON COUNTY

Period Studied: 1966 through 1969

* * * * * * * * *

Month	Day of the Week							Monthly Total	% Of Total
	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.		
January		2						2	2.5
February			1			2	3	6	7.6
March		2						2	2.5
April	1	1						2	2.5
May	1	3		1			1	6	7.6
June	2	1		1	3	3	1	11	13.9
July	1			2	1	1	2	7	8.9
August		1	1		2	1	4	9	11.4
September		1	1	1	2	1		6	7.6
October			1	1	2	3	3	10	12.7
November	3		1	4		2	1	11	13.9
December		1	3		1	1	1	7	8.9
Day Total	8	12	8	10	11	14	16	79	
% of Total	10.1	15.2	10.1	12.7	13.9	17.7	20.3		100.0

Peak Accident Day: Sunday

Peak Accident Month: June & November

ACCIDENT ANALYSIS

Table 3

ANNUAL ACCIDENT SUMMARY

FIFTEEN HIGH ACCIDENT LOCATIONS IN MASON COUNTY

Period Studied: 1966 through 1969

* * * * * * * *

Accident Type	Day	Night	Total
Fatal Accident	1	1	2
Personal Injury Acc.	18	11	29
Property Damage Acc.	24	24	48
Total	43	36	79

* * * * * * * *

Month	Fatal		Injury		Prop. Damage		Sub. Total		Total
	Day	Night	Day	Night	Day	Night	Day	Night	
January					1	1	1	1	2
February			2		3	1	5	1	6
March					2		2		2
April			1	1			1	1	2
May			1	1	1	3	2	4	6
June			4		4	3	8	3	11
July		1	2		3	1	5	2	7
August			3	1	2	3	5	4	9
September	1				1	4	2	4	6
October			3	2	1	4	4	6	10
November			2	3	4	2	6	5	11
December				3	2	2	2	5	7
S. Total	1	1	18	11	24	24	43	36	
Total	2		29		48		79		79

Table 4

DAILY AND HOURLY ACCIDENT OCCURRENCE

FIFTEEN HIGH ACCIDENT LOCATIONS IN MASON COUNTY

Period Studied: 1966 through 1969

* * * * * * * * * * *

Hour	Day of the Week							Hour Total	% of Total
	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.		
12 - 1AM	1		1	1	1			4	5.1
1 - 2AM				1		2	3	6	7.6
2 - 3AM		1				1	1	3	3.8
3 - 4AM		1		1		1	1	4	5.1
4 - 5AM									
5 - 6AM	1							1	1.3
6 - 7AM									
7 - 8AM		1				1		2	2.5
8 - 9AM				1				1	1.3
9 - 10AM						1	1	2	2.5
10 - 11AM					1	1		2	2.5
11 - 12AM		1		1		1		3	3.8
12 - 1PM	2	1	1	1		1		6	7.6
1 - 2PM	1					1		2	2.5
2 - 3PM		1	1		1	2	2	7	8.9
3 - 4PM			1		2		2	5	6.1
4 - 5PM	1	1		1			3	6	7.6
5 - 6PM		1			1		1	3	3.8
6 - 7PM			1					1	1.3
7 - 8PM		1	1	2				4	5.1
8 - 9PM	1	1		1	1			4	5.1
9 - 10PM			1		1	1		3	3.8
10 - 11PM		1	1		1	1	2	6	7.6
11 - 12PM	1	1			2			4	5.1
Not Stated									
Day Total	8	12	8	10	11	14	16	79	100.0
% of Total	10.1	15.2	10.1	12.7	13.9	17.7	20.3	100.0	100.0

Peak Accident Hour: 2 - 3 P.M.

Peak Accident Day: Sunday

Table 5

AGE OF DRIVERS INVOLVED IN ACCIDENTS

FIFTEEN HIGH ACCIDENT LOCATIONS IN MASON COUNTY

Period Studied: 1966 through 1969

* * * * * * * * * * *

Age Group	Number of Drivers Involved in				Percent
	Fatal	Injury	Prop. Damage	Total	
Under 16					
16-19	1	13	20	34	34.3
20-24	1	5	13	19	19.2
25-34		8	5	13	13.1
35-44		6	7	13	13.1
45-54		3	7	10	10.1
55-64		3	3	6	6.1
65-74			2	2	2.0
75 & Over			1	1	1.0
Not Stated			1	1	1.0
Total	2	38	59	99	100.0

* * * * * * * *

Table 6

RESIDENCE OF DRIVERS INVOLVED IN ACCIDENTS

Residence	Number of Drivers Involved in				Percent
	Fatal	Injury	Prop. Damage	Total	
Local	2	25	49	76	76.8
Michigan		11	8	19	19.2
Out of State		2	1	3	3.0
Not Stated			1	1	1.0
Total	2	38	59	99	100.0

ACCIDENT ANALYSIS

Table 7

WEATHER CONDITIONS AT SCENE OF ACCIDENTS

FIFTEEN HIGH ACCIDENT LOCATIONS IN MASON COUNTY

Period Studied: 1966 through 1969

* * * * * * * * * * *

Weather	Severity of Accident				Percent
	Fatal	Injury	Prop. Damage	Total	
Clear or Cloudy	2	18	34	54	68.3
Rain		8	9	17	21.5
Fog			1	1	1.3
Snow or Sleet		3	4	7	8.9
Not Stated					
Total	2	29	48	79	100.0

* * * * * * * * *

TABLE 8

PAVEMENT CONDITIONS AT SCENE OF ACCIDENTS

Pavement	Severity of Accident				Percent
	Fatal	Injury	Prop. Damage	Total	
Dry	2	14	27	43	54.4
Wet		11	11	22	27.9
Snowy/Icy		4	10	14	17.7
Icy					
Not Stated					
Total	2	29	48	79	100.0

APPENDIX I

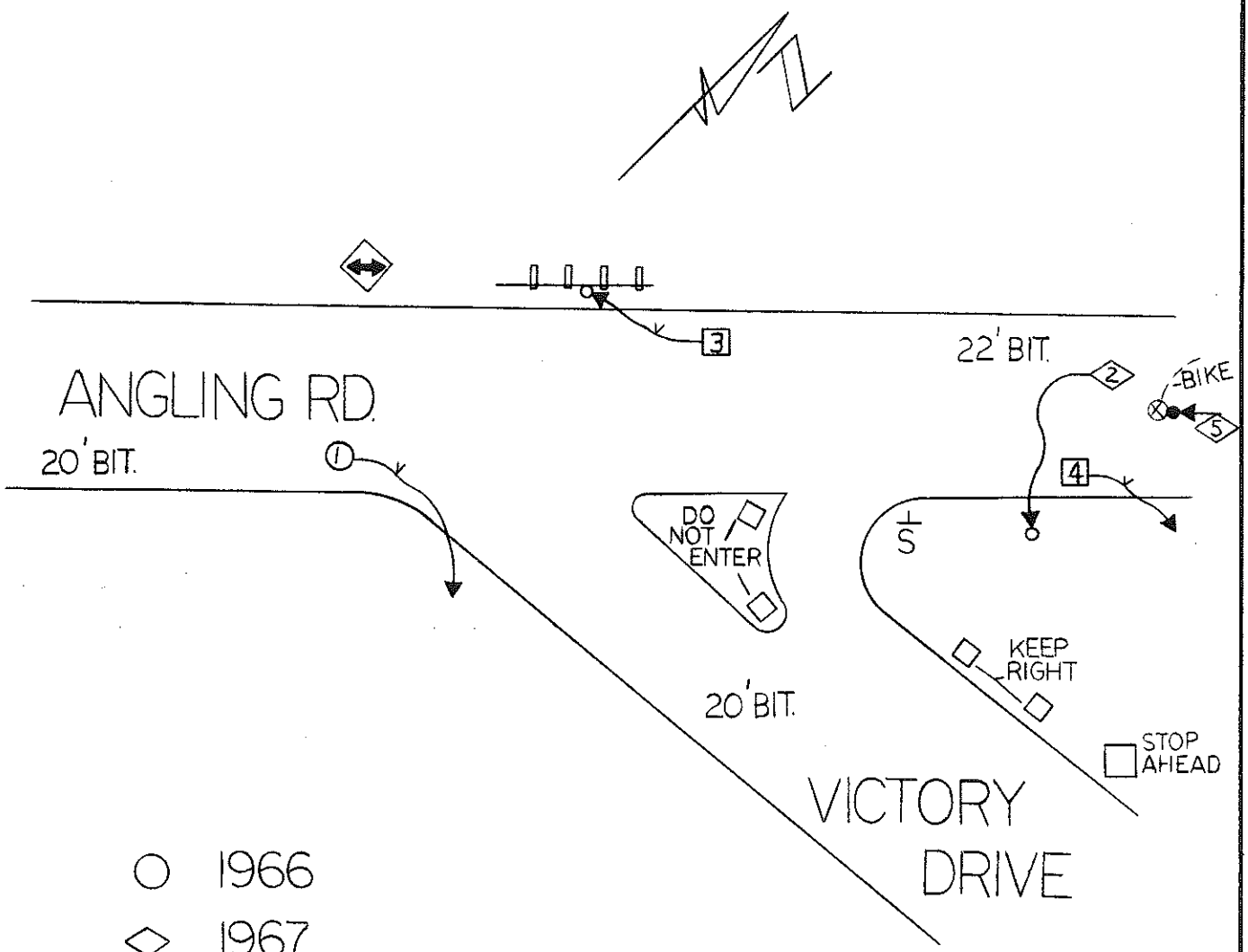


FIGURE 14

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

Stop & Go Signal — Stop Sign
Flashing Beacon — Yield Sign

Fatal — Overturned — Out of Control
Injury — Backing — Driver Intent
Skidding — Pedestrian — Deer
Jackknife — Tree — Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
Description HAMLIN, VICTORY TWP. MASON CO.
ANGLING RD. at VICTORY DRIVE

Accidents – Total 5 (3)
P.D. 2 Injury 2
Fatal 1 (1)
Acc. Rate/mv
Acc. Rate/mvm
C.S. Miles
Drawn DJM Date 4-13-70 Rev.
Plan No. #7

WESTBOUND

VICTORY DRIVE

SOUTHWESTBOUND

ANGLING ROAD

NORTHEASTBOUND

ANGLING ROAD

FIGURE 14a

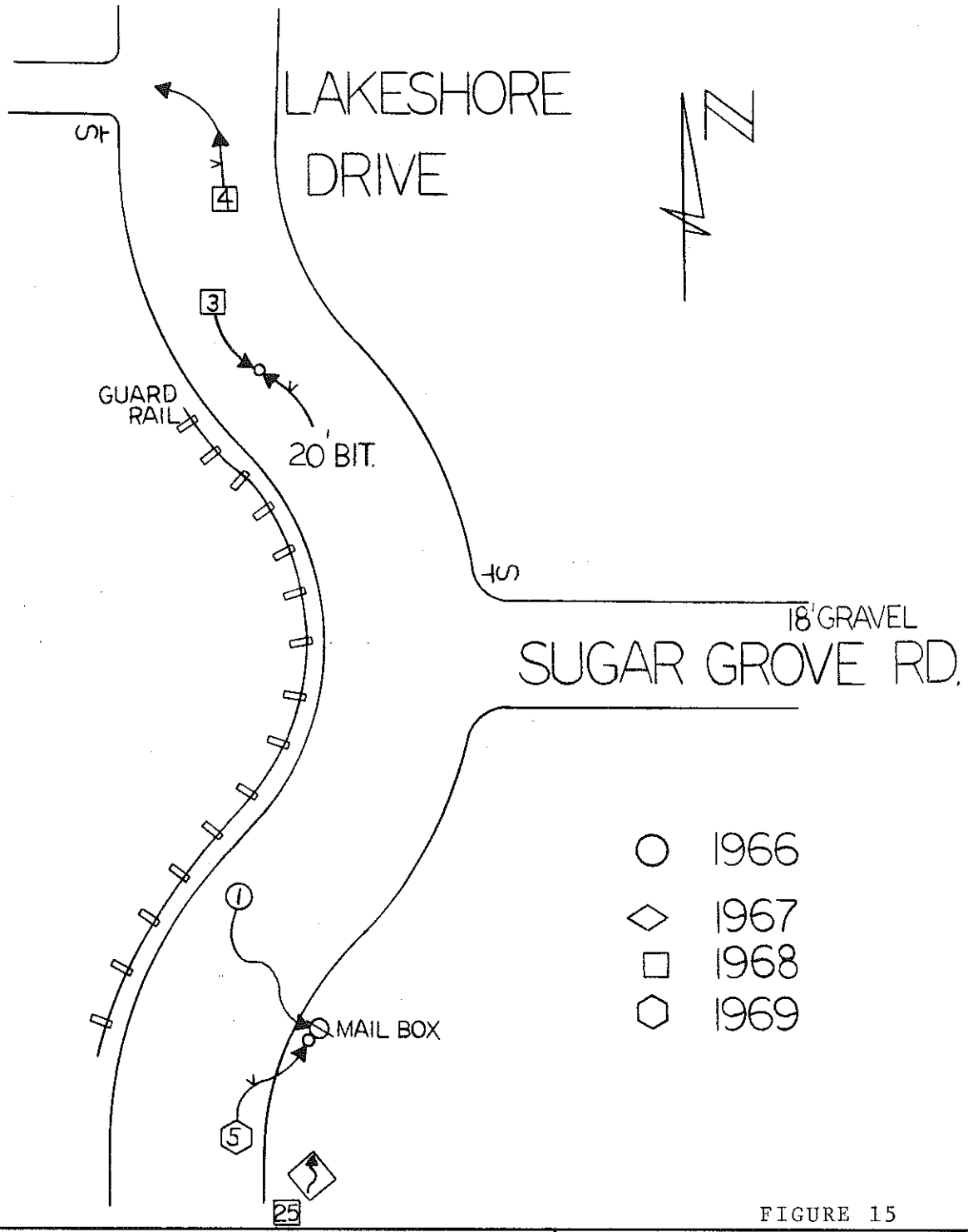


FIGURE 15

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

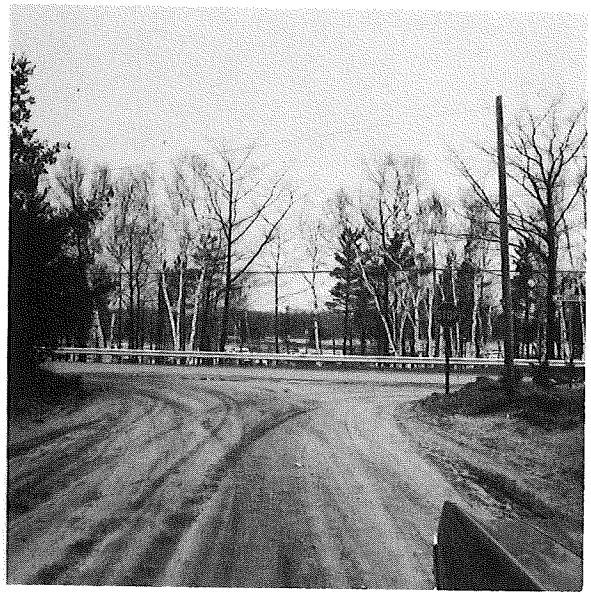
Stop & Go Signal — S R Y F Y
Flashing Beacon
Stop Sign — S
Yield Sign — Y

Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator — V

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
HAMLIN TWP. Description MASON CO.
LAKESHORE DRIVE at SUGAR GROVE RD.

Accidents — Total 5
P.D. 2 Injury 2 (2)
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm
C.S. Miles
Drawn DJM Date 1-9-70 Rev.
Plan No. #8

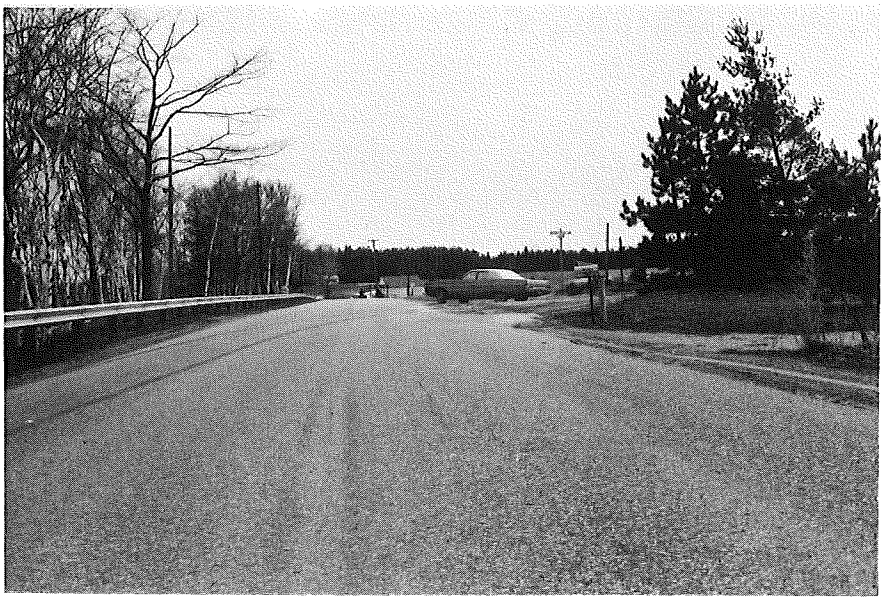


WESTBOUND

SUGAR GROVE ROAD

SOUTHBOUND

N. LAKESHORE DRIVE



NORTHBOUND

N. LAKESHORE DRIVE

FIGURE 15a

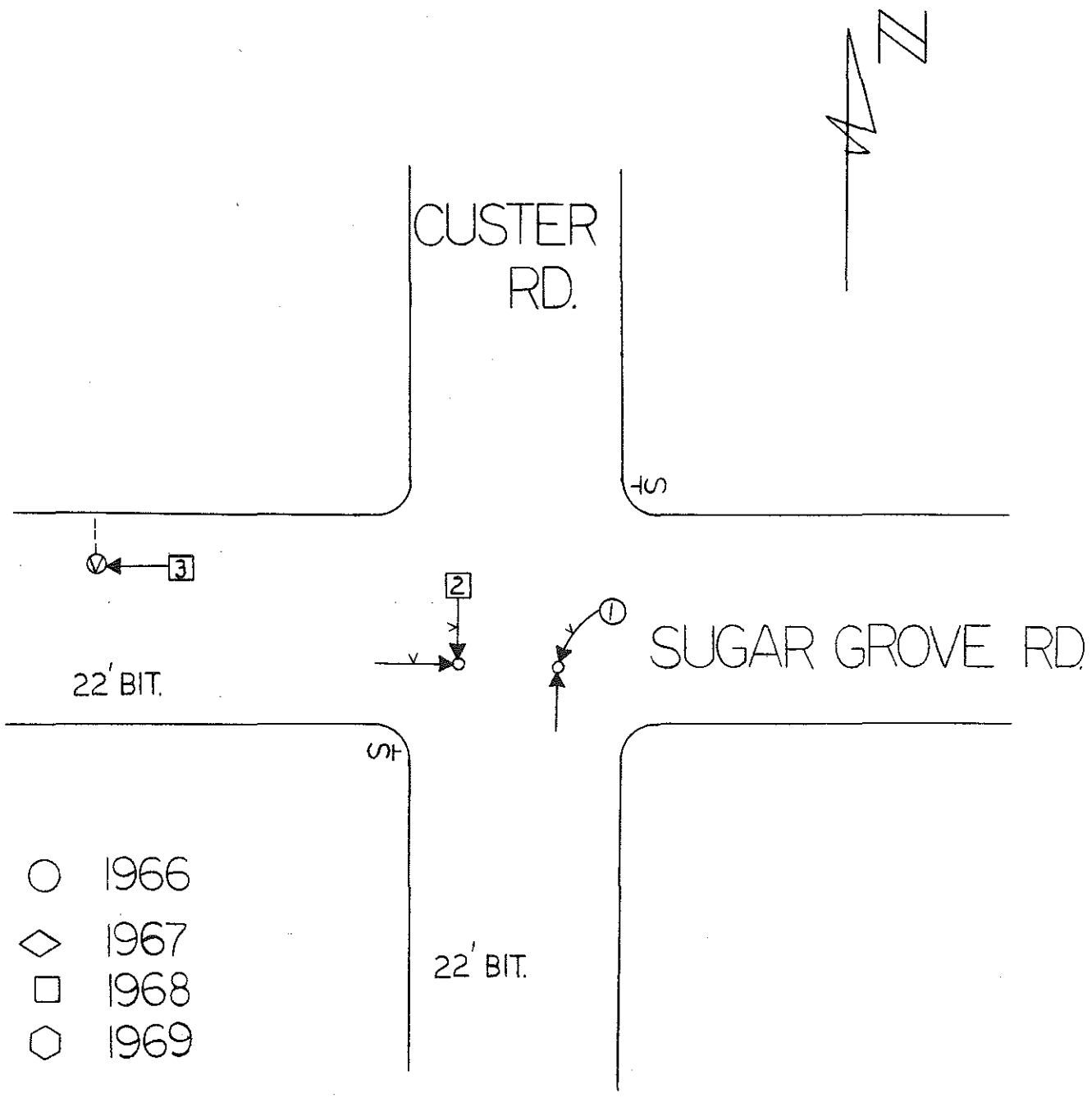


FIGURE 16

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

Stop & Go Signal — Flashing Beacon — Stop Sign — Yield Sign

Fatal — Injury — Skidding — Jackknife — Overturned — Backing — Pedestrian — Tree — Out of Control — Driver Intent — Deer — Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969

SHERMAN TWP. Description MASON CO.

CUSTER RD. at SUGAR GROVE RD.

Accidents – Total 3 (4)
P.D. 1 Injury 2
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm

C.S. Miles
Drawn DJM Date 4-14-70 Rev.
Plan No. #15

NORTHBOUND

CUSTER ROAD

SOUTHBOUND

CUSTER ROAD

FIGURE 16a

WESTBOUND

SUGAR GROVE ROAD

EASTBOUND

SUGAR GROVE ROAD

FIGURE 16b

APPENDIX II

Section B. Regulatory Signs

Regulatory Signs shall be used to inform highway users of traffic laws or regulations that apply at given places or on given highways. They are essential to indicate the applicability of legal requirements that would not otherwise be apparent. Great care must be exercised to see that they are erected wherever needed to fulfill this purpose, but unnecessary mandates should be avoided.

Included among regulatory signs are some, like those marking the end of a restricted zone, that are related to operational controls though not in themselves imposing any obligations or prohibitions.

Regulatory signs shall be erected at those locations where the regulations apply and shall be mounted so as to be easily visible and legible to the motorist whose actions they are to govern. Signs that have been erected but are no longer applicable shall be removed. Regulatory signs cannot be expected to command respect and obedience unless the regulations thereon set forth are adequately enforced.

Regulatory signs are classified in the following groups:

(1)	Right-of-Way a. "STOP" Sign b. "YIELD" Sign	(R1 Series)
(2)	Speed	(R2 Series)
(3)	Movement a. Turning b. Alignment c. One Way d. Exclusion	(R3 Series)
(4)	Parking	(R4 Series)
(5)	Pedestrian	(R5 Series)
(6)	Miscellaneous	(R6 Series)

With few exceptions, hereinafter detailed in the specifications for individual signs, regulatory signs are rectangular in shape with the larger dimension vertical and have black legends on white backgrounds. The principal exceptions referred to are the "STOP" sign, the Yield sign, the One Way arrow, and the Parking signs.

STOP SIGN

Reflectorized

R1-1-24	24″ x 24″	(8″ letters)
R1-1-30	30″ x 30″	(12″ letters)
R1-1-36	36″ x 36″	(12″ letters)

All "STOP" signs shall be reflectorized or internally illuminated so that the shape, color, and legend will be comparable to that in day time conditions and will not produce detrimental glare to traffic.

The "STOP" sign may be supplemented by two alternating red flashing beacons in the face or by one red flashing beacon directly above the sign. Such beacon(s) shall be operated continuously.

Place at the point where it is desired to have traffic stop, or as near thereto as possible at the following locations:

1. On streets or highways intersecting a through street or highway.
2. Railroad crossing where a stop is required by order of the appropriate public authority.
3. Opposite all Stop lines applied on the pavement, except at intersections controlled by a traffic control signal.
4. At intersections where a flashing red beacon exists.

There shall be no "STOP" signs on approaches to an intersection where such approaches are controlled by a traffic control signal.

An overhead internally illuminated "STOP" sign may be used in lieu of roadside "STOP" signs.

Secondary messages shall not be used on the face of a "STOP" sign. At a four-way stop intersection, each "STOP" sign may

Section C. Warning Signs

Introduction

Warning signs shall be used for the purpose of warning traffic of existing or potentially hazardous conditions either on or adjacent to the roadway. Warning signs require caution on the part of the motorist and may call for reduction of speed or other maneuver in the interest of his own safety and that of other motorists and pedestrians. Adequate warnings are of great assistance to the vehicle operator and are valuable in safeguarding and expediting traffic. However, the use of warning signs should be kept to a minimum. Too frequent use of them or their unnecessary use to warn of conditions which are apparent tends to bring disrespect for all signs.

The conditions warranting warning signs are classified in the following groups according to the type of conditions to which they are applied:

1.	Changes in Horizontal Alignments	(W1 Series)
2.	Intersections	(W2 Series)
3.	Advance Warning of Control Devices	(W3 Series)
4.	Converging Traffic Lanes	(W4 Series)
5.	Narrow Roadways	(W5 Series)
6.	Changes in Highway Design	(W6 Series)
7.	Grades	(W7 Series)
8.	Roadway Surface Conditions	(W8 Series)
9.	Schools and Pedestrians	(W9 Series)
10.	Railroad Crossings	(W10 Series)
11.	Entrances and Crossings	(W11 Series)
12.	Miscellaneous	(W12 Series)
13.	Construction and Maintenance	(W13 Series)*

Warning signs with certain exceptions shall be diamond-shaped (square with one diagonal vertical) and shall have a "Highway Yellow" background with black legend. These exceptions are

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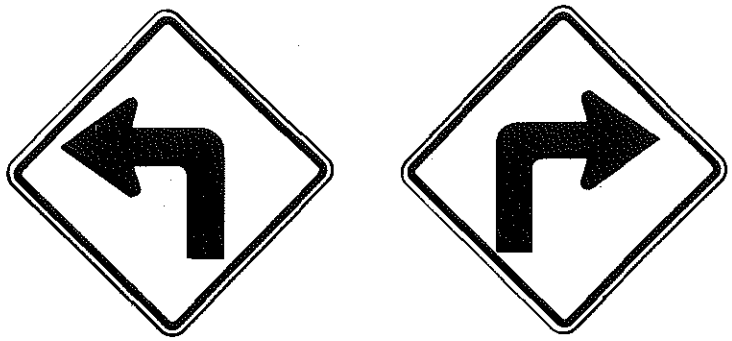
*Special warning signs for highway construction and maintenance projects are to be found in Part II of this Manual.

the Railroad Crossing signs, the Target Arrow signs, the Curve Speed panel, the Exit Speed sign, the Obstruction panel, and the Lattice Background. Other exceptions to the diamond shape are provided for in the case of temporary signs for highway construction and maintenance.

The use of warning signs should be limited to those standard signs set forth in this section. However, after the Engineer has exhausted all possibilities, it may be found that no standard sign fits the situation and warning signs, other than those specified, may be required. Such signs shall conform with the general specifications for size (30″ minimum), shape, and color of warning signs. All warning signs having significance during hours of darkness shall be reflectorized or illuminated.

TURN SIGN



Reflectorized

W1-1-30 30″ x 30″
W1-1-36 36″ x 36″
W1-1-48 48″ x 48″

The Turn sign shall be used to denote changes in the horizontal alignment of all roads (except minor roads and streets where in the judgment of the engineer the use of this sign is unnecessary) where a ball bank indicator or Devil Level registers ten degrees or more at a speed of 30 miles per hour or less. Where this sign is warranted, consideration should be given to the use of a Target Arrow (W1-6). Additional protection may be provided by use of the Curve Speed panel (W12-1).

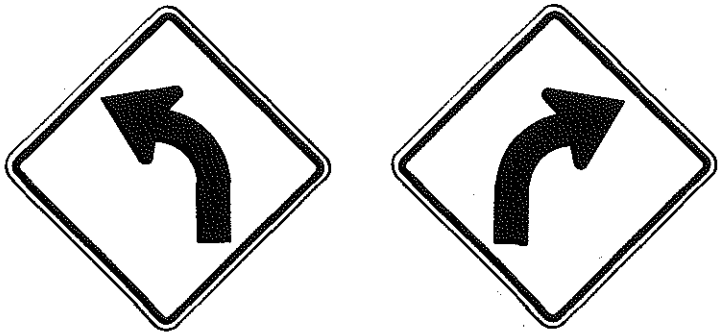
This sign shall be located in advance of the point of curvature at the approximate distance indicated below:

85th Percentile Speed			
35 & Below	36-45	46-55	56 & Over
250′	400′	550′	750′

Turns or a turn and a curve that are less than 400 feet apart shall be designated by the W1-3 sign.

For placement see figure 1-11.

CURVE SIGN



Reflectorized

W1-2-30 30″ x 30″
W1-2-36 36″ x 36″
W1-2-48 48″ x 48″

The Curve sign shall be used to denote changes in alignment where a ball bank indicator or Devil Level registers 10° or more at speeds between 30 and 60 miles per hour, and at such other locations where the change in alignment of the roadway is not apparent to the driver. Additional protection may be provided by use of the Curve Speed panel (W12-1).

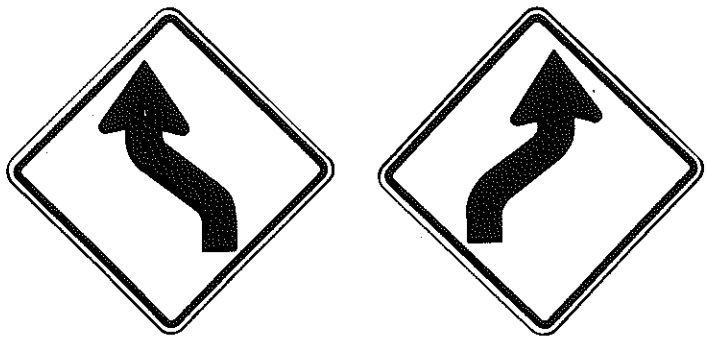
The Curve sign shall be located in advance of the point of curvature at the approximate distance indicated below:

85th Percentile Speed			
35 & Below	36-45	45-55	56 & Over
250′	400′	550′	750′

Curves that are less than 400 feet apart shall be designated by the W1-4 sign.

For placement see figures 1-11 and 1-35.

REVERSE CURVE SIGN



Reflectorized

W1-4-30 30″ x 30″
W1-4-36 36″ x 36″
W1-4-48 48″ x 48″

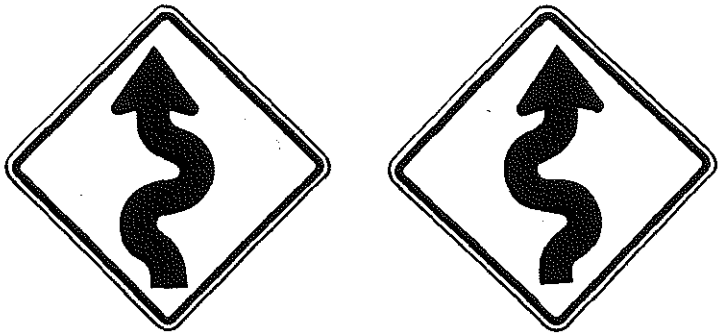
On all roads (except minor roads and streets, where in the judgment of the engineer the use of this sign is unnecessary) where two curves in opposite directions are separated by a tangent of less than 400 feet a Reverse Curve sign shall be used. Additional protection may be provided by use of the Curve Speed panel (W12-1). The speed indication displayed shall be that of the slower curve.

This sign shall be located in advance of the point of curvature of the first curve at the approximate distance indicated below:

85th Percentile Speed			
35 & Below	36-45	46-55	56 & Over
250′	400′	550′	750′

For placement see figure 1-11.

WINDING ROAD SIGN



Reflectorized

W1-5-30 30″ x 30″
W1-5-36 36″ x 36″
W1-5-48 48″ x 48″

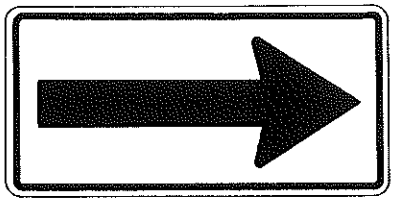
The Winding Road sign shall be used where there is a series of three or more turns or curves, separated by tangent distances of less than 400 feet. Where this sign is warranted, consideration should be given to the use of a Target Arrow (W1-6) in target position at each turn or curve. Additional protection may be provided by use of the Curve Speed panel (W12-1). The speed indication displayed shall be that of the slower turn or curve.

This sign shall be located in advance of the point of curvature of the first curve or turn at the approximate distance indicated below:

85th Percentile Speed			
35 & Below	36-45	46-55	56 & Over
250′	400′	550′	750′

For placement see figure 1-11.

TARGET ARROW SIGN



Reflectorized

W1-6-48 48″ x 24″

W1-6-96 96″ x 48″

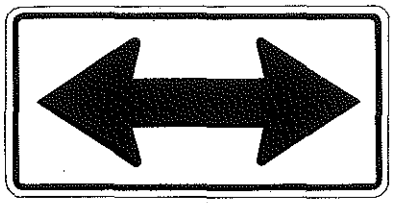
This sign may be used as a supplement to a Turn or Curve sign for potentially hazardous turns or curves. To increase its target value and to obscure misleading topography, the sign may be mounted on a Lattice Background (W12-10).

Where further emphasis of the required movement is desired, the W1-6-96 may be used in lieu of the unit consisting of the W1-6-48 and the W12-10.

This sign shall not be used to mark the ends of medians, centerpiers, etc., where there is no change in the direction of travel for all traffic. Further, it shall not be used as a route directional confirmatory marker or in any location where an intersecting street or highway of equal or nearly equal importance presents a choice of movement.

When used, the Target Arrow sign shall be erected in target position and, if possible, mounted high enough to be visible for at least 500 feet. It shall be placed at five feet minimum bottom height and two feet from the edge of the shoulder or curb face.

BI-DIRECTIONAL TARGET ARROW SIGN



Reflectorized

W1-7-48 48″ x 24″

W1-7-96 96″ x 48″

The Bi-Directional Target Arrow sign may be used at "T" or "Y" intersections to inform the driver of the abrupt changes in highway alignment.

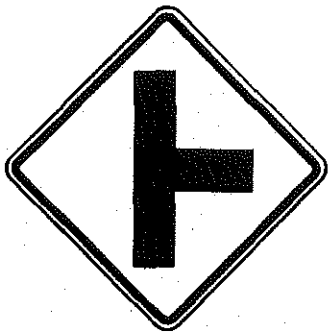
This sign shall not be used to mark the ends of medians, center-piers, etc., where there is no change in the direction of travel for all traffic. For low speed minor streets a diamond hazard marker may be used in lieu of the W 1-7.

When used, this sign shall be erected in target position and, if possible, it should be mounted high enough to be visible for at least 500 feet. It shall be placed at five feet minimum bottom height and two feet from the edge of the shoulder or curb face.

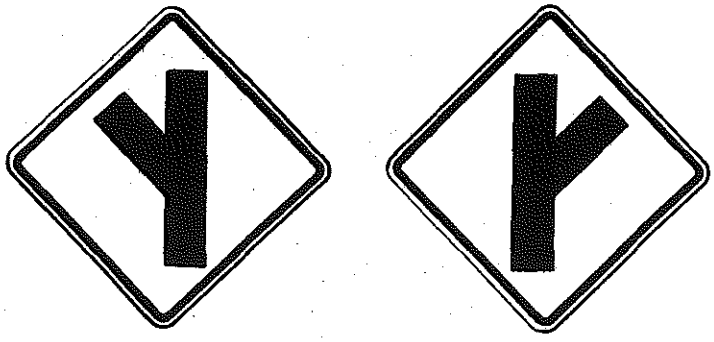
Where further emphasis of the required movements is desired, the W1-7-96 may be used in lieu of the W1-7-48.

SIDE ROAD SIGN

Reflectorized



W2-2-30 30″ x 30″
W2-2-36 36″ x 36″



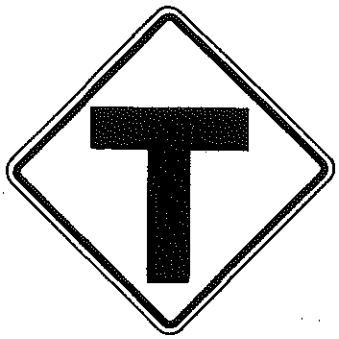
W2-3-30 30″ x 30″
W2-3-36 36″ x 36″

The Side Road sign, showing a side road symbol, either left or right, and at an angle of either 90 or 45 degrees, may be used in advance of a side road intersection following the same criteria given for the Cross Road sign (W2-1).

The relative importance of the intersecting roads may be shown by different widths of line.

For placement see figure 1-11.

"T" SYMBOL SIGN



Reflectorized

W2-4-30 30″ x 30″

W2-4-36 36″ x 36″

This sign may be used to warn traffic approaching a "T" intersection on the road that forms the stem of the "T", i.e., where traffic must make a turn either to the right or to the left. This sign should not generally be used on an approach where traffic is required to stop before entering the intersection, nor at a "T" intersection that is channelized by traffic islands, nor where junction signs or advance turn arrows are present.

The relative importance of the intersecting roads may be shown by different widths of line. It may also be desirable to place a Bi-Directional Target Arrow sign (W1-7) at the head of the "T" in target position.

Where used, the "T" symbol sign shall be located in advance of the intersection at the approximate distance indicated below:

85th Percentile Speed			
35 & Below	36-45	46-55	56 & Over
250′	400′	550′	750′

For placement see figure 1-11.

STOP AHEAD SIGN

Reflectorized

W3-1-30 30″ x 30″ (6″ letters)
W3-1-36 36″ x 36″ (8″ letters)

The "STOP AHEAD" sign shall be erected in advance of an intersection where traffic is required to stop and the "STOP" sign is not visible to motorists for a sufficient distance or where emphasis is needed because of poor observance of the stop. The "STOP AHEAD" sign may also be used in advance of a red flashing beacon.

Where required, the W3-1-30 shall be used in advance of a 24-inch "STOP" sign and the W3-1-36 in advance of a 30 or 36-inch "STOP" sign.

Except where used on State trunkline highways at junctions with other State trunkline highways, it shall be located in advance of the required stop at the approximate distance indicated below:

85th Percentile Speed			
35 & Below	36-45	46-55	56 & Over
250′	400′	550′	750′

For location on State trunkline highways see figures 1-17 and 1-26.

For placement see figure 1-11.

CURVE SPEED PANEL

Reflectorized

W12-1-21 21″ x 21″ (10″ and 3″ letters)
W12-1-24 24″ x 24″ (12″ and 3″ letters)

The Curve Speed panel may be used as a supplement to the W1-1 through W1-5 signs only and shall display a speed legend in increments of five miles per hour. Since this legend is advisory, no Traffic Control Order is required. The W12-1-21 shall only be used with the appropriate 30 or 36 inch W1 sign and the W12-1-24 with the appropriate 48 inch W1 sign.

To determine the accurate negotiable speed on a turn or curve by the use of a ball bank indicator or Devil Level, several runs should be made in the same direction to obtain the most accurate reading possible. Readings obtained from several trial runs in the same direction shall determine the curve speed for that respective direction. Since the comfortable turn or curve speed on a specific turn or curve may vary, depending on direction of travel, the same procedure shall be used to obtain the curve speed for the opposite direction.

The following table indicates the speed to be used on the Curve Speed panel.

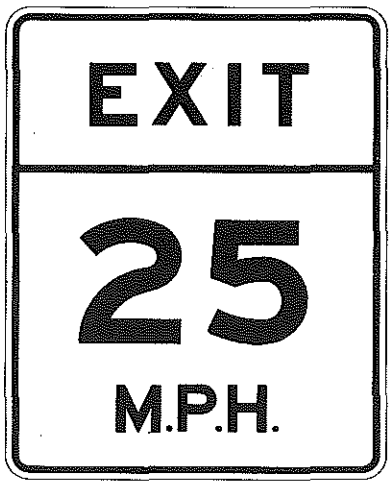
Indicator Reading	Speedometer Reading	Appropriate Panel Legend
10°	60, 59, or 58	60
10°	57, 56, 55, 54, or 53	55
10°	52, 51, 50, 49, or 48	50
10°	47, 46, 45, 44, or 43	45
10°	42, 41, 40, 39, or 38	40
10°	37, 36, 35, 34, or 33	35
12°	32, 31, 30, 29, or 28	30
12°	27, 26, 25, 24, or 23	25

Indicator Reading	Speedometer Reading	Appropriate Panel Legend
14°	22, 21, 20, 19, or 18	20
14°	17, 16, 15, 14, or 13	15
14°	12, 11, or 10	10

The speed legend displayed may equal but never exceed that of the posted speed limit in a Speed Control Zone.

For placement see figure 1-11.

EXIT (RAMP) ____ MILES PER HOUR SIGN



Reflectorized

W12-2-48 48″ x 60″ (8″, 16″, and 6″ letters)

This advisory sign shall be used only at ramps or exists at interchanges where it is necessary to indicate a lower speed. Where deemed appropriate, the word "RAMP" may be used in lieu of "EXIT".

If a safe speed indication is required for a second curve on an off-ramp well beyond the gore, a curve sign with a curve speed panel should be used.

For placement see figure 1-35.

DEER AREA SIGN

Reflectorized

W12-8-36 36″ x 36″ (8″ letters)

This sign may be used in advance of, and at intervals throughout, sections of highway where deer cross in somewhat well defined patterns and evidence exists that such crossings constitute a hazard.

A joint investigation must be made by representatives of the Michigan Department of Conservation and the agency having jurisdiction over the highway before this sign may be installed.

For placement see figure 1-11.

Reflectorization

All pavement markings having application at night shall be reflectorized.

Maintenance

All markings shall be maintained in effective condition at all times. The frequency of repainting depends on the type of surface, composition, and rate of application of paint, climate, and volume of traffic. Particular care should be taken, especially in the case of broken lines, to paint over the old markings as exactly as possible. Otherwise, they will appear increasingly ragged after successive repaintings.

Center Lines

A center line is used to designate the center of the traveled part of a roadway carrying traffic in both directions. Under some circumstances, as at a pavement-width transition, where parking is allowed on one side, or where a truck lane is provided, it need not be at the geometrical center of the pavement. On all major rural highways having an even number of lanes, and on many urban streets and less important rural roads, center lines are necessary and should be applied throughout the entire length of the pavement. In urban locations and on some rural roads where a continuous center line is not provided, short sections of center line are useful on approaches to busy intersections, marked crosswalks, railroad crossings, around curves or at hillcrests. When so used, the center line serves both to warn of any unusual conditions and to organize and control traffic through a hazardous or congested zone.

The center line on a two-lane paved rural highway shall be a broken white line, not less than 4 nor more than 6 inches wide. Line segments may be 20 feet in length with 30-foot gaps or 15-foot segments separated by 25-foot gaps. On four-lane undivided rural pavements, or on pavements of a greater even number of lanes, the center line shall consist of two solid yellow lines, each not less than 4″ nor more than 6″ wide, separated by a space of not less than 3″. Lines dividing a one-way roadway into two or more lanes are lane lines.

As a guide to the application of center line markings, the following warrants are suggested:

1. Center lines are desirable on all paved highways and as a minimum should be placed throughout the length of:
   a. Two-lane pavements carrying an ADT (Average Daily Traffic) in excess of 1,000 vehicles.
   b. Two-lane pavements narrower than 20′ carrying an ADT in excess of 500 vehicles.
   c. Two-lane pavements narrower than 18′ but not less than 16′ in width carrying an ADT in excess of 300 vehicles. Center lines should not be used on pavements narrower than 16′.
   d. All four, six, and eight lane undivided pavements.
2. Center lines should be placed at other locations where accident experience indicates their need, and on hard surface roads in areas where driver visibility is likely to be reduced frequently as by fog.

The center line on a two-way city street having only one lane for moving traffic in each direction shall be a solid white line. Such line shall be not less than 4 nor more than 6 inches wide.

A double solid yellow line shall be used on a two-way street with four or more lanes for moving traffic except where a single lane has been reserved for left turning vehicles or where one or more lanes are in use for reversible lane control. In such cases, a solid white line shall be used as shown in figure 3-16.

On a two way street, where it is desired to exclude traffic from a portion of pavement between traffic moving in opposite directions the double solid yellow line shall be used.

Lane Lines

Lane lines are helpful in the organization of traffic in its proper channels, and in increasing the efficiency of the use of the roadway surface at congested locations. They should be used:

1. On all rural highways with an odd number of traffic lanes.
2. In addition to the center line, on all undivided rural highways of four or more lanes.
3. At the approaches to important intersections and cross-