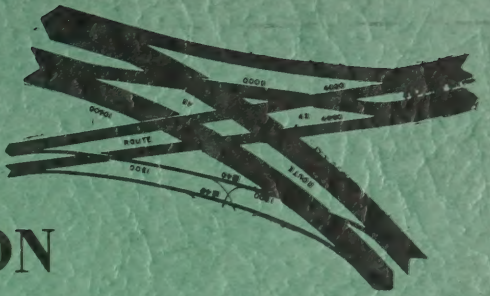
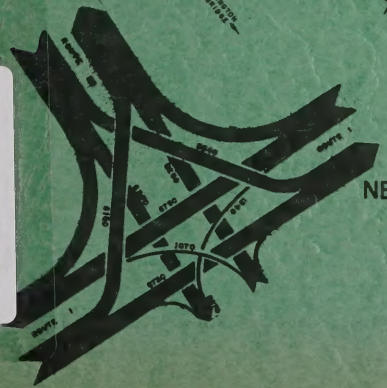
FINAL REPORT



INTERSECTION

DESIGN



NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC
IN COOPERATION WITH
US DEPARTMENT OF TRANSPORTATION
BUREAU OF PUBLIC ROADS
FALL 1969

DIGEST OF INTERSECTION DESIGN

The most difficult and crucial parts of any modern highway system are the crossings, intersections and interchanges. They create the most severe problems for the designers because various obstacles often prevent the solution of the specific problem.

It is not possible to set up a general pattern that would be applicable to all intersections. In each instance the designer has to compare a number of possibilities, evaluating their implications and the effects of their use on the basis of past experience.

As a reference for such studies and a tool for handling intersection problems, the New Jersey Department of Transportation, after three years of research and analyses, has put together descriptions of thirty of the most typical intersections in existence in the State. They were selected to cover the five major variants of up-to-date intersections: signalized and non-signalized, cloverleafs and partial cloverleafs, as well as circles, altogether in eighteen variants.

In this report, all the relevant operational figures have been gathered for each of the examples, defining the practical consequences of the specific designs in use. In addition to the characteristics of traffic flow and the accident record at each intersection, the features of the terrain, the signing and signalization (i.e., the control of traffic by means of signs and/or lights) are shown, as well as other indications of value to the technicians. All this is related to precise drawings, aerial photographs, tables and diagrams. The report includes interpretative comments by specialized engineers.

The attached illustrations are examples of these technical methods applied to two typical intersections: Route 4 with Route 17 and Route 1-9 with Communipaw Avenue. Travel time and accidents were, naturally, the most meaningful elements.

The dynamic character of today's circulation added to the complexity of the project. Therefore, special attention had to be given to the volume and nature of vehicular movements, particularly the percentage of trucks.

The individual accidents -- their number and kind -- are being examined for clues, leading ultimately to improvements in road design and regulation of traffic. The last diagram shows their relations to the parts of the highway complex.

A discussion of the Route 1-9 and Communipaw Avenue intersection at the end of the attachments exemplifies the technician's critical approach to a specific crossing.

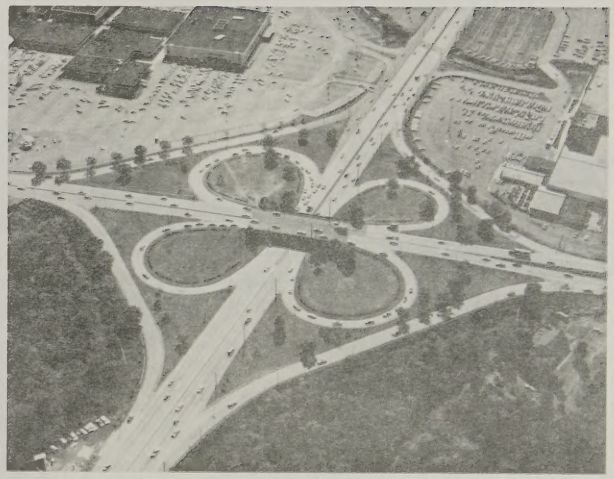
PHOTO 3

N.J. Routes 4 and 17

Cloverleaf

Year of Construction: 1933

Photographed 6/1/67 - 1630 hours
600' Altitute, Looking Northwest



Photographed 6/1/67 - 1630 hours
800' Altitude, Looking West

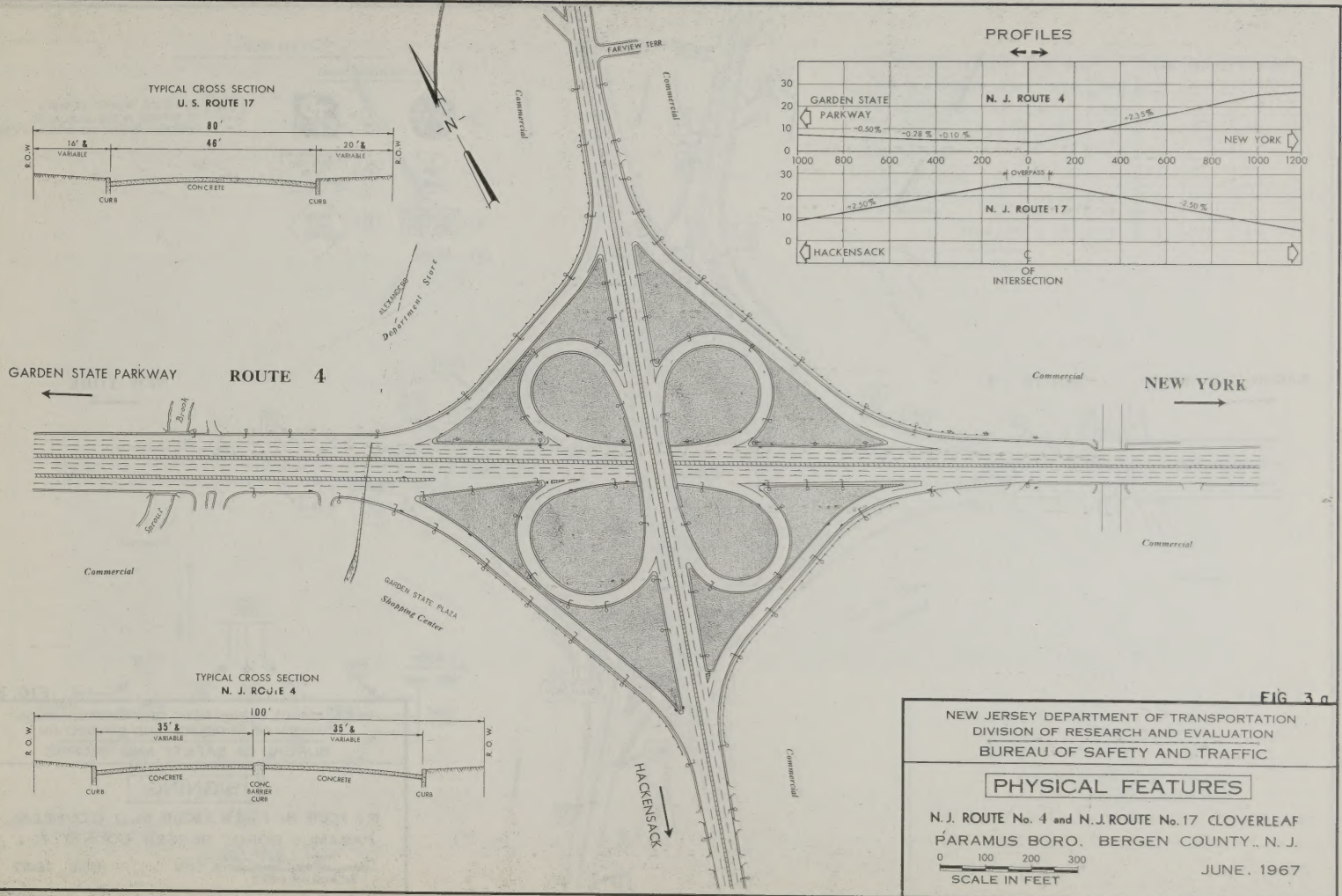


FIG 3a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

N. J. ROUTE No. 4 and N. J. ROUTE No. 17 CLOVERLEAF
PARAMUS BORO. BERGEN COUNTY., N. J.

0 100 200 300
SCALE IN FEET

JUNE. 1967

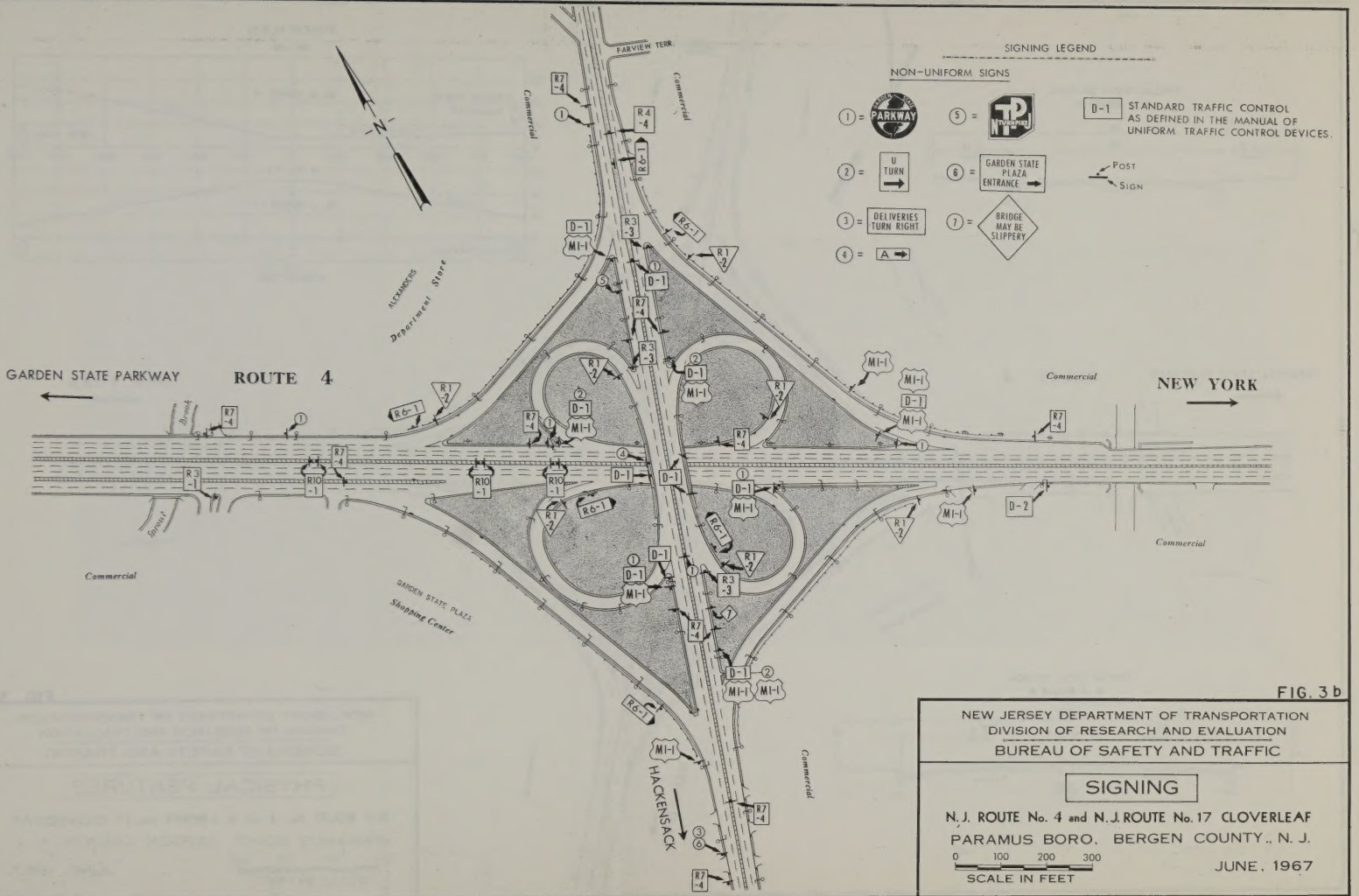


FIG. 3b

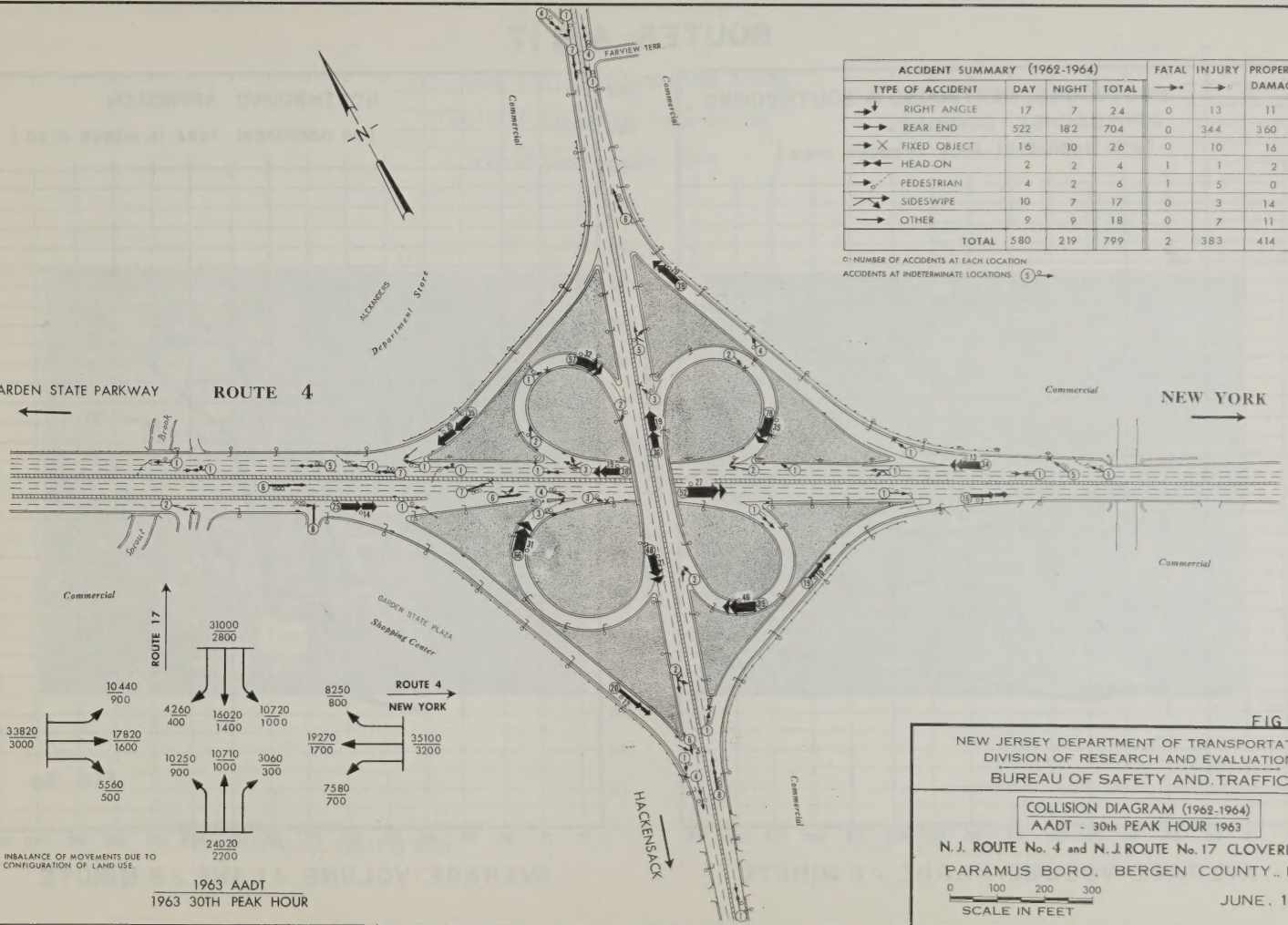
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

N. J. ROUTE No. 4 and N. J. ROUTE No. 17 CLOVERLEAF
PARAMUS BORO. BERGEN COUNTY., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1967



ACCIDENT SUMMARY (1962-1964) TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	FATAL →•	INJURY →◦	PROPERTY DAMAGE
RIGHT ANGLE	17	7	24	0	13	11
REAR END	522	182	704	0	344	360
FIXED OBJECT	16	10	26	0	10	16
HEAD-ON	2	2	4	1	1	2
PEDESTRIAN	4	2	6	1	5	0
SIDESWIPE	10	7	17	0	3	14
OTHER	9	9	18	0	7	11
TOTAL	580	219	799	2	383	414

○= NUMBER OF ACCIDENTS AT EACH LOCATION
ACCIDENTS AT INDETERMINATE LOCATIONS (5)→

FIG 3c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

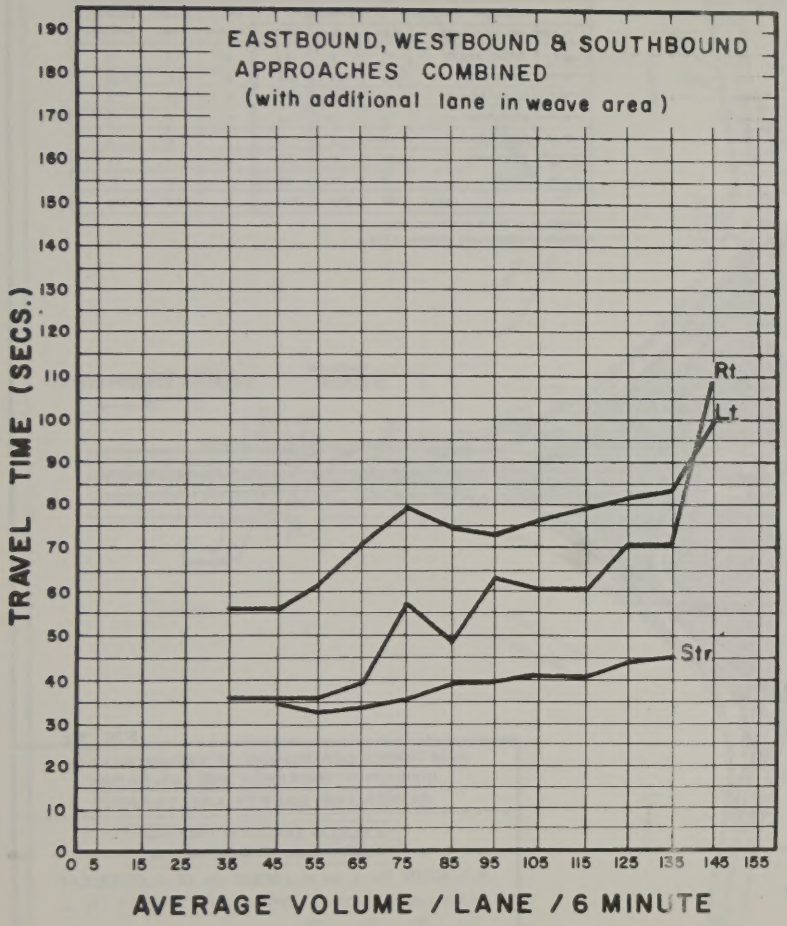
COLLISION DIAGRAM (1962-1964)
AADT - 30th PEAK HOUR 1963

N. J. ROUTE No. 4 and N. J. ROUTE No. 17 CLOVERLEAF
PARAMUS BORO. BERGEN COUNTY, N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1967

ROUTES 4 & 17



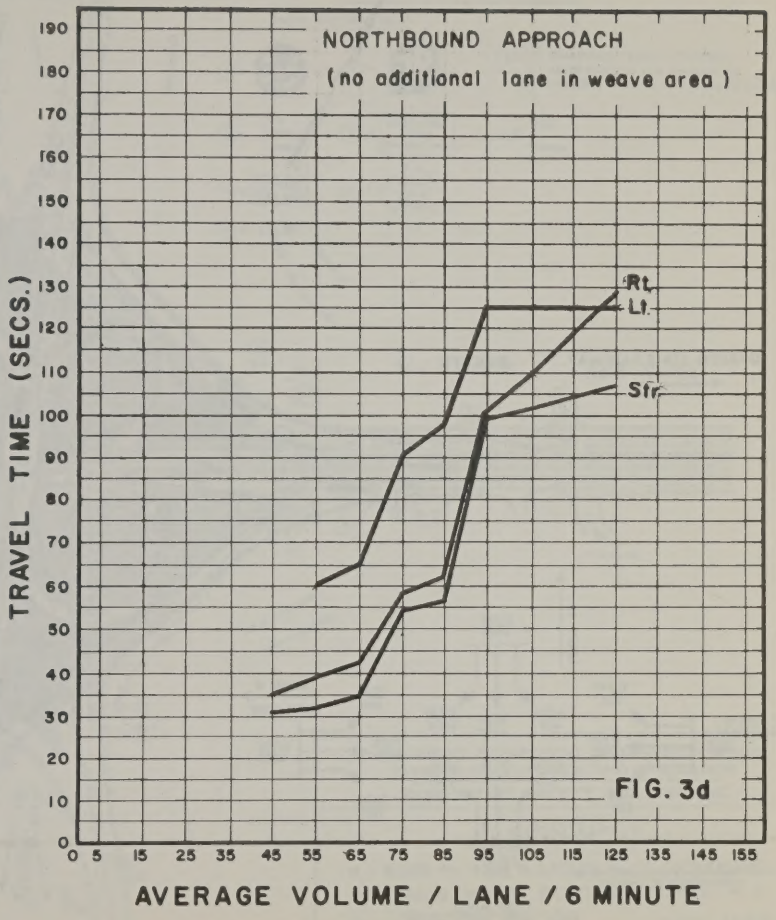


FIG. 3d

PHOTO 28

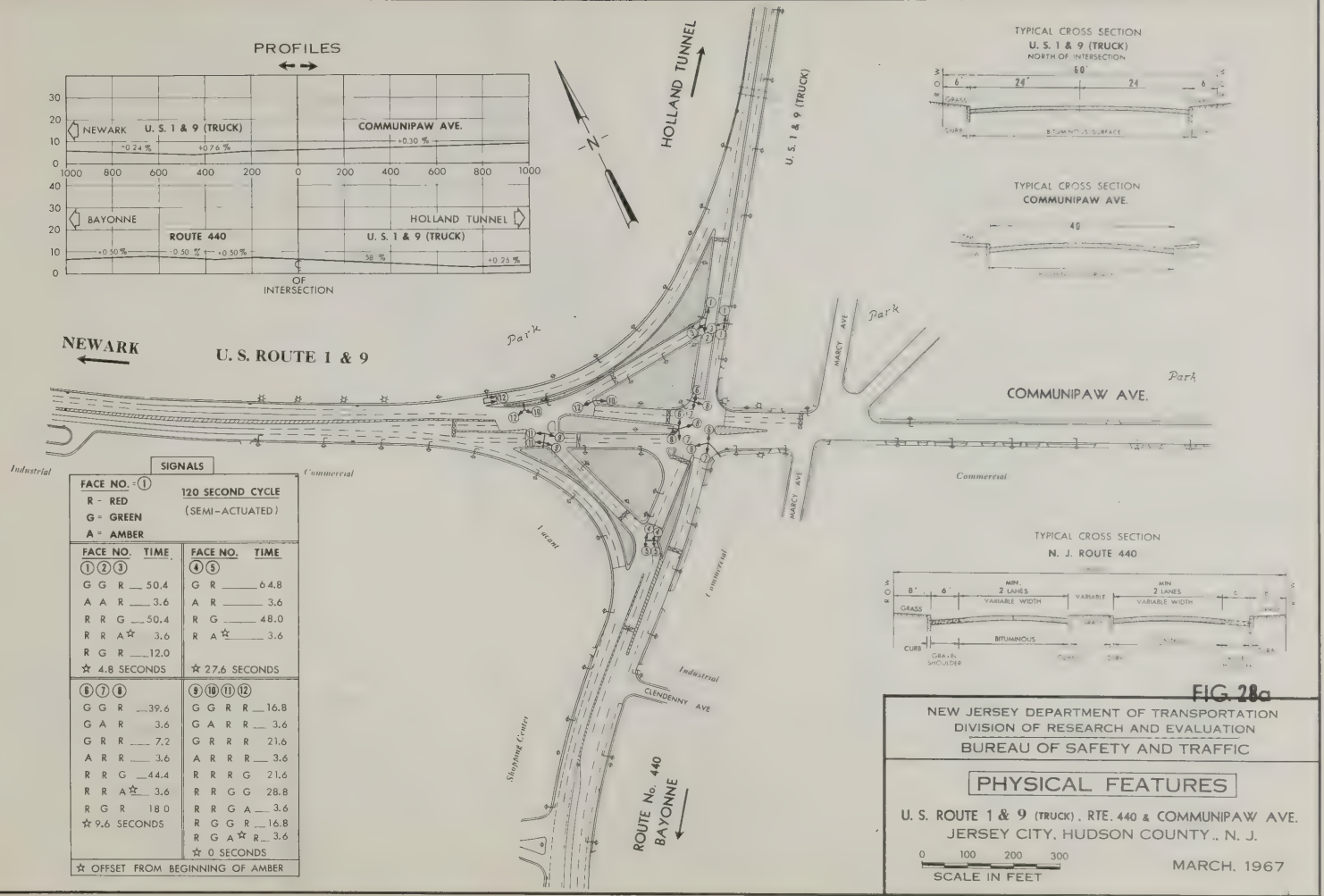
U.S. Route 1-9(T) and Communipaw Avenue

Signalized Channelized Intersection

Year of Construction: 1954

Photographed 6/29/67 - 1600 hours
700' Altitude, Looking West

Photographed 6/29/67 - 1600 hours
500' Altitude, Looking East



SIGNALS

FACE NO. - ①
R - RED
G = GREEN
A = AMBER

120 SECOND CYCLE
(SEMI-ACTUATED)

FACE NO. ①②③	TIME	FACE NO. ④⑤	TIME
G G R	50.4	G R	64.8
A A R	3.6	A R	3.6
R R G	50.4	R G	48.0
R R A ☆	3.6	R A ☆	3.6
R G R	12.0		
☆ 4.8 SECONDS		☆ 27.6 SECONDS	

FACE NO. ⑥⑦⑧	TIME	FACE NO. ⑨⑩⑪⑫	TIME
G G R	39.6	G G R R	16.8
G A R	3.6	G A R R	3.6
G R R	7.2	G R R R	21.6
A R R	3.6	A R R R	3.6
R R G	44.4	R R R G	21.6
R R A ☆	3.6	R R G G	28.8
R G R	18.0	R R G A	3.6
☆ 9.6 SECONDS		R G G R	16.8
		R G A ☆ R	3.6
		☆ 0 SECONDS	

☆ OFFSET FROM BEGINNING OF AMBER

FIG. 28a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE 1 & 9 (TRUCK), RTE. 440 & COMMUNIPAW AVE.
JERSEY CITY, HUDSON COUNTY., N. J.

0 100 200 300
SCALE IN FEET

MARCH, 1967

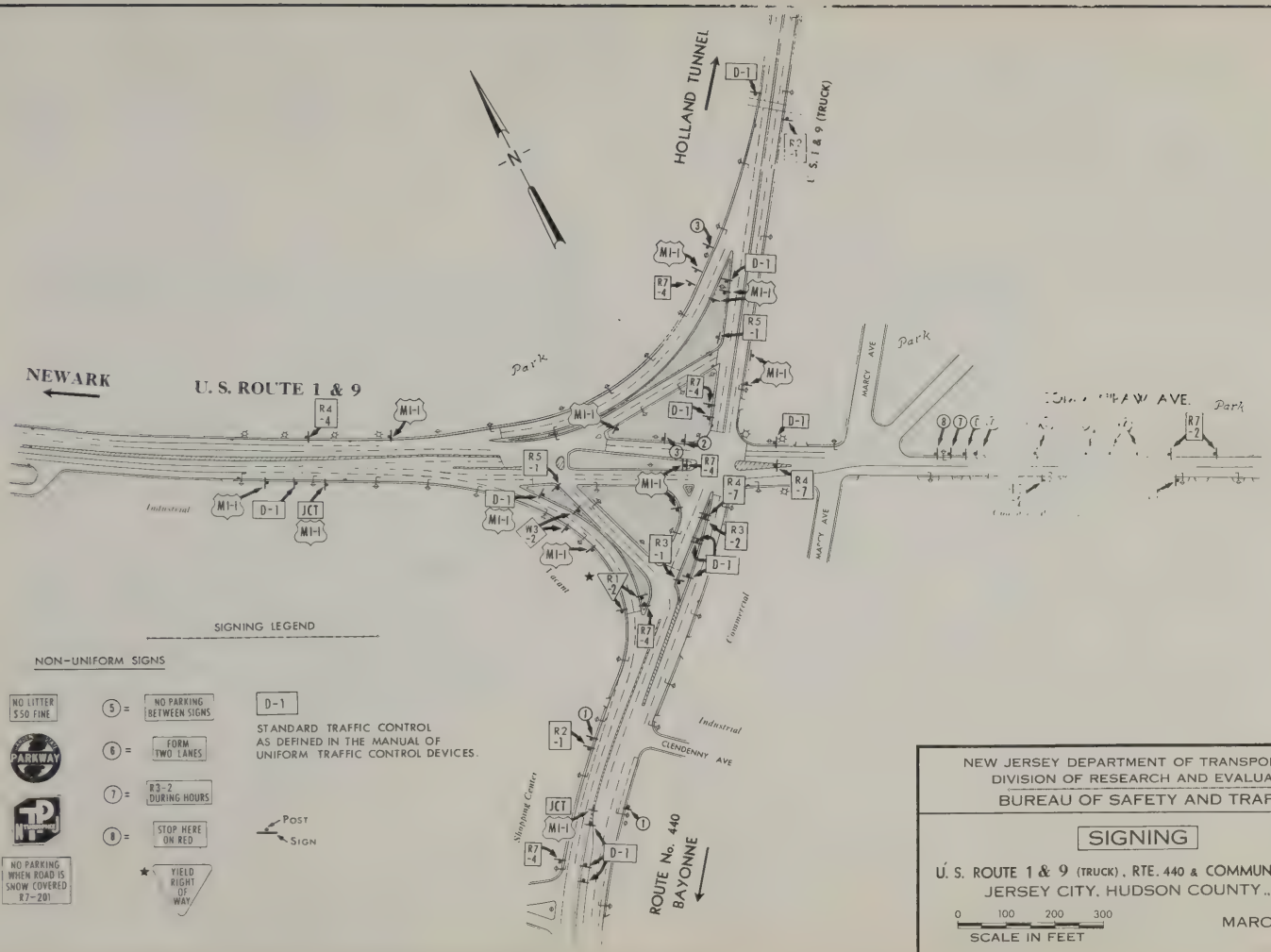


FIG. 28b

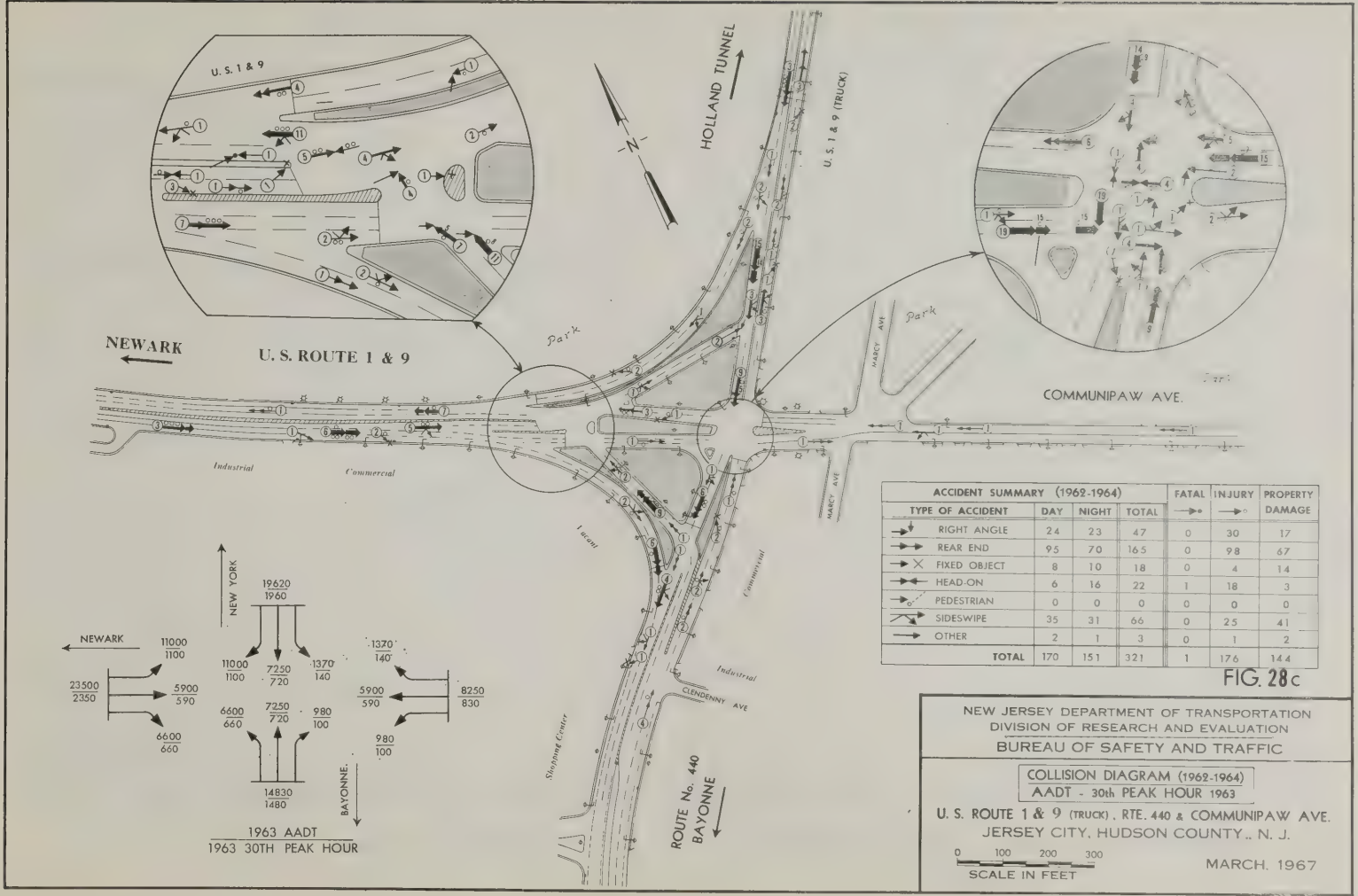
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. ROUTE 1 & 9 (TRUCK), RTE. 440 & COMMUNIPAW AVE.
JERSEY CITY, HUDSON COUNTY., N. J.

0 100 200 300
SCALE IN FEET

MARCH, 1967



ACCIDENT SUMMARY (1962-1964)				FATAL	INJURY	PROPERTY
TYPE OF ACCIDENT	DAY	NIGHT	TOTAL			DAMAGE
RIGHT ANGLE	24	23	47	0	30	17
REAR END	95	70	165	0	98	67
FIXED OBJECT	8	10	18	0	4	14
HEAD-ON	6	16	22	1	18	3
PEDESTRIAN	0	0	0	0	0	0
SIDESWIPE	35	31	66	0	25	41
OTHER	2	1	3	0	1	2
TOTAL	170	151	321	1	176	144

FIG. 28c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

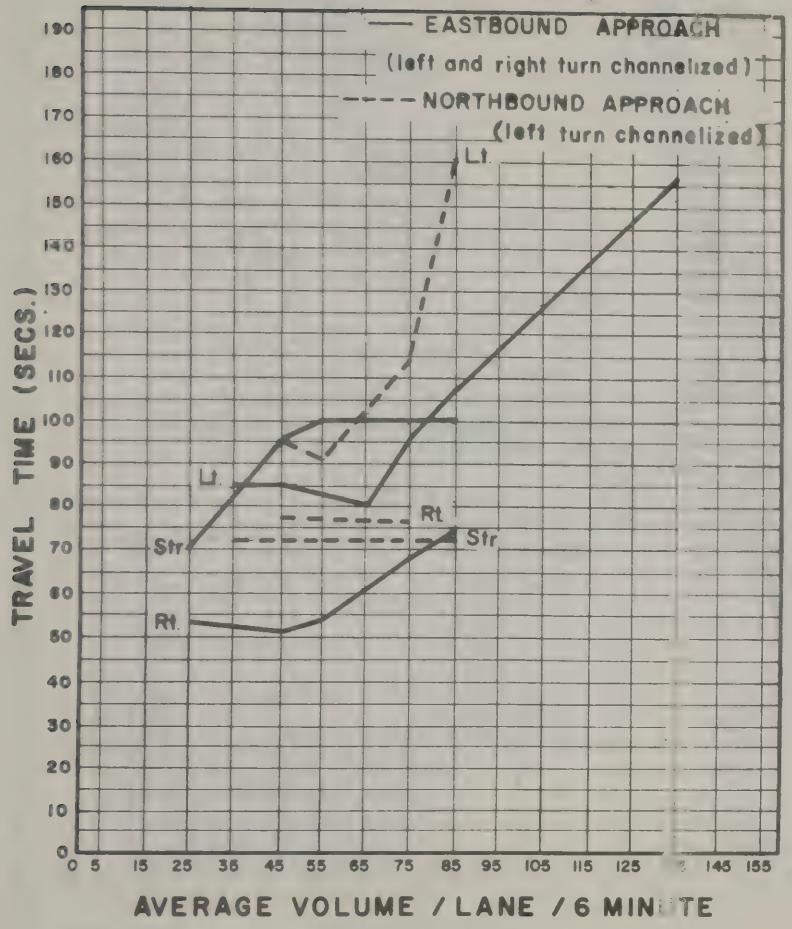
COLLISION DIAGRAM (1962-1964)
AADT - 30th PEAK HOUR 1963

U. S. ROUTE 1 & 9 (TRUCK), RTE. 440 & COMMUNIPAW AVE.
JERSEY CITY, HUDSON COUNTY, N. J.

0 100 200 300
SCALE IN FEET

MARCH, 1967

ROUTE 1-9 AND COMMUNIPAW AVENUE



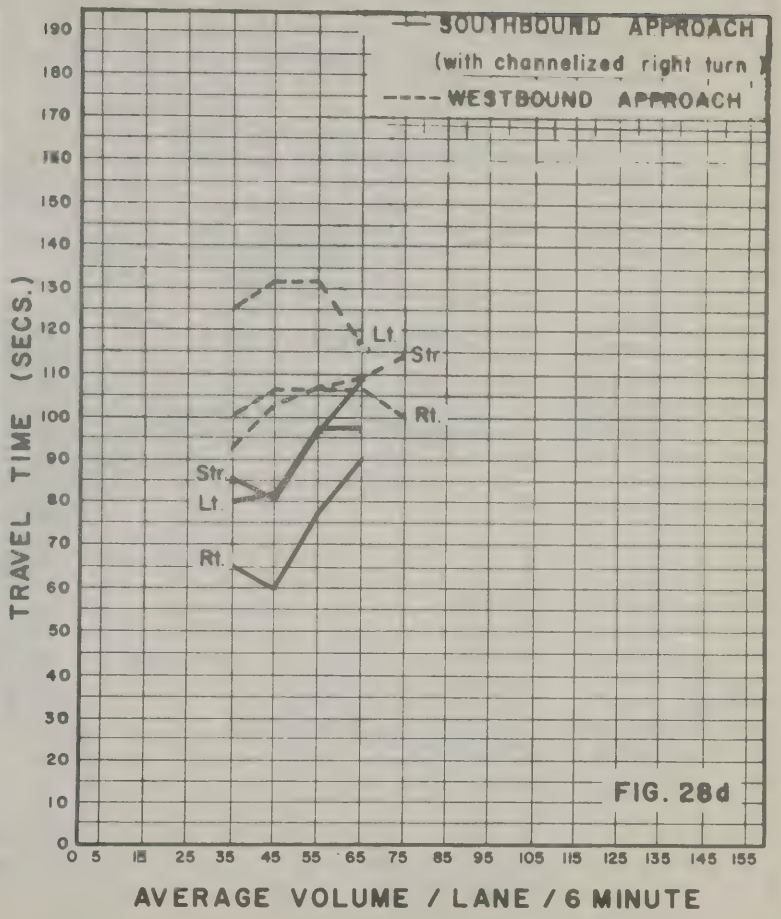


FIG. 28d

ROUTES 1&9T AND 440

Posted Speeds: Route 1&9T - 45 mph
Route 440 - 25 mph

Comments by W. R. Bellis:

This intersection was converted from a right-angle signalized intersection to a channelized intersection in 1949. A report on this intersection appears in Highway Research Board Proceedings for 1951. Route 1&9T was then Route 25 Truck, also called Communipaw Avenue. This intersection has two heavy left turns; the largest volume studied except for 4 grade-separated intersections; and the largest turning movement volume except for that at Routes 4 and 17 cloverleaf. Sixty percent of the traffic is turning movement traffic which is the largest percentage of any of the 30 intersections. The leg towards Newark has 42 percent trucks on a 24-hour basis.

The accident rate is high, exceeded by 9 other intersections, and the injury rate is high, exceeded by only 5 other locations studied. Fifty-one percent of the accidents are rear-end accidents, compared with 53 percent for the signalized intersections, and 54 percent for all intersections studied. Twenty percent of the accidents are sideswipe accidents. This percentage is exceeded by two other intersections, and compares with 8 percent sideswipes for the average of the 13 signalized intersections, and 11 percent for the average of the 30 intersections. Fourteen percent of the accidents are right-angle accidents, compared to 19 percent for the average of the signalized intersections, and 16 percent for the average of the 30 intersections. Forty-seven percent of the accidents occurred at night, compared with 40 percent for the signalized intersections, and 35 percent for the total intersections.

The straight through movement on the major road takes 48 seconds longer than on a cloverleaf. The right turn takes 24 seconds longer, and the left turn 50 seconds longer. During off-hours, this left turn takes about 20 seconds longer than on a cloverleaf, but during the peak hour 80 seconds longer.

For the minor movements, straight through, the travel time is 60 seconds longer than on a cloverleaf, the right turn 45 seconds longer, and the left turn 34 seconds longer. Some minor improvements are under contract at this intersection at the present time.

Note that there are 4 signalized locations within this overall intersection.

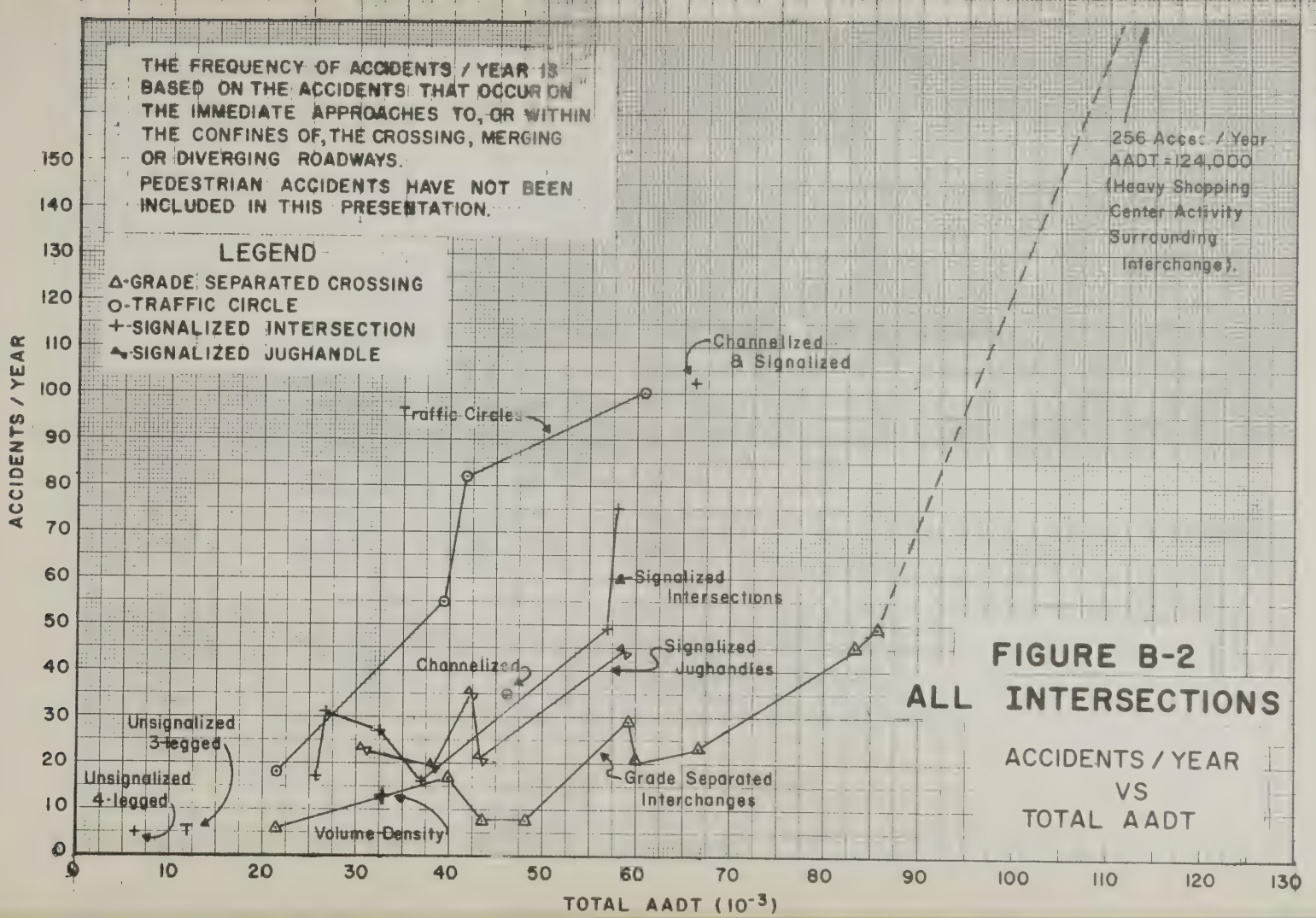


FIGURE B-2

ALL INTERSECTIONS

ACCIDENTS / YEAR VS TOTAL AADT

A B S T R A C T

INTERSECTION DESIGN

Thirty sites, representing several intersection and interchange design types in the State of New Jersey, are presented in this report to provide better engineering tools to the highway designer. The presentation includes physical features, signing and collision diagrams, AADT, 30th peak hour volumes, travel time figures and accident experience. Comments on the design, accident experience and travel time for all movements are added for each of the sites studied.

A section of the report covers an analysis of the accident experience of the designs and the particular design features. A methodology for summarizing the parameters, studied in the report, is presented for an overall comparison of the different design types.

TABLE OF CONTENTS

LIST OF SITES

Figures 1 thru 30 include the following plates:

Photos
Physical Features (a)
Signing (b)
Collision Diagram (3 year period), AADT, 30th Peak Hour Volume (c)
Travel Time vs. Average Volume/Lane/6 minute period (d)

Comments on the designs are provided with each site.

LIST OF FIGURES IN APPENDIX B

LIST OF TABLES IN APPENDIX C

INTRODUCTION

The following report is the result of a three year research program conducted by the Bureau of Safety & Traffic, Division of Research & Evaluation, New Jersey Department of Transportation, in cooperation with the Bureau of Public Roads. A total of thirty sites, representative of various intersection and interchange designs, were studied in a comparative manner with the purpose of providing information to the designer, enabling him to evaluate existing designs for use in improving future designs. The parameters studied were travel time and accidents.

It is anticipated that other states will find value in the results of this study and will continue research in this area.

SCOPE OF REPORT

Field studies were conducted on the following intersection and interchange types:

3 - full cloverleafs
(sites 1,3 and 4)

1 - full cloverleaf, but minus a loop ramp
(site 2)

2 - two-quadrant cloverleafs
(sites 5 and 6)

1 - modified diamond
(site 7)

1 - two-quadrant diamond
(site 8)

2 - modified two-quadrant cloverleafs
(sites 9 and 10)

4 - traffic circles
(sites 11,12,13 and 14)

1 - channelized intersection
(site 15)

3 - signalized (semi-actuated) intersections
(all turns permitted)
(sites 16,17 and 18)

2 - signalized (semi-actuated) intersections
(left-turn bays provided)
(sites 19 and 20)

1 - signalized (semi-actuated) intersection (no left-turns permitted) (site 21)

1 - signalized (volume density) intersection (site 22)

3 - signalized (semi-actuated) jughandle intersections (sites 23,24 and 25)

1 - signalized (semi-actuated) thru-circle intersection (site 26)

1 - signalized (semi-actuated) reverse jughandle intersection (site 27)

1 - signalized (semi-actuated) and channelized intersection (site 28)

1 - "Tee" intersection (before and after signalization) (site 29)

1 - non-signalized intersection (site 30)

The following items are provided for each of the designs:

1. Aerial photographs.
2. Physical feature plate including horizontal and vertical alignment and roadside features.
3. Signing plate, referencing all uniform signs to the "Manual on Uniform Traffic Control Devices" (1961).
4. Collision diagram plate, including the AADT for all movements and the 30th peak hour volumes.
5. Travel time figure showing the travel time of all moves thru the design from a point 1000' prior to and 1000' past the intersecting roadways.
6. Posted speed limits for the design and comments on the design using the parameters considered in the study.

Theoretically, there is an economic benefit to the user when impedances to flow are reduced. Time savings, accident experience, operating costs and comfort and convenience are the principal measures of benefit for comparison of efficiency.

The object of this study is to provide a method of analysis of various type intersections. The principal items for comparison are travel time and

accident data. Each of the intersections presented is accompanied by comments covering its overall efficiency.

The extent of influence of one road on another road's traffic stream is not easily determined. Backups from one may extend several hundred or thousand feet upstream. Ramp terminals of grade-separated crossings may be 500 feet from the projected crossing of the connected roads. For these reasons, all data have been collected for a 2000 foot section of each crossing roadway, 1000 feet in advance of, and 1000 feet beyond the crossing of the center lines of the two roads.

PHOTO 1

U.S. Route 1 and Milltown Road

Cloverleaf

Year of Construction: 1960

Photographed 6/1/67 - 1730 hours
500' Altitude, Looking West

Photographed 6/1/67 - 1730 hours
700' Altitude, Looking West

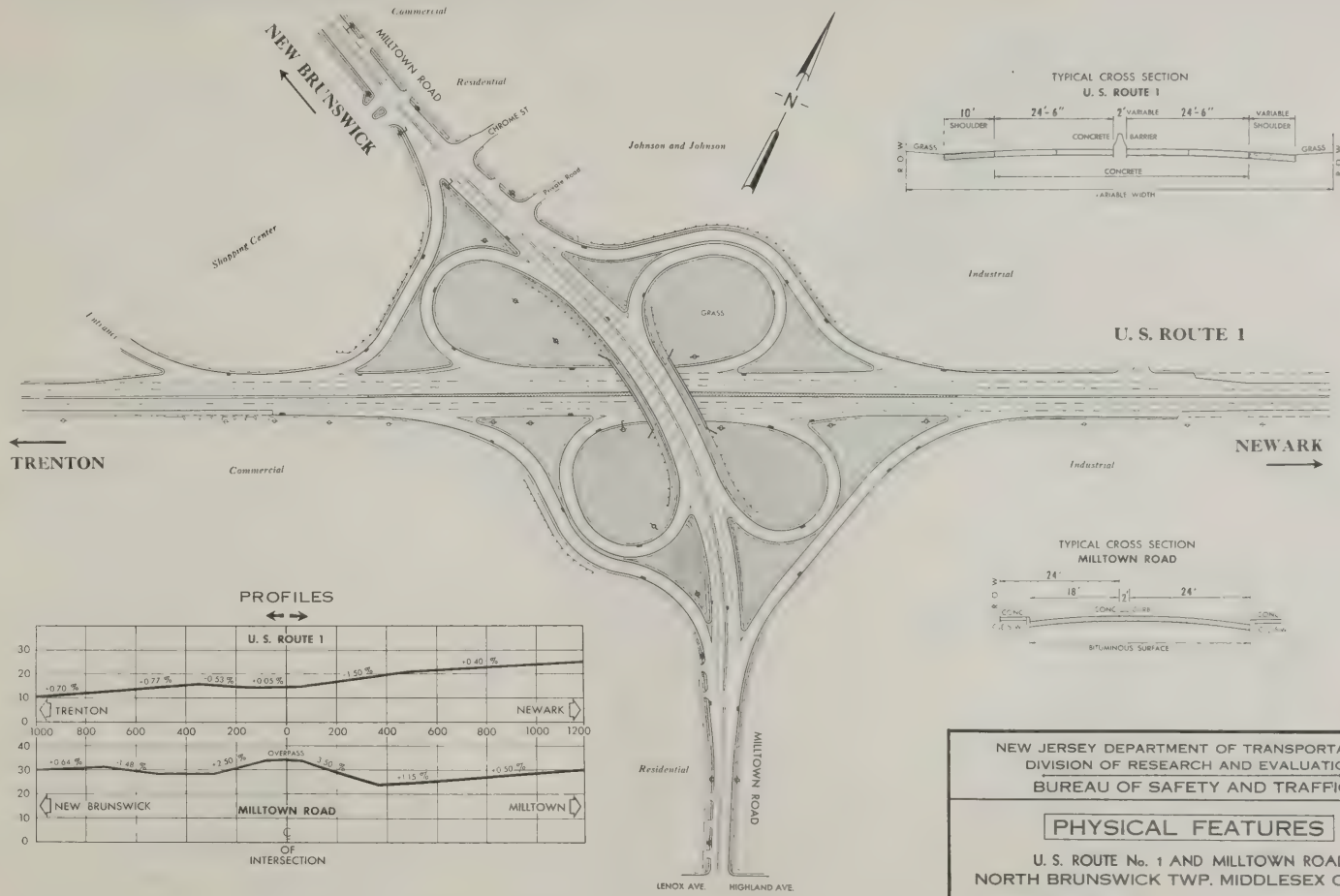


FIG 1a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE No. 1 AND MILLTOWN ROAD
NORTH BRUNSWICK TWP. MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JANUARY, 1967

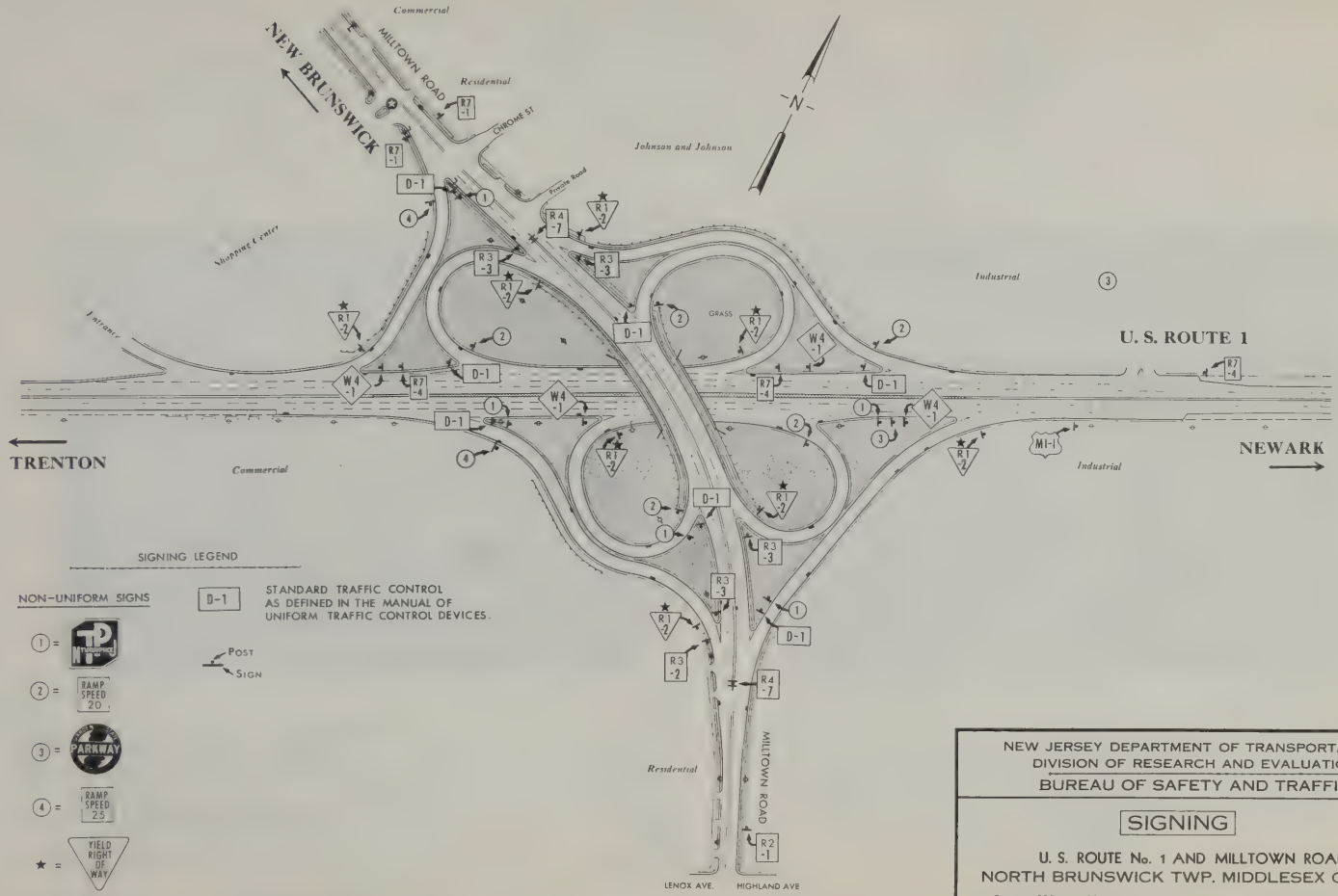


FIG 1b

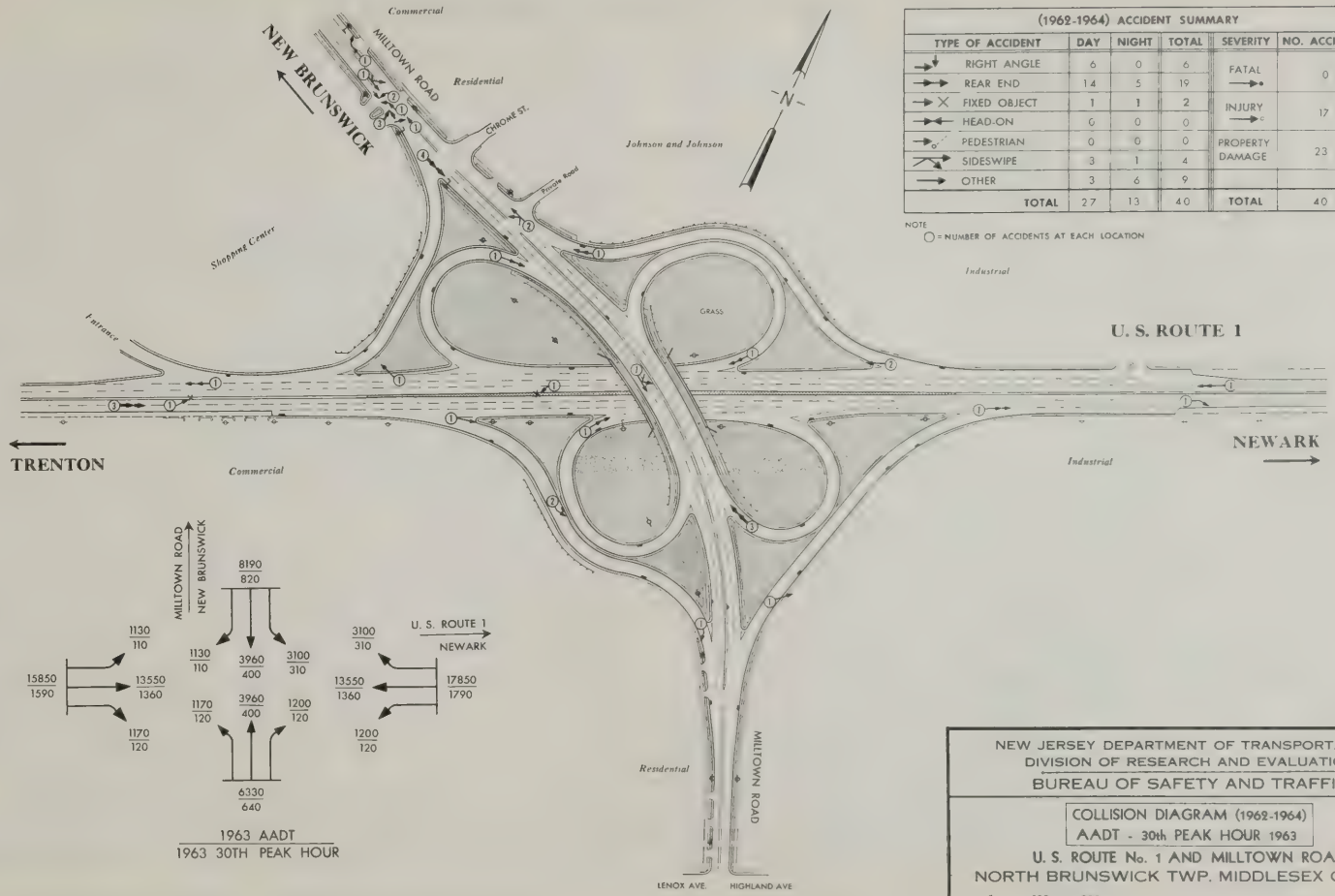
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. ROUTE No. 1 AND MILLTOWN ROAD
NORTH BRUNSWICK TWP. MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JANUARY, 1967



(1962-1964) ACCIDENT SUMMARY					
TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	SEVERITY	NO. ACCIDENTS
RIGHT ANGLE	6	0	6	FATAL	0
REAR END	14	5	19		
FIXED OBJECT	1	1	2	INJURY	17
HEAD-ON	0	0	0		
PEDESTRIAN	0	0	0	PROPERTY DAMAGE	23
SIDESWIPE	3	1	4		
OTHER	3	6	9		
TOTAL	27	13	40	TOTAL	40

NOTE
○ = NUMBER OF ACCIDENTS AT EACH LOCATION

FIG 1c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

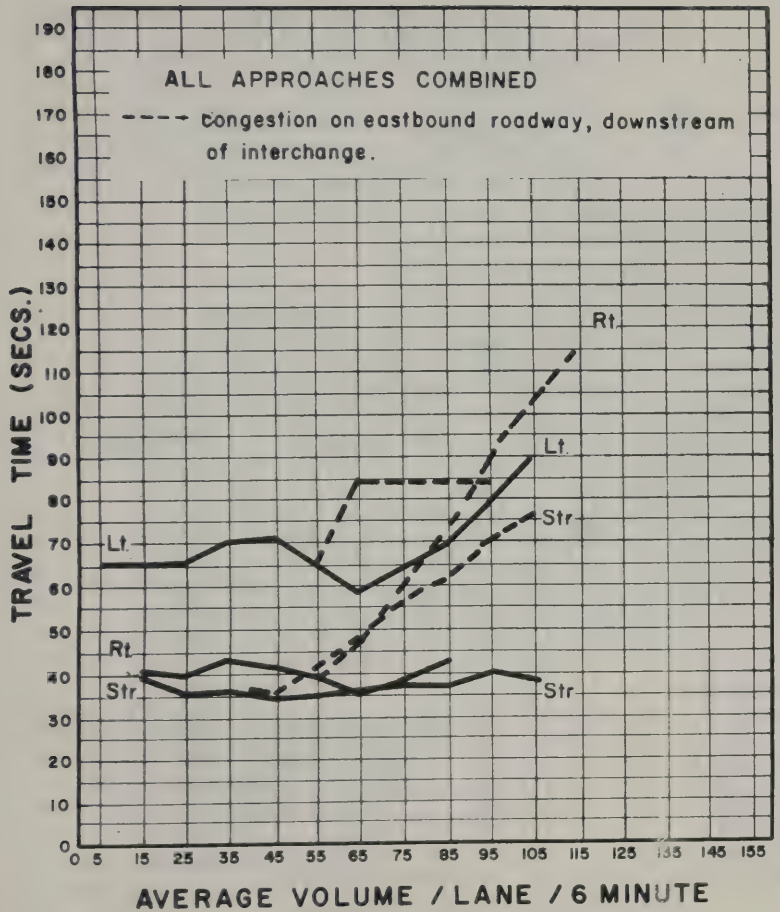
COLLISION DIAGRAM (1962-1964)
AADT - 30th PEAK HOUR 1963

U. S. ROUTE No. 1 AND MILLTOWN ROAD
NORTH BRUNSWICK TWP. MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JANUARY, 1967

ROUTE 1 & MILLTOWN ROAD



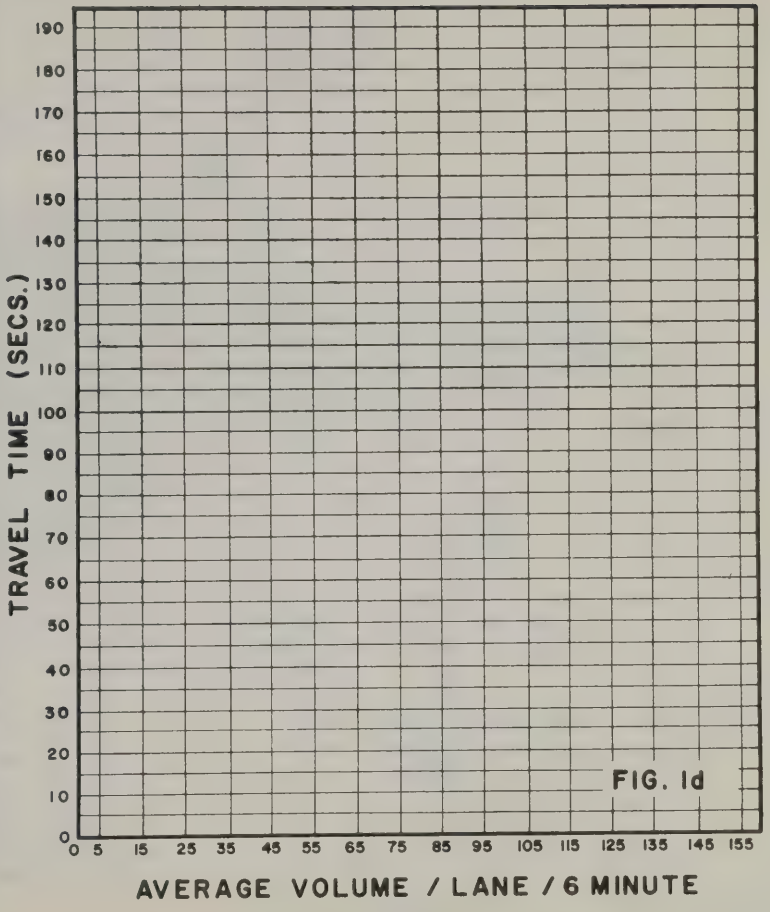


FIG. 1d

ROUTE 1 AND MILLTOWN ROAD

Posted Speeds: Route 1 - 50 mph
Milltown Rd. - 40 mph

Comments by W. R. Bellis:

This is a full cloverleaf of a relatively modern design, having been constructed in 1960. During 1963 the interchange was used by 17,600,000 vehicles or 48,220 on an average day, 19 percent of which was truck traffic. During 1968 traffic volumes were about 22 percent greater than in 1963. Traffic using this interchange is about 3 percent greater than average for the 30 intersections studied. It has the smallest volume of any of the 4 cloverleafs studied. Turning traffic amounted to 13,200 cars an average day or 27 percent of the total traffic using the interchange. The turning movement volume is slightly more than that for the average of the 30 intersections, and the turning movement percentage is the same as that for the average.

The 3-year accident rate of 200/100 MVM is better than any of the other cloverleafs studied and better than any of the intersections studied except the one at Route 22 and Thompson Ave. The largest accident rate of the 30 intersections studied was 2,140 and the average was 943. The injury accident rate of 35 at the intersection of Route 22 and Thompson Ave. was the lowest, followed by a rate of 85 at this interchange. The highest injury accident rate was 1,060.

There were 40 accidents during the 3-year period; two of the intersections studied had fewer. The largest number of accidents was 799 and the average number for the 30 intersections was 183.5, during the 3-year period.

Forty-seven percent of the accidents at this interchange were rear-end accidents, the smallest percentage for any of the 4 cloverleafs, while the average of the 4 cloverleafs was 79 percent and the average of the 30 intersections was 54 percent. There were 4 sideswipe accidents during the 3 years, which amounts to 10 percent of the total, and compares with 6 percent for all of the cloverleafs, and 11 percent for all 30 intersections. There were 6 right-angle accidents, amounting to 15 percent of the total, all of which occurred at the shopping center access points. For the average cloverleaf, 3 percent of the accidents were right-angle accidents, and for the average intersection, 16 percent. Thirty-two percent of the accidents were nighttime accidents compared to the average cloverleaf which had 29 percent, and the average intersection which had 35 percent.

The accident rate of 200/100 MVM is lower than I would expect. I would expect an accident rate of about 350/100 MVM. The accident rate for the 5.8 miles of Route 1 in North Brunswick Township, where this intersection is located, was 342 in 1963. On Route 1, the roadway is 2 lanes in each direction, but within this interchange the roadway is widened to 3 lanes in each direction, and in the weaving area to 4 lanes in each direction. This widening was not done at the intersection of Route 1 and Route 35. Also, the merging and diverging points and the acceleration and deceleration designs are much better at this intersection than at the Route 1 and Route 35 cloverleaf. This has paid off in savings of many accidents at these points. The nearby shopping center access is a source of delays and numerous accidents. It

must be noted that at the intersection of Routes 1 and 18, for northbound Route 1 traffic, several accidents occurred for a similar design.

This intersection ranks very high, based principally on its accident and injury rate and on its low travel time. Overall, it ranks third, being exceeded by the intersections of Routes 1 and 35 and Routes 1 and 18; the latter is actually not a true cloverleaf because of the one semi-directional left turn movement.

As a full cloverleaf, it would be expected to rank very high. The principal weakness in a cloverleaf is the inside loop for left turns which requires additional travel distance at slower speeds and which causes weaving at four locations. The median left turn travel time for this movement is 75 seconds; the time varied from 60 to 90 seconds. The posted speed limit on Route 1 is 50 mph, so that at this speed a vehicle would travel 2,000 feet in 27 seconds. The median straight-through car traveled the distance in 37 seconds with a range of 35 to 40 seconds. During this study, southbound traffic on Milltown Road was frequently delayed by the backup of traffic from a signalized intersection. Discounting this, the left turn on the larger turning radius of the inside loop at Milltown Road was 5 seconds less than on the loop of Route 35. The improved design at the Milltown Road interchange does not seem to have saved much in travel time compared to the intersection at Routes 1 and 35.

PHOTO 2

U.S. Route 1 and N.J. Route 18

Cloverleaf

Year of Construction: 1960

Photographed 6/1/67 - 1730 hours
600' Altitude, Looking West

Photographed 6/1/67 - 1730 hours
800' Altitude, Looking Northeast

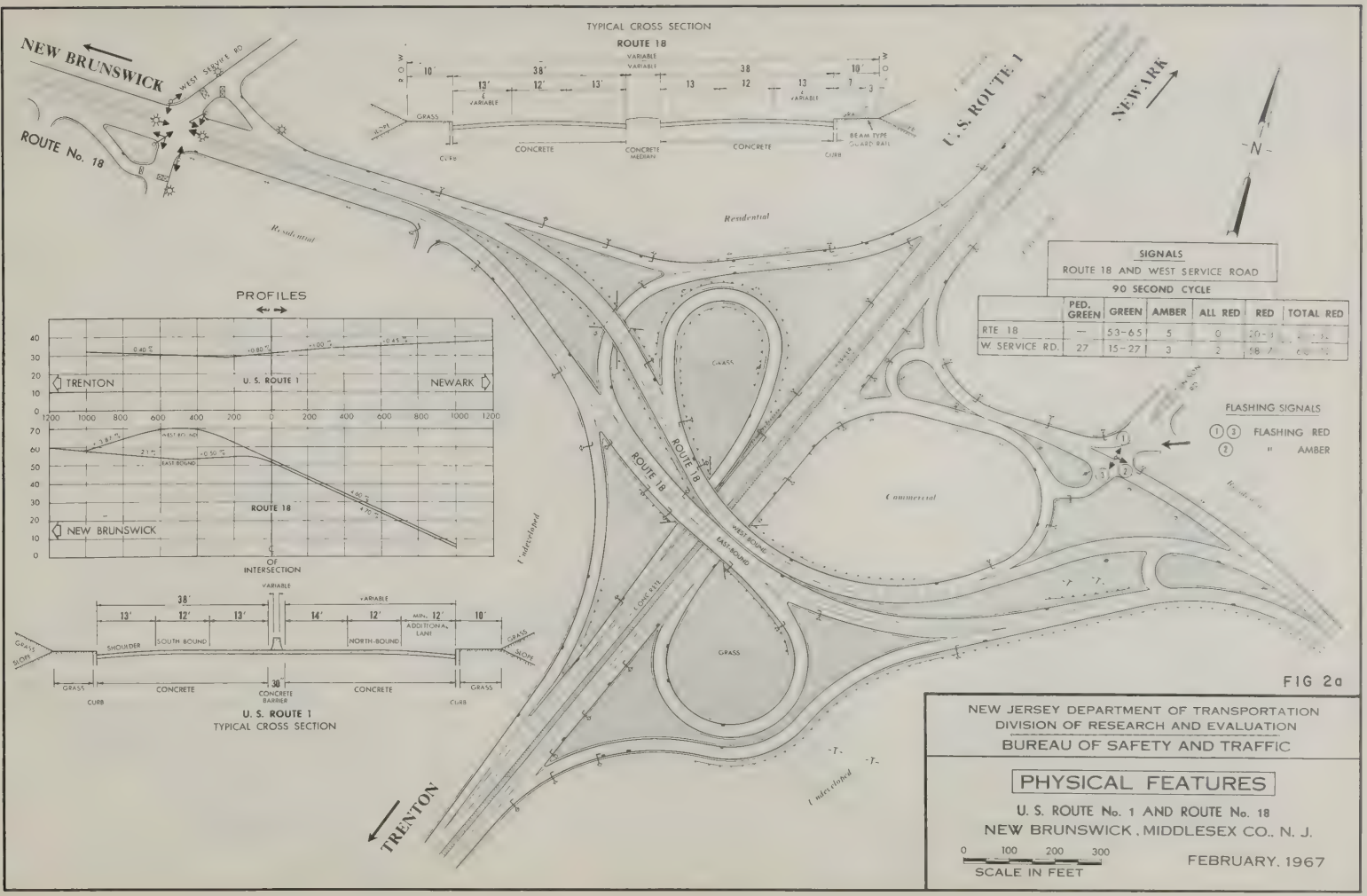


FIG 2a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE No. 1 AND ROUTE No. 18
NEW BRUNSWICK, MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

FEBRUARY, 1967

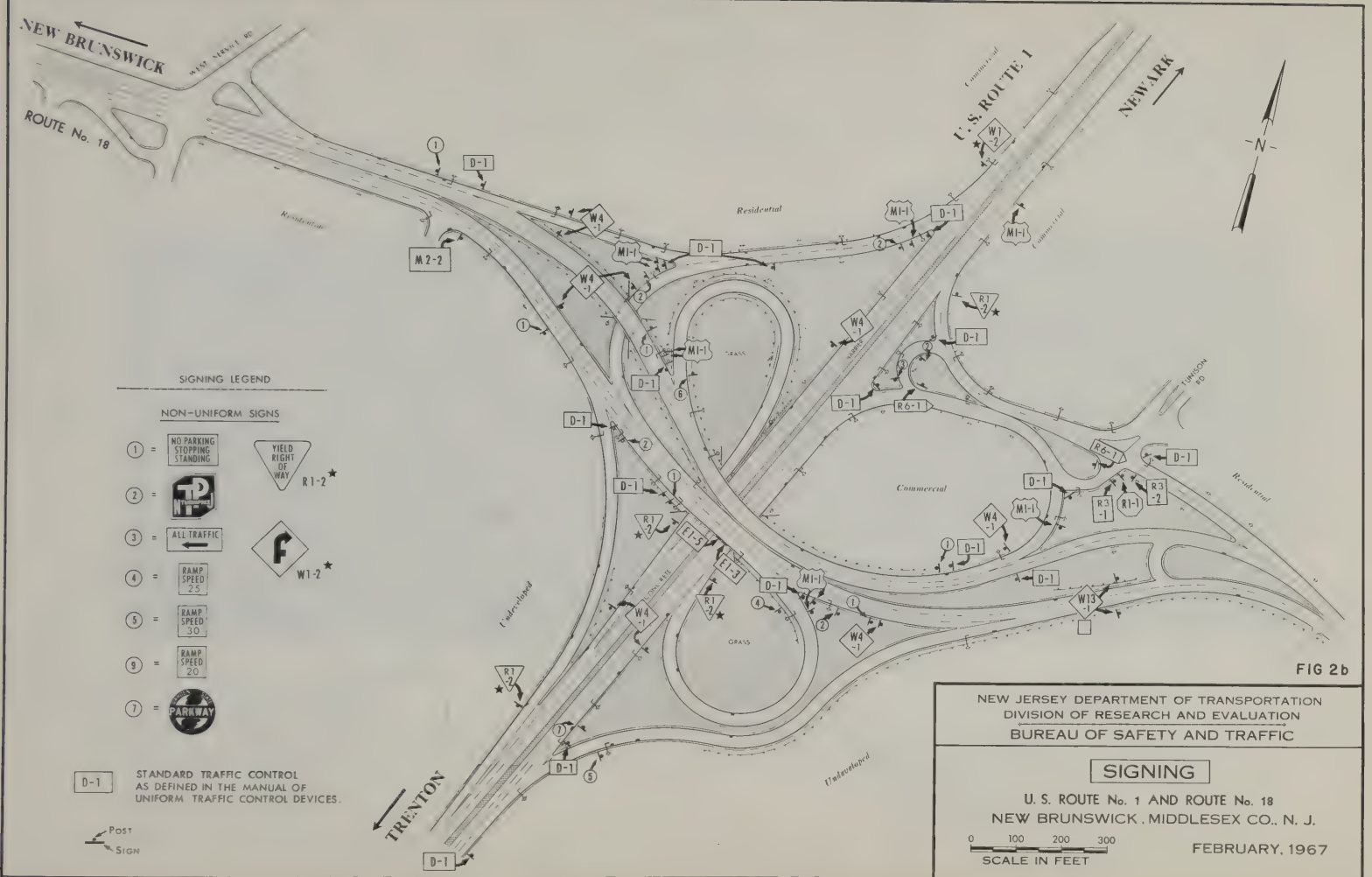


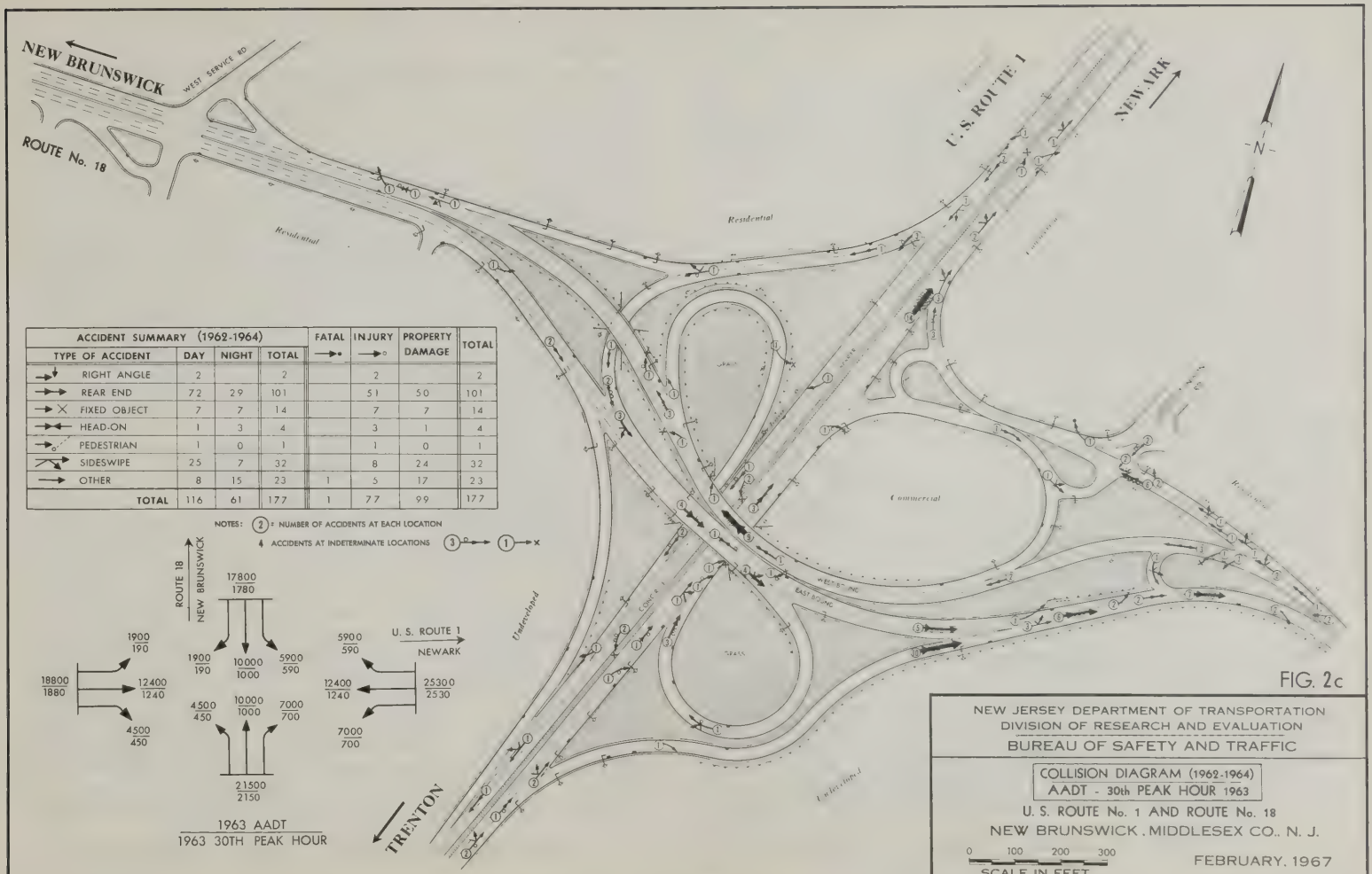
FIG 2b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. ROUTE No. 1 AND ROUTE No. 18
NEW BRUNSWICK, MIDDLESEX CO., N. J.

FEBRUARY, 1967



ACCIDENT SUMMARY (1962-1964) TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	FATAL →•	INJURY →○	PROPERTY DAMAGE	TOTAL
RIGHT ANGLE	2		2		2		2
REAR END	72	29	101		51	50	101
FIXED OBJECT	7	7	14		7	7	14
HEAD-ON	1	3	4		3	1	4
PEDESTRIAN	1	0	1		1	0	1
SIDESWIPE	25	7	32		8	24	32
OTHER	8	15	23	1	5	17	23
TOTAL	116	61	177	1	77	99	177

NOTES: (2) = NUMBER OF ACCIDENTS AT EACH LOCATION
ACCIDENTS AT INDETERMINATE LOCATIONS (3)→ (1)→×

1963 AADT
1963 30TH PEAK HOUR

FIG. 2c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

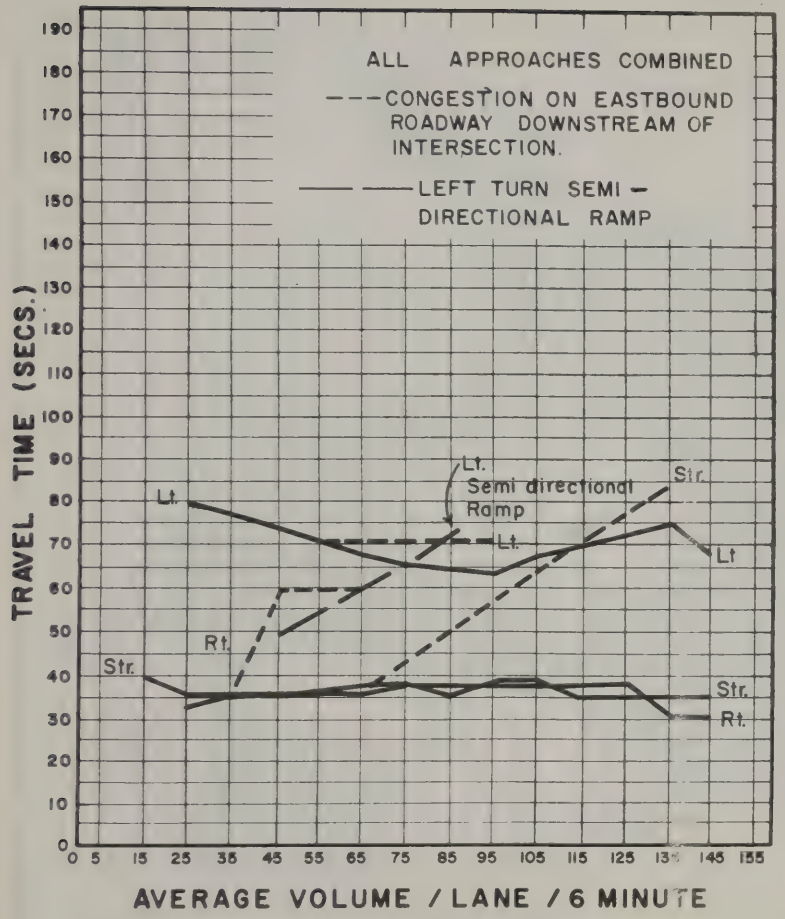
COLLISION DIAGRAM (1962-1964)
AADT - 30th PEAK HOUR 1963

U. S. ROUTE No. 1 AND ROUTE No. 18
NEW BRUNSWICK, MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

FEBRUARY, 1967

ROUTES 18 & 18



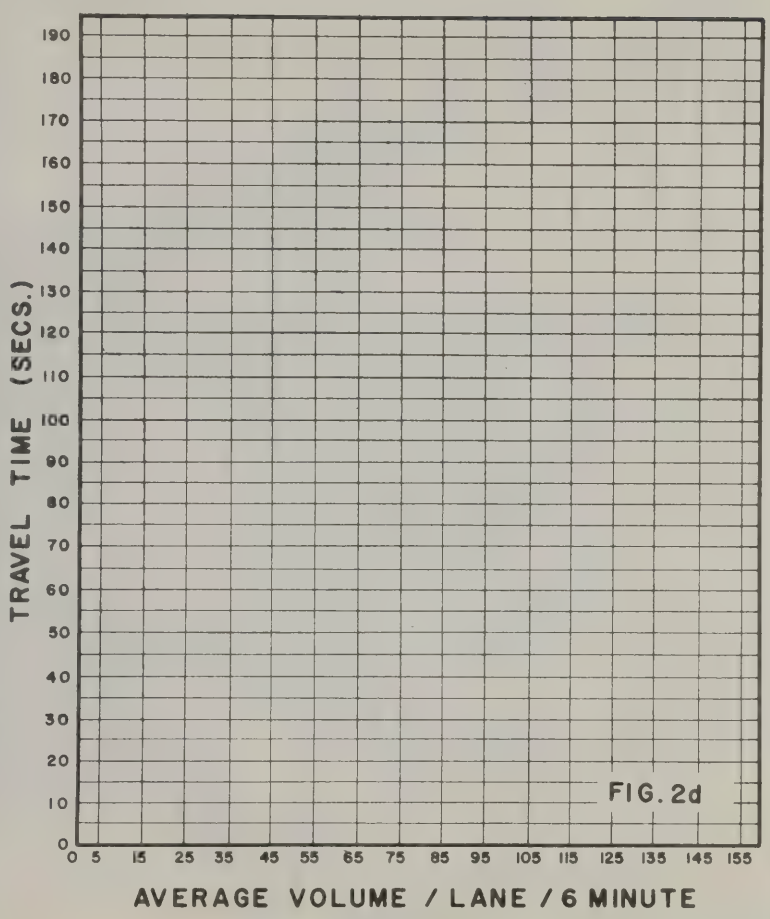


FIG. 2d

ROUTE 1 AND ROUTE 18

Posted Speeds: Route 1 - 50 mph
Route 18 - 45 mph

Comments by W. R. Bellis:

This is a modified cloverleaf in that one of the left turns is made by way of a semi-directional left turn movement. This eliminates two of the four weaving areas but in so doing, increases the cost of the intersection because of the additional bridge needed.

Forty-six percent of the traffic is turning movement traffic. This compared with 39 percent for the average of the 4 cloverleaf interchanges and 27 percent for the average of the 30 intersections.

The accident and injury rates were not as good as one would expect for this type of intersection. Two signalized intersections had better rates. Two partial cloverleafs had better rates, and two of the other cloverleafs had better rates. Many of the accidents happened at weaving areas, entrances to ramps and exits from ramps.

Route 18 westbound, overpassing Route 1, is on a horizontal and vertical curve, which reduces the sight distance. The situation is further compounded, because there is a weave area,just over the crest vertical curve. The eastbound overpass for Route 18 is also on a horizontal curve with a short sight distance, at the end of which a decision must be made. These factors may contribute to the concentration of accidents in these areas.

Fifty-seven percent of the accidents are rear-end accidents, compared with 53 percent for the 13 traffic signal locations, and 54 percent for the average of all intersections studied. Only 6 of the 30 intersections have a higher percentage of rear-end accidents. Eighteen percent of the accidents are sideswipes, compared with an average of 6 percent for the 4 cloverleafs, 8 percent for the 13 traffic signal locations, and 11 percent for the average of all 30 intersections. Only 4 of the 30 intersections have a higher percentage of sideswipes. This site has the best record of all 30 intersections as far as right-angle accidents are concerned.

This intersection ranks number two for the overall travel time including all movements. The semi-directional left turn movement indicates a saving of up to 20 seconds compared to the inside loop movement.

Overall, this intersection ranks number one in efficiency followed by the cloverleaf at Routes 1 and 35 and the cloverleaf at Route 1 and Milltown Road. From 1937 to 1953 this intersection was a traffic circle. Then, the pavement was built straight through the circle for Route 1, and traffic signals installed at the two cross points with all turning movements made by way of the circle.

Route 1 is 1.2 miles long in New Brunswick with no other intersections. It would be expected that the grade separation would produce a reduction in accidents, injuries and fatalities. This has not been borne out. The injury rate for 1966 was higher than for any previous year since 1937. There is a continual upward trend in spite of the construction improvements. A diagram of the injury rate is included.

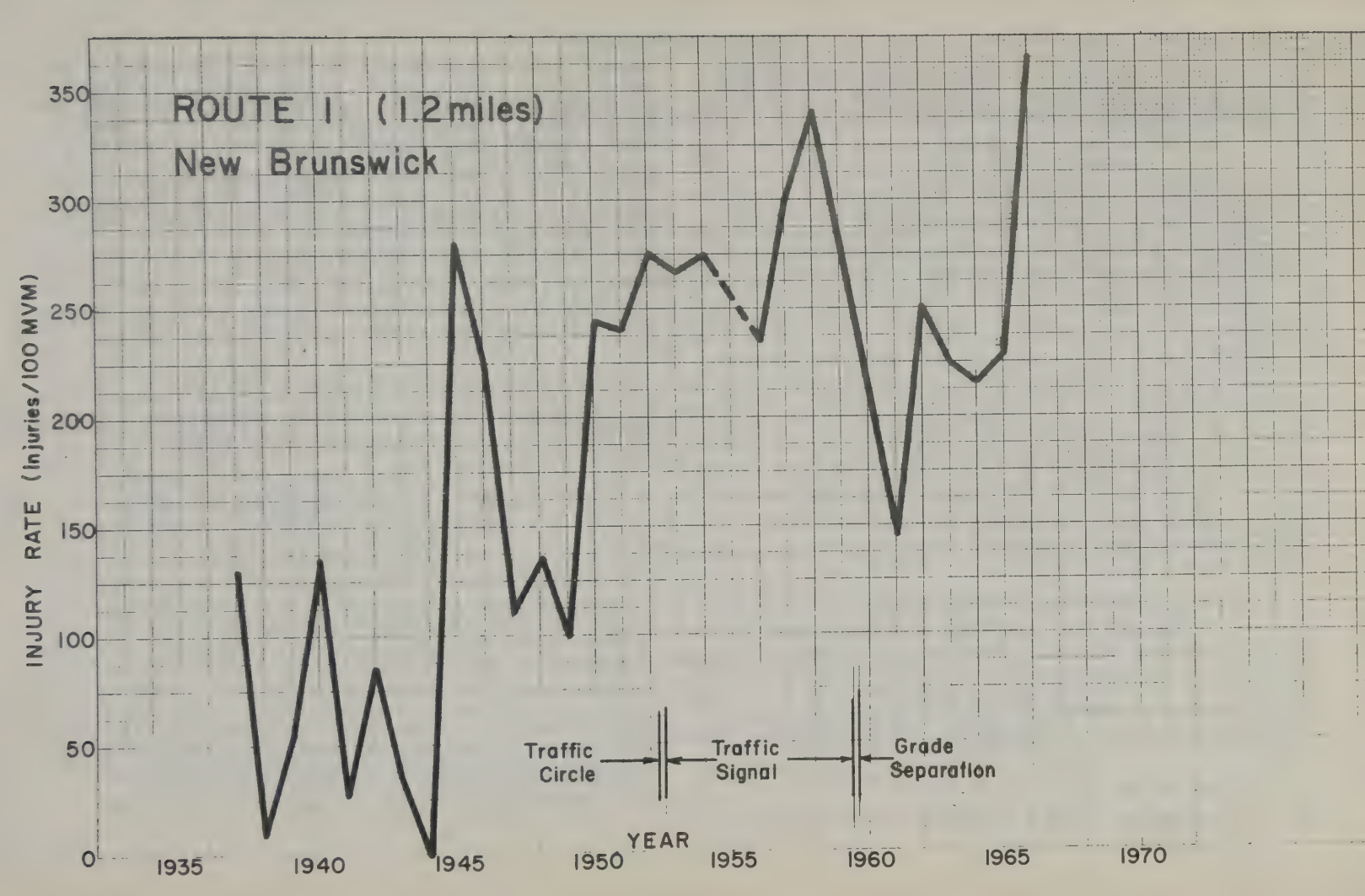

ROUTE 1 (1.2 miles)
New Brunswick
INJURY RATE (Injuries/100 MVM)
350
300
250
200
150
100
50
0
1935
1940
1945
1950
1955
1960
1965
1970
YEAR
Traffic Circle
Traffic Signal
Grade Separation

PHOTO 3

N.J. Routes 4 and 17

Cloverleaf

Year of Construction: 1933

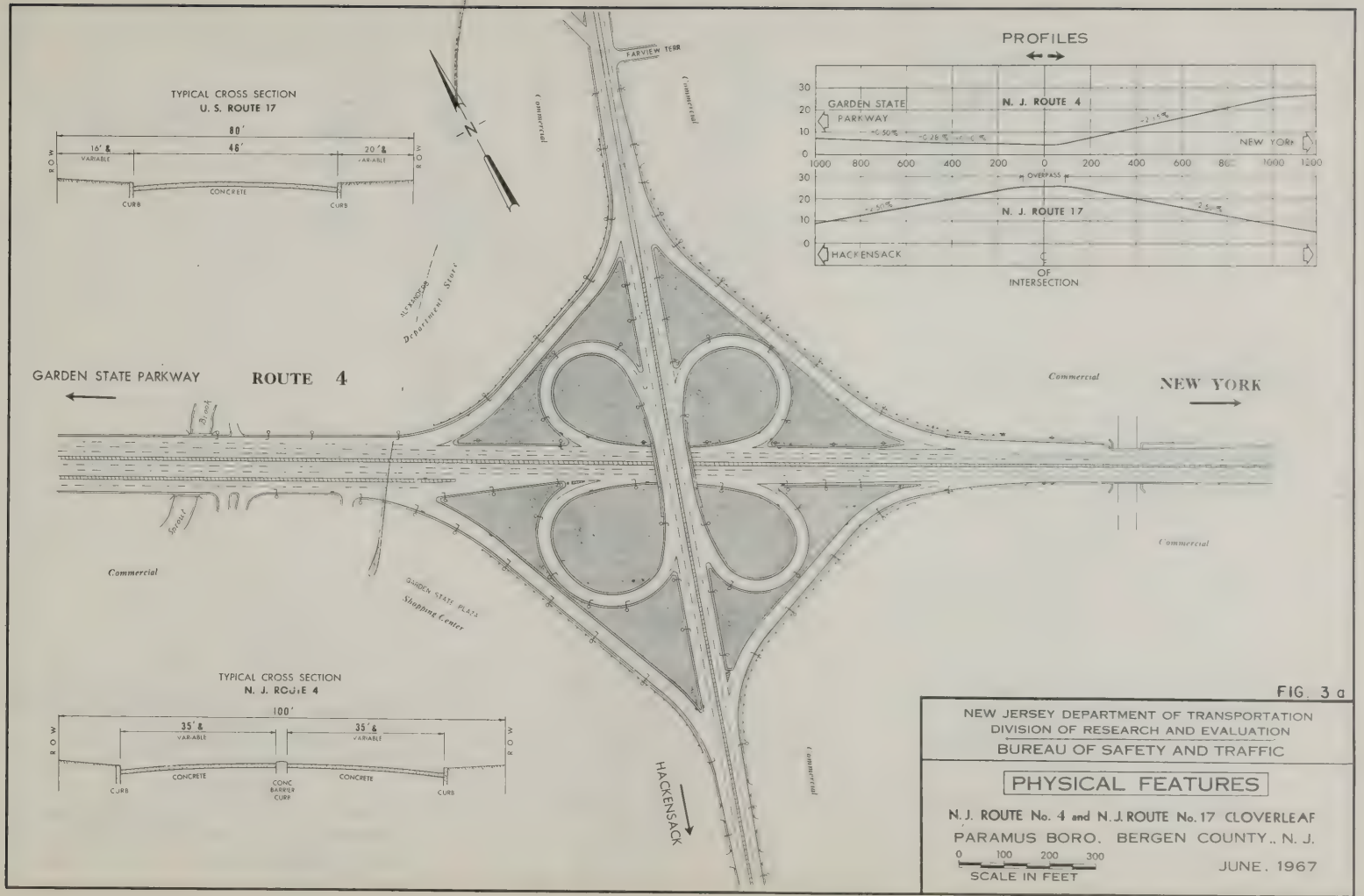


FIG. 3 a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

N. J. ROUTE No. 4 and N. J. ROUTE No. 17 CLOVERLEAF
PARAMUS BORO. BERGEN COUNTY., N. J.

0 100 200 300
SCALE IN FEET

JUNE. 1967

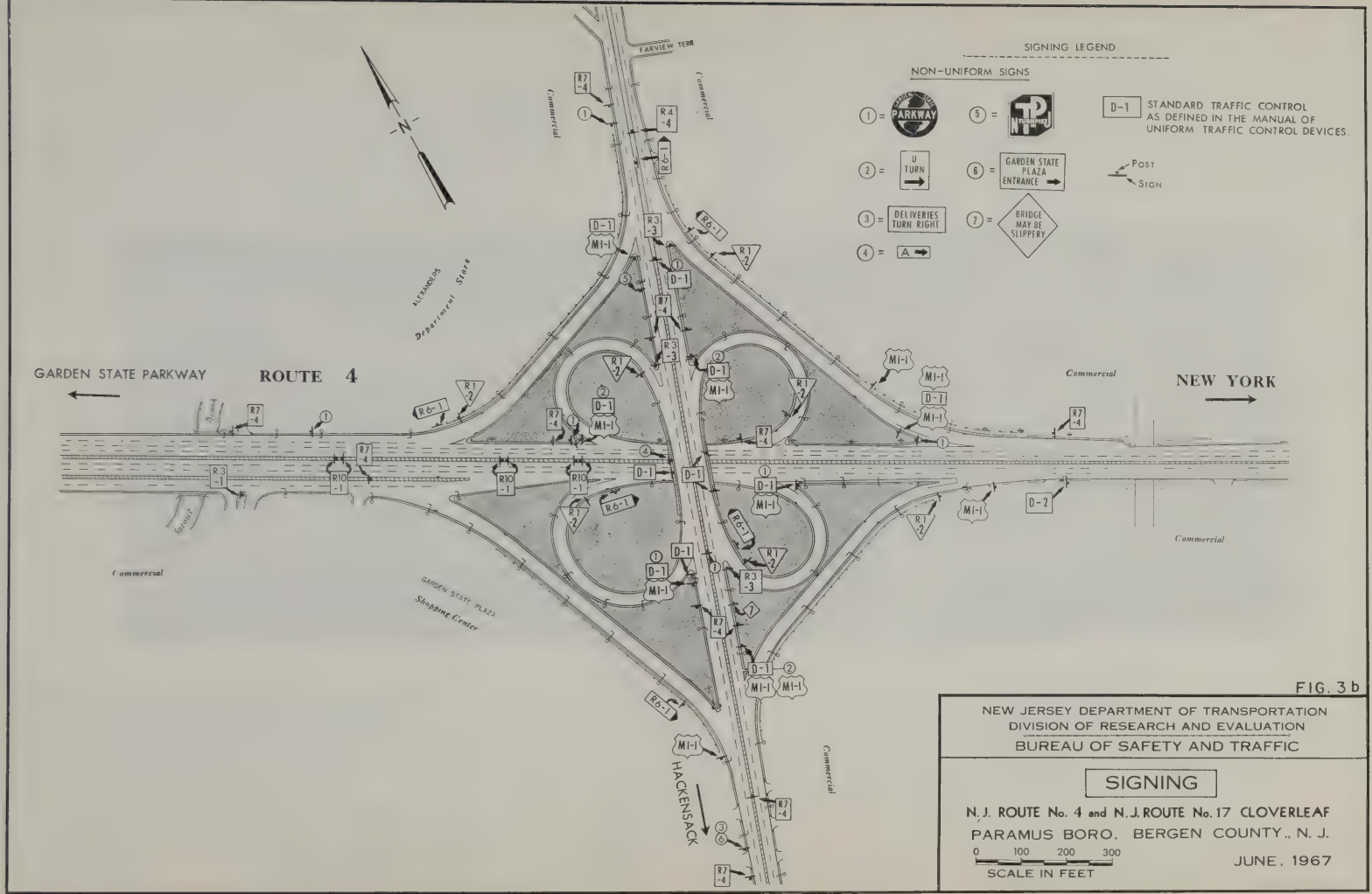
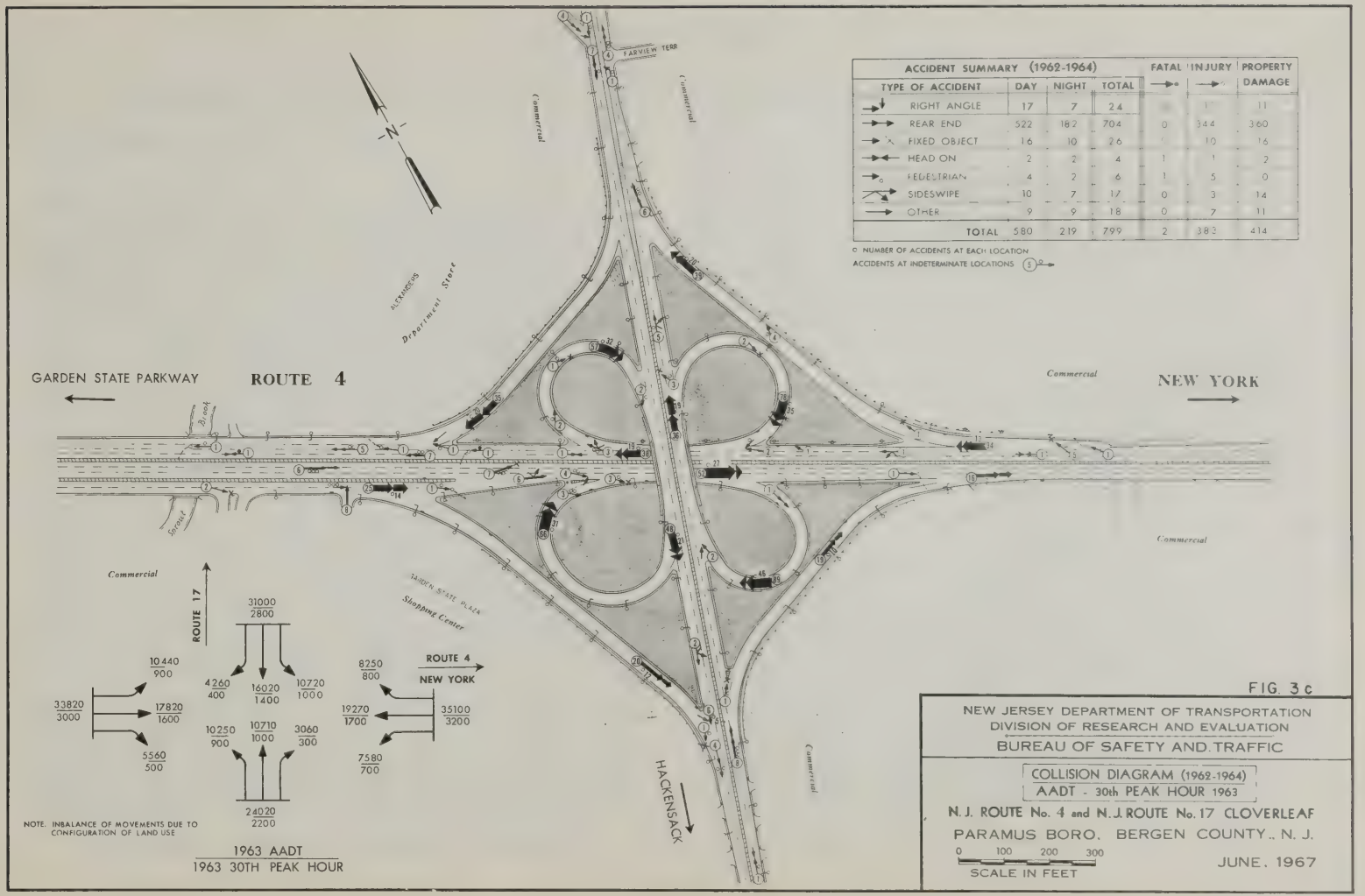


FIG. 3 b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

N. J. ROUTE No. 4 and N. J. ROUTE No. 17 CLOVERLEAF
PARAMUS BORO, BERGEN COUNTY, N. J.
0 100 200 300
SCALE IN FEET
JUNE, 1967



ACCIDENT SUMMARY (1962-1964) TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	FATAL	INJURY	PROPERTY DAMAGE
RIGHT ANGLE	17	7	24	0	13	11
REAR END	522	182	704	0	344	360
FIXED OBJECT	16	10	26	1	10	16
HEAD ON	2	2	4	1	1	2
PEDESTRIAN	4	2	6	1	5	0
SIDESWIPE	10	7	17	0	3	14
OTHER	9	9	18	0	7	11
TOTAL	580	219	799	2	383	414

○ NUMBER OF ACCIDENTS AT EACH LOCATION
ACCIDENTS AT INDETERMINATE LOCATIONS (5)—2→

FIG. 3c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

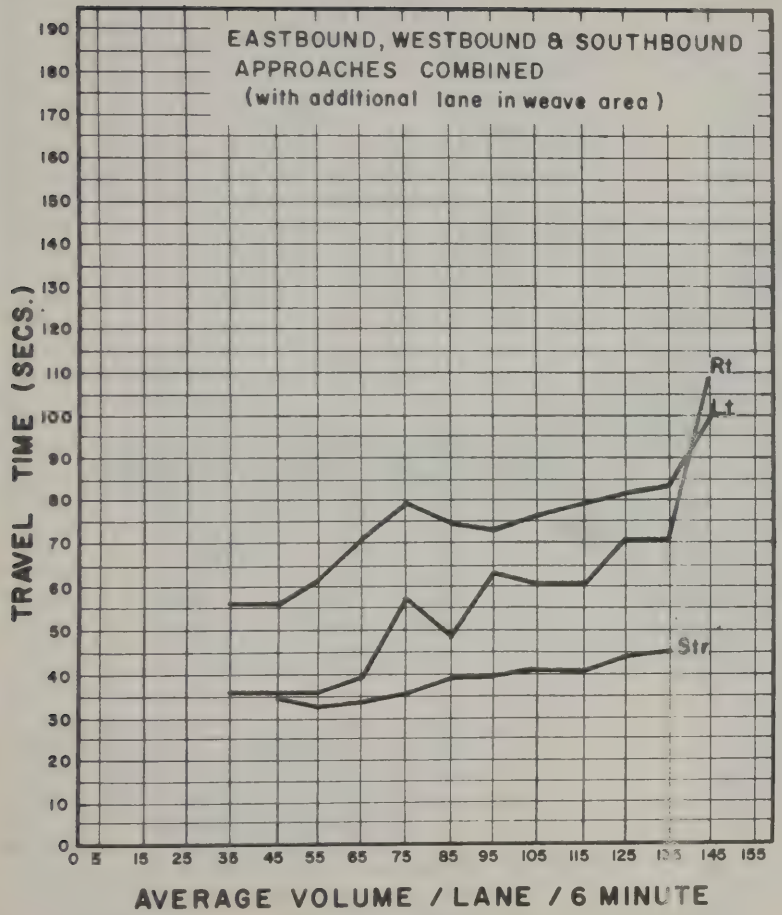
COLLISION DIAGRAM (1962-1964)
AADT - 30th PEAK HOUR 1963

N. J. ROUTE No. 4 and N. J. ROUTE No. 17 CLOVERLEAF
PARAMUS BORO. BERGEN COUNTY., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1967

ROUTES 4 & 17



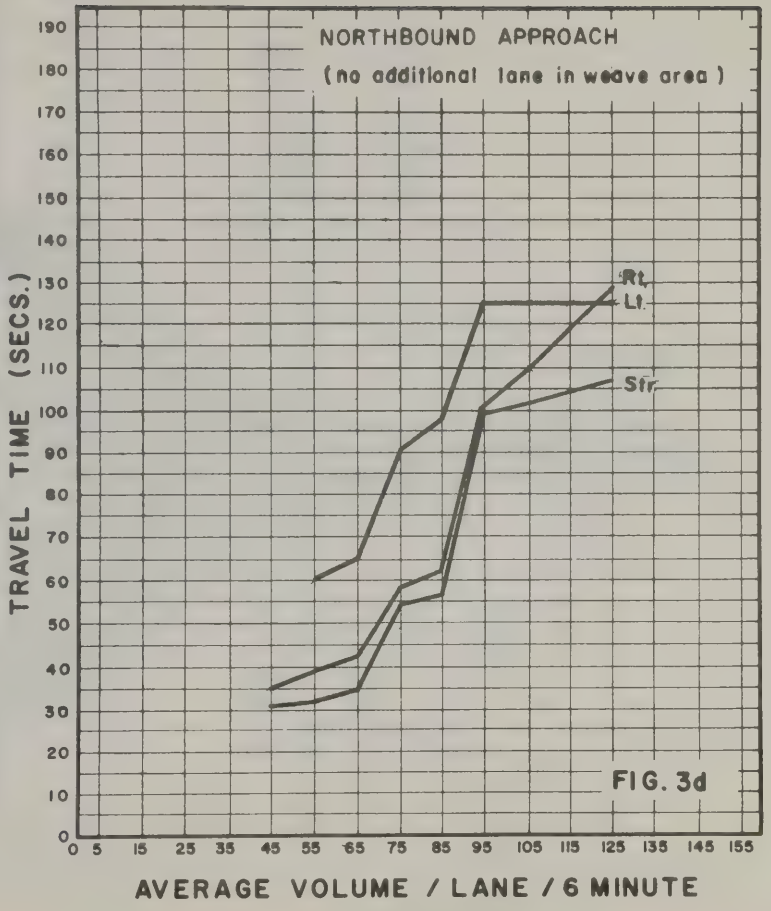


FIG. 3d

ROUTE 4 AND ROUTE 17

Posted Speeds: Route 4 - 50 mph
Route 17 - 50 mph

Comments by W. R. Bellis:

This intersection was built in 1933 with a larger turning radius for the inside loops than that for the Routes 1 and 35 cloverleaf. This intersection carries the heaviest volume of any of the intersections studied. It also has the largest volume of turning traffic, 48 percent of the total traffic. The average turning movement for the 30 intersections is 27 percent. The only two intersections having larger turn percentages are Routes 1&9T and 440, and Route 206 and White Horse Avenue, both of which are special designs favoring the heavy turning movements.

As indicated by the slowing up of traffic during heavy volume hours, the intersection is well over capacity. This is also reflected in the very bad accident and injury rates. The accident rate is exceeded by only one traffic circle and 3 signalized intersections. The injury rate is exceeded by only 4 signalized intersections. In 1963 the average daily traffic volume using the intersection was 123,940. The AADT has grown to 147,620 in 1968, almost 54,000,000 in the year, so it can be expected that the accident experience is much worse than it was in 1963.

Eighty-eight percent of the total accidents were rear-end accidents. This is the highest percentage of the intersections studied and can be associated with congestion. Rear-end accidents for the average of the 13 signalized intersections amounted to 53 percent. We generally think of traffic signals as being a source of rear-end accidents. The average of the 30 intersections had 54 percent rear-end accidents.

Sideswipe and right-angle accidents amounted to a small percentage. Twenty-seven percent of all accidents occurred at nighttime, compared to 35 percent for the average of the 30 intersections. The large shopping centers close-by contribute to the large volume of traffic but the accidents do not seem to be generated at the accesses to the shopping center.

A redesign of the intersection would be necessary to reduce the accidents. Directional left turn movements should replace the inside loop movements for the Route 17 southbound to Route 4 eastbound movement and for the northbound Route 17 to westbound Route 4 movement. During peak hours vehicles are being slowed down to 12 mph, on the average through the 2,000 foot distance.

Excessive delays because of the traffic congestion runs up as high as 95 seconds. Route 4 has been considered to be over-capacity for several years and influenced partly by this, Interstate Route 80 was planned parallel to Route 4 and also parallel to Route 46 in this area. Route 4 and Route 46 are about 3 miles apart and parallel. Interstate 80 varies from one to two miles away from each of these roads and was opened to traffic in 1965. The traffic volume on the Routes 4 and 17 cloverleaf was not reduced by the construction of Interstate 80. The volume increased about 20 percent, which is normal for the 4-year period. Between 1964 and 1968, although there was a shifting of traffic, Route 17 increasing more than normal and Route 4 increasing less than normal, it

is interesting to note that the George Washington Bridge during this period increased 39,800 cars per average day. West of the George Washington Bridge, the increase was 41,830 on the Route 4, 46 and I-80 combination, or about a 40,000 car increase on both the George Washington Bridge and the roads west of it. However, 6 miles further to the west, just east of Route 17, the increase was 74,740. The increase on the George Washington Bridge was 28 percent and the increase just east of Route 17 was 63 percent. The normal increase should be around 20 percent. This indicates that I-80 has generated a large amount of local traffic by virtue of taking traffic off of the over-congested Route 4 permitting an increase in local traffic which previously had been retarded. The sketch attached indicates these volume changes. It does not seem that another road parallel to either Route 4 or Route 17 would remedy the situation.

PHOTO 4

U.S. Route 1-9 and N.J. Route 35

Cloverleaf

Year of Construction: 1928

Photographed 5/18/67 - 1700 hours
600' Altitude, Looking West

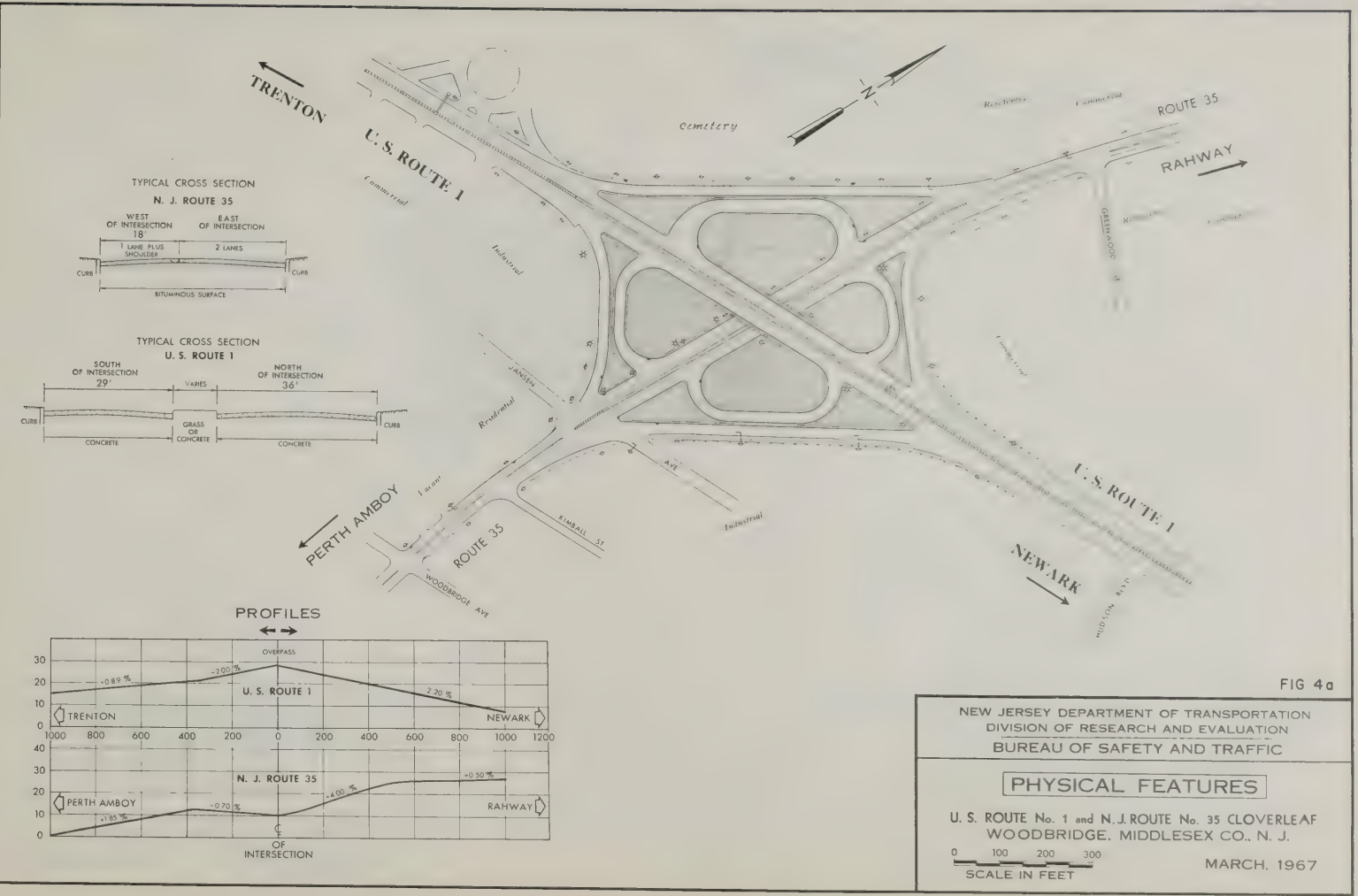


FIG 4a

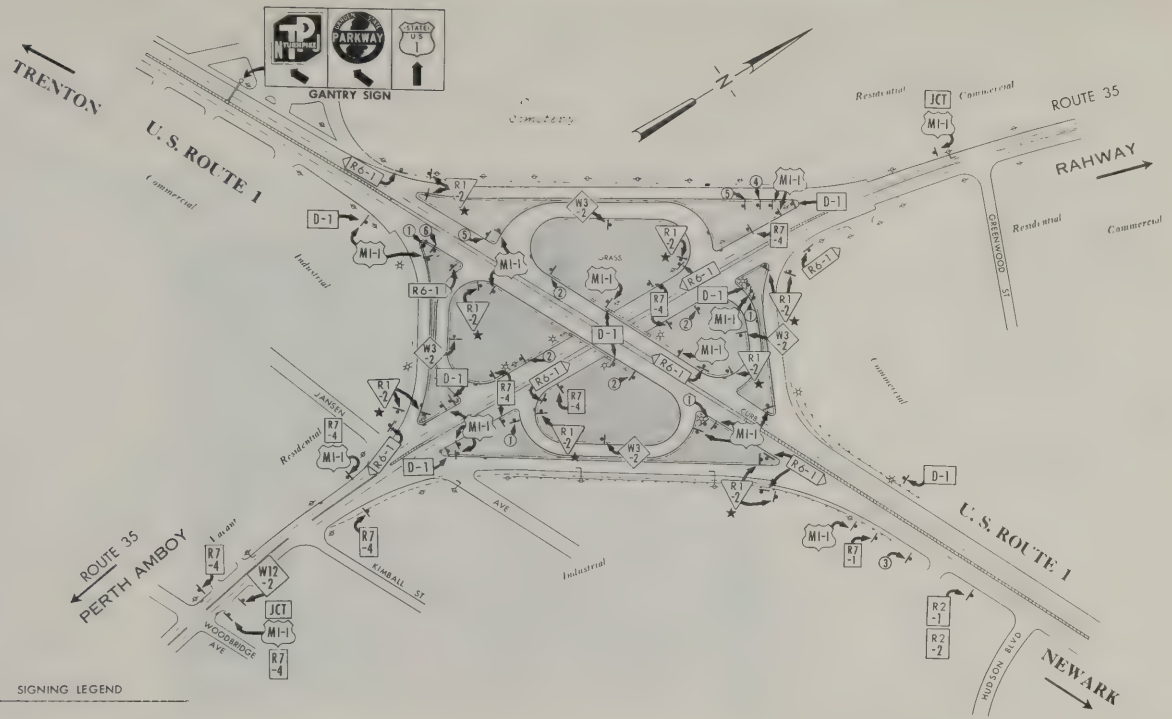
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE No. 1 and N. J. ROUTE No. 35 CLOVERLEAF
WOODBRIDGE, MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

MARCH, 1967



SIGNING LEGEND

NON-UNIFORM SIGNS

① = FOR U TURN FOLLOW BLUE SIGN

② = RAMP SPEED 15

③ = SPEEDERS LOSE LICENSES

④ = NJ TURNPIKE

⑤ = PARKWAY

⑥ = BRIDGE MAY BE SLIPPERY

★ = YIELD RIGHT OF WAY

D-1 = STANDARD TRAFFIC CONTROL AS DEFINED IN THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.

Post
Sign

FIG 4b

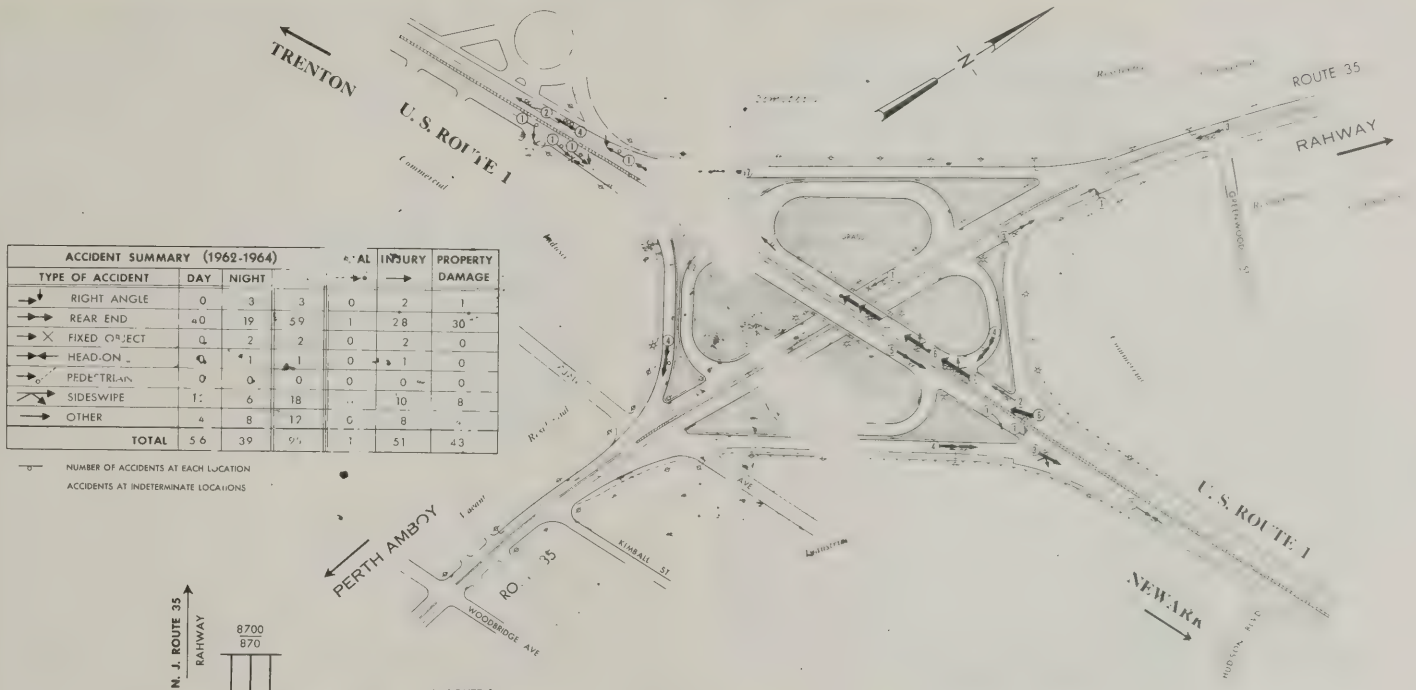
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. ROUTE No. 1 and N. J. ROUTE No. 35 CLOVERLEAF
WOODBRIDGE, MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

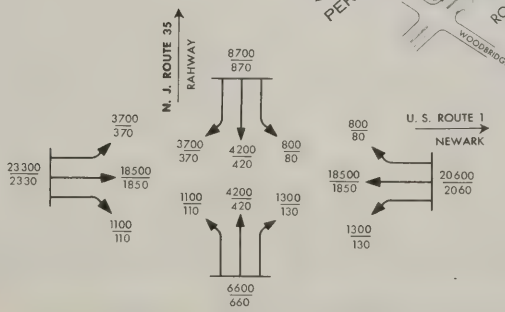
MARCH, 1967



ACCIDENT SUMMARY (1962-1964)				FATAL	INJURY	PROPERTY DAMAGE
TYPE OF ACCIDENT	DAY	NIGHT				
RIGHT ANGLE	0	3	3	0	2	1
REAR END	40	19	59	1	28	30
FIXED OBJECT	0	2	2	0	2	0
HEAD-ON	0	1	1	0	1	0
PEDESTRIAN	0	0	0	0	0	0
SIDESWIPE	12	6	18	0	10	8
OTHER	4	8	12	0	8	4
TOTAL	56	39	95	1	51	43

NUMBER OF ACCIDENTS AT EACH LOCATION

ACCIDENTS AT INDETERMINATE LOCATIONS



1963 AADT
1963 30TH PEAK HOUR

FIG 4c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

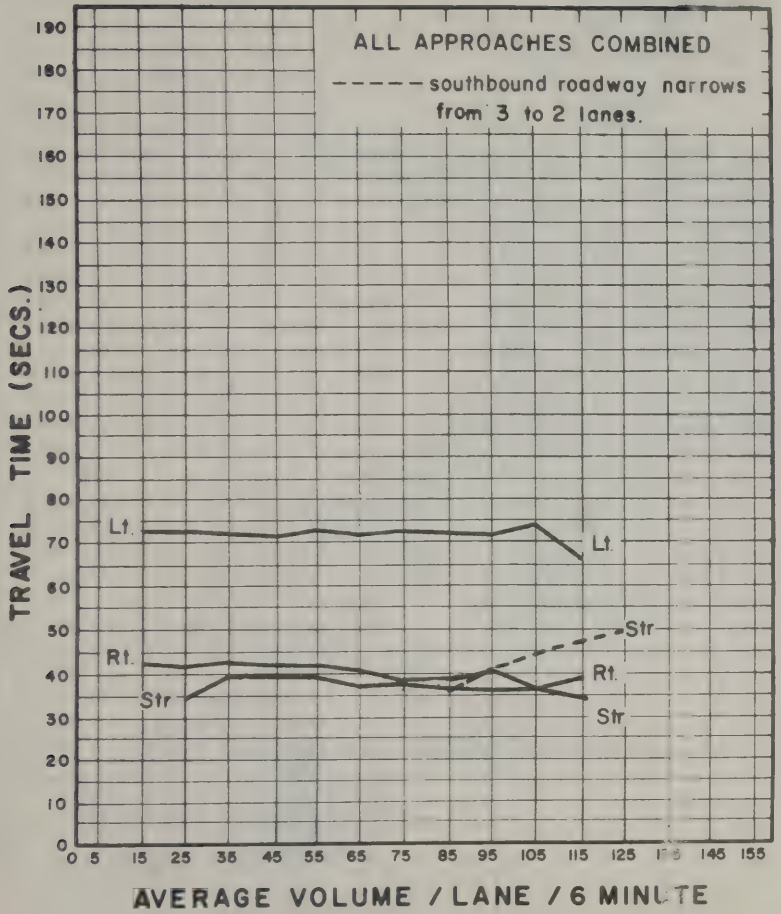
COLLISION DIAGRAM (1962-1964)
AADT - 30th PEAK HOUR 1963

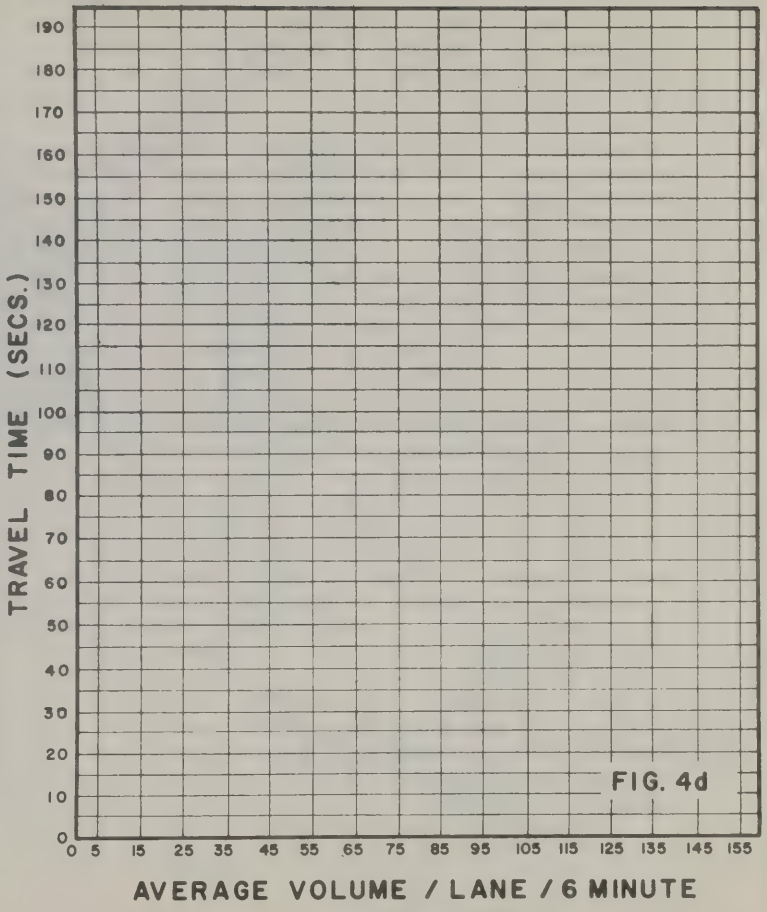
U. S. ROUTE No. 1 and N. J. ROUTE No. 35 CLOVERLEAF
WOODBRIDGE, MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

MARCH, 1967

ROUTES I-9 & 35


ALL APPROACHES COMBINED
----- southbound roadway narrows from 3 to 2 lanes.
TRAVEL TIME (SECS.)
AVERAGE VOLUME / LANE / 6 MINUTE
Lt.
Lt.
Str
Rt.
Rt.
Str
Str


TRAVEL TIME (SECS.)
AVERAGE VOLUME / LANE / 6 MINUTE
FIG. 4d

ROUTE 1&9 & ROUTE 35 (WOODBRIDGE CLOVERLEAF)

Posted Speeds: Route 1 - 50 mph
Route 35 - 40 mph

Comments by W. R. Bellis:

This intersection, built in 1928 at a construction cost of $565,776 included 3.8 miles of Route 1. It was shortly nicknamed by newspaper writers as a "cloverleaf" and was the first cloverleaf ever built. A 1932 illustration had the following comment: "Normal weekday traffic through the intersection approximately 3,000 per day; peak traffic 62,927 per day of 16 hours. Maximum hour 6,054; turning traffic about 23 percent of total. Some imperfections in layout were apparent after a short period of operation. Unnatural method of accomplishing left turn confusing to uninitiated drivers."

In 1963, there were 59,200 cars an average day, 23 percent of which was turning traffic, the same as the percentage 32 years previously, in spite of the fact that parallel routes have been constructed in the meantime, materially adjusting the traffic volume streams. In 1969 there were about 73,000 cars per average day. The accident and injury rates are the second best of the four cloverleafs studied. The intersection of Route 1 and Milltown Road is the only cloverleaf that was better.

On the basis of the accident rate, this intersection ranks number three of all 30 intersections studied, and sixth for injury rate. The accident rate is better than, and the injury rate is equal to, the rates at Routes 1 and 18, which is a more modern design. The fact that over 50 percent of the accidents occur in the weaving, diverging and merging areas indicate that this might be a weakness in the design. However, note that the Route 1 roadway toward Trenton narrows from 3 to 2 lanes. Later designs have made the weaving areas wider and the merging and diverging points much smoother but, as indicated at the intersection of Routes 1 and 18, the accident problem has not been overcome (33 percent of the accidents occurred at the merge and diverge points).

Sixty-two percent of the accidents at Routes 1 and 35 are rear-end accidents. This is a higher percentage than at the intersection of Route 1 and Milltown Road or at Routes 1 and 18, and is equal to or exceeded by only three signalized locations, Route 1&9 and Wood Avenue, Route 1 and Ryders Lane, and Route 22 and New Providence Road, the two latter being jughandles, and also exceeded by the cloverleaf at Routes 4 and 17. For the average of the 30 intersections, 54 percent of the accidents were rear-ends.

Eighteen percent of the accidents at Routes 1 and 35 were sideswipes. This is also a high percentage, being exceeded by only 4 other intersections, 3 of which were traffic circles, and one signalized intersection. The average of the 30 intersections indicated that 11 percent of the total accidents were sideswipes.

Right-angle accidents at Routes 1 and 35 amounted to 3 percent compared to an overall average of 16 percent for the 30 intersections.

Forty-one percent of the accidents occurred at nighttime, compared to an average for the 30 intersections of 35 percent, and a low of 10 percent at the intersection of Routes 9 and 516. Highway lighting appears to be adequate.

The left turns on the inside loop are about 5 seconds slower than at the intersection of Route 1 and Milltown Road, and also 5 seconds slower than the left turns at Routes 1 and 18. It does not seem, therefore, that on the basis of accidents and travel time, the modern design cloverleafs have contributed a significant improvement in spite of the fact that they occupy a greater land area and more pavement. Since 1960, still larger cloverleafs have been designed and still larger and more complex grade separations have been constructed in order to reduce accidents and improve on travel times. It is of vital importance to determine to what degree design must be improved to produce safety and still preserve a minimum of time loss. This intersection is currently being threatened with a redesign at which time we would lose a valuable means of comparison.

The overall ranking out of the 30 intersections is 2.

PHOTO 5

U.S. Route 9 and Route 516

Partial Cloverleaf

Year of Construction: 1942

Photographed 5/17/68 - 0900 hours
500' Altitude, Looking South

Photographed 5/17/68 - 0900 hours
700' Altitude, Looking East

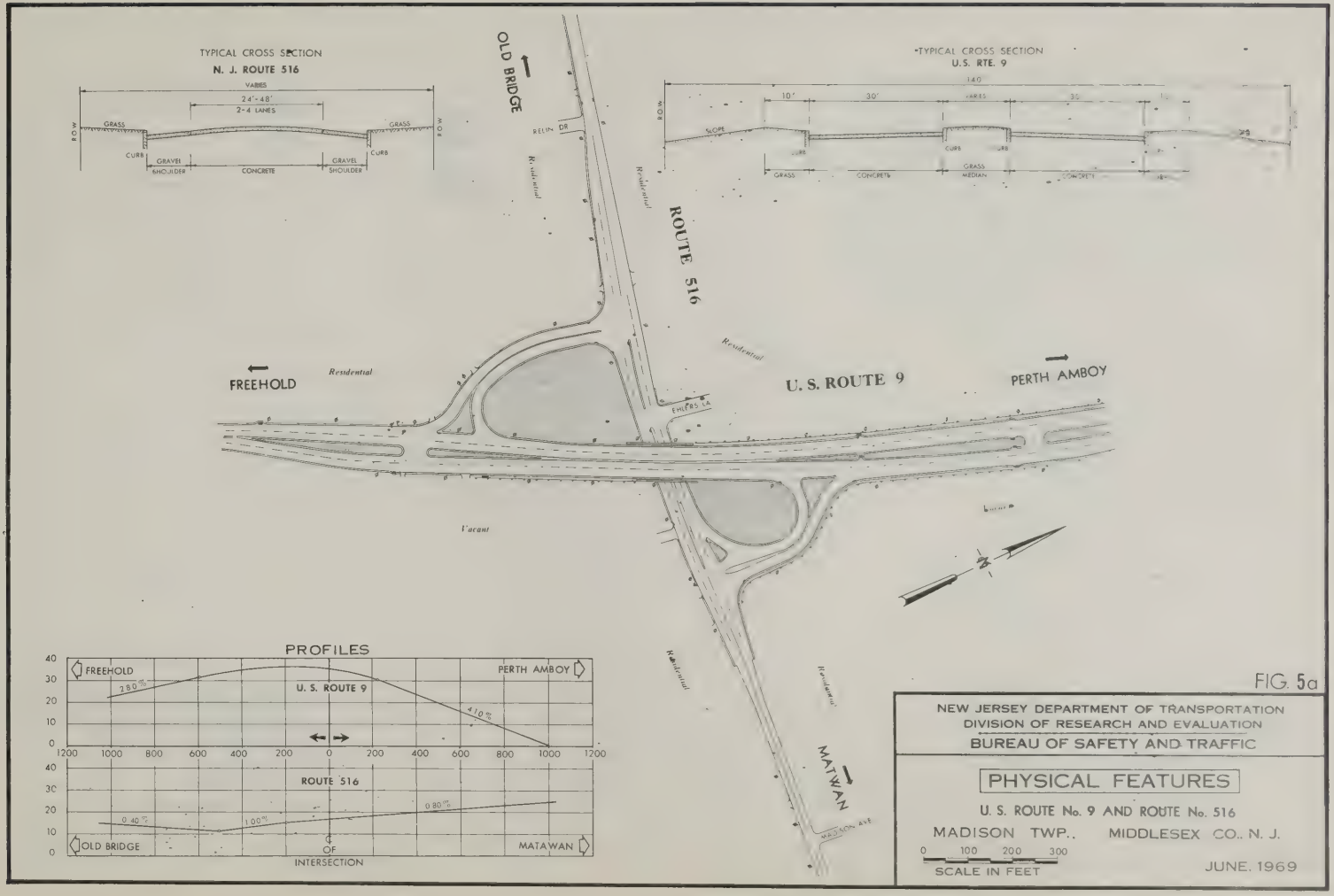


FIG. 5a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE No. 9 AND ROUTE No. 516
MADISON TWP., MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

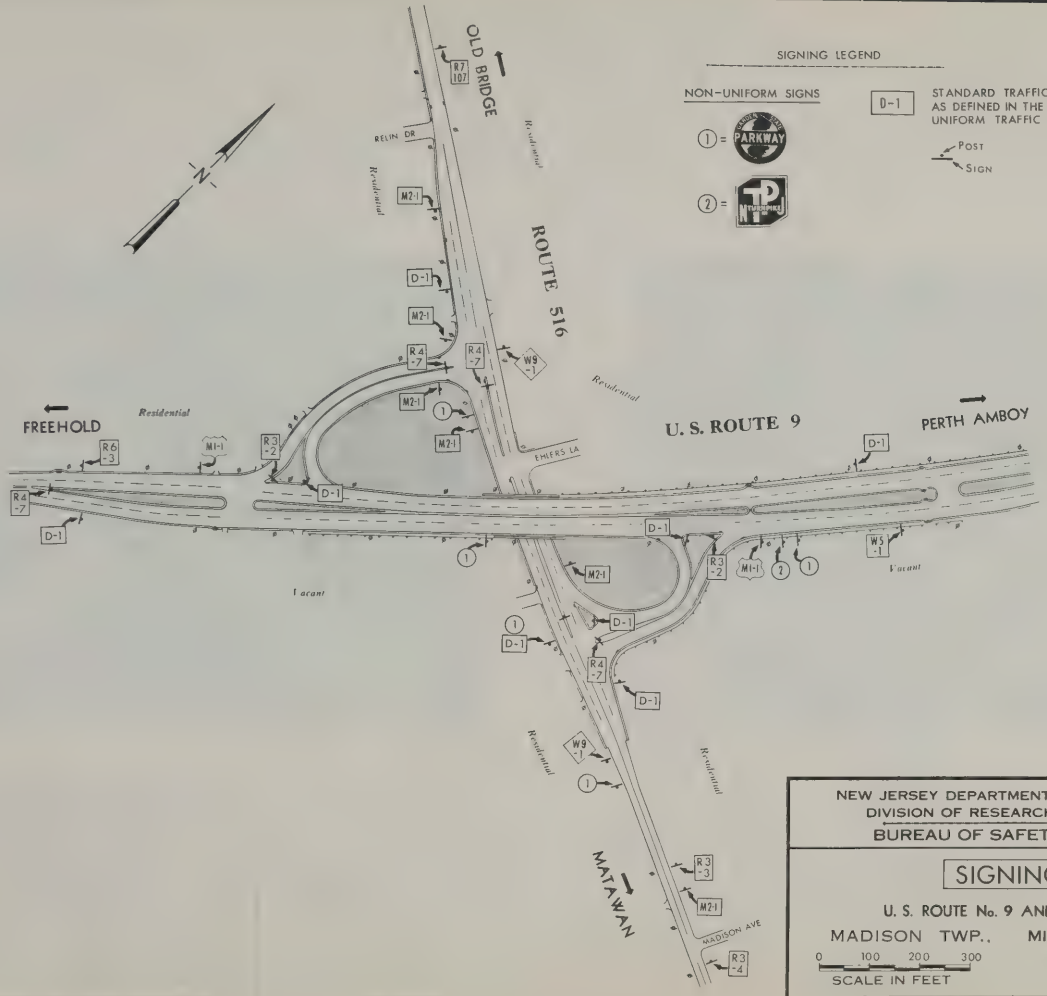


FIG. 5b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

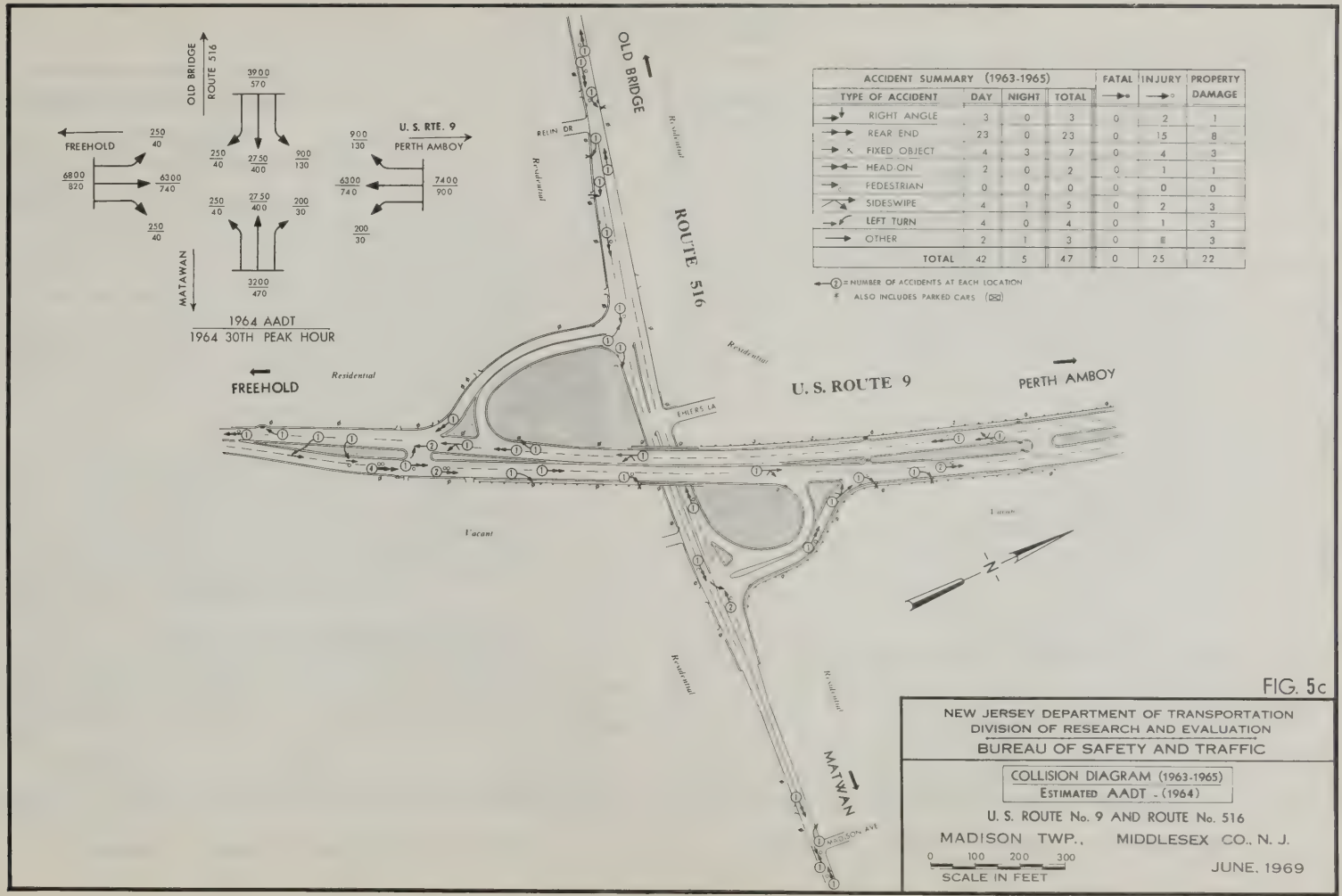
SIGNING

U. S. ROUTE No. 9 AND ROUTE No. 516

MADISON TWP., MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969



ACCIDENT SUMMARY (1963-1965)				FATAL	INJURY	PROPERTY
TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	→•	→○	DAMAGE
RIGHT ANGLE	3	0	3	0	2	1
REAR END	23	0	23	0	15	8
FIXED OBJECT	4	3	7	0	4	3
HEAD-ON	2	0	2	0	1	1
PEDESTRIAN	0	0	0	0	0	0
SIDESWIPE	4	1	5	0	2	3
LEFT TURN	4	0	4	0	1	3
OTHER	2	1	3	0	1	3
TOTAL	42	5	47	0	25	22

(2) = NUMBER OF ACCIDENTS AT EACH LOCATION
* ALSO INCLUDES PARKED CARS (P)

FIG. 5c

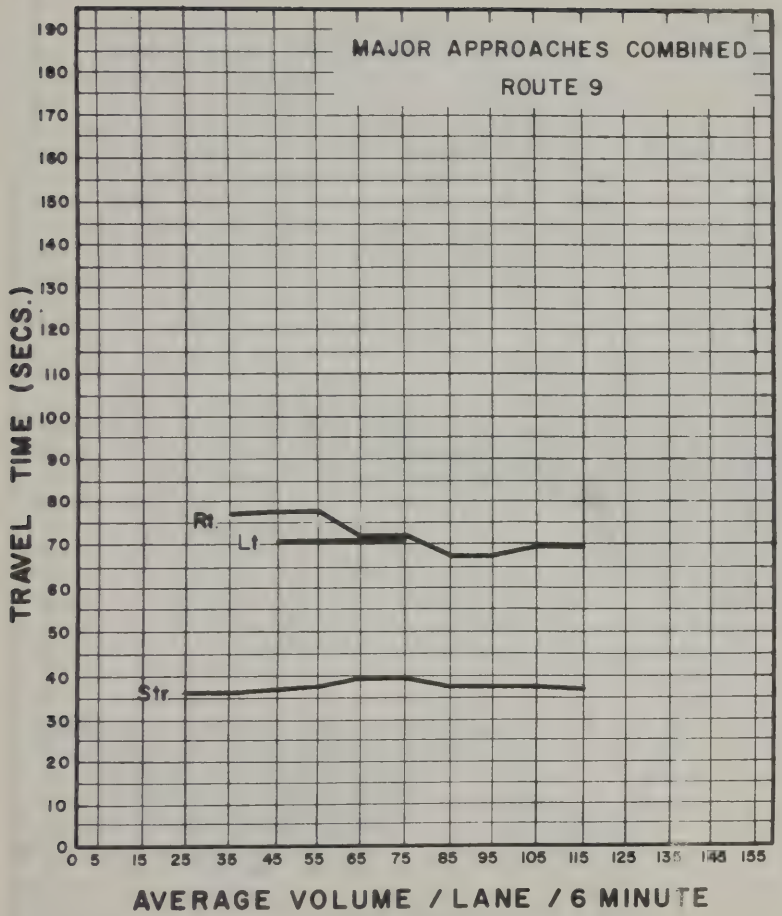
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

U. S. ROUTE No. 9 AND ROUTE No. 516
MADISON TWP., MIDDLESEX CO., N. J.

JUNE, 1969

ROUTES 9 & 516



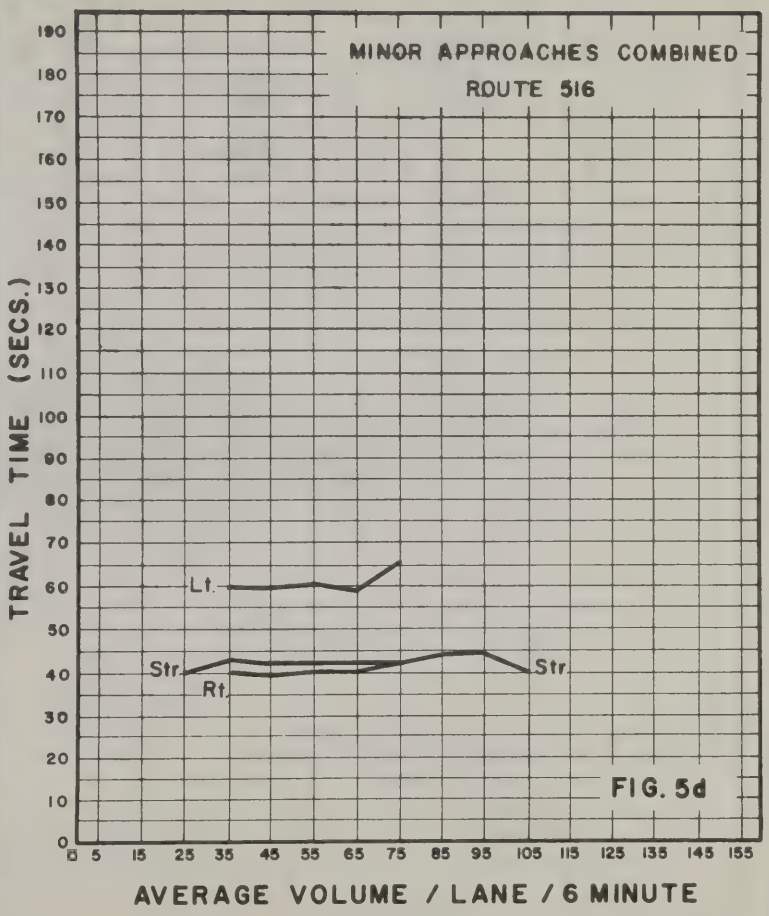


FIG. 5d

ROUTE 9 AND ROUTE 516

Posted Speeds: Route 9 - 50 mph
Route 516 - 50 mph

Comments by W. R. Bellis:

This intersection, built in 1942, carries a small amount of traffic. Only two of the intersections studied in this report carry less traffic.

The accident and injury rates are not good for a grade separated intersection. These rates are higher than any of the other grade separated intersections studied except the cloverleaf at Route 4 and Route 17 and the partial cloverleaf at Route 22 and Bloy Street, both of which are carrying volumes far in excess of their capacity.

Forty-eight percent of the accidents are rear-end accidents, compared to 54 percent for the average of the 30 intersections, and 52 percent for the average of the partial cloverleaf intersections. Ten percent of the accidents are sideswipes, compared to an average of 11 percent for the overall 30 intersections. Six percent of the accidents are right angle accidents compared to an average of 16 percent for the 30 intersections.

Only 10 percent of the accidents occur at night. This is the lowest nighttime accident percentage of all 30 intersections. The average for the 30 intersections is 35 percent with one intersection having 55 percent of the accidents at night.

There is an island opening at one of the ramp terminals. This is unnecessary and is an accident breeder.

The travel time for the straight through movement on the major highway is about the same as for the cloverleaf. The straight through movement on the minor road is about 6 seconds slower than that for a cloverleaf. This can be charged to the cross traffic. The right turns from the major highway are about 30 seconds slower than that for a cloverleaf but the right turns from the minor road are about the same as that for a cloverleaf. The left turns from the major highway are the same as for the cloverleaf and the left turns from the minor road are about 10 seconds faster than for a cloverleaf. In making these comparisons, the differences in turning movement paths, with those of a cloverleaf, should be noted.

PHOTO 6

U.S. Route 9 and Route 514

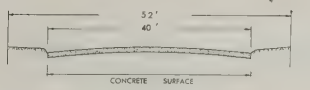
Partial Cloverleaf

Year of Construction: 1938

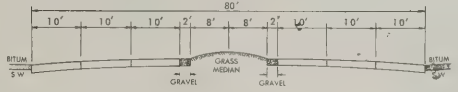
Photographed 5/17/68 - 0830 hours
500' Altitude, Looking North

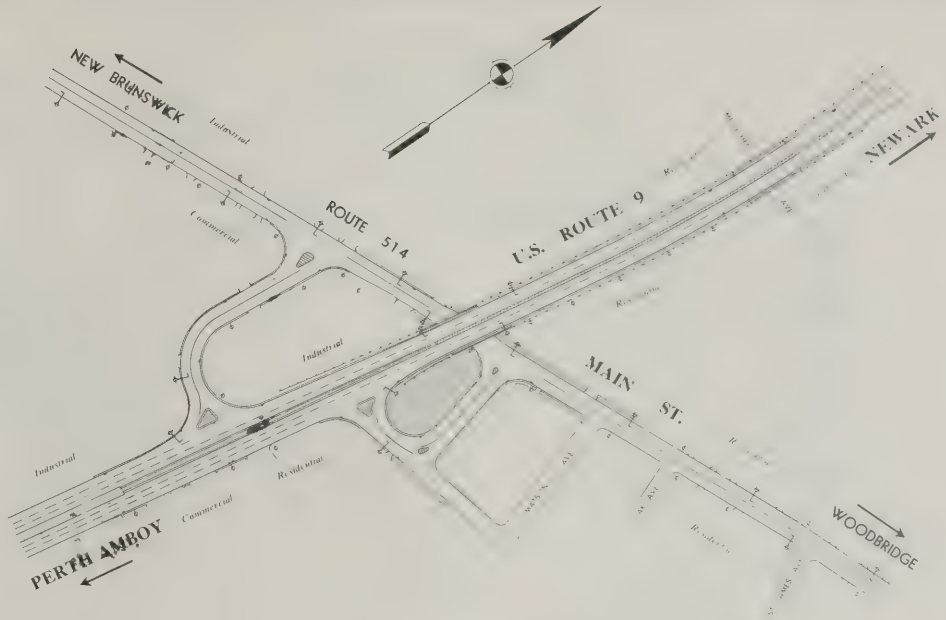
Photographed 5/17/68 - 0830 hours
800' Altitude, Looking Southwest

TYPICAL CROSS SECTION
RTE 514 (MAIN ST.)



TYPICAL CROSS SECTION
U.S. RTE. 9





PROFILES

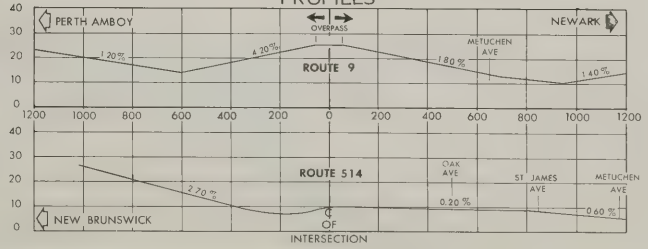


FIG. 6a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE 9 and RTE. 514 – MAIN STREET
WOODBRIDGE – MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

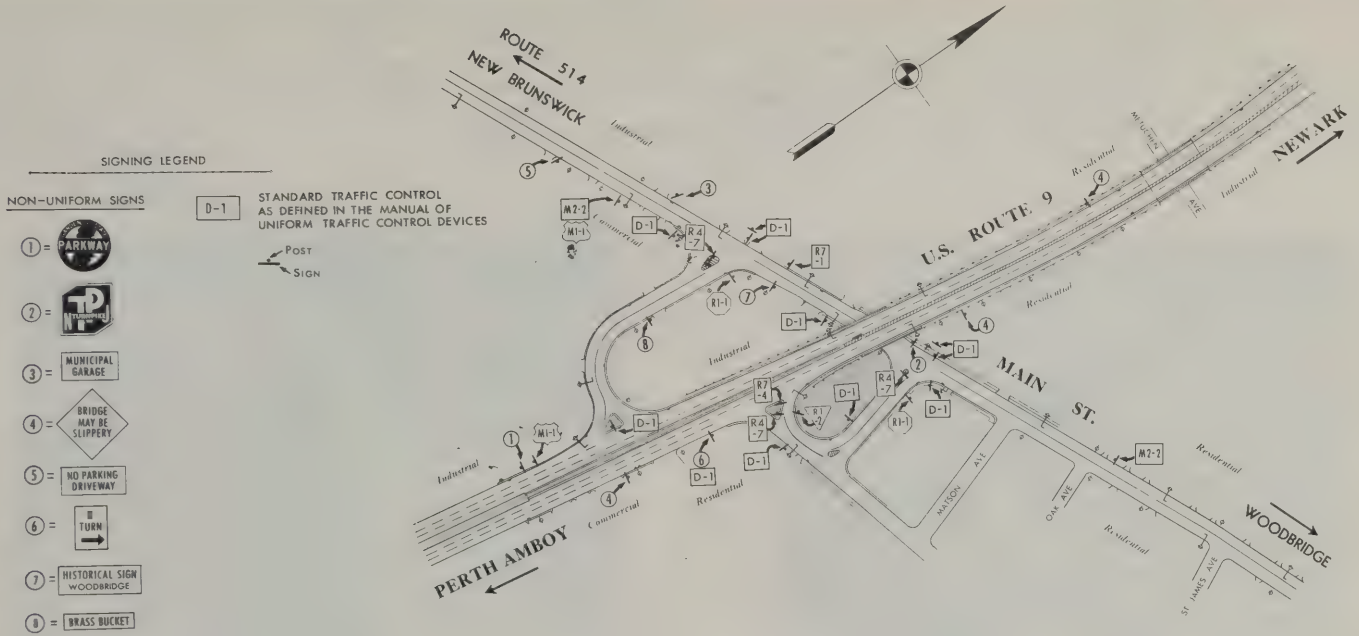


FIG. 6b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. ROUTE 9 and RTE. 514 – MAIN STREET
WOODBRIDGE – MIDDLESEX CO., N. J.

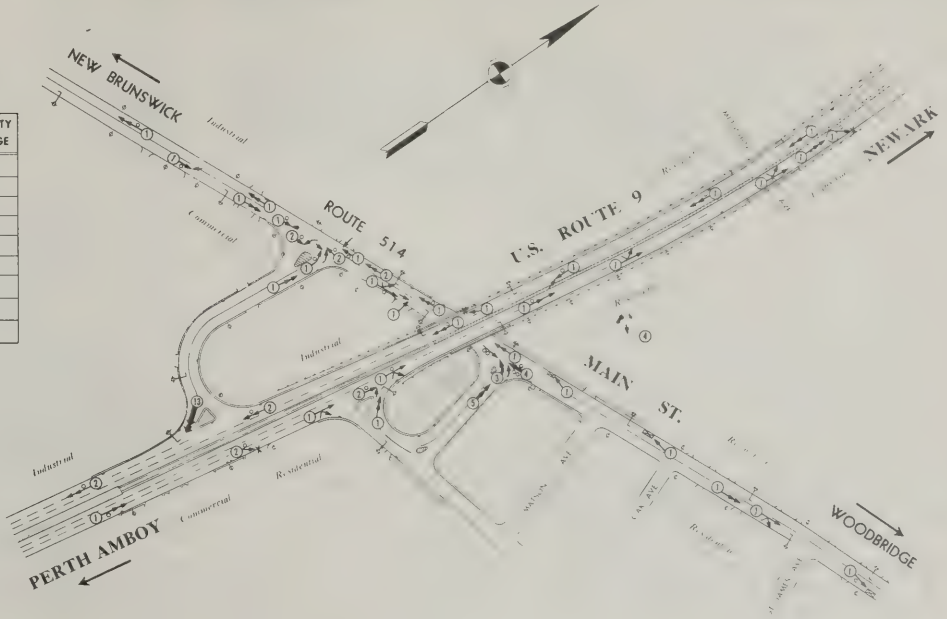
0 100 200 300
SCALE IN FEET

JUNE, 1969

ACCIDENT SUMMARY (1963-1965)				FATAL	INJURY	PROPERTY
TYPE OF ACCIDENT	DAY	NIGHT	TOTAL			DAMAGE
RIGHT ANGLE	8	6	14	0	9	5
REAR END	26	12	38	0	20	18
FIXED OBJECT	2	5	7	0	3	4
HEAD-ON	1	2	3	0	3	0
PEDESTRIAN	0	0	0	0	0	0
SIDESWIPE	4	2	6	0	3	3
LEFT TURN	1	1	2	0	1	1
OTHER	0	0	0	0	0	0
TOTAL	42	28	70	0	39	31

(1) = NUMBER OF ACCIDENTS AT EACH LOCATION

* ALSO INCLUDES PARKED CARS (⊠)



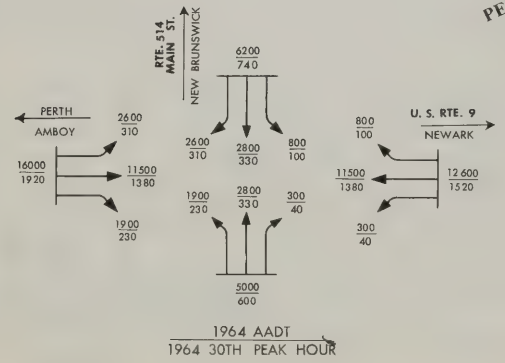


FIG. 6c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

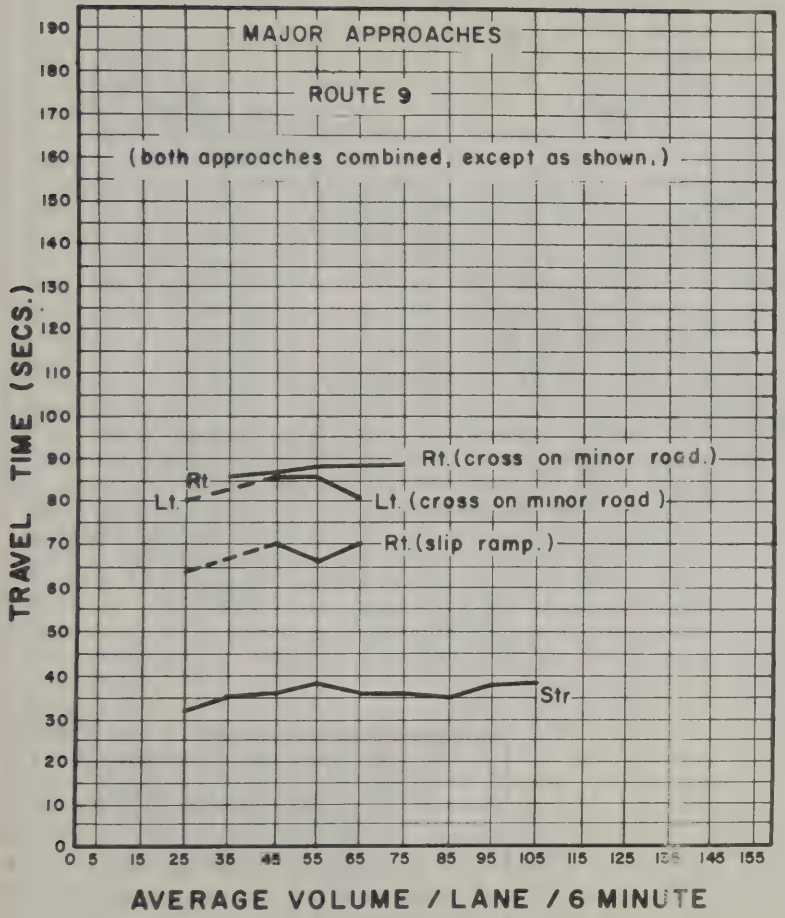
COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

U. S. ROUTE 9 and RTE. 514 – MAIN STREET
WOODBRIDGE – MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTES 9 & 514



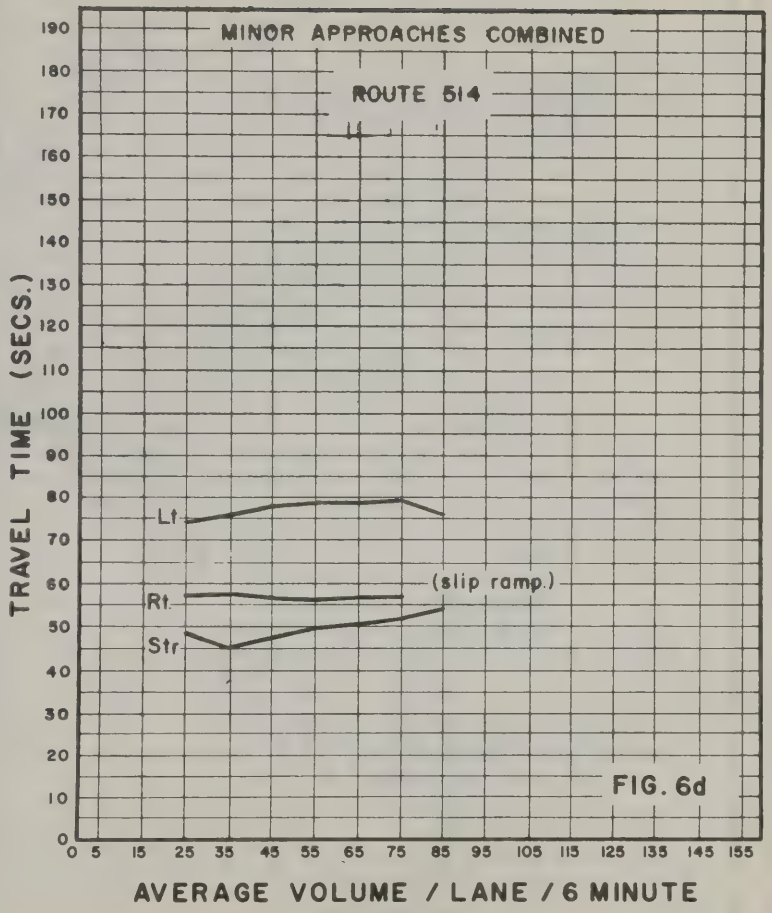


FIG. 6d

ROUTE 9 AND ROUTE 514

Posted Speeds: Route 9 - 50 mph
Route 514 - 25 mph

Comments by W. R. Bellis:

This intersection, built in 1938, has ramps in two quadrants permitting cross traffic on the minor road. The turning movement percentage is 28, compared to 27 percent for the average of all 30 intersections.

Fifty-four percent of the accidents are rear-end accidents, which is almost equal to the average of 53 percent for the 13 signalized intersections. Eight percent of the accidents are sideswipes, compared to an average of 8 percent for the signalized intersections, and 11 percent for the average of the 30 intersections. Twenty percent of the accidents are right-angle accidents, which is almost equal to the 19 percent for the 13 signalized intersections, and compares to 16 percent for the average of the 30 intersections. Forty percent of the accidents occur at nighttime, compared with an overall average of 35 percent for the 30 intersections.

From the major approaches, the straight through traffic is the fastest of all 30 intersections. The right turns are relatively slow, ranking 24 out of 30. The right turns on the outer ramp average 67 seconds, and on the loop ramp, where cross traffic exists, the average is 87 seconds. The right turns take 30-40 seconds longer than those on the full cloverleaf. The left turns from the major roadway, crossing at the minor road, are about 10 seconds slower than on a cloverleaf. From the minor road approaches, the straight through and right turn movements (slip ramp) require about 15 seconds longer than those on a cloverleaf, but the left turns take up to 5 seconds longer than on a cloverleaf.

Most of the accidents occur at ramp terminals.

PHOTO 7

N.J. Route 17 and Farview Avenue

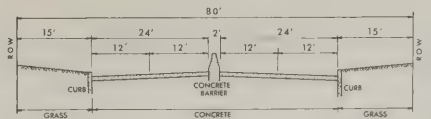
Diamond with Loop Ramp

Year of Construction: 1957

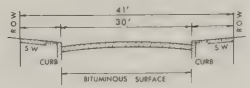
Photographed 8/21/67 - 1630 hours
800' Altitude, Looking West

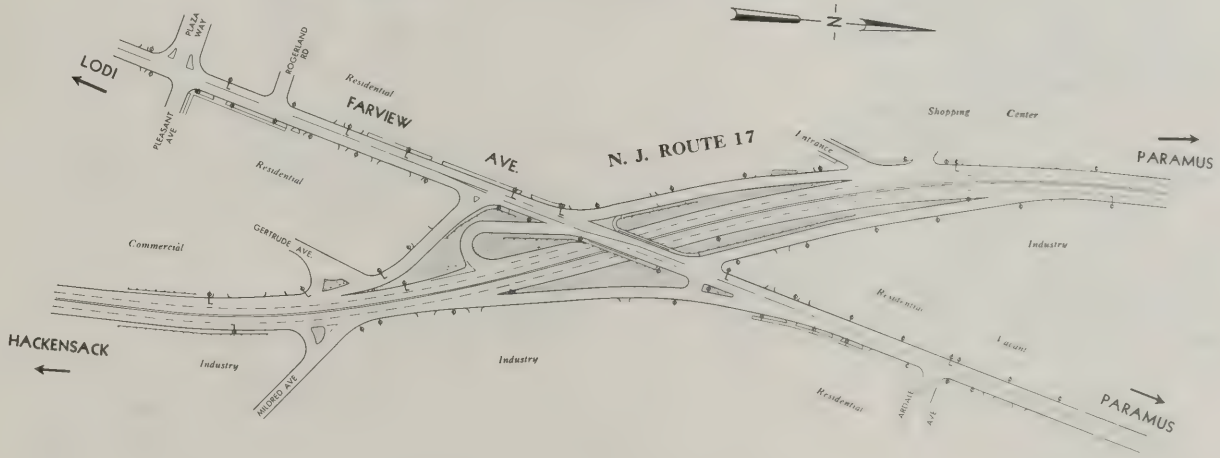
Photographed 8/21/67 -1630 hours
800' Altitude, Looking East

TYPICAL CROSS SECTION
N. J. RTE. 17



TYPICAL CROSS SECTION
FARVIEW AVE.





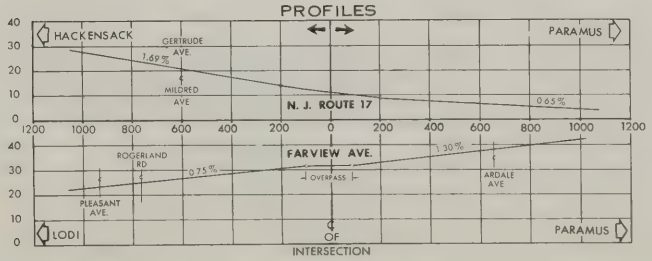


FIG. 7a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

N. J. ROUTE 17 and FARVIEW AVE.
ROCHELLE PARK, BERGEN CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

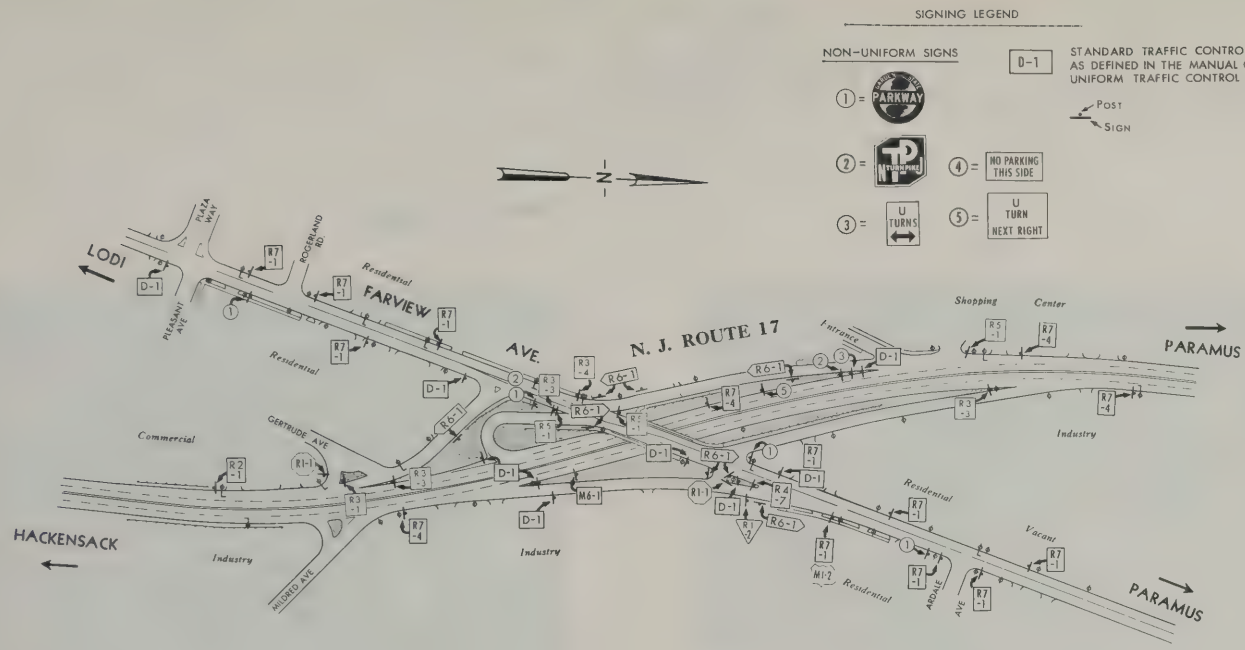


FIG. 7b

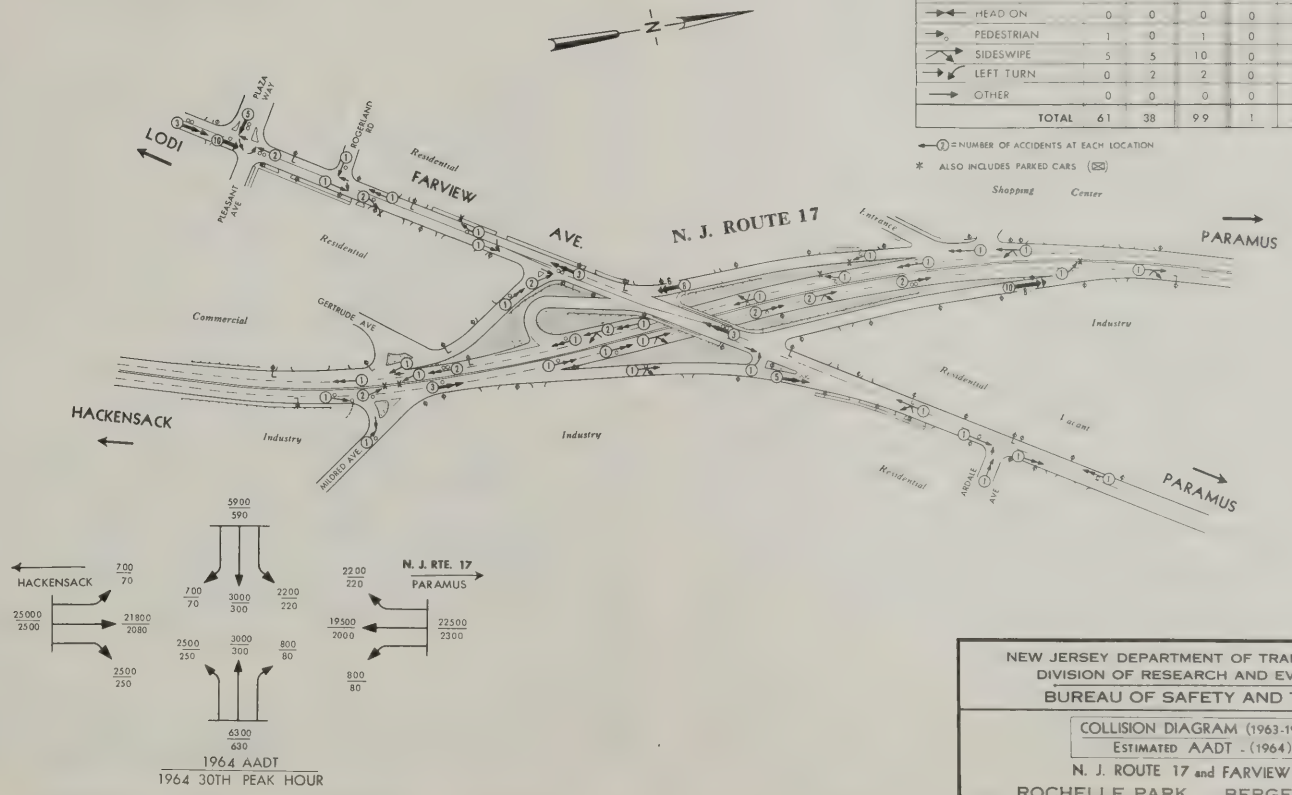
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

N. J. ROUTE 17 and FARVIEW AVE.
ROCHELLE PARK, BERGEN CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969



ACCIDENT SUMMARY (1963-1965)				FATAL	INJURY	PROPERTY DAMAGE
TYPE OF ACCIDENT	DAY	NIGHT	TOTAL			
RIGHT ANGLE	16	8	24	0	6	18
REAR END	34	19	53	0	34	19
FIXED OBJECT *	5	4	9	1	5	3
HEAD ON	0	0	0	0	0	0
PEDESTRIAN	1	0	1	0	1	0
SIDESWIPE	5	5	10	0	3	7
LEFT TURN	0	2	2	0	2	0
OTHER	0	0	0	0	0	0
TOTAL	61	38	99	1	51	47

(2) = NUMBER OF ACCIDENTS AT EACH LOCATION

* ALSO INCLUDES PARKED CARS (⊠)

FIG. 7c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

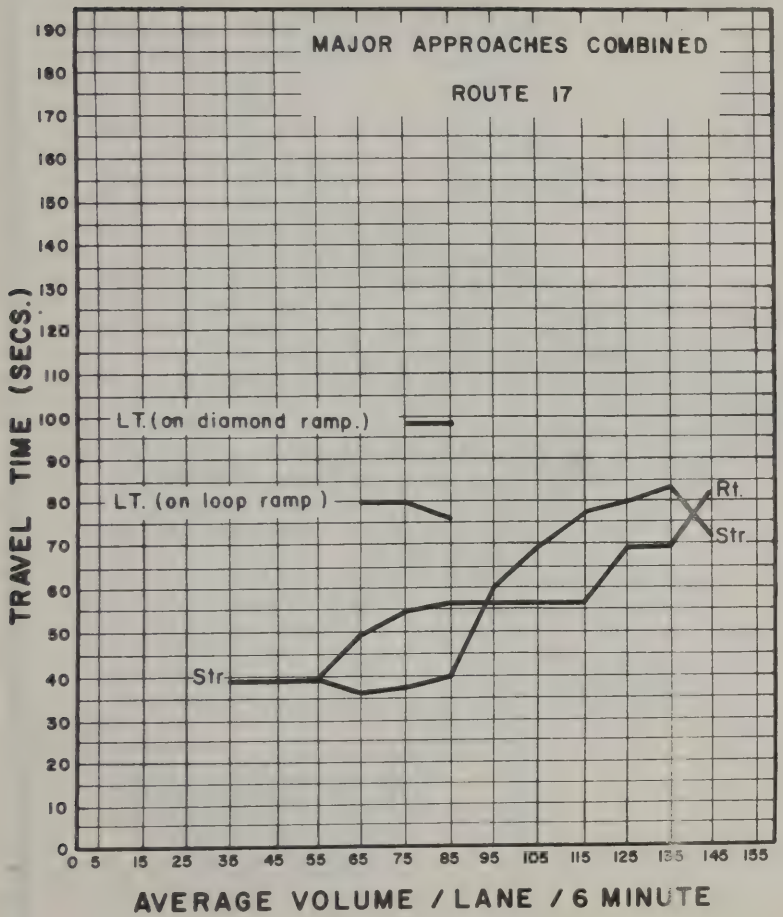
COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

N. J. ROUTE 17 and FARVIEW AVE.
ROCHELLE PARK, BERGEN CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTE 17 & FARVIEW AVENUE



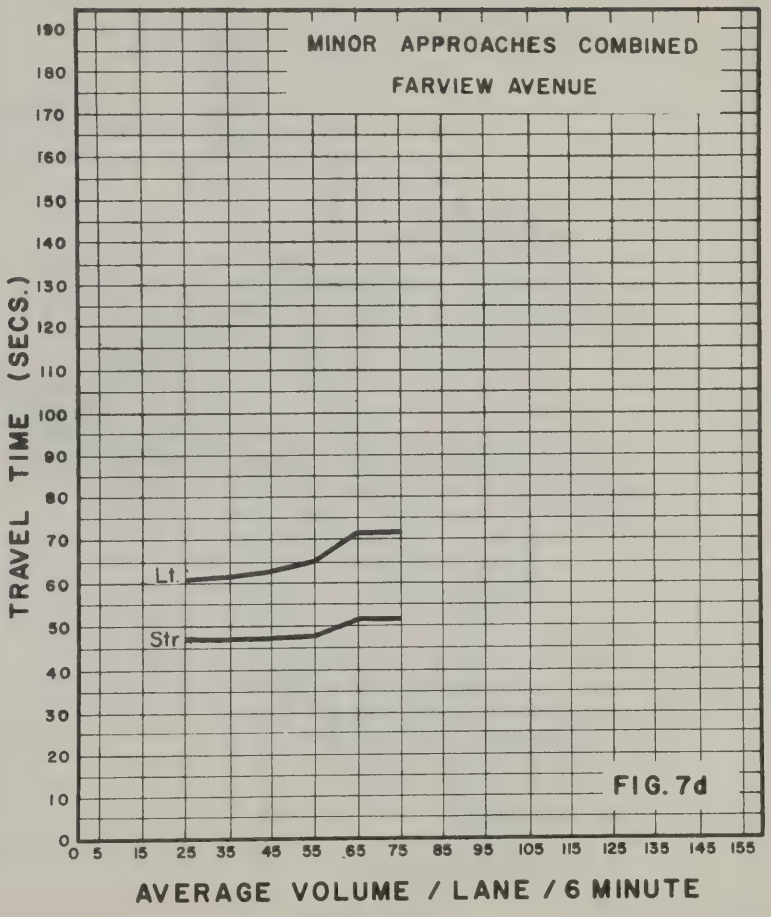


FIG. 7d

ROUTE 17 AND FARVIEW AVE.

Posted Speeds: Route 17 - 50 mph
Farview Ave. - 30 mph

Comments by W. R. Bellis:

This intersection illustrates a design providing for all movements, and doing a very minimum of property damage. The average daily volume of almost 60,000 cars in 1964 is above average for those intersections studied, and, although the turning movement volume is above average, the percentage of turning movement volume of 21 percent compares with 27 percent for the average of the 30 intersections, and 16 percent for the average of the 6 partial cloverleafs. This low percentage of turning movements was undoubtedly a factor in the selection of this type of design.

In spite of the cross traffic at three locations on the minor road, the accident and injury rates are very good. Note that the profile on both roads is very good, giving good sight distance to each point of possible conflict. In fact, it is much better than any of the other grade separations. Fifty-three percent of the accidents are rear-end, compared with an average of 54 for the 30 intersections. Twenty-four percent of the accidents are right-angle accidents, compared to 16 percent for the 30 intersections. Thirty-eight percent of the accidents are nighttime accidents, compared to 35 percent for the average of the 30 intersections.

During off-hours, the straight through movements on the major roadway are as fast as those for the cloverleaf but during the peak hours, it is slowed down considerably, indicating an over-capacity condition. This over-capacity condition causes delays of up to 50 seconds. Traffic volumes on Route 17 during peak hours are about the same as those on Route 22 at Thompson Avenue during peak hours. Route 17 has two 12 foot lanes in each direction with a center barrier in between, and a vertical curb with no shoulders. Route 22 has two 12 foot lanes, and a 10 foot shoulder in each direction with a center barrier separating the two roadways. This difference could partially account for the restricted capacity and the slower speeds on Route 17. An additional factor is the heavy interchanging traffic on three successive interchanges of Route 17; Passaic, 0.3 miles south, and Route 4, 0.5 miles north. The right turn from the major highway also reflects some of this loss. During peak hours, a 40-second loss could be caused by the congestion on the major highway. The average left turn from the major highway is about 15 seconds slower than that for a cloverleaf. The one left turn on the inside loop is about the same as that for a cloverleaf. The straight through movements on the minor road are about 10 seconds slower than on a cloverleaf. The left turns from the minor road average 4 seconds faster than on a cloverleaf.

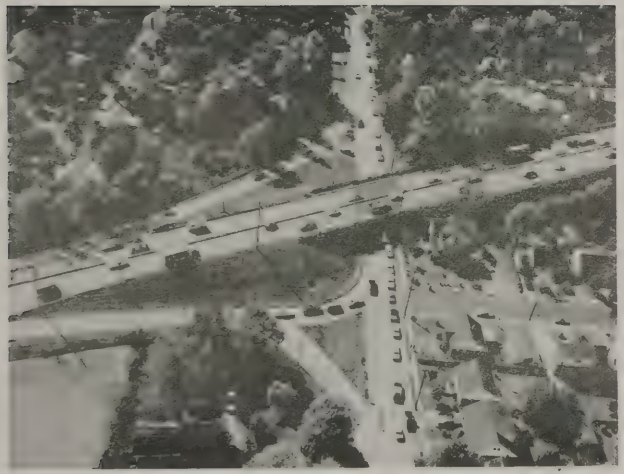
This intersection rates very high on the overall comparison, ranking number 4.

PHOTO 8

N.J. Route 17 and Passaic Avenue

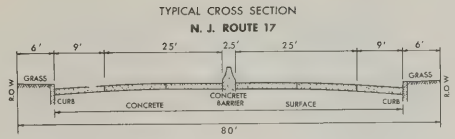
Partial Diamond

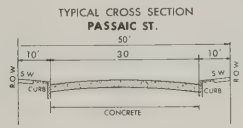
Year of Construction: 1957

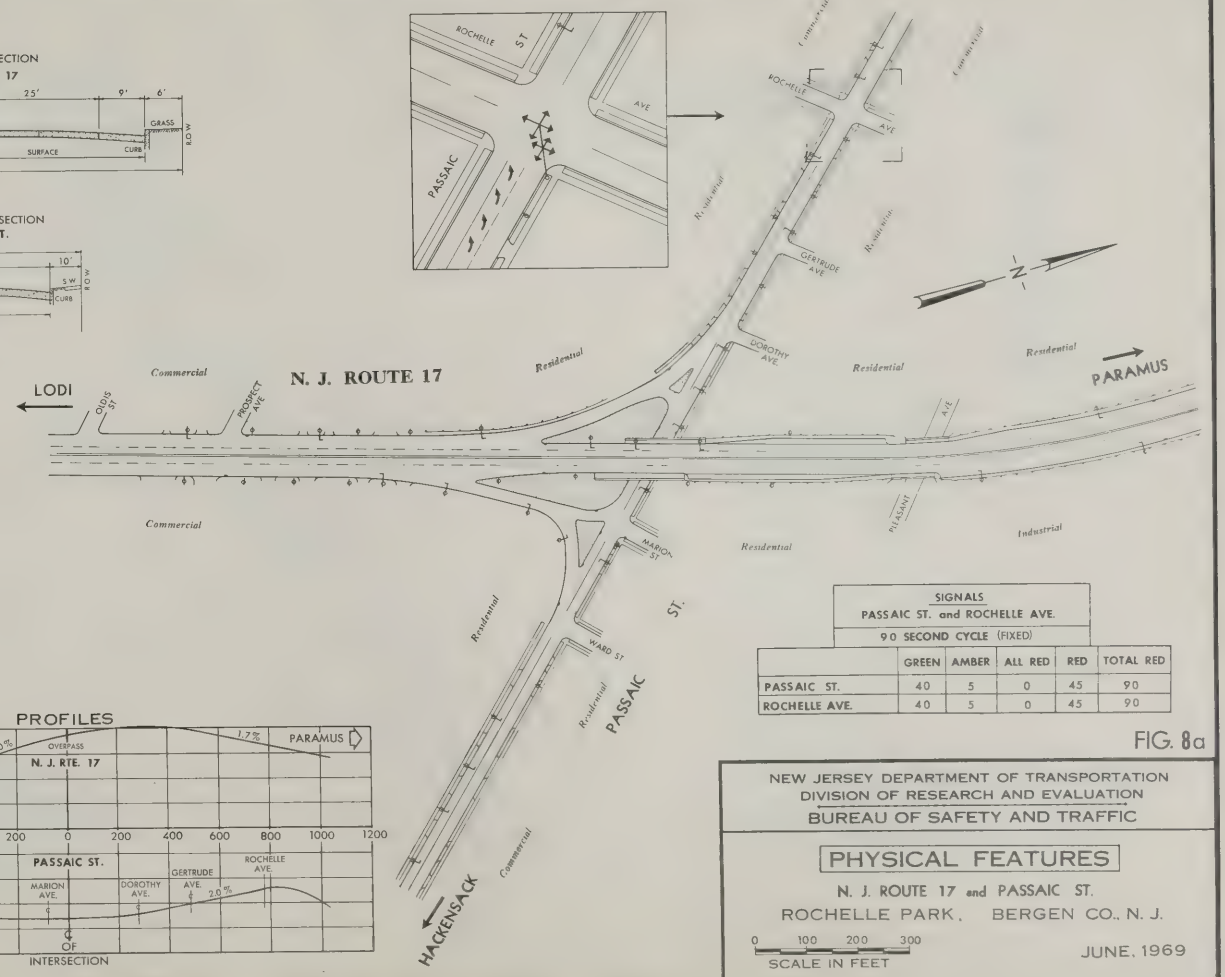


Photographed 8/21/67 - 1630 hours
500' Altitude, Looking West

Photographed 8/21/67 - 1630 hours
800' Altitude, Looking South







SIGNALS PASSAIC ST. and ROCHELLE AVE. 90 SECOND CYCLE (FIXED)					
	GREEN	AMBER	ALL RED	RED	TOTAL RED
PASSAIC ST.	40	5	0	45	90
ROCHELLE AVE.	40	5	0	45	90

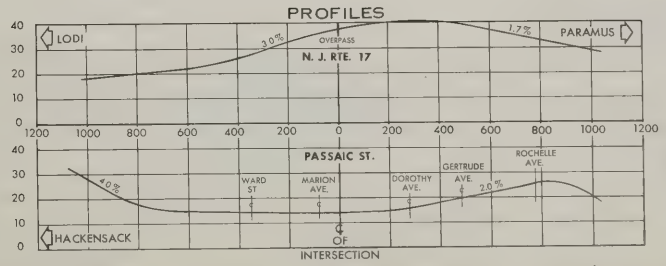


FIG. 8a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

N. J. ROUTE 17 and PASSAIC ST.
ROCHELLE PARK, BERGEN CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

SIGNING LEGEND

NON-UNIFORM SIGNS

① = PARKWAY

② = REDUCE SPEED AHEAD

③ = BRIDGE MAY BE SLIPPERY

④ = DO NOT BLOCK DRIVEWAY

⑤ = DO NOT BLOCK INTERSECTION

D-1 STANDARD TRAFFIC CONTROL AS DEFINED IN THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.

Post
Sign

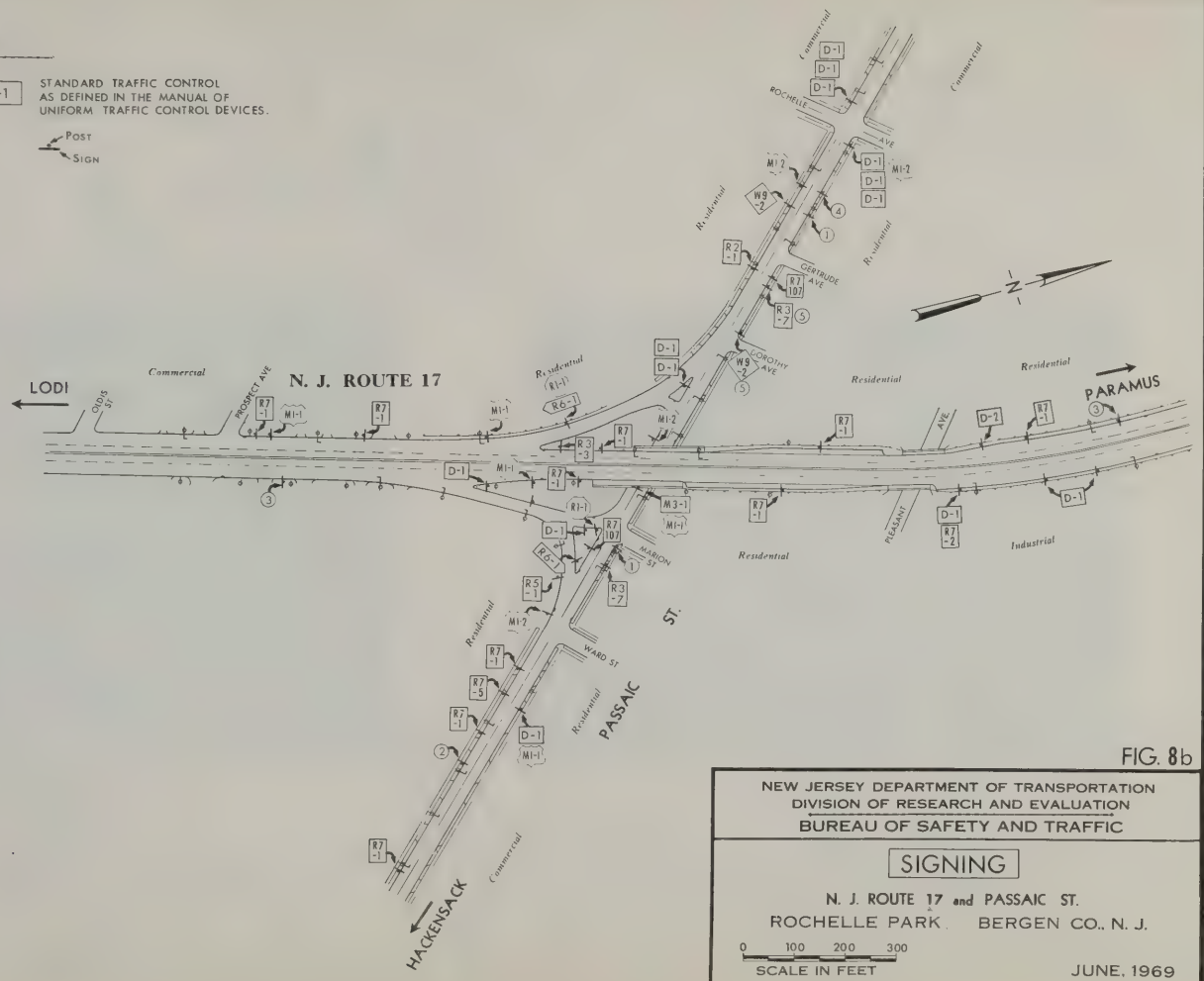


FIG. 8b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

N. J. ROUTE 17 and PASSAIC ST.
ROCHELLE PARK BERGEN CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ACCIDENT SUMMARY (1963-1965) TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	FATAL →•	INJURY →○	PROPERTY DAMAGE
RIGHT ANGLE	29	7	36	0	16	20
REAR END	53	17	70	0	37	33
FIXED OBJECT *	10	6	16	0	6	10
HEAD-ON	1	1	2	0	0	2
PEDESTRIAN	1	0	1	0	1	0
SIDESWIPE	5	1	6	0	2	4
LEFT TURN	5	1	6	0	0	6
OTHER	0	0	0	0	0	0
TOTAL	104	33	137	0	62	75

←(3)= NUMBER OF ACCIDENTS AT EACH LOCATION

* ALSO INCLUDES PARKED CARS (⊠)

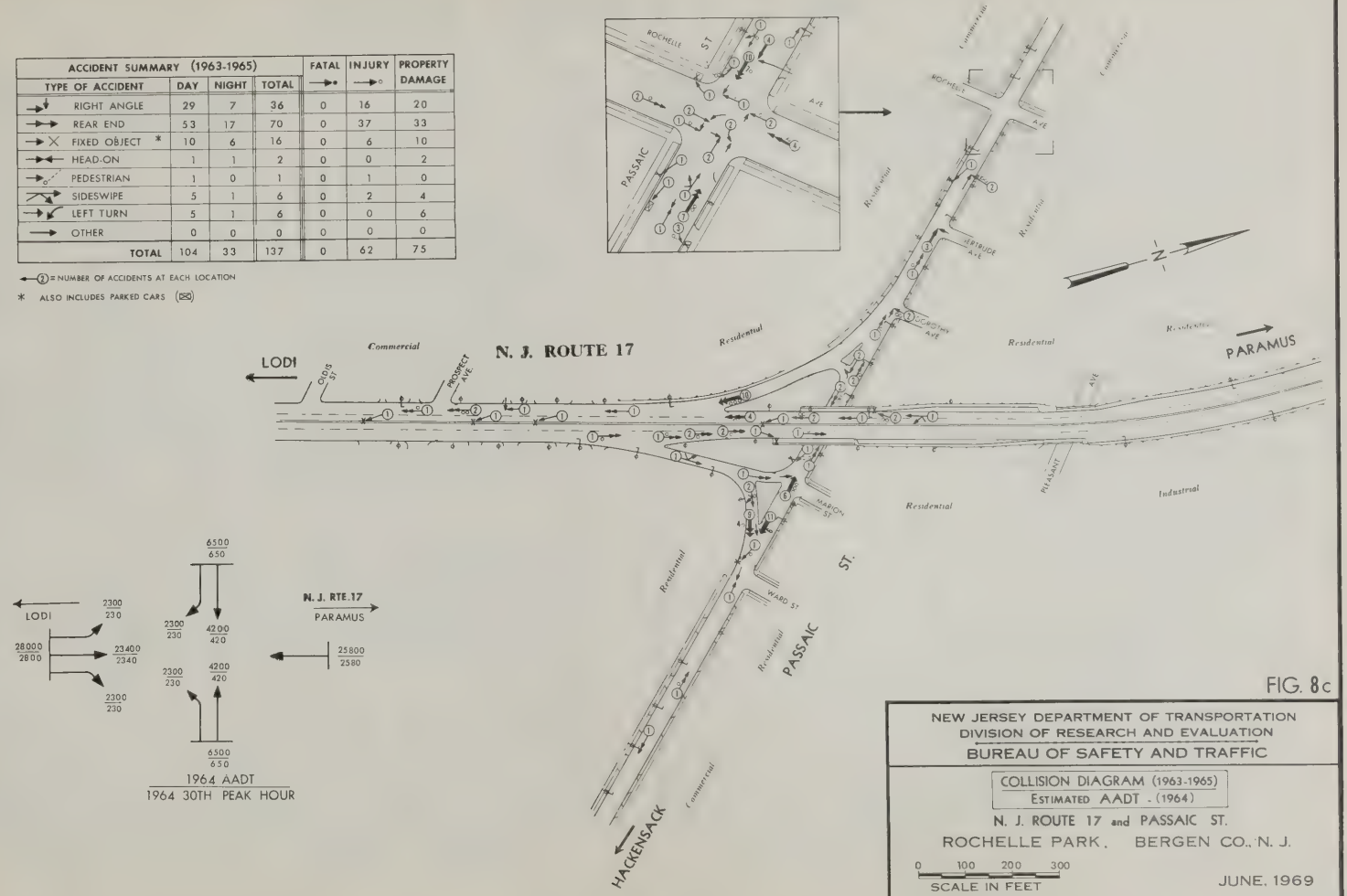


FIG. 8c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

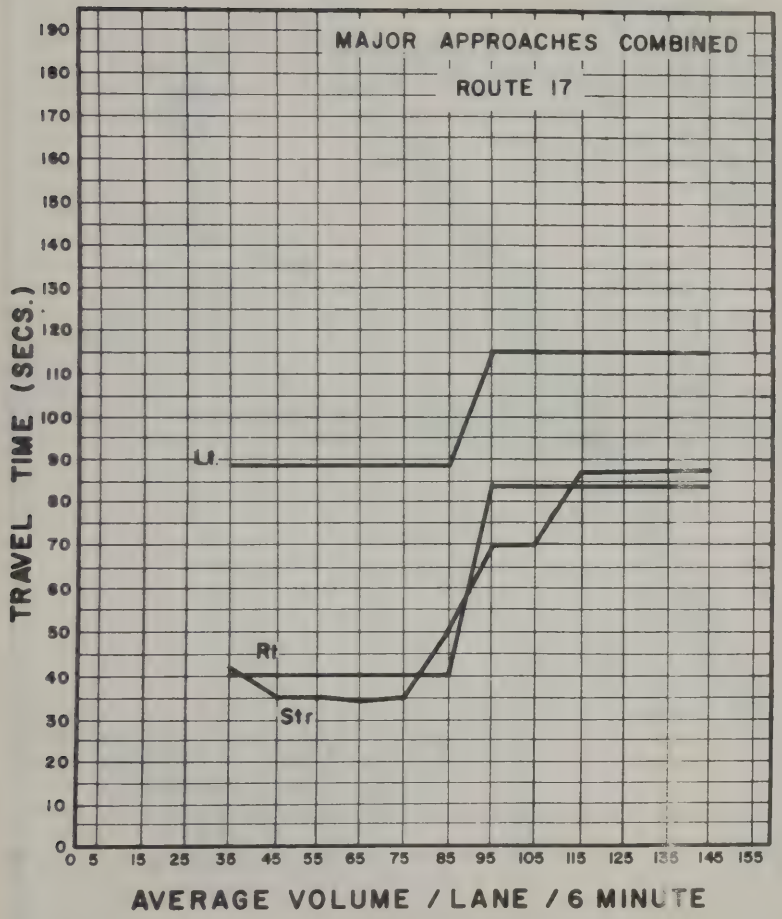
COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

N. J. ROUTE 17 and PASSAIC ST.
ROCHELLE PARK, BERGEN CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTE 17 & PASSAIC AVENUE



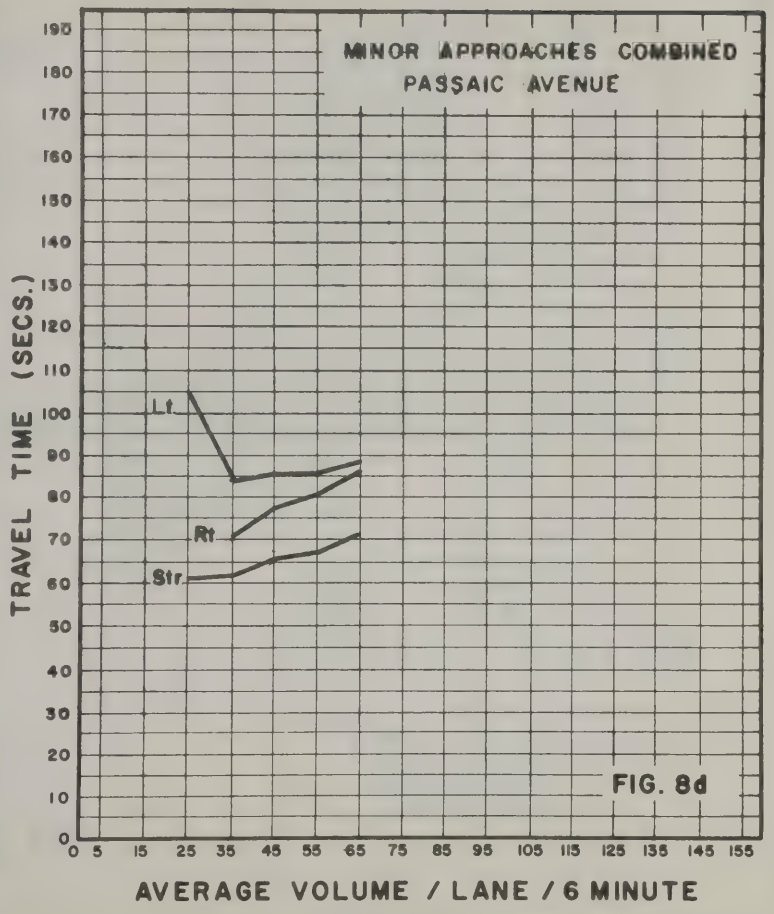


FIG. 8d

ROUTE 17 AND PASSAIC ST.

Posted Speeds: Route 17 - 50 mph
Passaic St. - 40 mph

Comments by W. R. Bellis:

This intersection carries the 4th largest volume of the 30 intersections. Fourteen percent of the traffic is turning movement traffic. This compares with an average of 27 percent for the 30 intersections.

The accident rate is better than 3 of the other grade separations studied. Only 4 percent of the accidents are sideswipes compared to 11 percent for the average of the 30 intersections. Twenty-six percent of the accidents are right-angle accidents, compared to 16 percent for the average of the 30 intersections. Twenty-four percent of the accidents occur at night, compared to 35 percent for the total; this is a low percentage, ranking 4th out of the 30 intersections.

The straight through traffic on the major road during off-hours traveled at the same speed as for the cloverleafs, but during the peak hour there is severe congestion indicating over-capacity. This congestion causes 53 seconds of delay. There are two lanes with a 9 foot shoulder in each direction.

The interchanging traffic is only to and from the south. The right turn from the major highway indicates a loss of over 40 seconds for the peak hour compared to the off-hour. The left turn from the major highway is 30 seconds slower than the inside loop of a cloverleaf. The straight through movement on the minor road is 30 seconds slower than on the cloverleaf. Passaic Street is 30 feet wide between curbs and has a traffic signal 800 feet west of interchange. This slows up traffic. The right turn from the traffic signal on the minor road is 40 seconds slower than for a cloverleaf, and the left turn from the minor road, involving cross traffic, is 25 seconds slower than for a cloverleaf.

PHOTO 9

U.S. Route 22 and Thompson Avenue

Partial Cloverleaf

Year of Construction: 1940

Photographed 8/21/67 - 1645 hours
800' Altitude, Looking West

Photographed 8/21/67 - 1645 hours
800' Altitude, Looking South

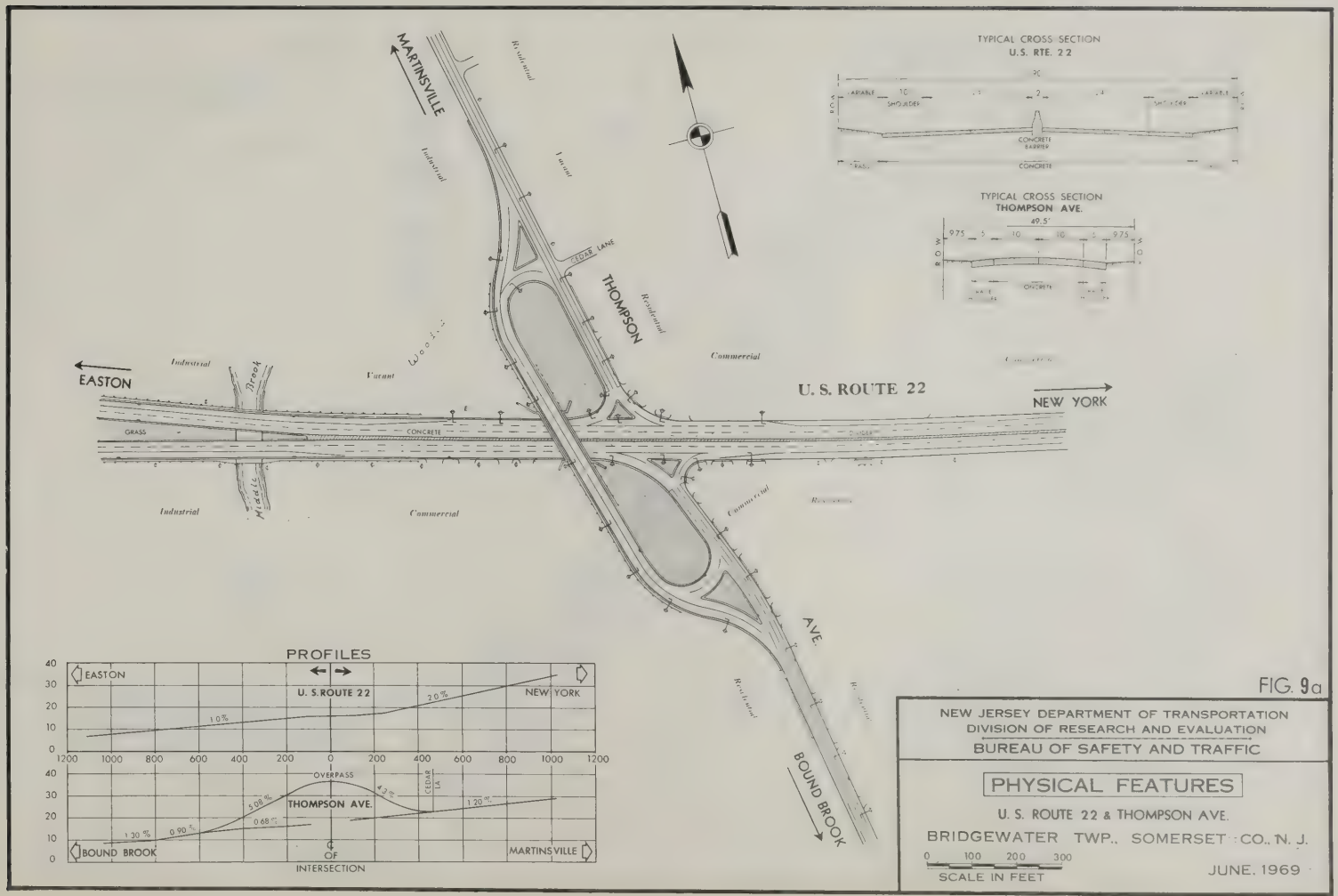


FIG. 9a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE 22 & THOMPSON AVE.

BRIDGEWATER TWP., SOMERSET CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

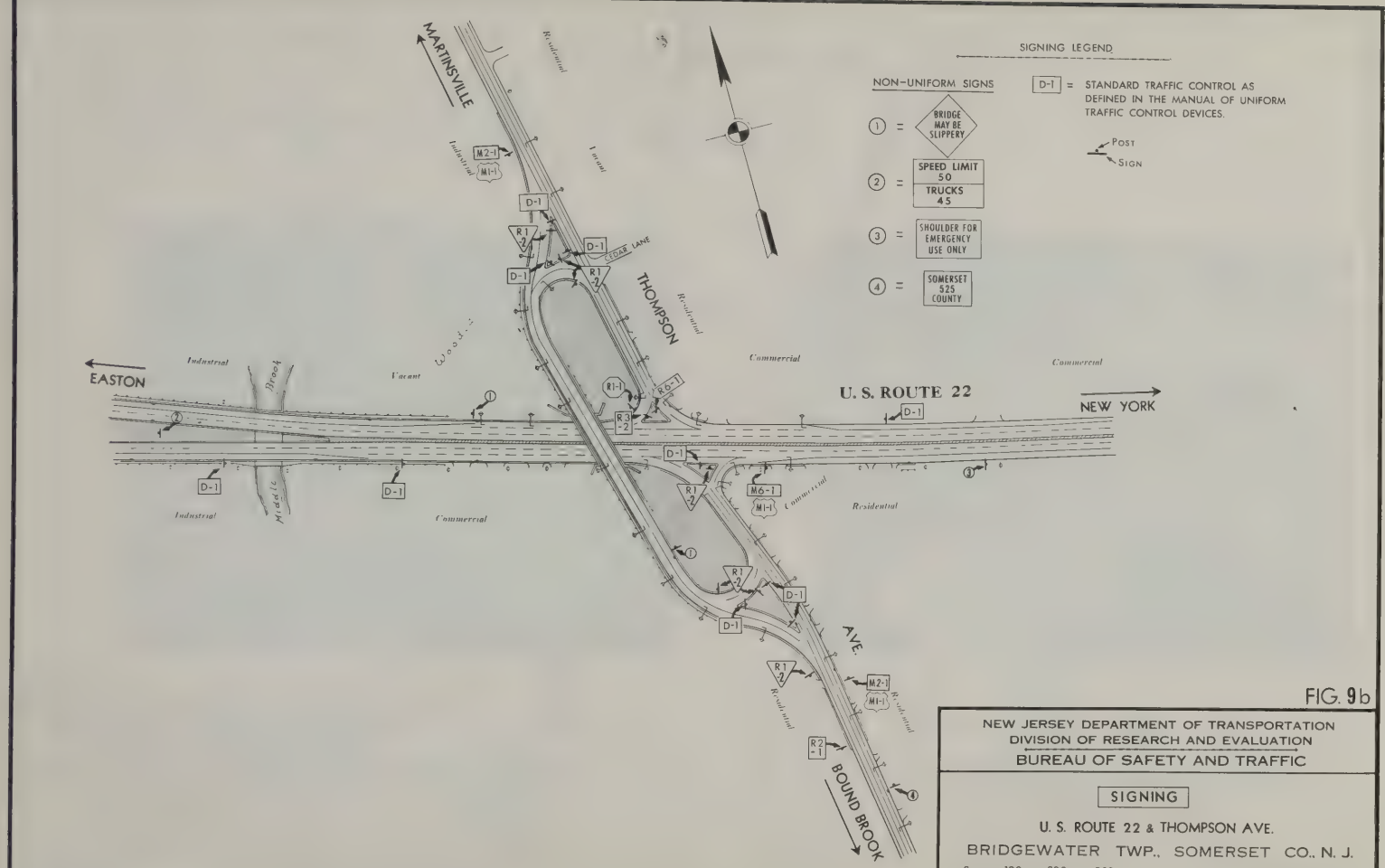


FIG. 9b

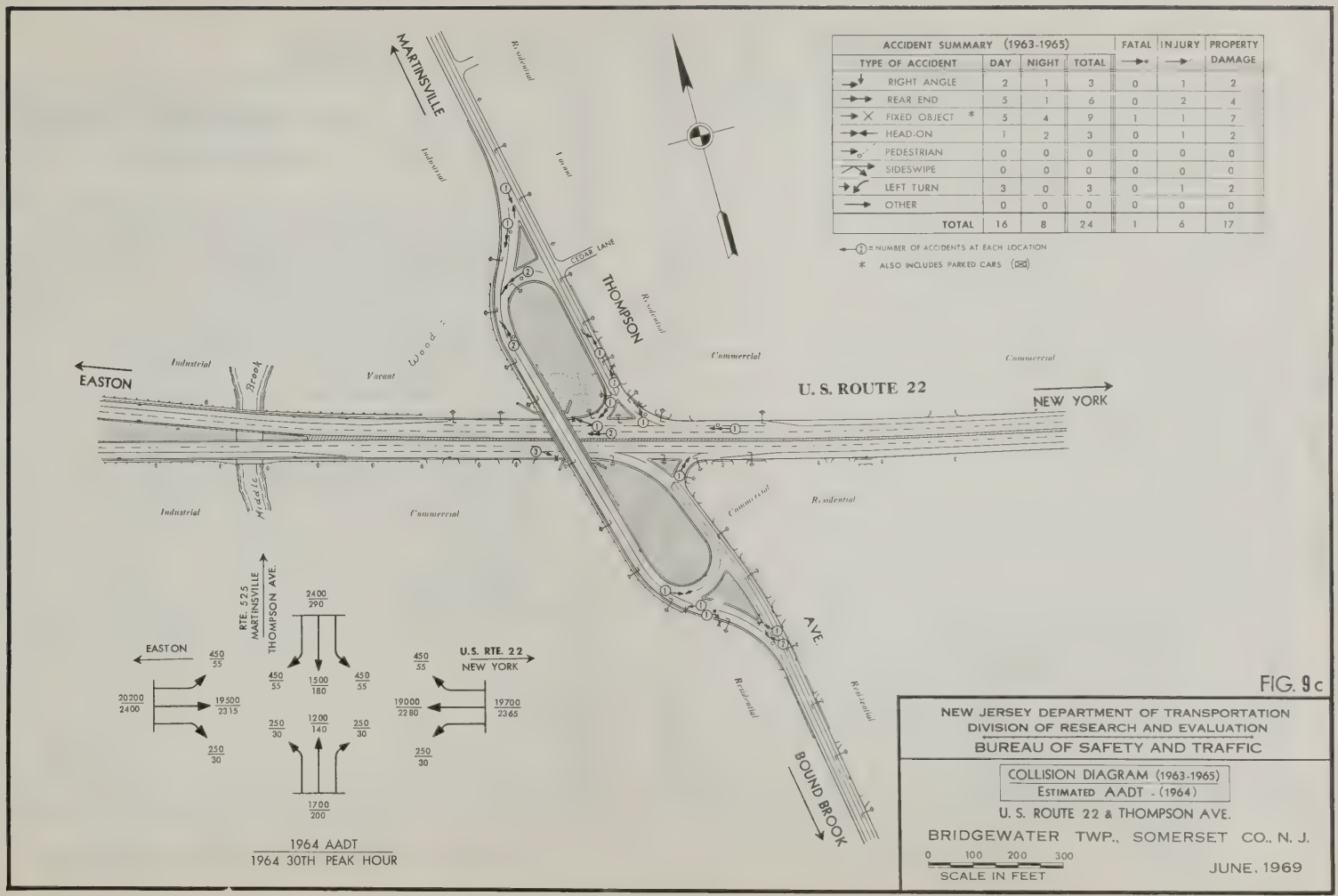
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. ROUTE 22 & THOMPSON AVE.
BRIDGEWATER TWP., SOMERSET CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969



1964 AADT
1964 30TH PEAK HOUR

ACCIDENT SUMMARY (1963-1965)				FATAL	INJURY	PROPERTY
TYPE OF ACCIDENT	DAY	NIGHT	TOTAL			DAMAGE
RIGHT ANGLE	2	1	3	0	1	2
REAR END	5	1	6	0	2	4
FIXED OBJECT *	5	4	9	1	1	7
HEAD-ON	1	2	3	0	1	2
PEDESTRIAN	0	0	0	0	0	0
SIDESWIPE	0	0	0	0	0	0
LEFT TURN	3	0	3	0	1	2
OTHER	0	0	0	0	0	0
TOTAL	16	8	24	1	6	17

(1) = NUMBER OF ACCIDENTS AT EACH LOCATION

* ALSO INCLUDES PARKED CARS (⊠)

FIG. 9c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

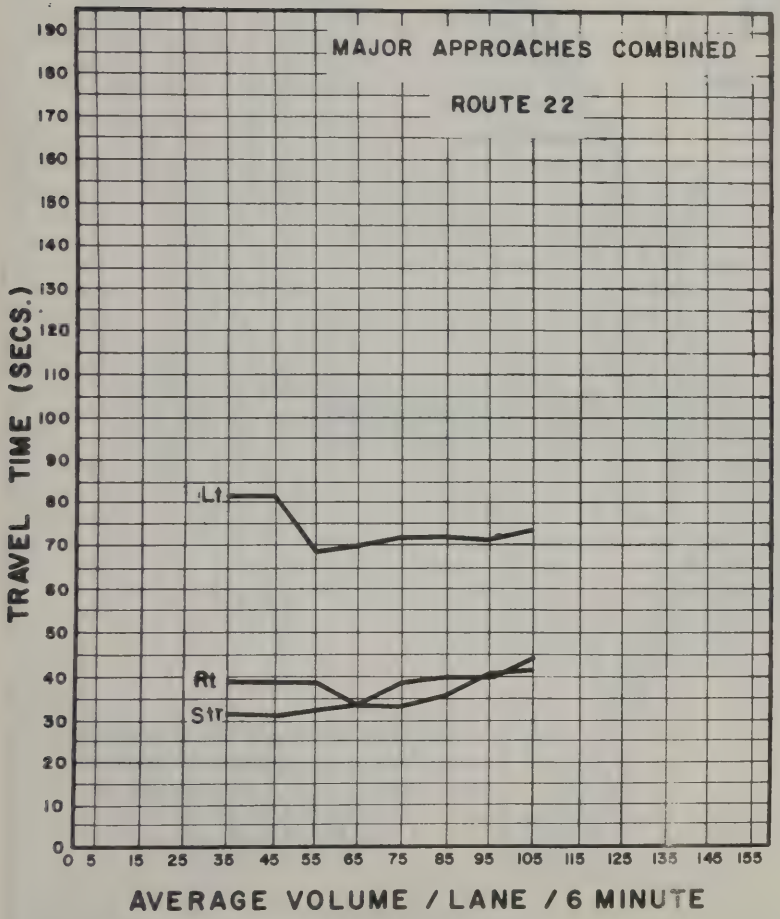
U. S. ROUTE 22 & THOMPSON AVE.

BRIDGEWATER TWP., SOMERSET CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTE 22 AND THOMPSON AVENUE



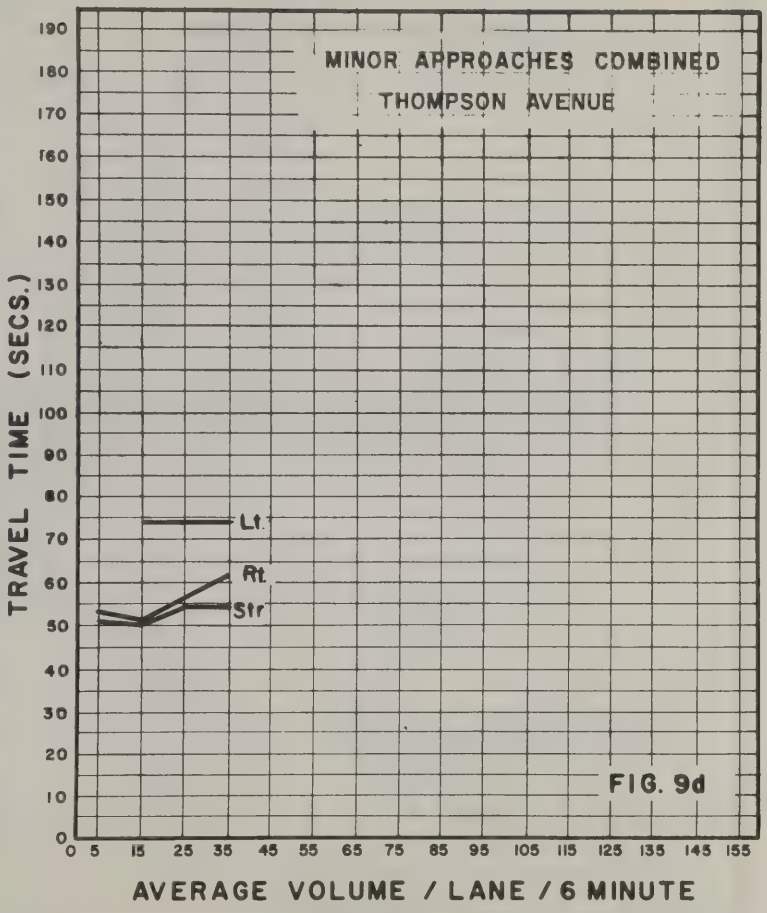


FIG. 9d

ROUTE 22 AND THOMPSON AVE.

Posted Speeds: Route 22 - 50 mph
Thompson Ave. - 35 mph

Comments by W. R. Bellis:

This intersection has the smallest percentage of turning movements of all 30 intersections studied--6 percent, compared to 27 percent for the average of all 30 intersections. The accident rate of 130 seems, to me, to be too small. This is the lowest accident rate of all the intersections; likewise the injury rate of 35 is the lowest of all 30 intersections. I would expect the accident rate to be about 3 times that which is indicated.

The travel times for the movements from the major highway are about the same as the movements on the full cloverleaf. The straight through and right turns from the minor road require about 15 seconds longer than on a full cloverleaf, and the left turns from the minor road require about the same length of time as that for a full cloverleaf.

This intersection was built in 1940 and has served very well. It is a good treatment for a major-minor road intersection. The property frontage at the intersection was undisturbed.

PHOTO 10

U.S. Route 22 and Bloy Avenue

Partial Cloverleaf

Year of Construction: 1941

Photographed 8/21/67 - 1700 hours
500' Altitude, Looking East

Photographed 8/21/67 - 1700 hours
800' Altitude, Looking Northeast

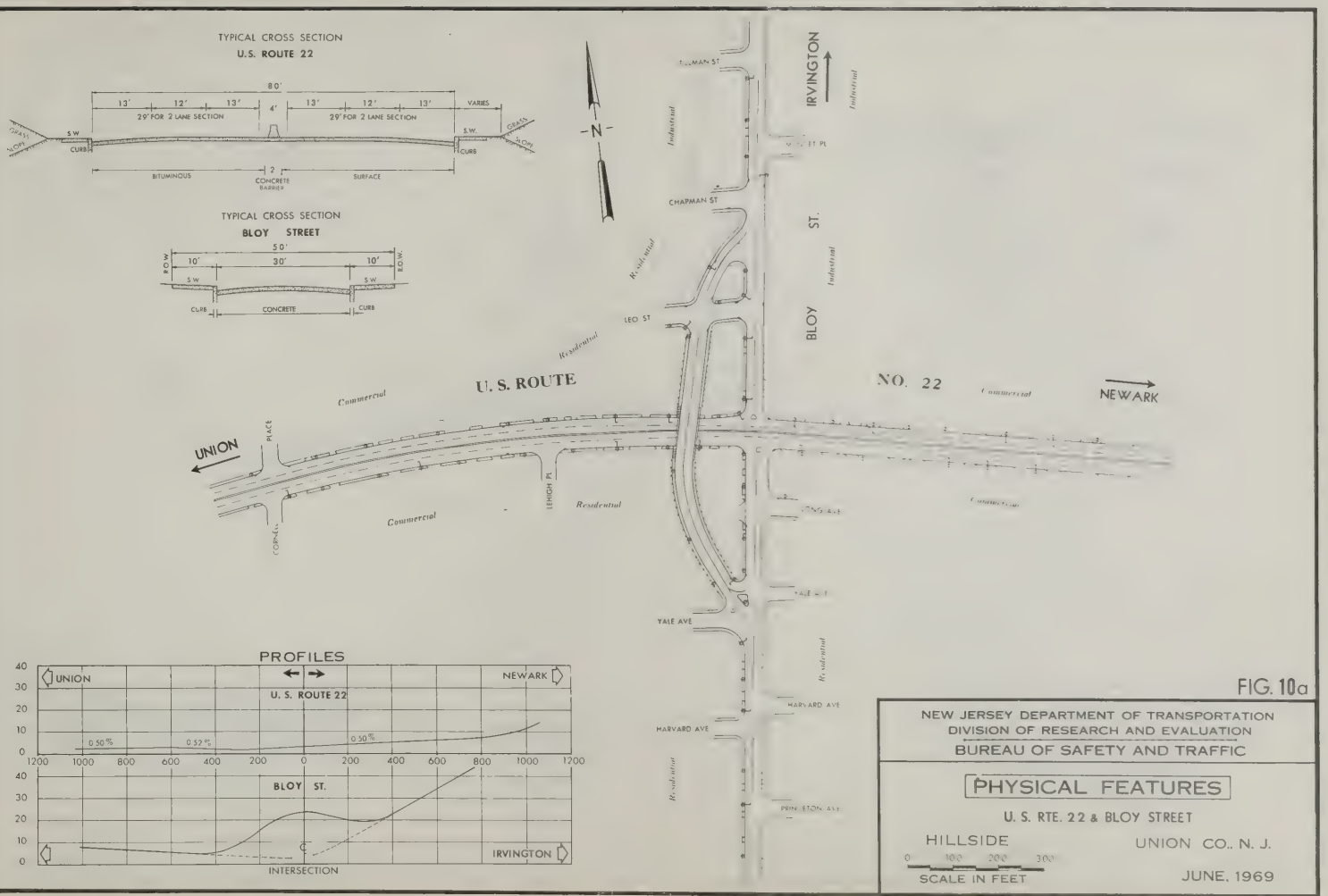


FIG. 10a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. RTE. 22 & BLOY STREET

HILLSIDE — UNION CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

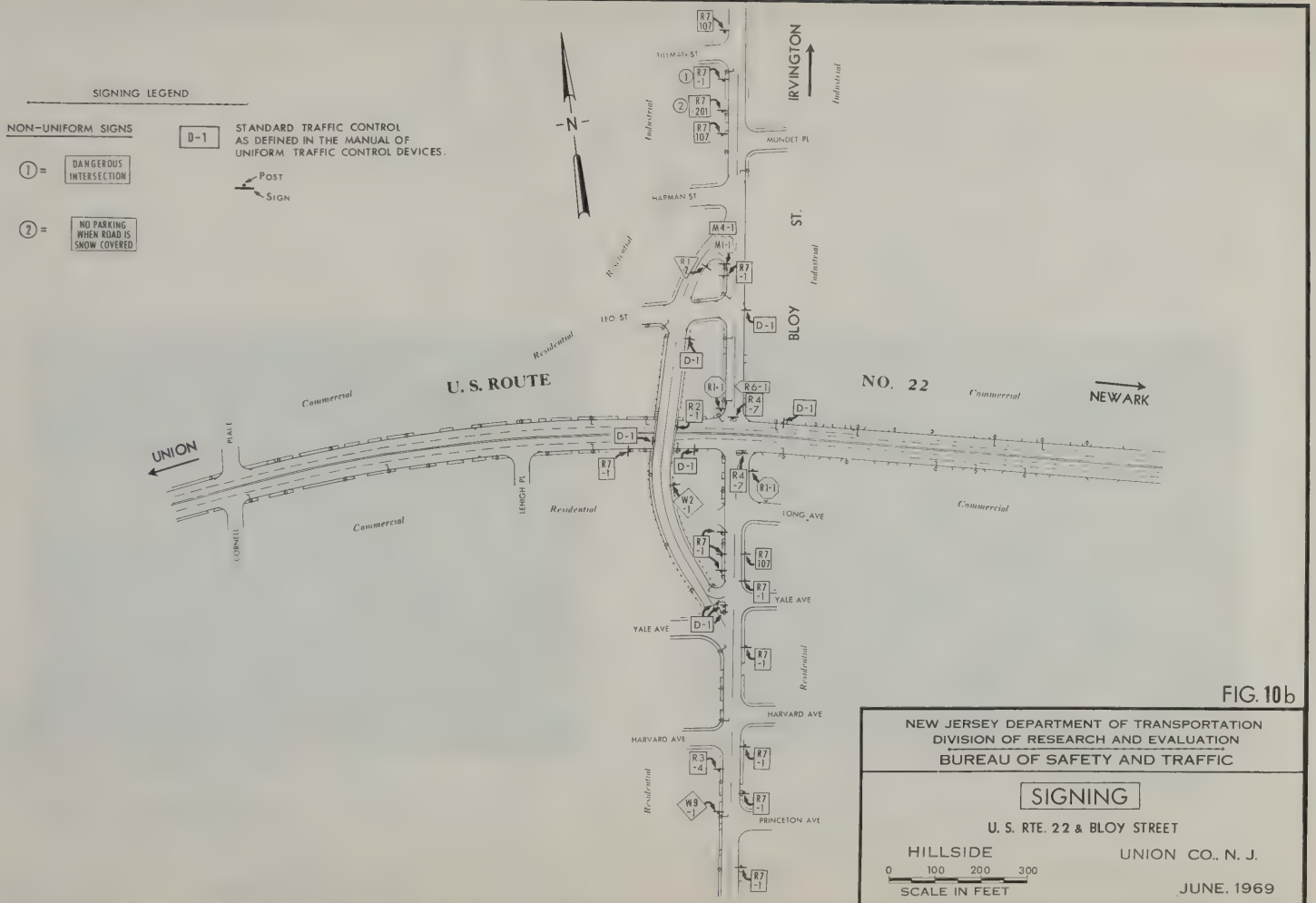


FIG. 10b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. RTE. 22 & BLOY STREET

HILLSIDE UNION CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ACCIDENT SUMMARY (1963-1965) TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	FATAL	INJURY	PROPERTY DAMAGE
RIGHT ANGLE	36	19	55	0	16	39
REAR END	102	33	135	0	67	68
FIXED OBJECT *	11	16	27	1	8	18
HEAD-ON	4	1	5	1	1	3
PEDESTRIAN	3	0	3	0	3	0
SIDESWIPE	14	5	19	0	7	12
LEFT TURN	0	0	0	0	0	0
OTHER	3	0	3	0	1	2
TOTAL	173	74	247	2	103	142

(2) = NUMBER OF ACCIDENTS AT EACH LOCATION

* ALSO INCLUDES PARKED CARS (⊠)

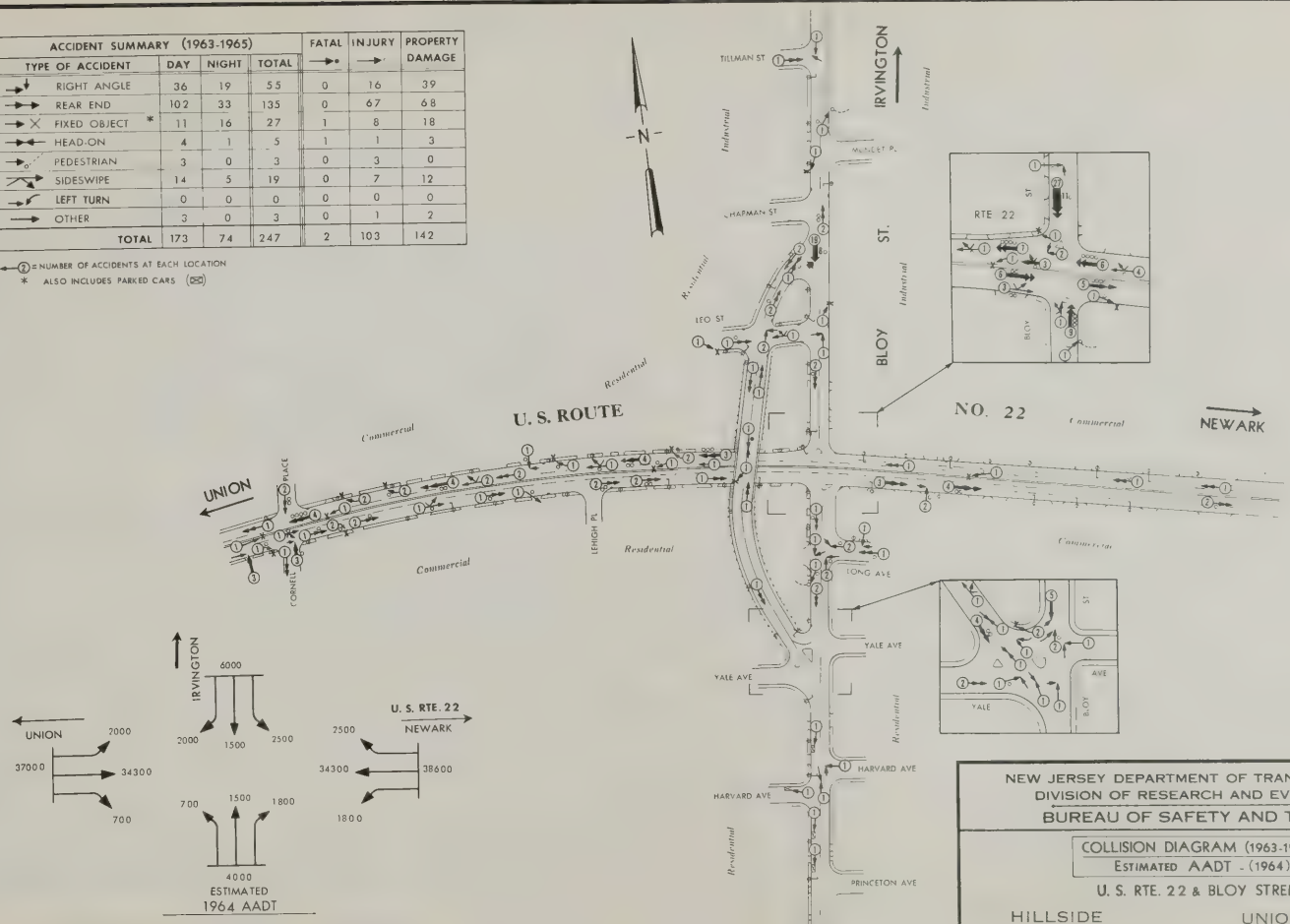


FIG. 10 c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

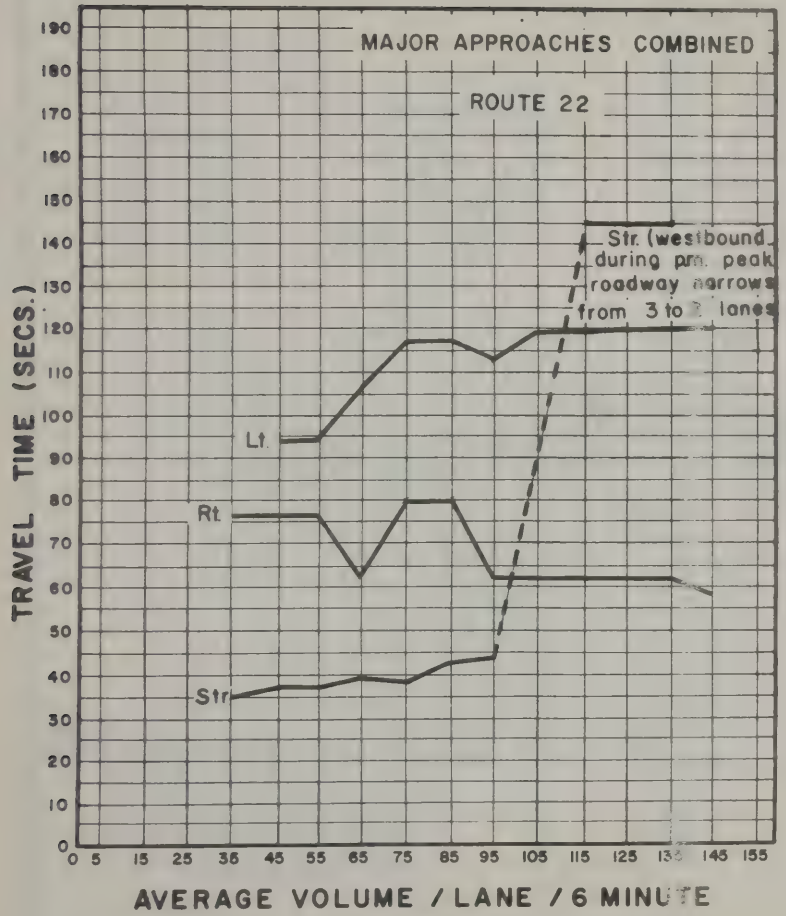
U. S. RTE. 22 & BLOY STREET

HILLSIDE — UNION CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTE 22 & BLOY AVENUE



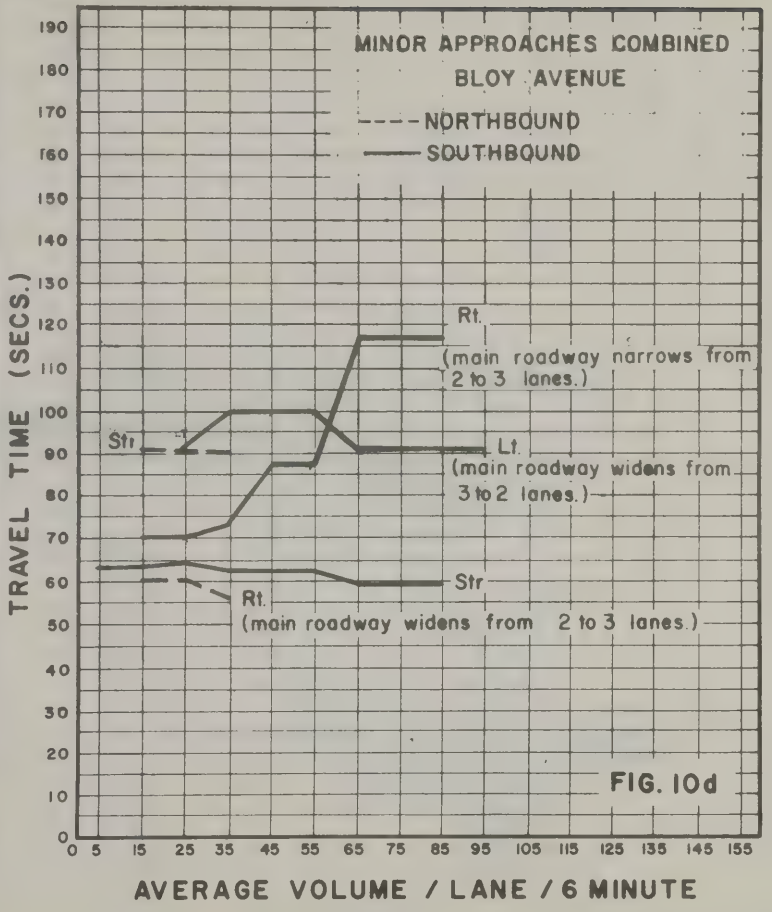


FIG. 10d

ROUTE 22 AND BLOY ST.

Posted Speeds: Route 22 - 45 mph
Bloy St. - 25 mph

Comments by W. R. Bellis:

This intersection carries the second largest total volume of any of the 30 intersections studied. Sixteen percent of the traffic is turning traffic compared to 27 percent for the average of the 30 intersections. The overpass was built offset from the major intersection so as not to damage the high ratables at the intersection proper. These businesses have continued in operation. Previous to the installation of the grade separation, the intersection was controlled by traffic signals. The conversion was made in 1941.

The accident experience is worse than any of the other grade separations, except the one at Routes 4 and 17. Similar to Routes 4 and 17, this intersection suffers a high degree of over-congestion, which is a primary contributor to the accident experience. The westbound Route 22 roadway, which narrows from 3 to 2 lanes, has 50 percent more accidents than the eastbound Route 22 roadway which widens from 2 to 3 lanes.

The Southbound Bloy Street, on a 6 percent downgrade, experiences a high accident frequency, 19 at the junction of the overpass, and 27 rear-end accidents at the junction with westbound Route 22.

Fifty-four percent of the accidents are rear-end accidents, which is equal to the average for the 30 intersections. Sideswipes accounted for 8 percent, compared to an average of 11 percent. Twenty-two percent of the accidents were right angles, compared to an average of 16 percent. Nighttime accidents accounted for 30 percent of the total accidents, which is nearly equal to the average of the 10 grade separated intersections studied, and compares with 35 percent for the average of all 30 intersections.

The straight through movement on Route 22 during off-hours is just as fast as it is for the other high speed intersections, but during peak hours westbound traffic requires an additional two minutes through this 2,000 foot distance. During the rush hours, the average speed is 9.4 mph through the 2,000 foot distance. This is slower than any of the other 30 intersections. Of the 30 intersections studied, there are only 3 slower for their major movement. Two of these are signalized intersections, Route 35 and Smith Street and Route 82 and Stuyvesant Avenue, and the third is a traffic circle, Route 1&9 and Bayway Avenue. The right turns from the major roadway average 20-40 seconds slower than on a cloverleaf. The average left turn is 30-40 seconds slower than on a cloverleaf. The straight through movement on the minor road is 25 and 55 seconds slower, depending on direction, than the cloverleaf. The right turns are 20-70 seconds slower, and the southbound Bloy Street left turn 25 seconds slower.

PHOTO 11

N.J. Routes 35 and 440

Traffic Circle

Year of Construction: 1940

Photographed 5/18/67 - 1700 hours
500' Altitude, Looking North

Photographed 5/18/67 - 1700 hours
700' Altitude, Looking Southwest

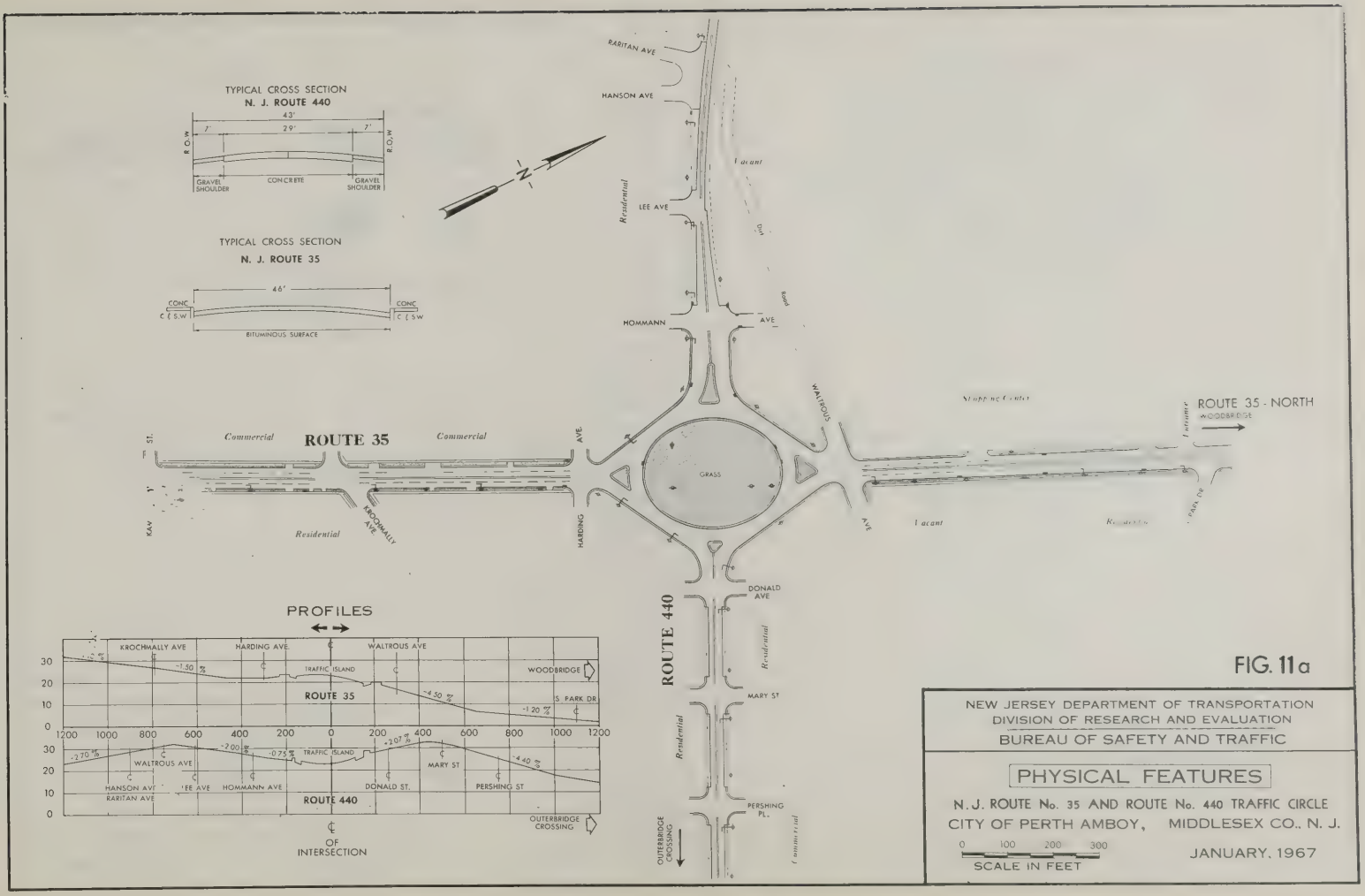


FIG. 11a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

N. J. ROUTE No. 35 AND ROUTE No. 440 TRAFFIC CIRCLE
CITY OF PERTH AMBOY, MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JANUARY, 1967

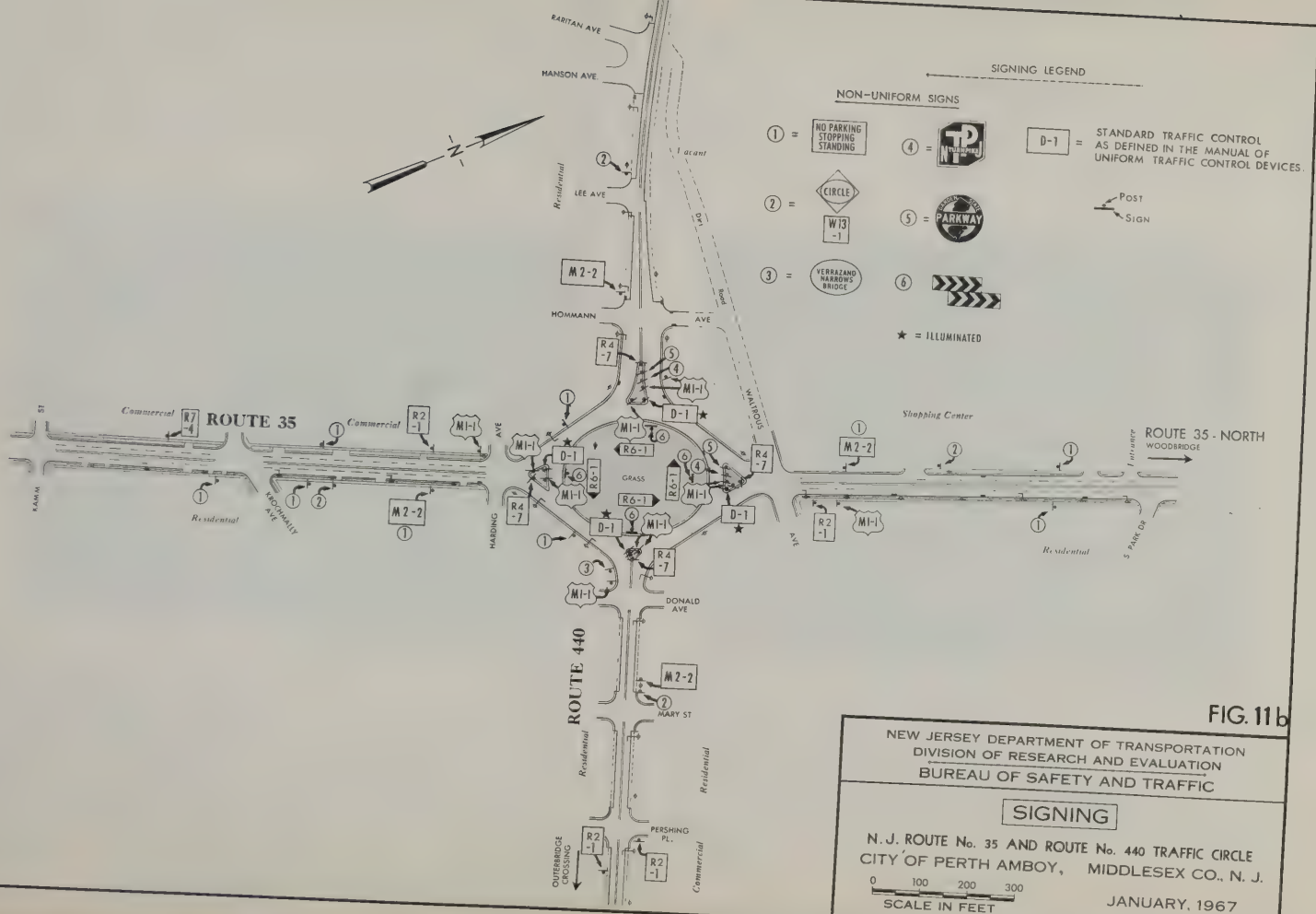


FIG. 11b

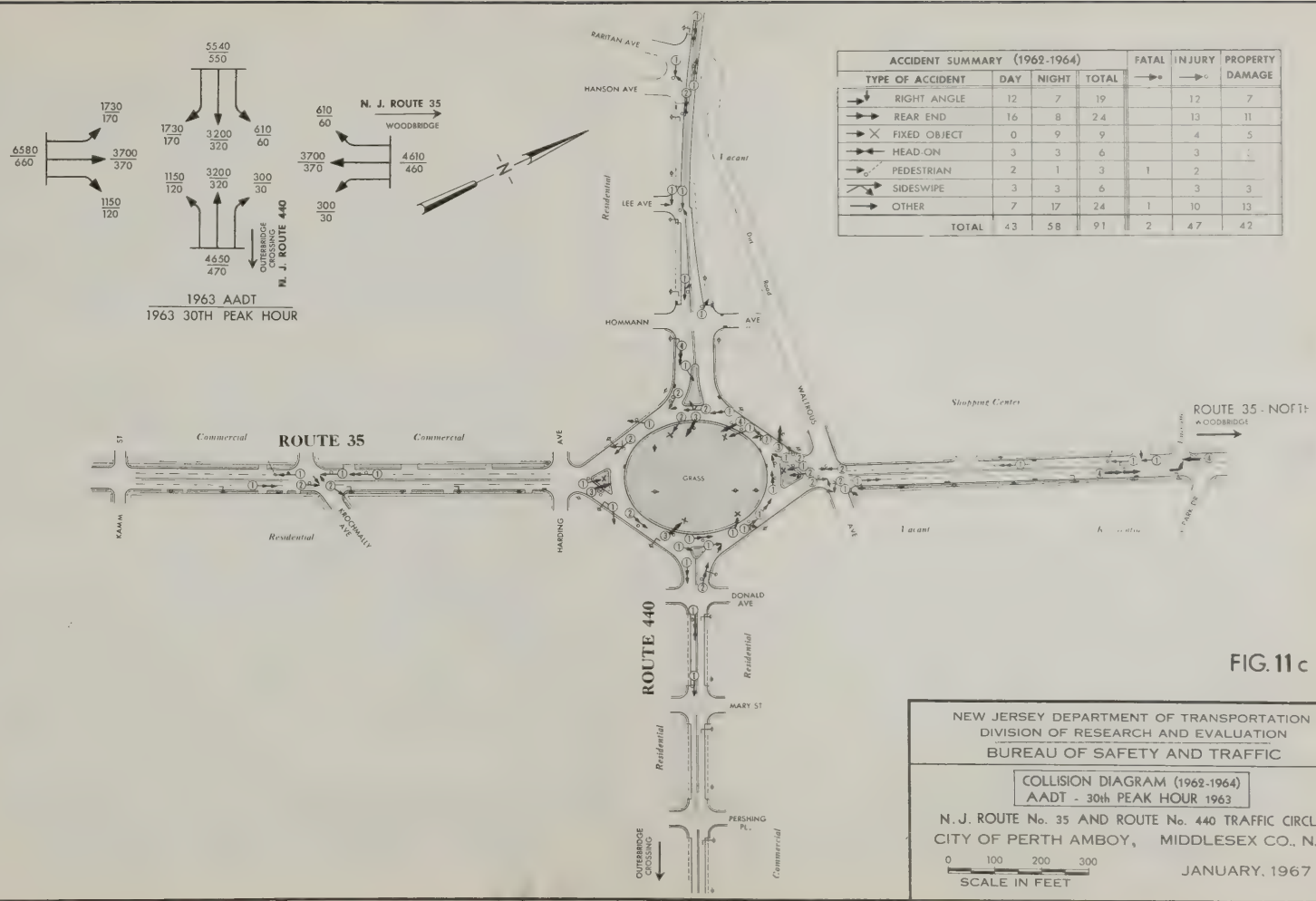
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

N. J. ROUTE No. 35 AND ROUTE No. 440 TRAFFIC CIRCLE
CITY OF PERTH AMBOY, MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JANUARY, 1967



ACCIDENT SUMMARY (1962-1964) TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	FATAL	INJURY	PROPERTY DAMAGE
RIGHT ANGLE	12	7	19		12	7
REAR END	16	8	24		13	11
FIXED OBJECT	0	9	9		4	5
HEAD-ON	3	3	6		3	
PEDESTRIAN	2	1	3	1	2	
SIDESWIPE	3	3	6		3	3
OTHER	7	17	24	1	10	13
TOTAL	43	58	91	2	47	42

FIG. 11 c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

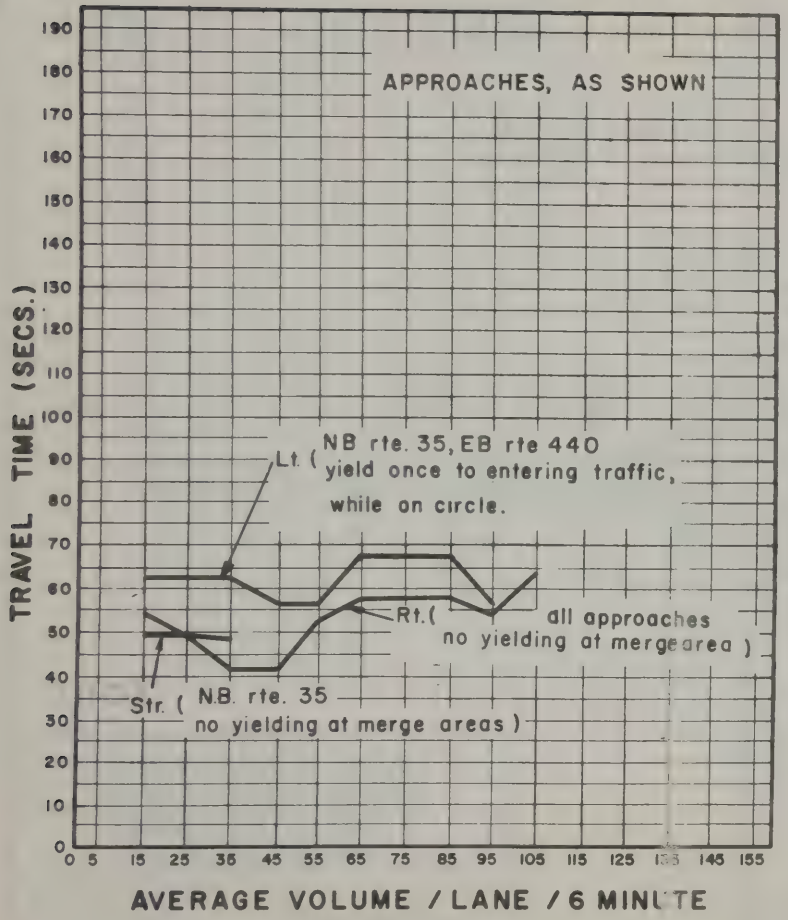
COLLISION DIAGRAM (1962-1964)
AADT - 30th PEAK HOUR 1963

N. J. ROUTE No. 35 AND ROUTE No. 440 TRAFFIC CIRCLE
CITY OF PERTH AMBOY, MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JANUARY, 1967

ROUTES 35 AND 440



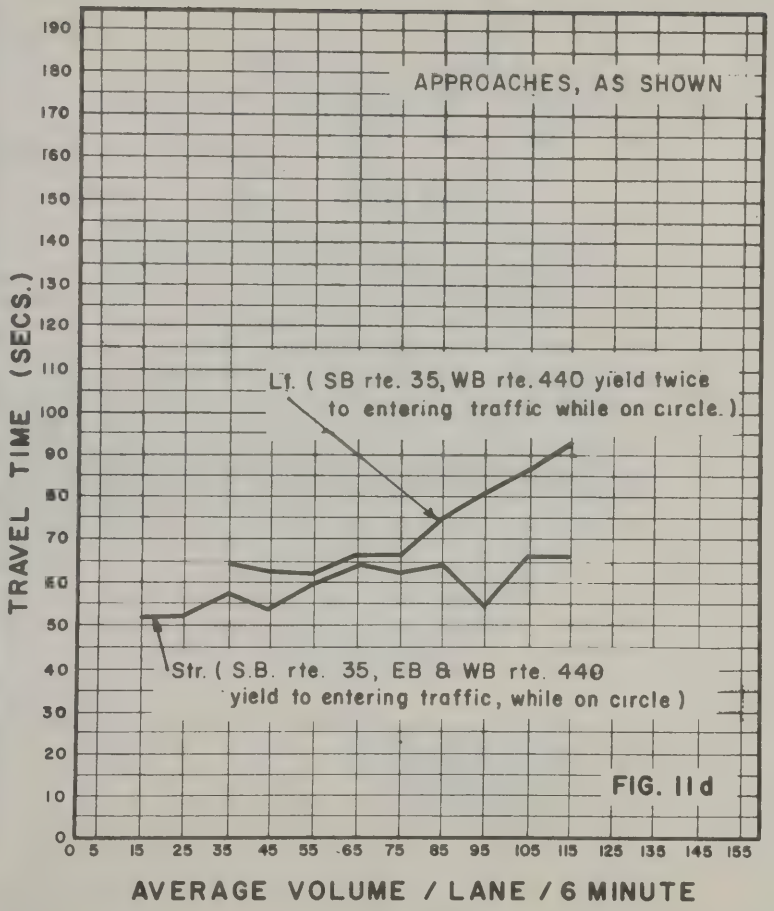


FIG. 11d

ROUTES 35 AND 440

Posted Speeds: Route 35 - 35 mph
Route 440 - 35 mph

Comments by W. R. Bellis:

This traffic circle carries a relatively small amount of traffic. Three of the 30 intersections carry a lesser volume. Thirty-five percent of the traffic is turning traffic. This compares with 25 percent for the average traffic circle studied, and 27 percent for the average of the 30 intersections.

The accident rate of 1020/100 MVM is the best of the 4 traffic circles. Twenty-six percent of the accidents are rear-end accidents, compared with 54 percent for the average of the 30 intersections. Six percent are sideswipes, compared to 11 percent for the 30 intersections. Twenty percent are right-angle accidents, compared to 16 percent for the 30 intersections. Nighttime accidents accounted for 52 percent, compared to 35 percent for the average of the 30 intersections.

Yielding movements, both entering and on this traffic circle, have resulted in an assortment of comparisons. No approach has a high volume, hence, over the years the traffic has assumed an "implied" control by the users. All entering traffic, except that on eastbound Route 440, is given the right-of-way (in deference to state law). Referring to Figure 11d, distinction is made between the "yielding" and "non-yielding" traffic.

The right turn movements are the only unimpeded movements on the circle. The right turn travel time is 7 seconds slower, during off-hours, and 20 seconds slower during peak hours than a cloverleaf.

For the unimpeded straight through movement, the travel time is 15 seconds slower than on a cloverleaf. For the impeded straight through movements, (where traffic yields to entering traffic while on the circle), the travel time is 20 seconds slower than for a cloverleaf.

The travel time for the left turn traffic is 10 seconds faster than on a cloverleaf, during off-peak hours. There are only two of the 30 intersections where the left turn from the major roadway is made faster than at this intersection. These are both unsignalized intersections.

PHOTO 12

U.S. Route 1 and Green Street

Traffic Circle

Year of Construction: 1929

Photographed 6/29/67 - 1700 hours
500' Altitude, Looking South

Photographed 6/29/67 - 1700 hours
700' Altitude, Looking West

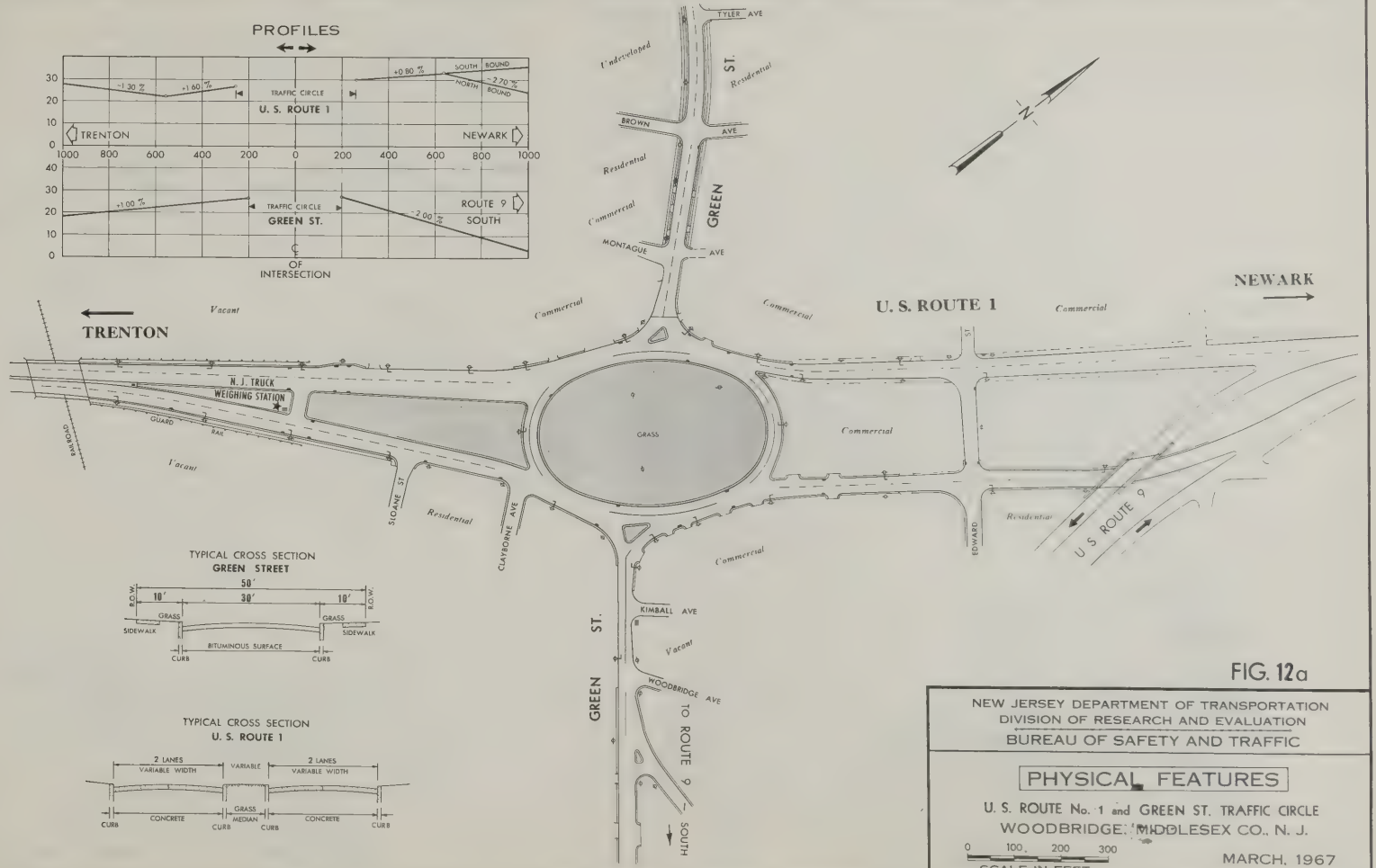


FIG. 12a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE No. 1 and GREEN ST. TRAFFIC CIRCLE
WOODBRIDGE, MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

MARCH, 1967

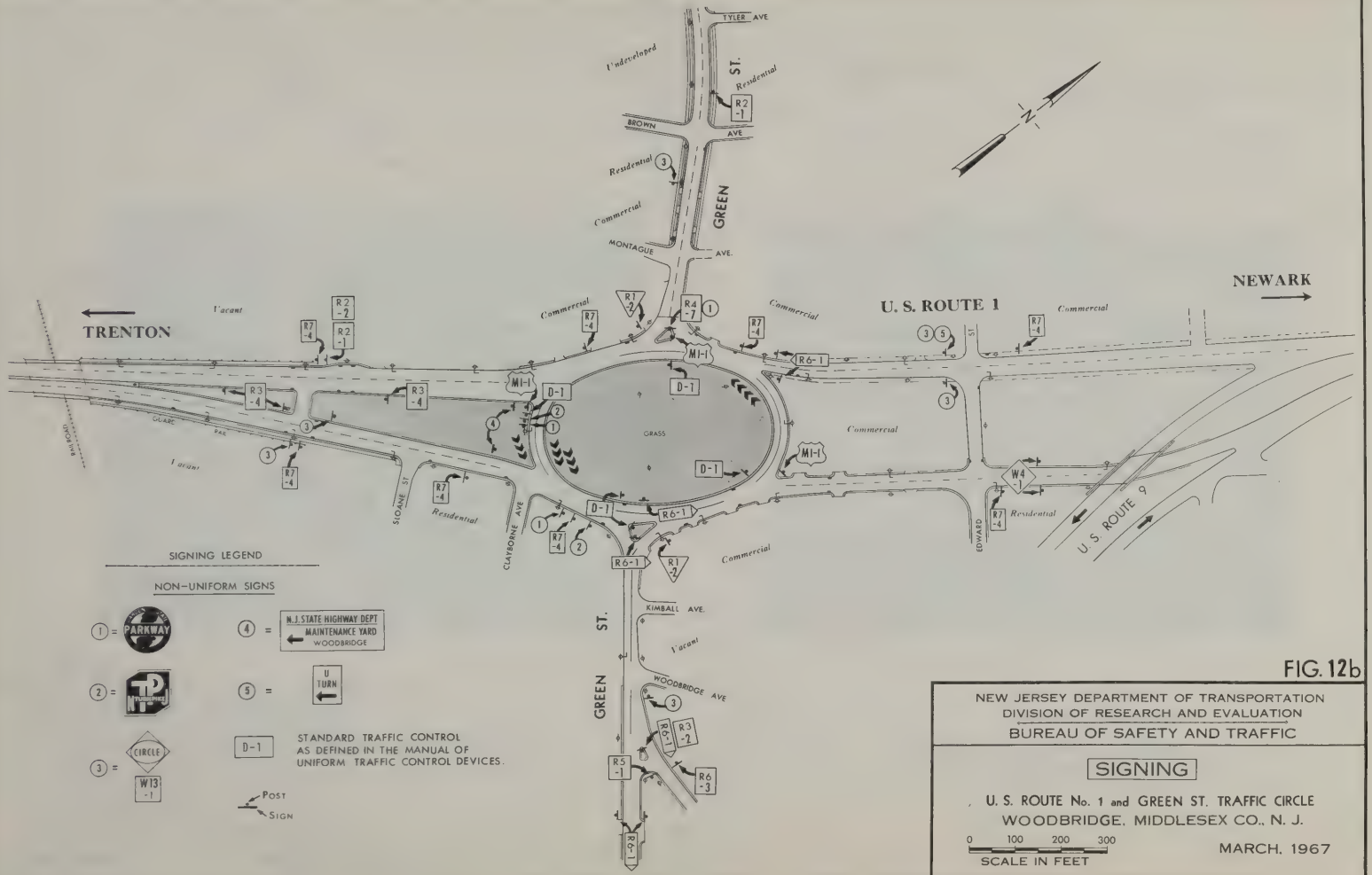


FIG. 12b

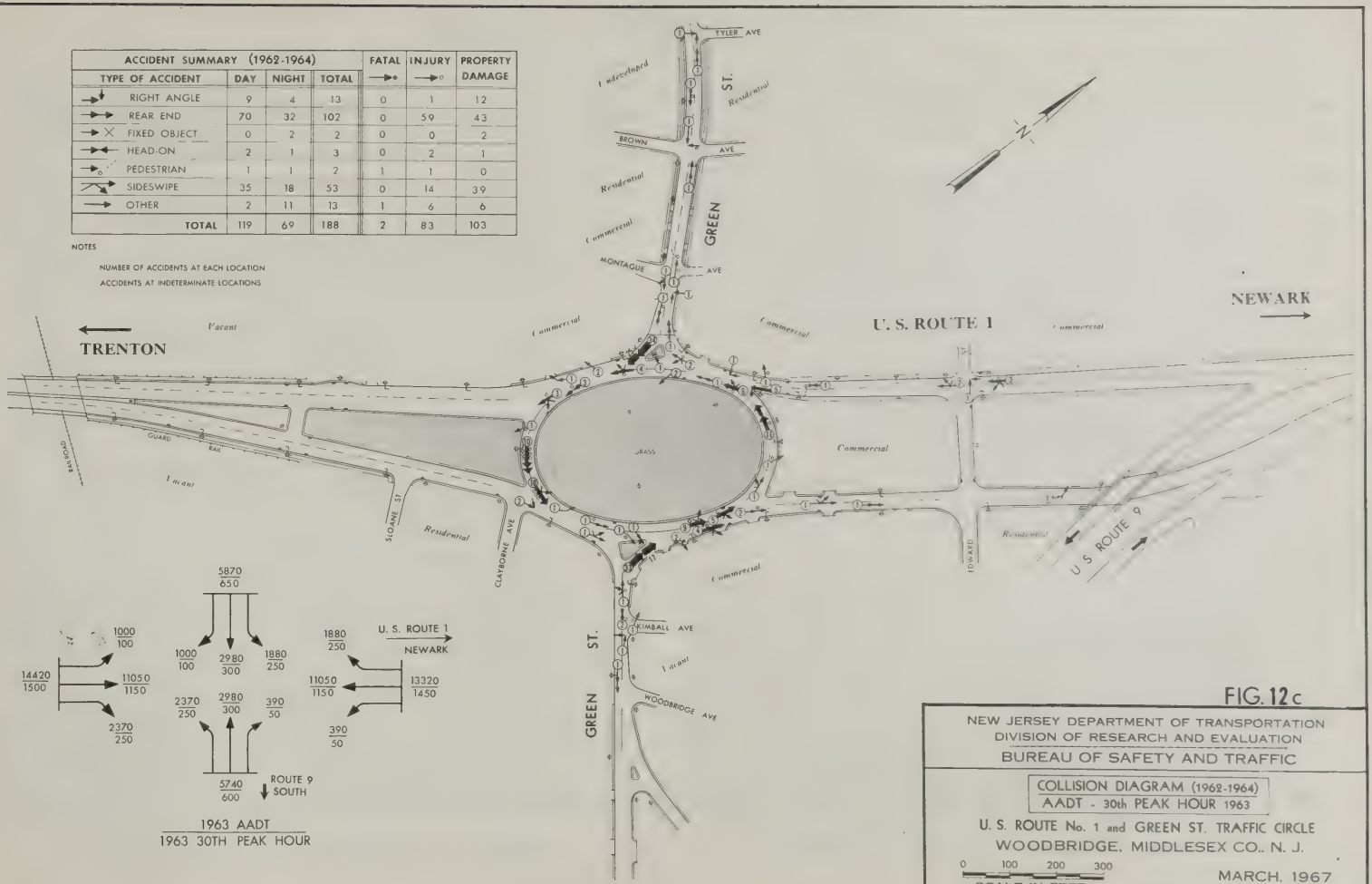
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

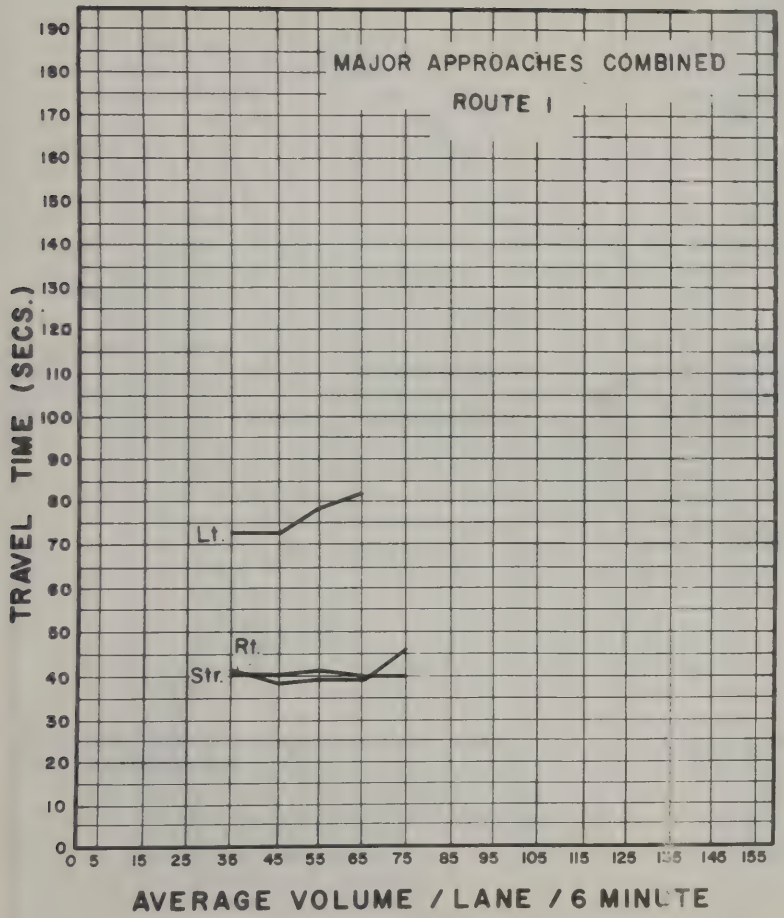
U. S. ROUTE No. 1 and GREEN ST. TRAFFIC CIRCLE
WOODBRIDGE, MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

MARCH, 1967


ACCIDENT SUMMARY (1962-1964)
TYPE OF ACCIDENT | DAY | NIGHT | TOTAL | FATAL | INJURY | PROPERTY DAMAGE
RIGHT ANGLE | 9 | 4 | 13 | 0 | 1 | 12
REAR END | 70 | 32 | 102 | 0 | 59 | 43
FIXED OBJECT | 0 | 2 | 2 | 0 | 0 | 2
HEAD-ON | 2 | 1 | 3 | 0 | 2 | 1
PEDESTRIAN | 1 | 1 | 2 | 1 | 1 | 0
SIDESWIPE | 35 | 18 | 53 | 0 | 14 | 39
OTHER | 2 | 11 | 13 | 1 | 6 | 6
TOTAL | 119 | 69 | 188 | 2 | 83 | 103
NOTES
NUMBER OF ACCIDENTS AT EACH LOCATION
ACCIDENTS AT INDETERMINATE LOCATIONS
TRENTON
NEWARK
U. S. ROUTE 1
TYLER AVE
BROWN AVE
GREEN ST.
MONTAGUE AVE
KIMBALL AVE
WOODBRIDGE AVE
SLOANE ST
CLAYBORNE AVE
TOWARD
U S ROUTE 9
GRASS
Vacant
Residential
Commercial
GUARD RAIL
RAILROAD
5870 / 650
1000 / 100
1880 / 250
2980 / 300
14420 / 1500
11050 / 1150
2370 / 250
390 / 50
13320 / 1450
5740 / 600
ROUTE 9 SOUTH
1963 AADT
1963 30TH PEAK HOUR
FIG. 12c
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC
COLLISION DIAGRAM (1962-1964)
AADT - 30th PEAK HOUR 1963
U. S. ROUTE No. 1 and GREEN ST. TRAFFIC CIRCLE
WOODBRIDGE, MIDDLESEX CO., N. J.
0 100 200 300
SCALE IN FEET
MARCH, 1967

ROUTE 1 & GREEN STREET



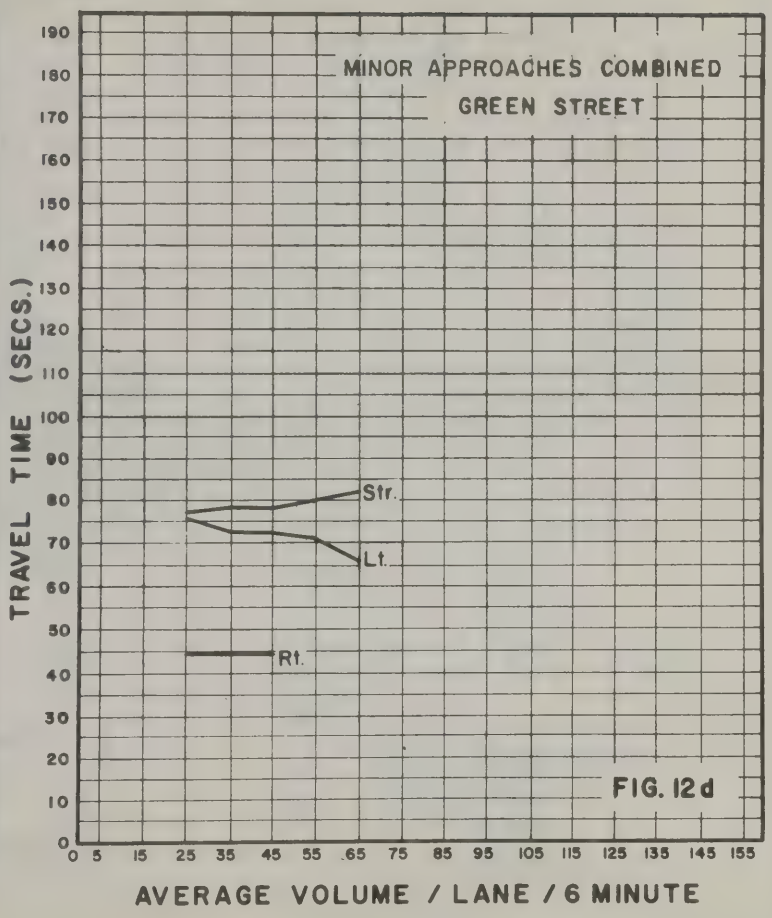


FIG. 12d

ROUTE 1 AND GREEN ST.

Posted Speeds: Route 1 - 50 mph
Green St. - 25 mph

Comments by W. R. Bellis:

This traffic circle has a high speed differential between the major movement and the minor movement. The straight through movement on the major road can be made at a fairly high speed, intimidating the traffic that wants to cross-weave from the minor road. The minor road traffic must wait for a long gap before crossing the major stream. Local people, who must cross Route 1 traffic, have registered many complaints because of, as they say, the long waiting time to get across. Luckily, the traffic volume on the major road is not near capacity so there are sufficient gaps in traffic.

Twenty-eight percent of the total traffic is turning movement traffic, which is almost equal to the average of 27 for the 30 intersections studied.

The injury rate is the best of the 4 traffic circles studied. Fifty-four percent of the accidents are rear-end accidents, which is the highest percentage of the 4 traffic circles, and compares with 37 percent for the average of the 4 traffic circles, and 54 percent for the average of the 30 intersections. Twenty-eight percent of the accidents are sideswipes, compared to 11 percent for the average of the 30 intersections. Six percent of the accidents are right-angle accidents, which is the lowest of all the traffic circles, and compares with 16 percent for the average traffic circle and 16 percent for the average of all intersections studied. Nighttime accidents account for 36 percent of the accidents, compared to 34 percent for the average of the 4 traffic circles, and 35 percent for the average of the 30 intersections.

The straight through movement on the major highway is only 3 seconds slower than that for the cloverleaf, and is the fastest of the 4 traffic circles. The right turns from the major roadway are only 2 seconds slower than for a cloverleaf, and is the fastest of the 4 traffic circles studied. The left turn is 5 seconds slower than for a cloverleaf. This movement must also cross the Route 1 straight through, high speed traffic.

On the minor roadway, the straight through movement is 43 seconds slower than that for a cloverleaf. Compared to the traffic circle at Route 35 and Route 440, the straight through movement on the Green Street circle is 22 seconds slower for the cross traffic, so that local traffic complaints must be based on their fear of right-angle accidents more than the time delay. Note that the right-angle accident is a low percentage.

The right turn movement from the minor road requires 5 seconds longer than for a cloverleaf, and is 8 seconds faster than for the circle at Routes 35 and 440. This right turn is faster than the other 3 traffic circles, so that local traffic is not delayed significantly in merging with this high speed traffic.

The left turn movement from the minor road is made in the same time required at a cloverleaf, and is 6 seconds faster than at Routes 35 and 440, and the fastest of all the traffic circles studied, likewise not supporting the local contention of excessive delays.

PHOTO 13

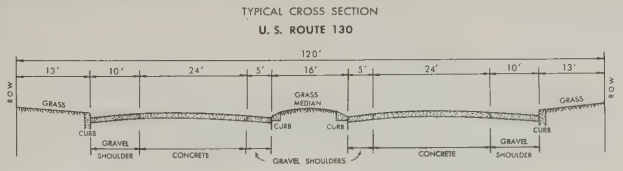
U.S. Routes 1 and 130

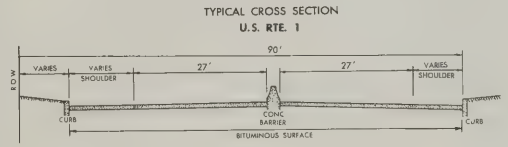
Traffic Circle

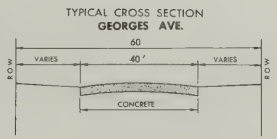
Year of Construction: 1941

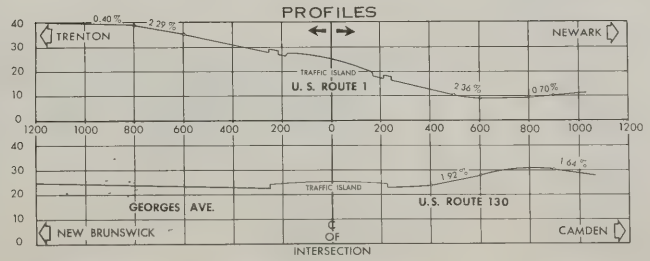
Photographed 8/21/67 - 1730 hours
500' Altitude, Looking Northwest

Photographed 8/21/67 - 1730 hours
1000' Altitude, Looking Northeast









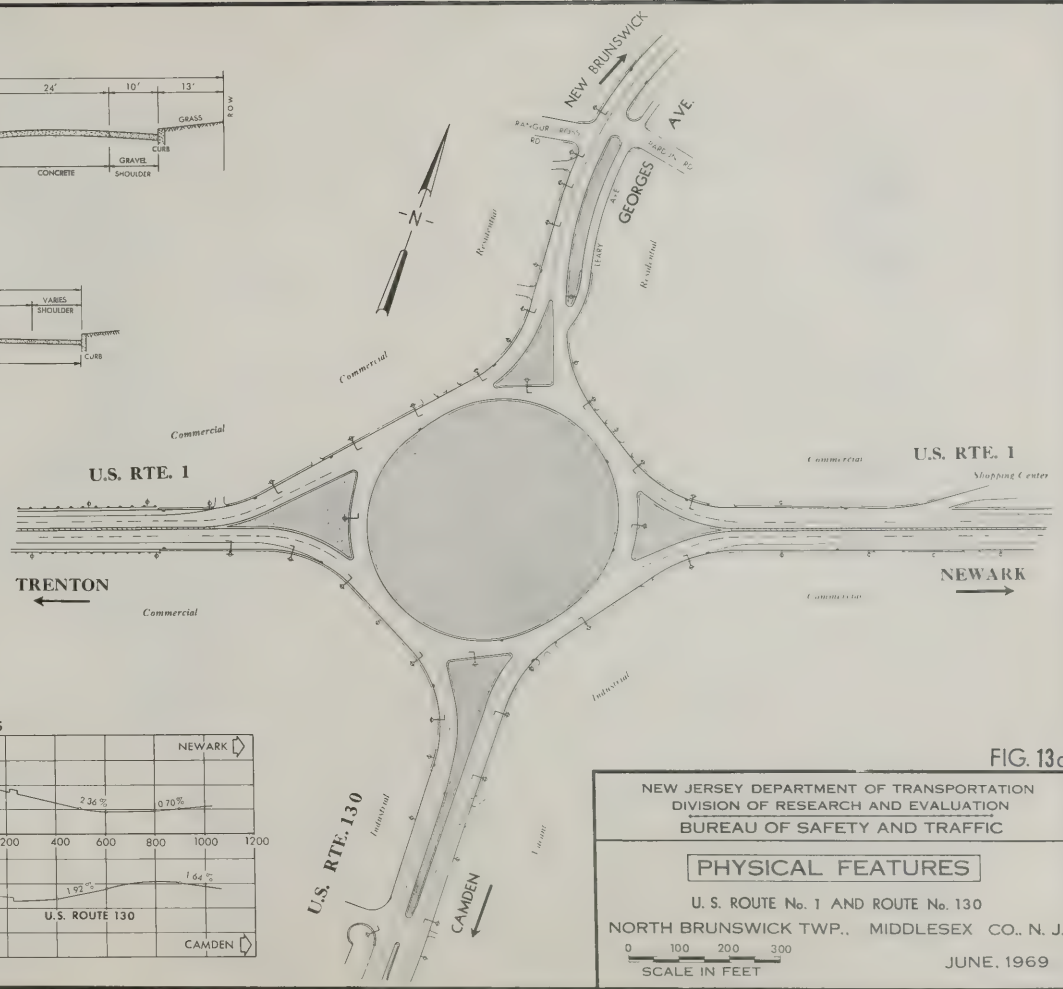


FIG. 13a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE No. 1 AND ROUTE No. 130
NORTH BRUNSWICK TWP., MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

SIGNING LEGEND

NON-UNIFORM SIGNS

① = PARKWAY

② = NJ TURNPIKE

③ =

④ =

⑤ =

⑥ = SLOW

FLASHING AMBER LIGHTS

D-1 STANDARD TRAFFIC CONTROL AS DEFINED IN THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.

POST / SIGN

★ = ILLUMINATED

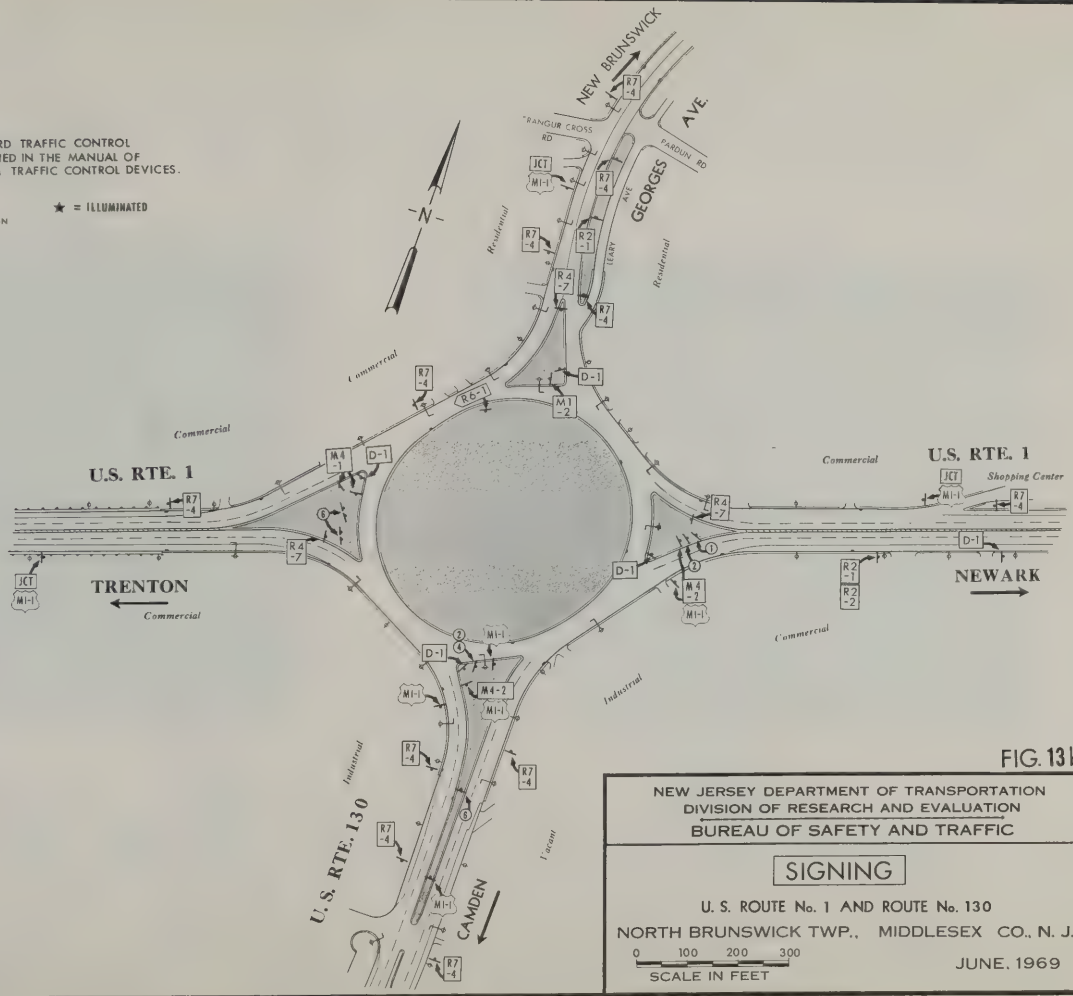


FIG. 13b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. ROUTE No. 1 AND ROUTE No. 130

NORTH BRUNSWICK TWP., MIDDLESEX CO., N. J.

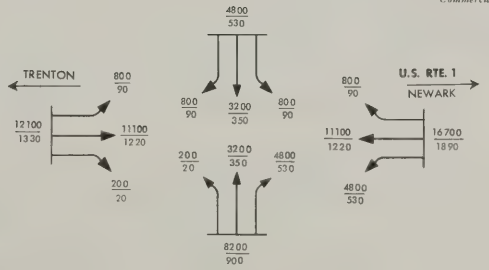
0 100 200 300
SCALE IN FEET

JUNE, 1969

ACCIDENT SUMMARY (1963-1965) TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	FATAL →•	INJURY →◦	PROPERTY DAMAGE
RIGHT ANGLE	36	13	49	0	11	38
REAR END	60	14	74	0	34	40
FIXED OBJECT *	66	14	80	0	31	49
HEAD-ON	0	0	0	0	0	0
PEDESTRIAN	0	0	0	0	0	0
SIDESWIPE	39	14	53	0	12	41
LEFT TURN	0	0	0	0	0	0
OTHER	3	2	5	0	2	3
TOTAL	204	57	261	0	90	171

→(2)← = NUMBER OF ACCIDENTS AT EACH LOCATION

* ALSO INCLUDES PARKED CARS



1964 AADT
1964 30TH PEAK HOUR

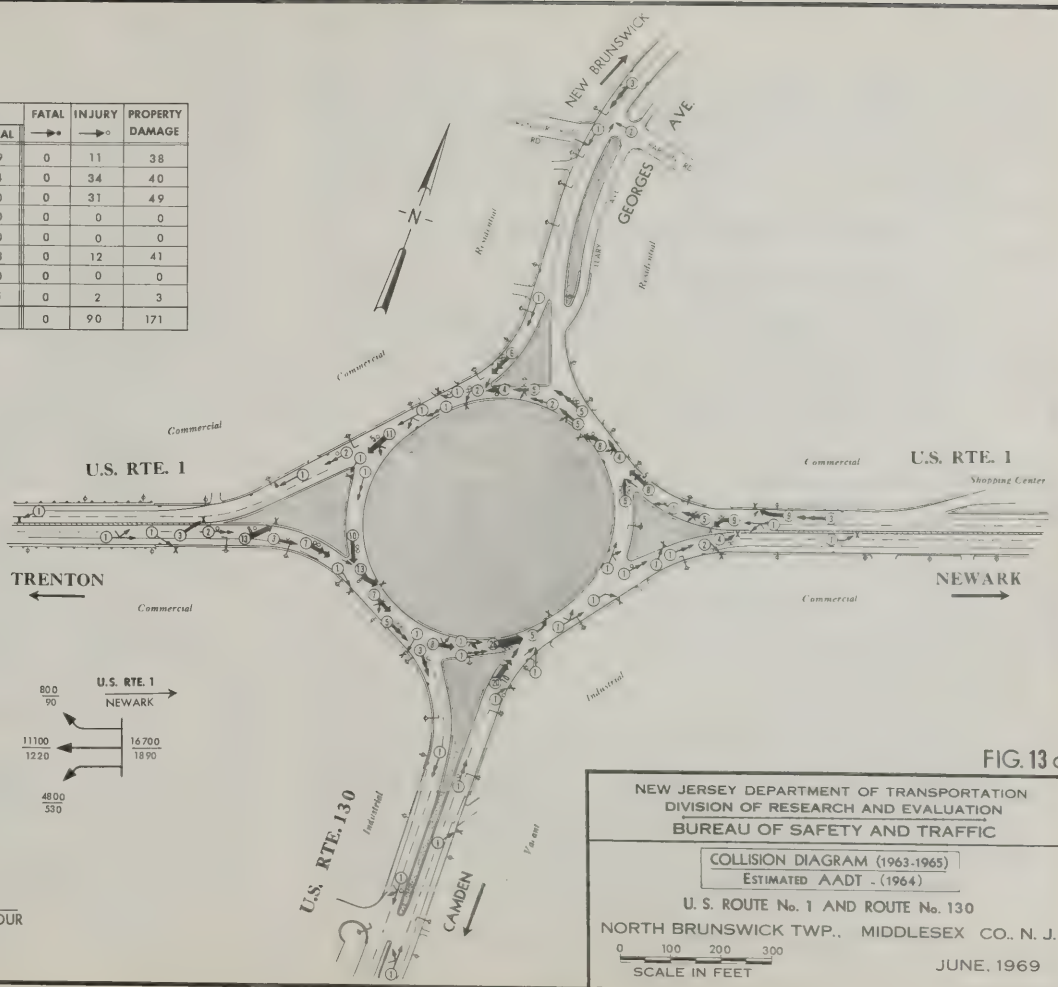


FIG. 13 c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

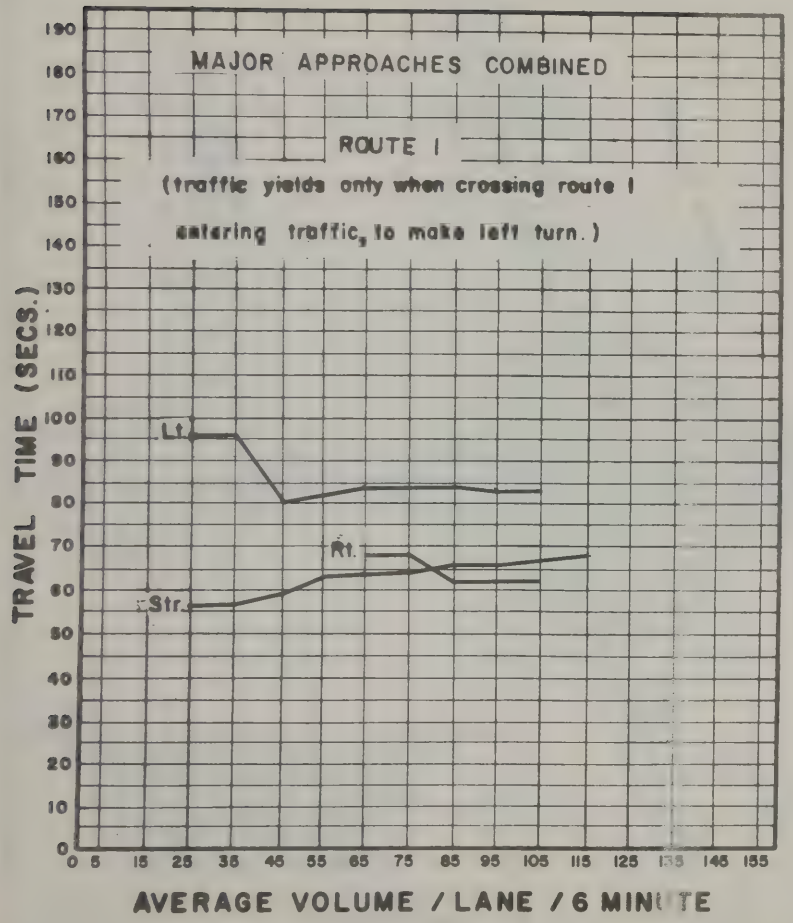
COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

U. S. ROUTE No. 1 AND ROUTE No. 130
NORTH BRUNSWICK TWP., MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTES 1 & 130



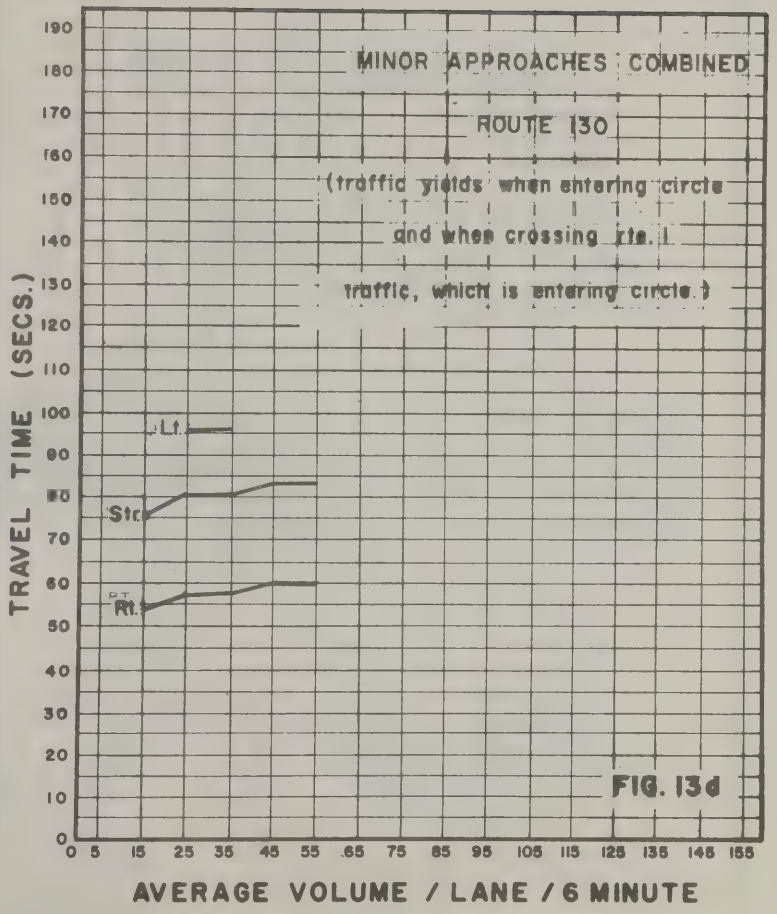


FIG. 13d

ROUTES 1 AND 130

Posted Speeds: Route 1 - 50 mph
Route 130 - 50 mph

Comments by W. R. Bellis:

There have been complaints about this circle because of excessive delays during peak hours. During these periods, police officers operate the circle as stop-and-go, to alternate the flow of traffic. If they do not, one stream will not stop to give other movements a chance to get across. The turning movement is 31 percent of the total traffic, and compares with 27 percent for the average of the 30 intersections. Plans are underway at the present time by the N. J. Department of Transportation to grade separate this intersection. Before the traffic circle was built in 1941, this intersection was controlled by traffic signals.

Twenty-eight percent of all of the accidents are rear-end accidents, compared with 54 percent for the average of the 30 intersections. Twenty percent of the accidents are sideswipes, compared to 11 percent for the average of the 30 intersections. Eighteen percent are right-angle accidents, compared to 16 percent for the average of the 30 intersections. Twenty-one percent of the accidents occur at night, compared to 35 percent for the average of the 30 intersections.

The average straight through movement on the major road requires 25 seconds longer than for a cloverleaf. During peak hours it requires 12 seconds longer than during the off-hours. During the peak hours, the straight through movement is 13 seconds slower than for the traffic circle at Routes 35 and 440. The straight through movement on the minor roadway requires 42 seconds longer than for a cloverleaf. During the peak hour, it requires 8 seconds longer than during the off-hour and 17 seconds longer than the circle of Routes 35 and 440.

For the right turn on the major roadway, the peak hour requires 6 seconds longer than the off-hour, and the average time is 25 seconds slower than at a cloverleaf. During the peak hour, this right turn is 4 seconds slower than at the Routes 35 and 440 traffic circle. The right turn from the minor road requires 17 seconds longer than at a cloverleaf. The peak hour is 6 seconds slower than during the off-hour and the peak hour is 4 seconds faster than at the Routes 35 and 440 traffic circle.

For the left turns from the major roadway, it requires 18 seconds longer than the left turn on a cloverleaf. During the peak hour, it requires 16 seconds longer than during the off-hour and during the peak hour it requires 28 seconds longer than at the circle of Routes 35 and 440. The left turns from the minor road require 26 seconds longer than at a cloverleaf. There is no difference between the peak hour and the off-peak hour, and compared to the Routes 35 and 440 circle, it requires 4 seconds longer.

During the collection of this data, the police officers allowed the traffic to travel without their assistance. The differentials in time between the off-hours and the peak hours observed in this study do not seem to justify the use of police officers.

Either these small time differentials are

enough to justify converting this circle to a grade separation or some other factor is the prime reason. It is possible that traffic gets through the intersection faster without the police officers than they do with the police officers.

PHOTO 14

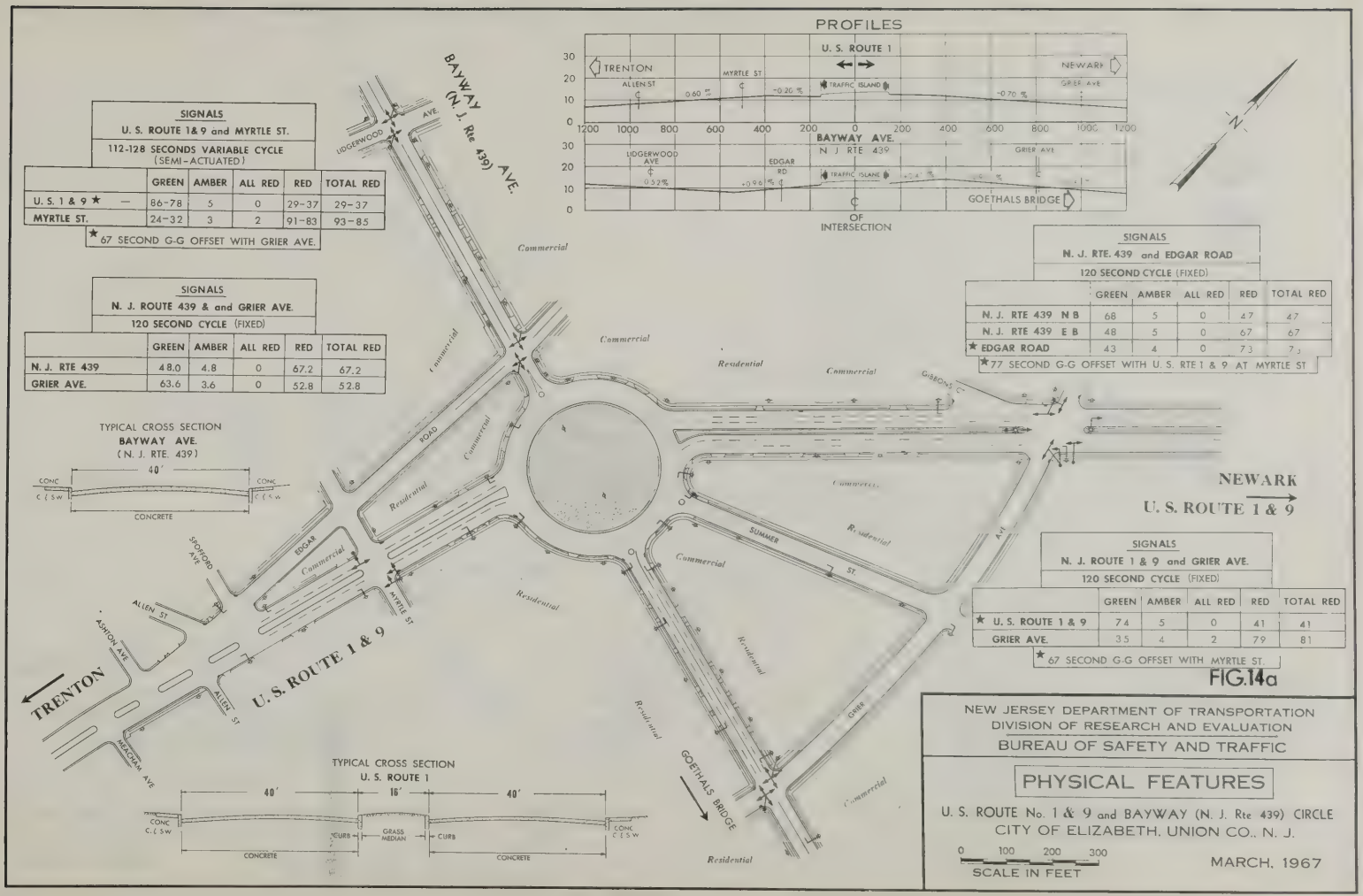
U.S. Route 1-9 and Bayway Avenue

Traffic Circle

Year of Construction: 1929

Photographed 5/18/67 - 1700 hours
500' Altitude, Looking Southeast

Photographed 5/18/67 - 1700 hours
700' Altitude, Looking West



SIGNALS
U. S. ROUTE 1& 9 and MYRTLE ST.
112-128 SECONDS VARIABLE CYCLE
(SEMI-ACTUATED)

	GREEN	AMBER	ALL RED	RED	TOTAL RED
U. S. 1 & 9 ★ —	86-78	5	0	29-37	29-37
MYRTLE ST.	24-32	3	2	91-83	93-85

★ 67 SECOND G-G OFFSET WITH GRIER AVE.

SIGNALS
N. J. ROUTE 439 & and GRIER AVE.
120 SECOND CYCLE (FIXED)

	GREEN	AMBER	ALL RED	RED	TOTAL RED
N. J. RTE 439	48.0	4.8	0	67.2	67.2
GRIER AVE.	63.6	3.6	0	52.8	52.8

SIGNALS
N. J. RTE. 439 and EDGAR ROAD
120 SECOND CYCLE (FIXED)

	GREEN	AMBER	ALL RED	RED	TOTAL RED
N. J. RTE 439 N B	68	5	0	47	47
N. J. RTE 439 E B	48	5	0	67	67
★ EDGAR ROAD	43	4	0	73	73

★77 SECOND G-G OFFSET WITH U. S. RTE 1 & 9 AT MYRTLE ST

SIGNALS
N. J. ROUTE 1 & 9 and GRIER AVE.
120 SECOND CYCLE (FIXED)

	GREEN	AMBER	ALL RED	RED	TOTAL RED
★ U. S. ROUTE 1 & 9	74	5	0	41	41
GRIER AVE.	35	4	2	79	81

★ 67 SECOND G-G OFFSET WITH MYRTLE ST.

FIG.14a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE No. 1 & 9 and BAYWAY (N. J. Rte 439) CIRCLE
CITY OF ELIZABETH, UNION CO., N. J.

0 100 200 300
SCALE IN FEET

MARCH, 1967

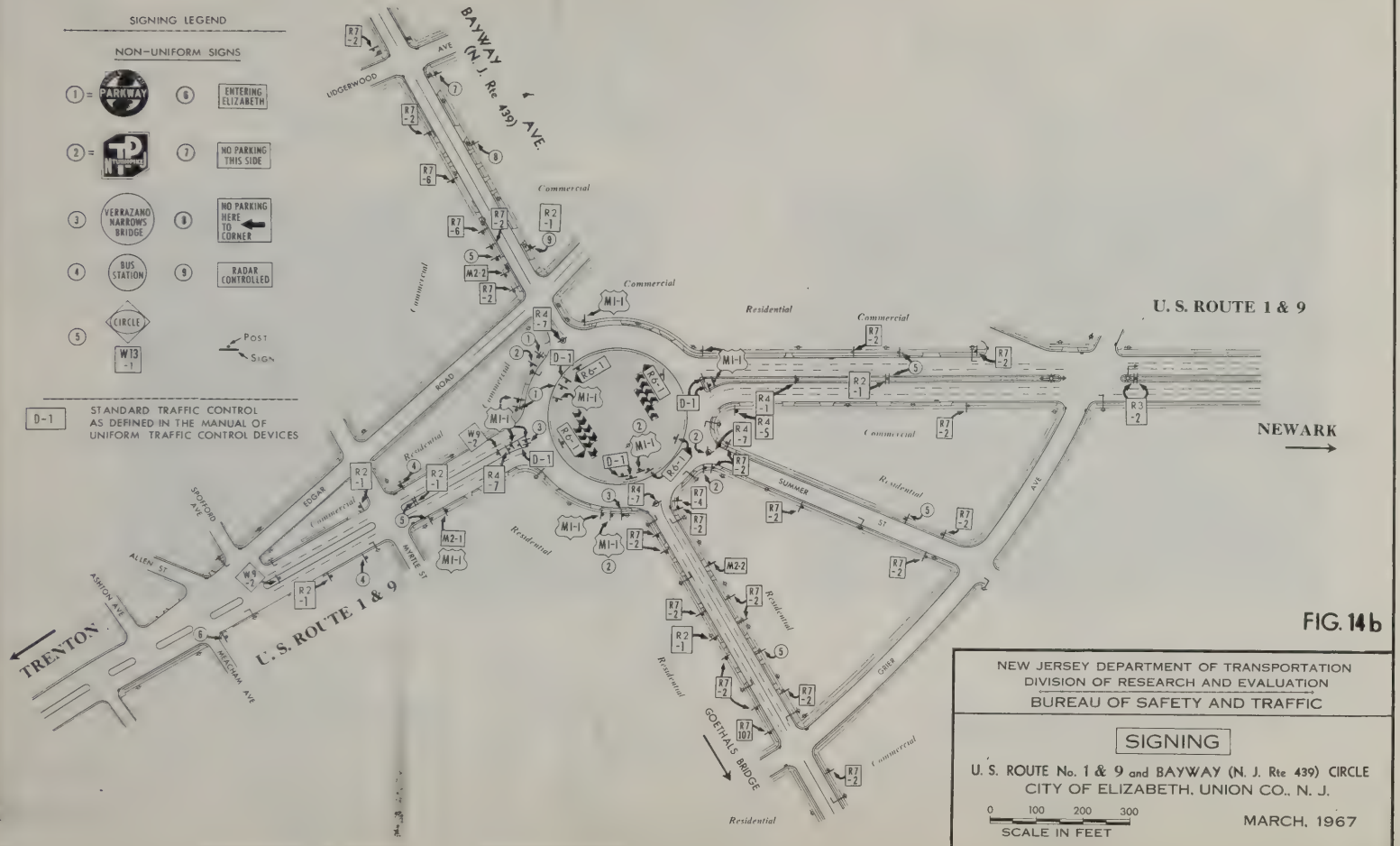


FIG. 14b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. ROUTE No. 1 & 9 and BAYWAY (N. J. Rte 439) CIRCLE
CITY OF ELIZABETH, UNION CO., N. J.

0 100 200 300
SCALE IN FEET

MARCH, 1967

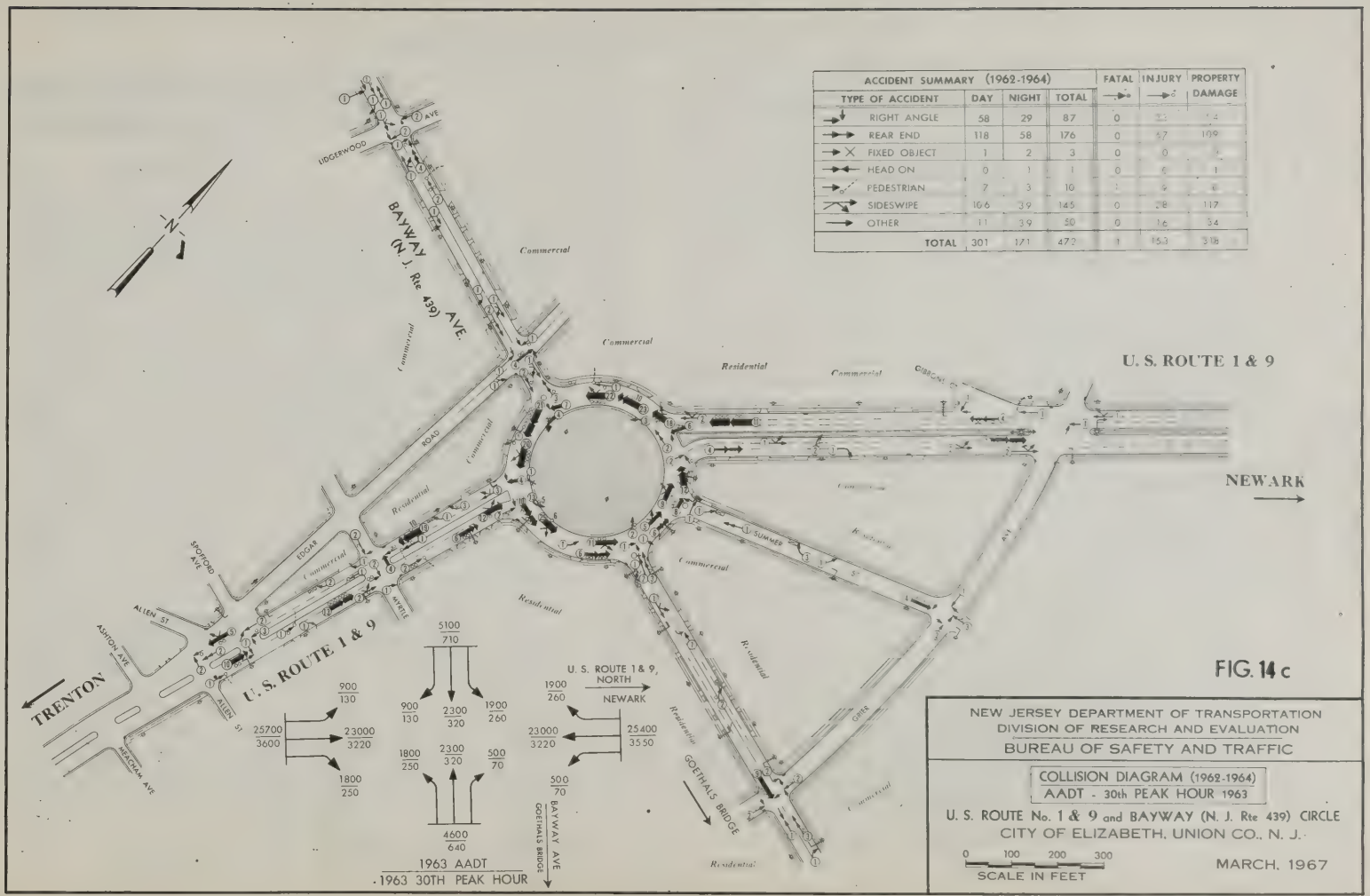


FIG. 14 c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

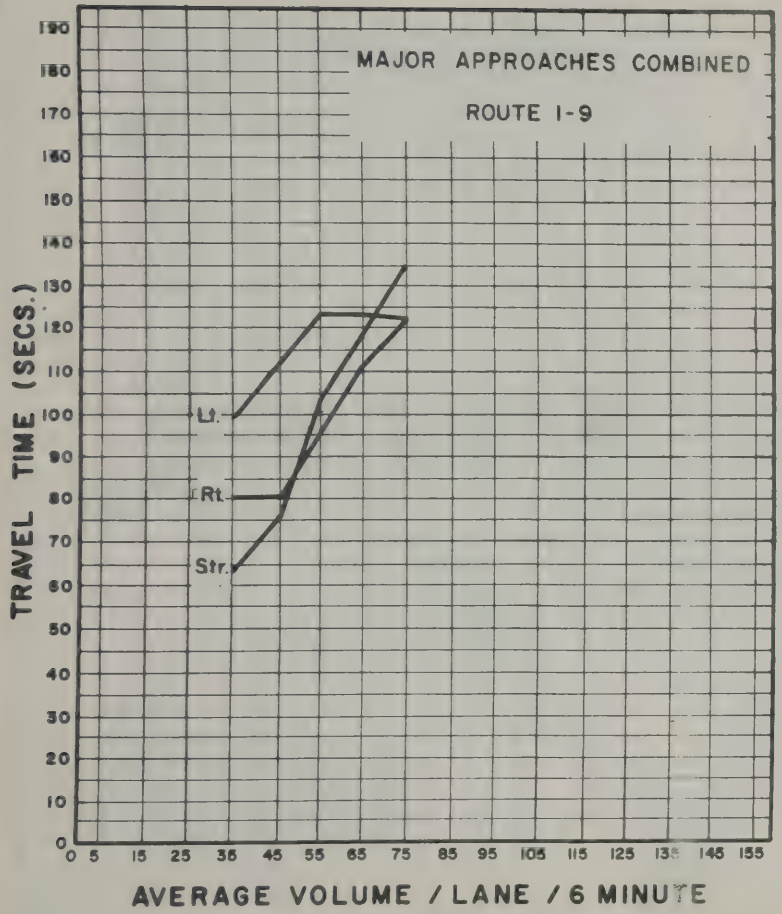
COLLISION DIAGRAM (1962-1964)
AADT - 30th PEAK HOUR 1963

U. S. ROUTE No. 1 & 9 and BAYWAY (N. J. Rte 439) CIRCLE
CITY OF ELIZABETH, UNION CO., N. J.

0 100 200 300
SCALE IN FEET

MARCH, 1967

ROUTES 1-9 & BAYWAY AVENUE



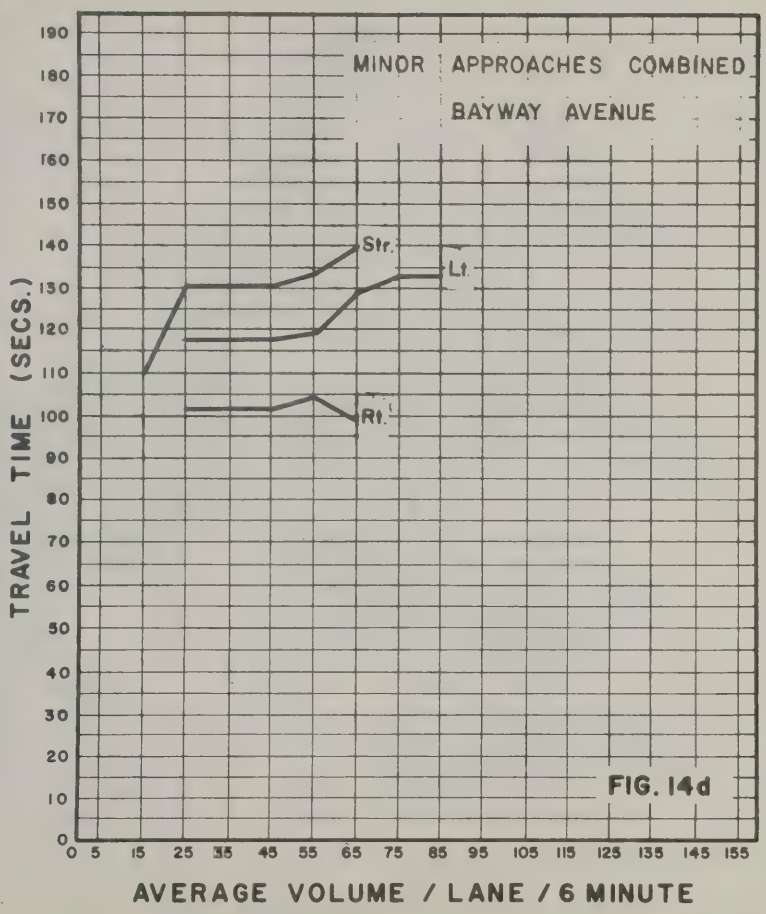


FIG. 14d

ROUTE 1&9 AND BAYWAY AVE.

Posted Speeds: Route 1&9 - 40 mph
Bayway Ave. - 30 mph

Comments by W. R. Bellis:

This circle carries more traffic than any of the other traffic circles, and is recognized as highly inadequate. Sixteen percent of the traffic is turning movement traffic, compared to 25 percent for the average of the 4 circles, and 27 percent for the average of the 30 intersections.

The accident rate is very high, being exceeded only by 2 other intersections studied. These are Route 1&9 and Wood Avenue, and Route 27 and Plainfield Avenue, both signalized intersections. During the 3-year period there were more accidents than at any of the other 30 intersections studied except one, the Routes 4 and 17 cloverleaf. Thirty percent of the accidents were sideswipes, which is the highest percentage of any of the traffic circles, and compares with an average of 25 percent for the 4 circles, and 11 percent for the average of the 30 intersections. Right-angle accidents accounted for 18 percent of the total accidents, compared with 16 percent for the average of the 4 traffic circles, and 16 percent for the average of the 30 intersections. Thirty-six percent of the accidents occurred at night, compared with 34 percent for the average of the 4 circles, and 35 percent for the average of the 30 intersections.

Overall travel times through this intersection were slower than any other of the 30 intersections. For the straight through movement, it takes 50 seconds longer on this circle than it does at the Routes 35 and 440 circle, and 63 seconds longer than at a cloverleaf. During the off-hours, this movement is made in 64 seconds, and during the peak hours in 135 seconds, indicating that congestion or over-capacity causes a loss of 70 seconds in the 2,000 feet. From the minor road, the straight through movement is the slowest movement of all 30 intersections except at 2 traffic signal locations. During off-hours it requires 75 seconds longer than for a cloverleaf, and during peak hours 100 seconds longer than on a cloverleaf.

The congestion causes a 40 second loss for the right turn. There are only 2 other intersections which have slower movements for the right turn from the major highway. These are both signalized intersections. These right turns take twice as long as at two of the traffic circles studied. During the off-hours, it requires 45 seconds longer than on the Route 1 and Milltown Road cloverleaf, and during peak hours, 42 seconds longer. On the minor road, the right turn during off-hours requires 65 seconds longer than for a cloverleaf, and during peak hours 60 seconds longer than for a cloverleaf.

The left turn from the minor road is one of the slowest movements of all 30 intersections, requiring 50 seconds longer than on a cloverleaf.

There are 4 signalized intersections, one on each leg of the traffic circle, within the study area. These are synchronized for progressive movement. The offsets for the minor road are such that most of the traffic from the minor road arrives at the circle during the period when the smallest amount of traffic is arriving from the major road. It is expected that these offsets may not be maintained in good operation at all times because the

signals are not interconnected.

The New Jersey Turnpike is one mile away and parallel to Route 1&9. Route 27 is a half mile away, on the other side and parallel, and a new state highway is now under construction between Route 1&9 and the New Jersey Turnpike. When completed, this new route should take some of the major route traffic out of the circle.

PHOTO 15

U.S. Route 206 and Whitehorse Avenue

Channelized Traffic Circle

Year of Construction: 1947

Photographed 5/17/68 - 0930 hours
500' Altitude, Looking West

Photographed 5/17/68 - 0930 hours
800' Altitude, Looking East

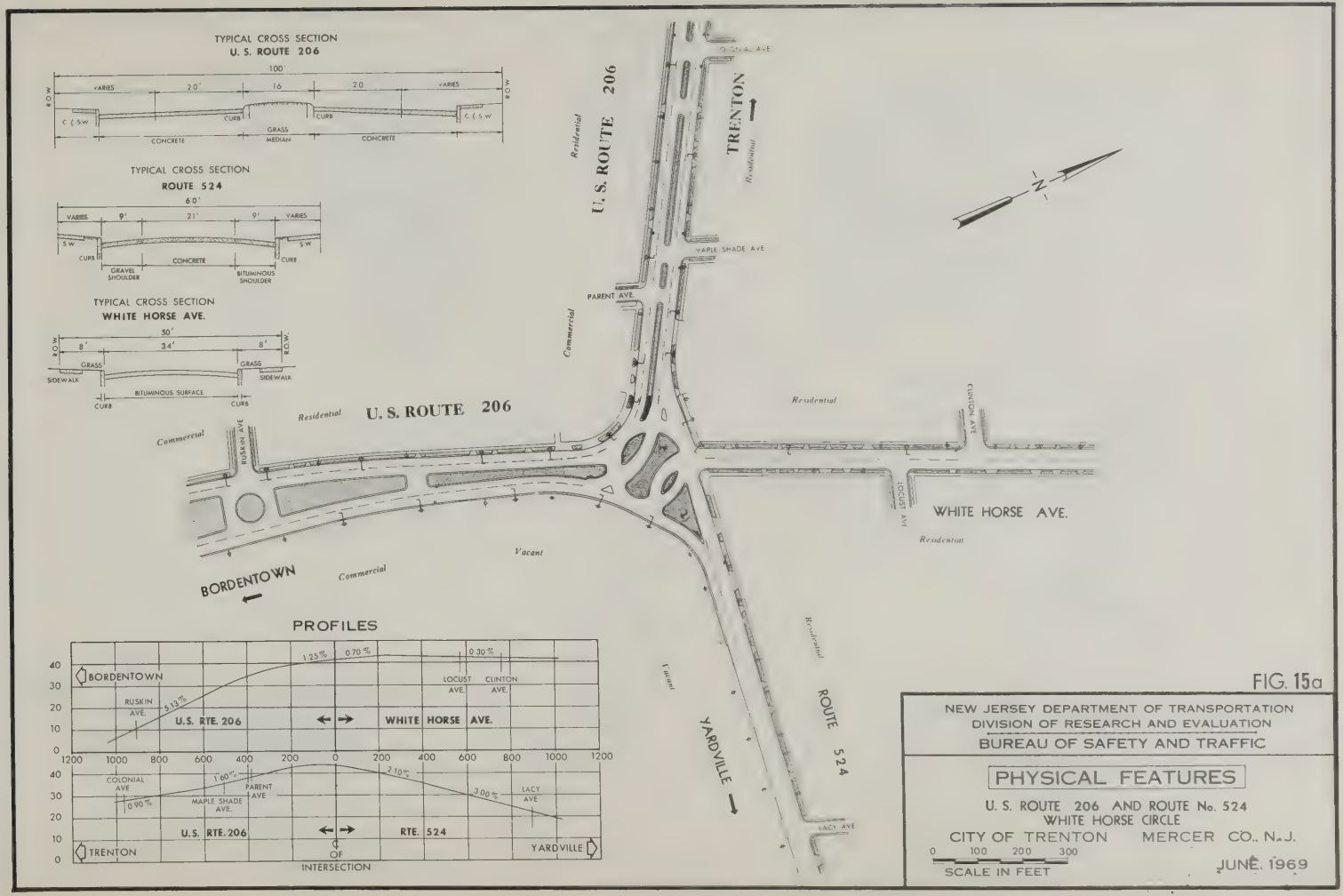


FIG. 15a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE 206 AND ROUTE No. 524
WHITE HORSE CIRCLE
CITY OF TRENTON MERCER CO., N.J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

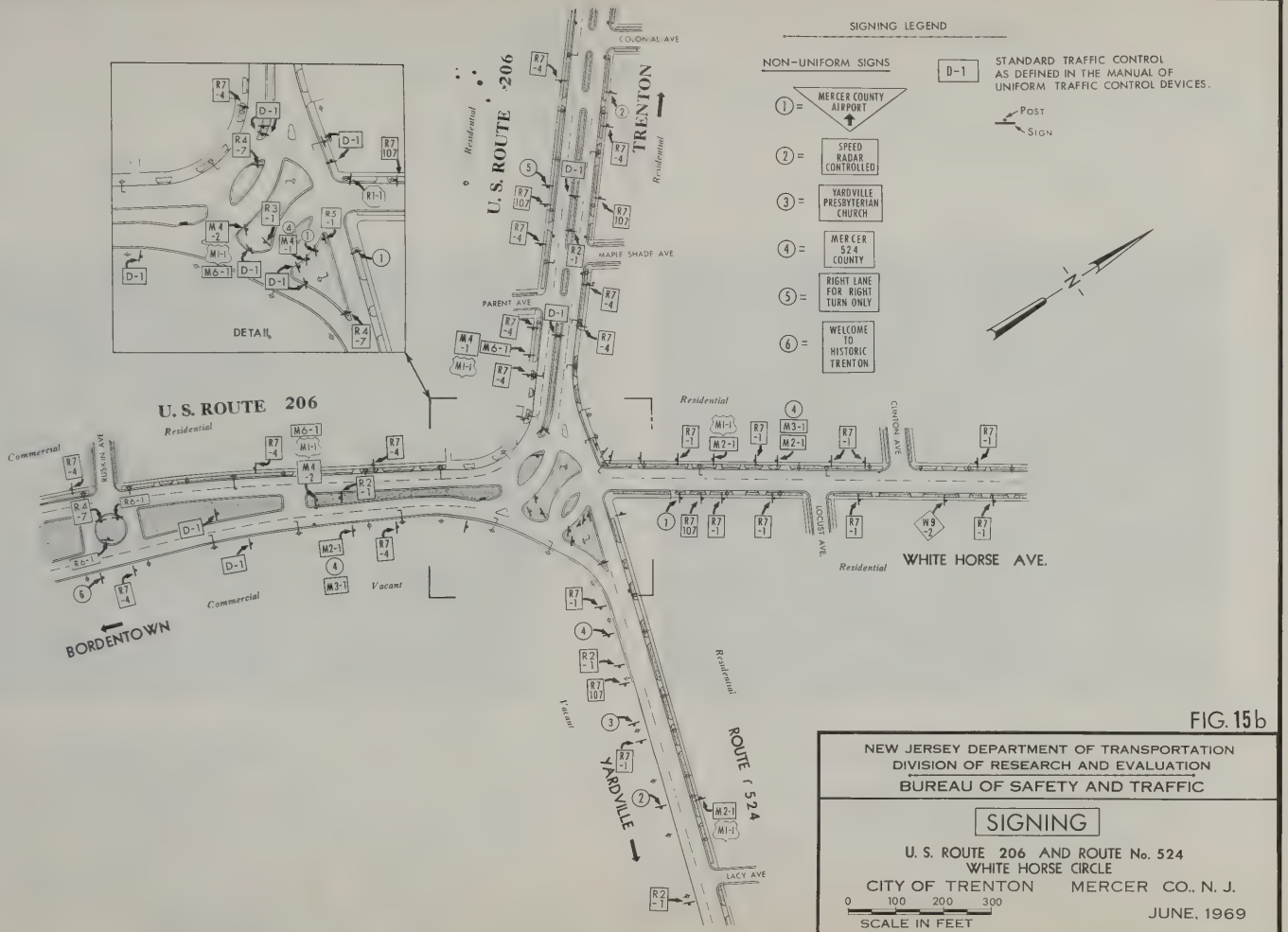


FIG. 15b

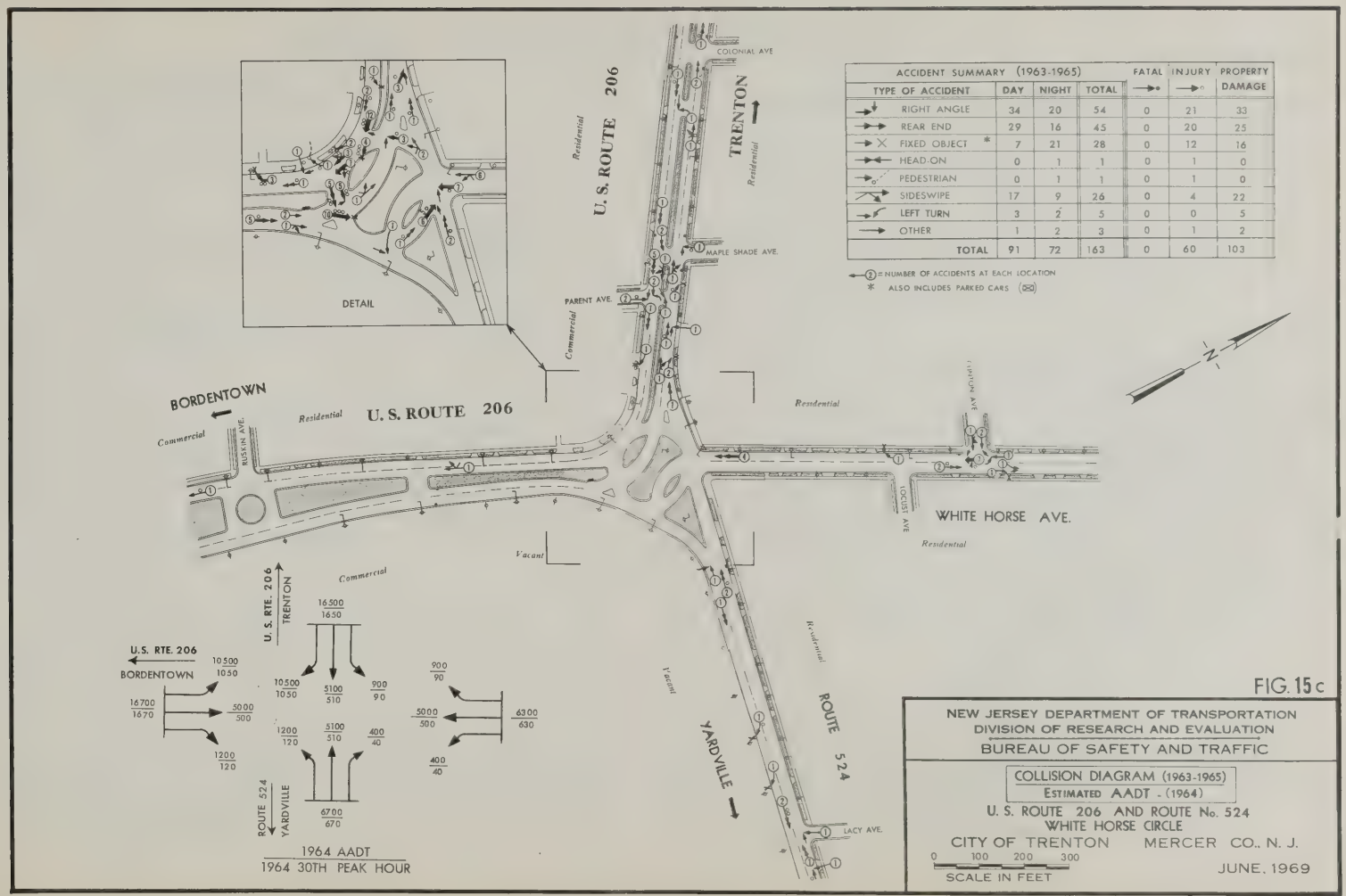
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. ROUTE 206 AND ROUTE No. 524
WHITE HORSE CIRCLE
CITY OF TRENTON MERCER CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969



ACCIDENT SUMMARY (1963-1965) TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	FATAL	INJURY	PROPERTY DAMAGE
RIGHT ANGLE	34	20	54	0	21	33
REAR END	29	16	45	0	20	25
FIXED OBJECT *	7	21	28	0	12	16
HEAD-ON	0	1	1	0	1	0
PEDESTRIAN	0	1	1	0	1	0
SIDESWIPE	17	9	26	0	4	22
LEFT TURN	3	2	5	0	0	5
OTHER	1	2	3	0	1	2
TOTAL	91	72	163	0	60	103

(2) = NUMBER OF ACCIDENTS AT EACH LOCATION
* ALSO INCLUDES PARKED CARS (⊠)

FIG. 15 c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

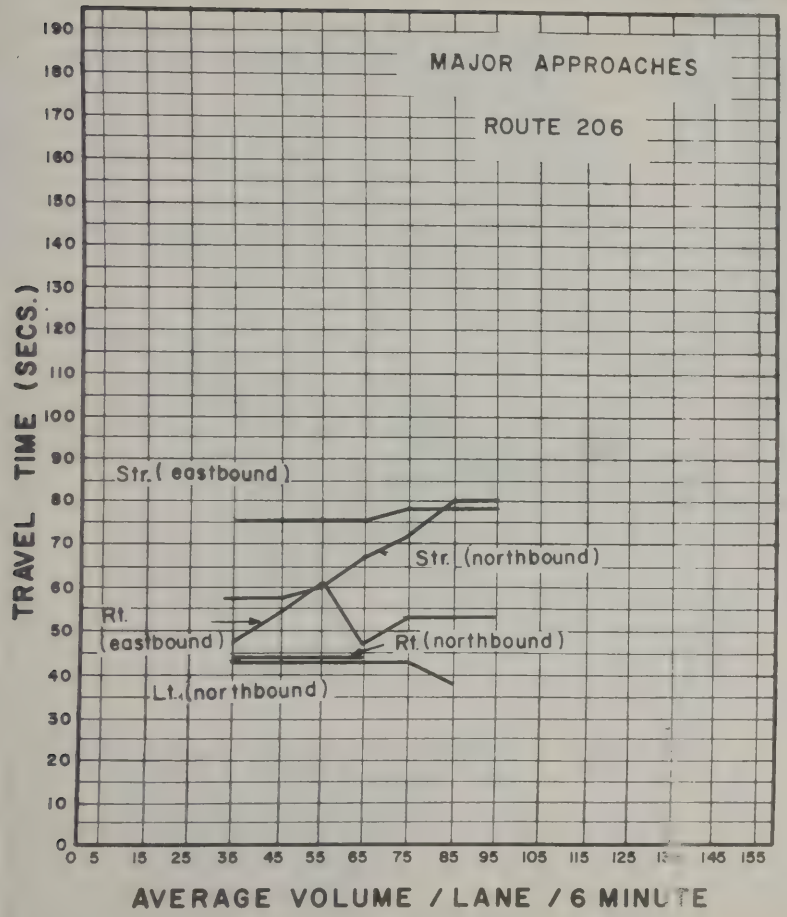
COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

U. S. ROUTE 206 AND ROUTE No. 524
WHITE HORSE CIRCLE
CITY OF TRENTON MERCER CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTE 206 & WHITEHORSE AVENUE



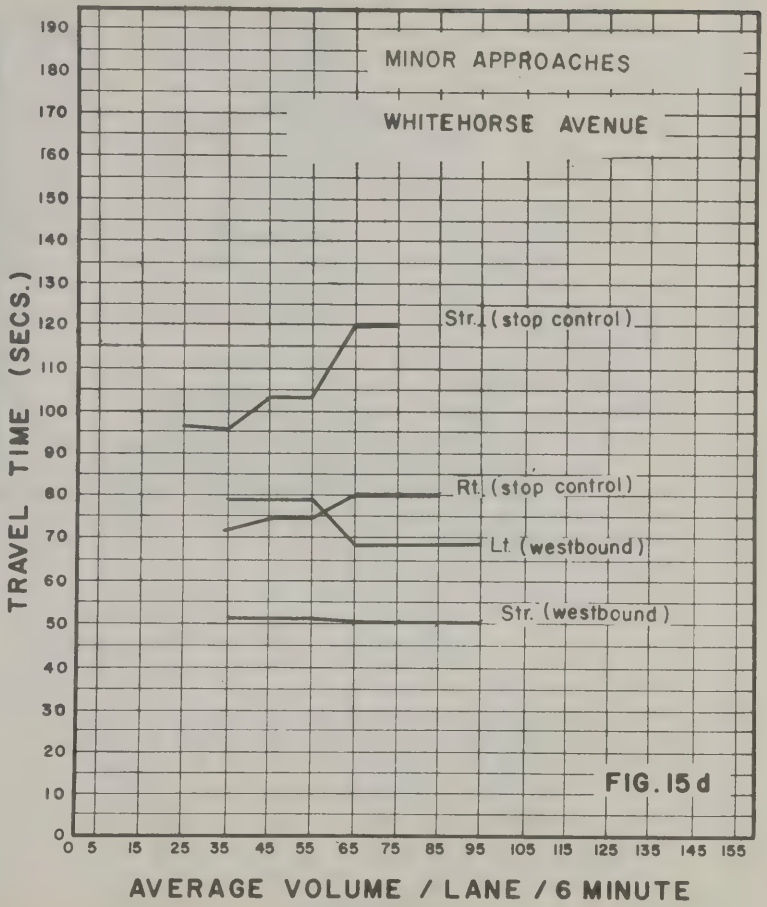


FIG. 15 d

ROUTE 206 AND WHITEHORSE AVE.

Posted Speeds: Route 206 - 45 mph
Whitehorse Ave. - 25 mph

Comments by W. R. Bellis:

This channelized intersection, without traffic signals, favors a very heavy left turn movement and its corresponding right turn. The total turning movement is 56 percent of the total traffic using the intersection, compared with 27 percent for the average of the 30 intersections studied, and this intersection ranks number 2 in the largest percentage of turning movements, behind Routes 1&9T and 440.

The accident and injury rates are quite high. Twenty-seven percent of the accidents are rear-ends, compared to 54 percent for the average of the 30 intersections. Fifteen percent are side-swipes, compared to 11 percent for the average of the 30 intersections. Thirty-three percent are right-angle accidents, compared to 16 percent for the average of the 30 intersections. Forty-four percent occur at night, compared to the overall average of 35 percent.

From the major approach, the straight through movement is 31 seconds slower than for a cloverleaf. The right turn is 12 seconds slower than at a cloverleaf, and the favored left turn is 30 seconds faster than for a cloverleaf.

The southbound Whitehorse Avenue straight through movement (with a stop control) is 60 seconds slower than on a cloverleaf, and westbound Broad Street is 5 seconds slower. The right turn is 36 seconds slower, and the left turn about the same as for a cloverleaf.

It can be seen that the left turn from the major road is quite fast and that there is little difference between the off-hours and peak hours, whereas one of the straight through movements from the minor road is quite slow, and has a 25 second differential between off-hours and peak hours. At the point where these two streams of traffic cross, there is no stop or yield sign and the minor road straight through movement gives way, by choice, to the left turn movement from the major roadway. If a stop street sign were to be installed at this point, it is believed that the flow of traffic would be greatly impaired.

This intersection is rated very high in overall efficiency. Prior to building this intersection in 1947, it had been planned to build a normal traffic circle. Necessary land was acquired in two of the quadrants but the land in the other two quadrants could not be purchased for a price which the highway department felt was reasonable. The existing intersection was therefore designed to fit the available right-of-way. Additional highways are to be built nearby, which will relieve this intersection of much of its problems.

PHOTO 16

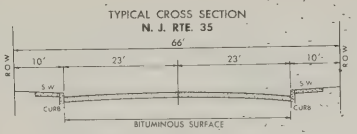
N.J. Route 35 and Smith Street

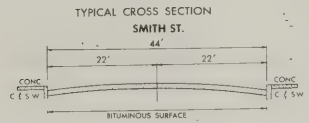
Signalized Intersection

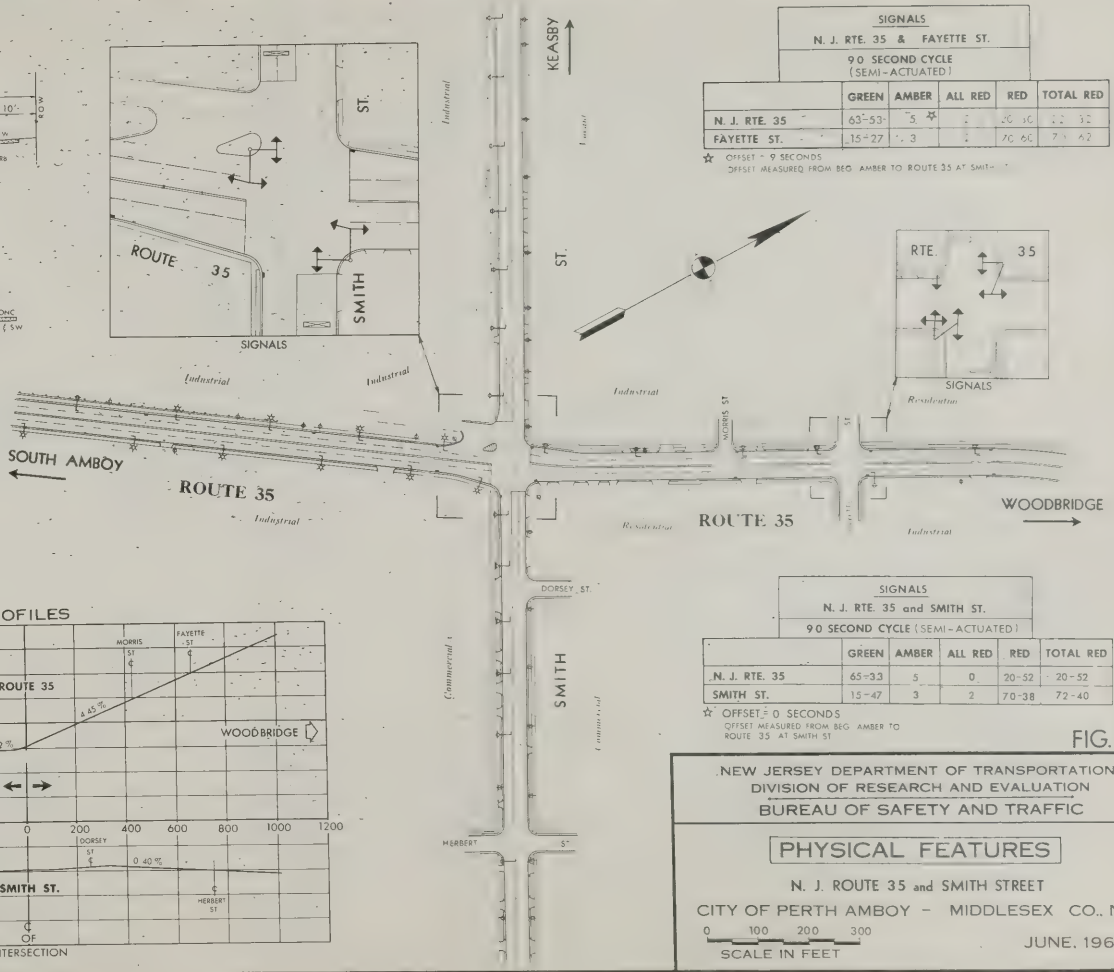
Year of Construction: 1960

Photographed 8/21/67 - 1730 hours
500' Altitude, Looking Northeast

Photographed 8/21/67 - 1730 hours
800' Altitude, Looking West







SIGNALS
N. J. RTE. 35 & FAYETTE ST.
90 SECOND CYCLE
(SEMI-ACTUATED)

	GREEN	AMBER	ALL RED	RED	TOTAL RED
N. J. RTE. 35	63-53	5 ☆	2	20-30	22-32
FAYETTE ST.	15-27	3	2	70-60	72-62

☆ OFFSET = 9 SECONDS
OFFSET MEASURED FROM BEG. AMBER TO ROUTE 35 AT SMITH ST.

SIGNALS
N. J. RTE. 35 and SMITH ST.
90 SECOND CYCLE (SEMI-ACTUATED)

	GREEN	AMBER	ALL RED	RED	TOTAL RED
N. J. RTE. 35	65-33	5	0	20-52	20-52
SMITH ST.	15-47	3	2	70-38	72-40

☆ OFFSET = 0 SECONDS
OFFSET MEASURED FROM BEG. AMBER TO ROUTE 35 AT SMITH ST.

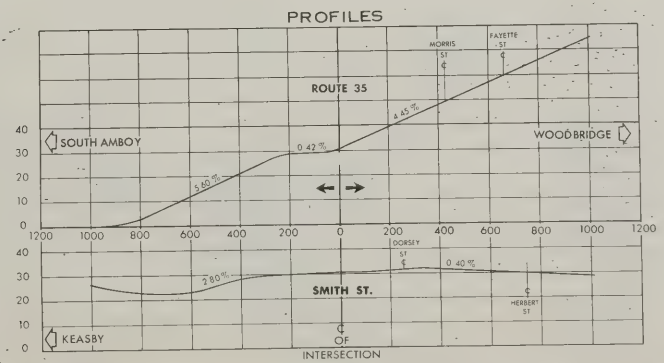


FIG. 16a

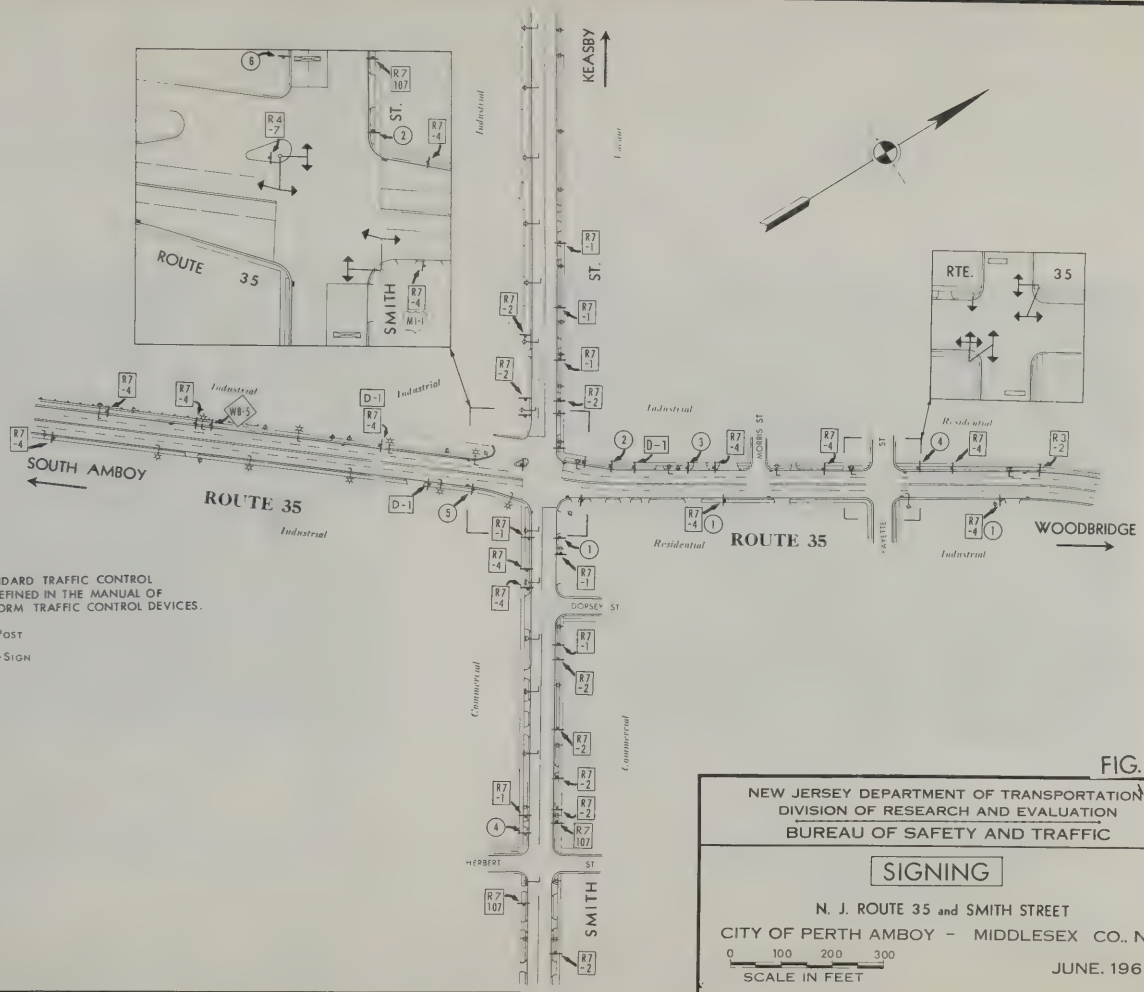
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

N. J. ROUTE 35 and SMITH STREET
CITY OF PERTH AMBOY - MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969



SIGNING LEGEND

NON-UNIFORM SIGNS

① = PARKWAY

② = NJ

③ = HISTORICAL MARKER

④ = SHOPPERS PARKING

⑤ = WELCOME TO PERTH AMBOY

⑥ = STOP HERE ON RED

D-1 STANDARD TRAFFIC CONTROL AS DEFINED IN THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.

Post
Sign

FIG. 16b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

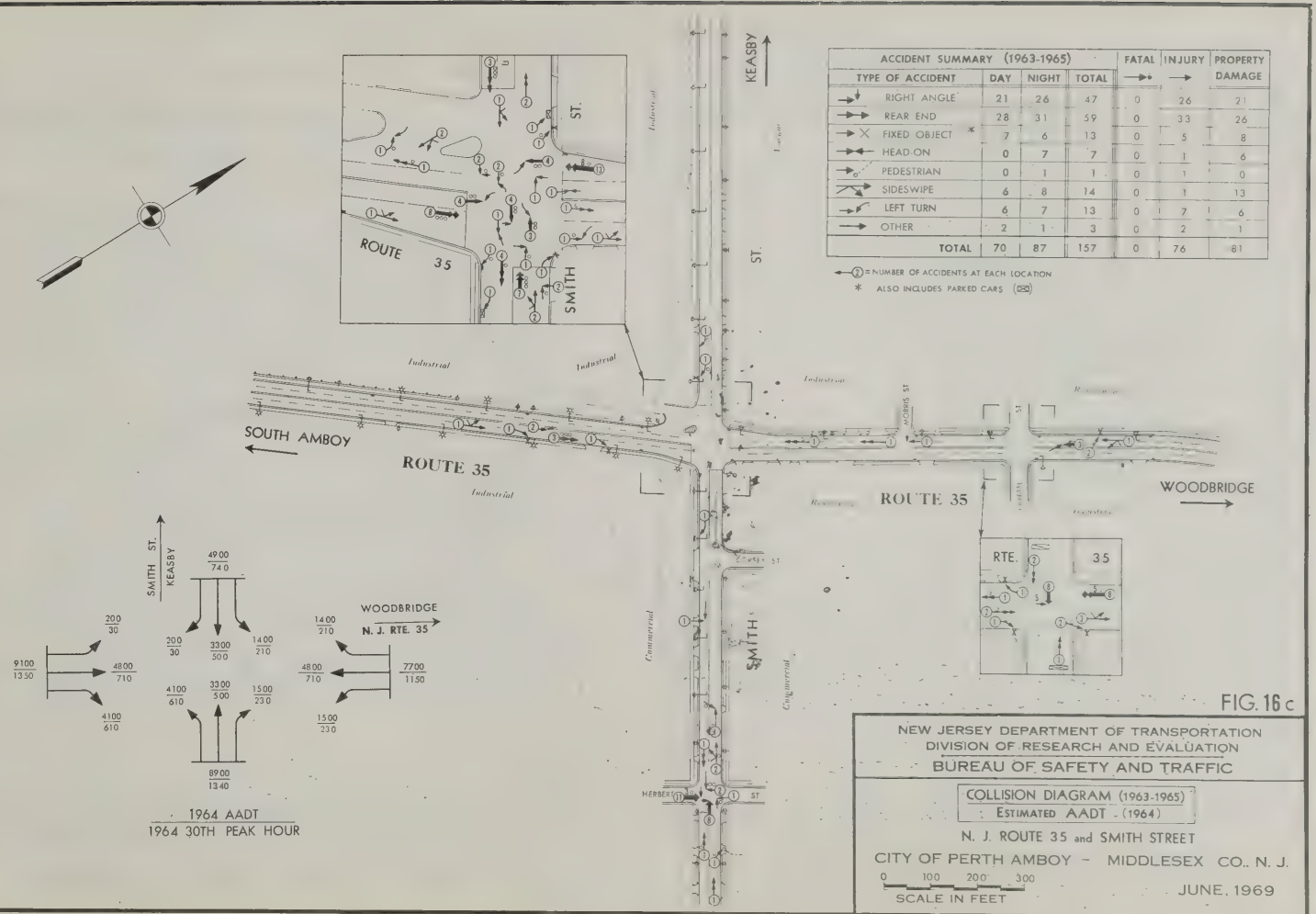
SIGNING

N. J. ROUTE 35 and SMITH STREET

CITY OF PERTH AMBOY - MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE. 1969



ACCIDENT SUMMARY (1963-1965)				FATAL	INJURY	PROPERTY DAMAGE
TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	→	→	
RIGHT ANGLE	21	26	47	0	26	21
REAR END	28	31	59	0	33	26
FIXED OBJECT *	7	6	13	0	5	8
HEAD-ON	0	7	7	0	1	6
PEDESTRIAN	0	1	1	0	1	0
SIDESWIPE	6	8	14	0	1	13
LEFT TURN	6	7	13	0	7	6
OTHER	2	1	3	0	2	1
TOTAL	70	87	157	0	76	81

(2) = NUMBER OF ACCIDENTS AT EACH LOCATION

* ALSO INCLUDES PARKED CARS (⊠)

1964 AADT
1964 30TH PEAK HOUR

FIG. 16 c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

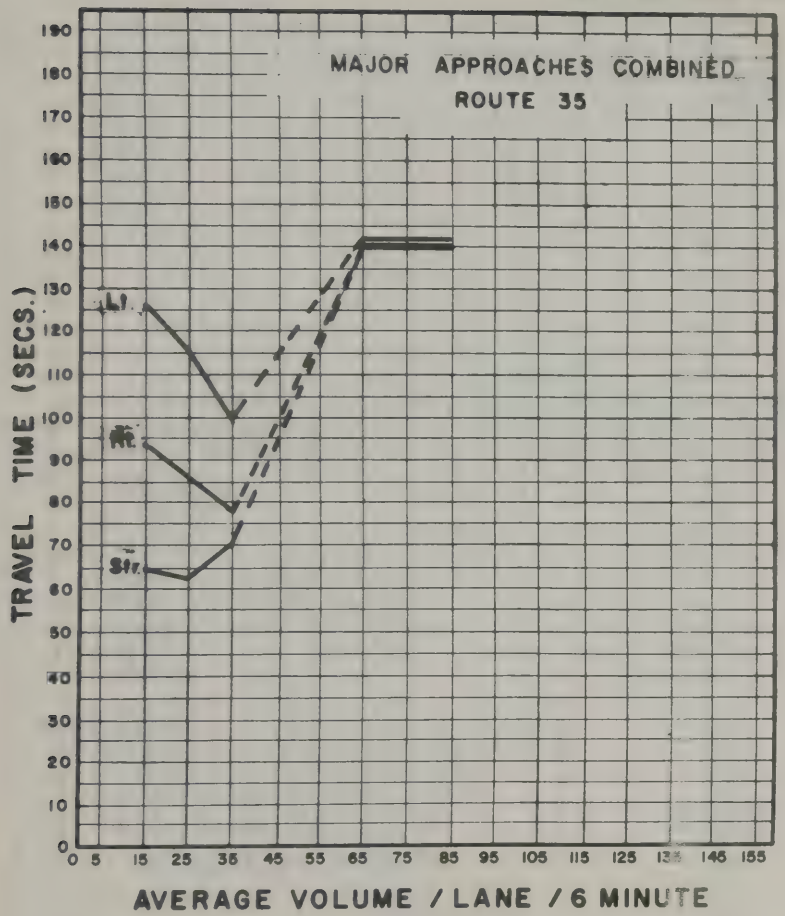
COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

N. J. ROUTE 35 and SMITH STREET
CITY OF PERTH AMBOY - MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTE 35 AND SMITH STREET



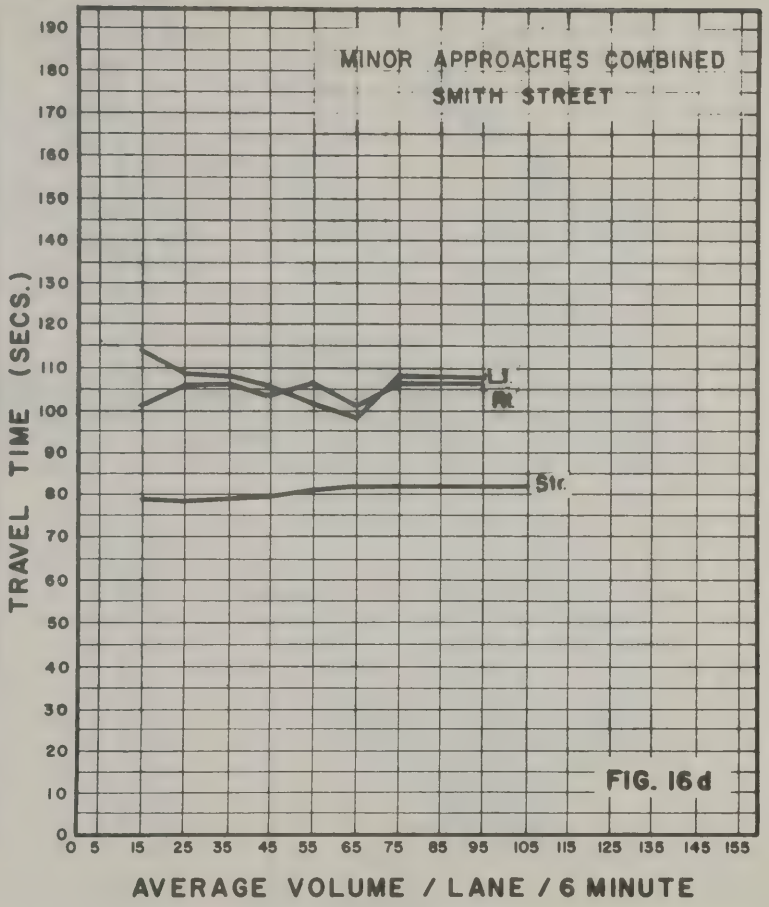


FIG. 16d

ROUTE 35 AND SMITH ST.

Posted Speeds: Route 35 - 45 mph NB/35 mph SB
Smith St. - 25 mph

Comments by W. R. Bellis:

This intersection has a large turning movement volume, being exceeded by only 4 of the 30 intersections studied. The turning movement percentage is also high, 47 percent, exceeded by only 3 of the locations studied. The 47 percent compares with 24 percent for the average of 13 signalized locations, and 27 percent for the average of the 30 intersections studied.

The accident rate is not good. Thirty-seven percent of the accidents are rear-end accidents, compared with 53 percent for the average of 13 signalized intersections, and 54 percent for the average of the 30 intersections studied. Twenty-nine percent of the accidents are right-angle accidents, compared with 19 percent for the average of the 13 signalized intersections, and 16 percent for the average of the 30 intersections. Fifty-five percent of the accidents are nighttime accidents, compared with 40 percent for the average of 13 traffic signals, and 35 percent for the average of the 30 intersections. It is the highest nighttime percentage of all the intersections studied. The intersection is well lighted. Speeds are relatively slow but Route 35 is on the steepest grade of all major legs studied.

The straight through movement on the major highway is the slowest, with Route 82 and Stuyvesant Avenue, of any of the 30 intersections studied, requiring 64 seconds longer than for a cloverleaf. During the peak hour, it is slower than any of the other locations, being 77 seconds slower than during the off-hour. This is indicative of the over-capacity condition of the road, with a 30th peak hour volume of 1350 cars, even though there are two lanes (23 feet) in each direction. There are vertical curbs with no shoulders.

The right turns from the major highway are also very slow, being next to the slowest of all 30 intersections studied. Here too, there is a big difference between off-hour travel times and peak hour travel times, the peak hour being 62 seconds slower than the off-hour. The average travel time is 69 seconds slower than that on a cloverleaf.

The left turn from the major highway is also very slow, being next to the slowest of all 30 intersections. During the peak hour, travel time is 42 seconds slower than during the off-hour. The average travel time is 50 seconds slower than that for a cloverleaf.

It is noted that although the 30th peak hour volumes on the major legs are about the same for the minor road, nevertheless the signal timing is such that the minor road is given 14 seconds longer maximum green than the major road. Also, it is noted that Route 35 is given 20 seconds shorter green time at Smith Street than it is at Fayette Street. These signals are about 600 feet apart.

PHOTO 17

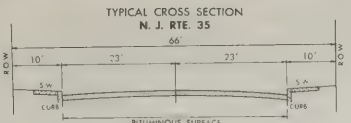
N.J. Route 35 and Main Street

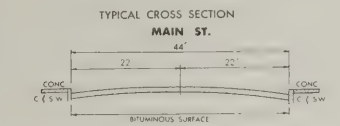
Signalized Intersection

Year of Construction: 1940 and 1965

Photographed 5/17/68 - 0830 hours
500' Altitude, Looking South

Photographed 5/17/68 - 0830 hours
600' Altitude, Looking East





SIGNALS

N. J. RTE. 35 & S. PARK DRIVE
80 SECOND CYCLE (SEMI-ACTUATED)

	PED. GRN.	GREEN	AMBER	RED
N. J. RTE. 35	——	61-52	4	15-24
S. PARK DRIVE	20	12-21	3	65-56

☆ OFFSET – 7 SECONDS TO RTE. 35 & MAIN ST

SIGNALS

N. J. RTE. 35 & MAIN ST.
80 SECOND CYCLE (FIXED

	GREEN	AMBER	RED
N. J. RTE. 35	44.0	3.2	32.8
MAIN ST.	29.6	3.2	47.2

☆ OFFSET MEASURED FROM BEG. AMBER TO ROUTE 35 & MAIN ST

SIGNALS

N. J. RTE. 35 & GROVE - NEW STS.
80 SECOND CYCLE (SEMI-ACTUATED)

	GREEN	AMBER	ALL RED	RED	TOTAL RED
N. J. RTE. 35	58-49	3	2	17-26	19-28
GROVE - NEW STS.	12-21	3	2	63-54	65-56

☆ OFFSET = 6 SECONDS TO RTE 35 & MAIN ST

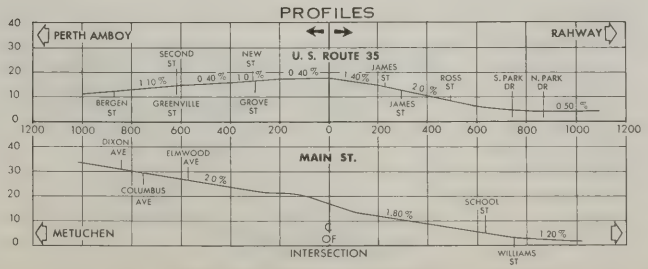


FIG. 17a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

N. J. ROUTE 35 and MAIN STREET
WOODBRIDGE – MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

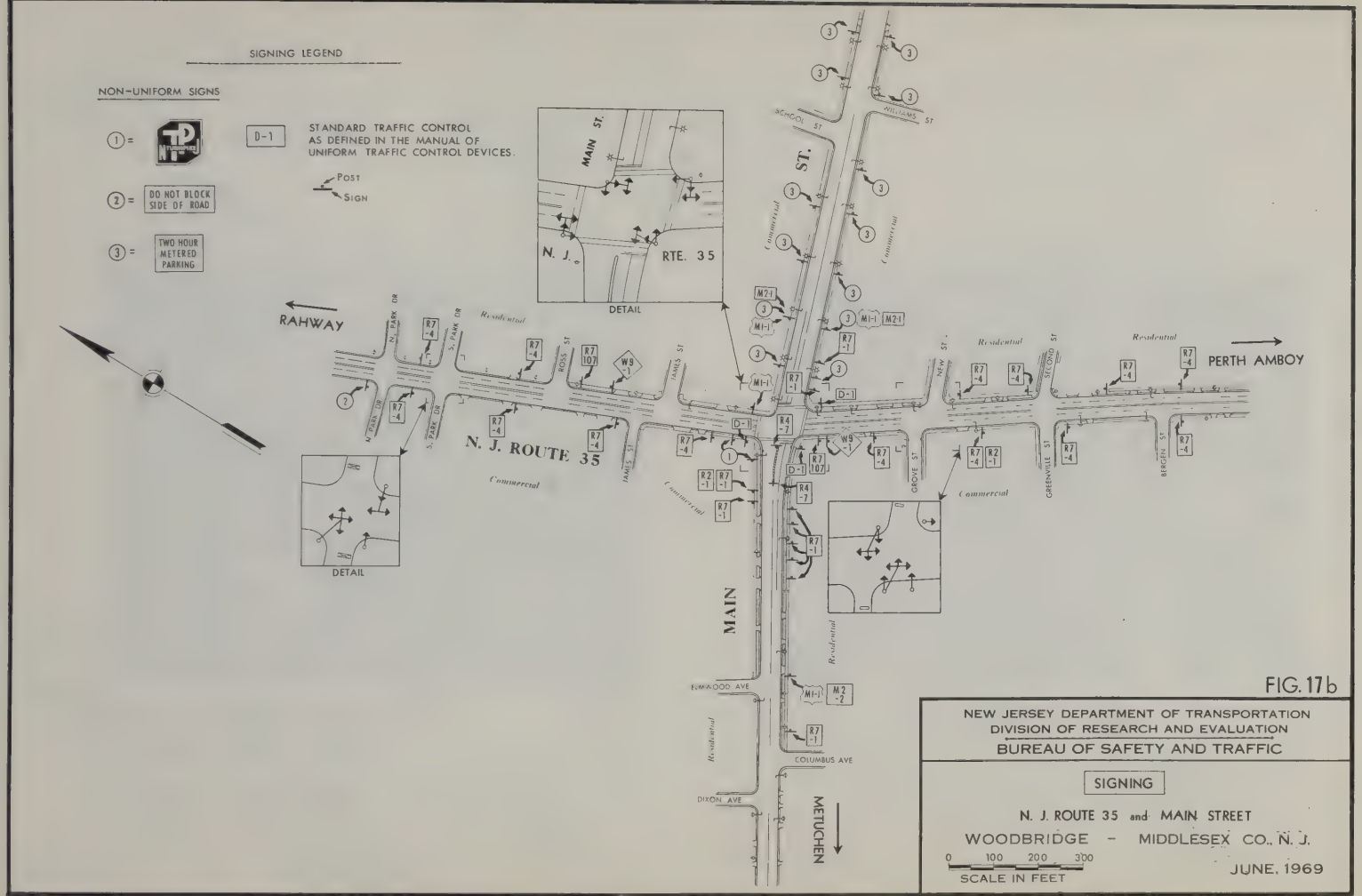


FIG. 17b

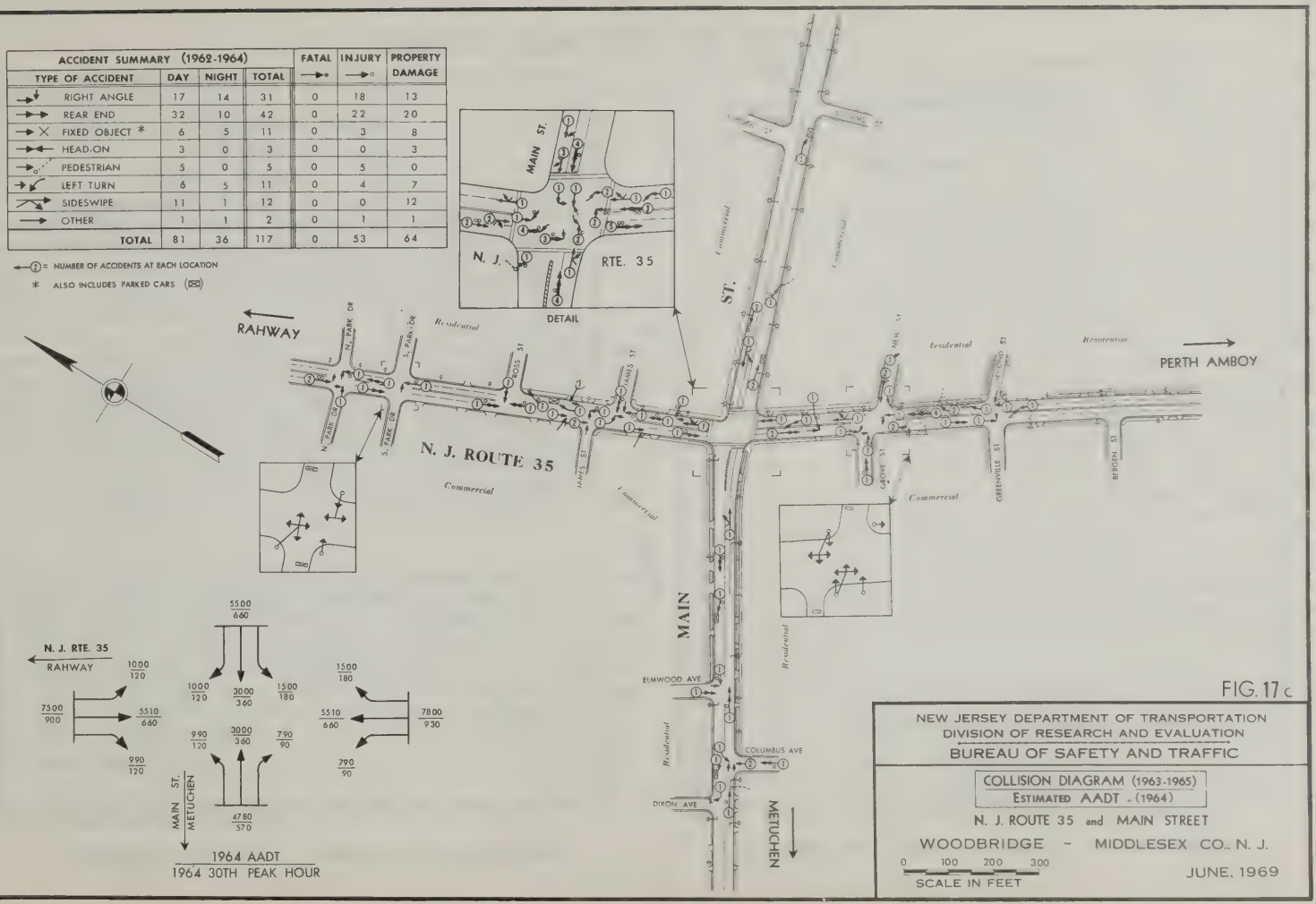
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

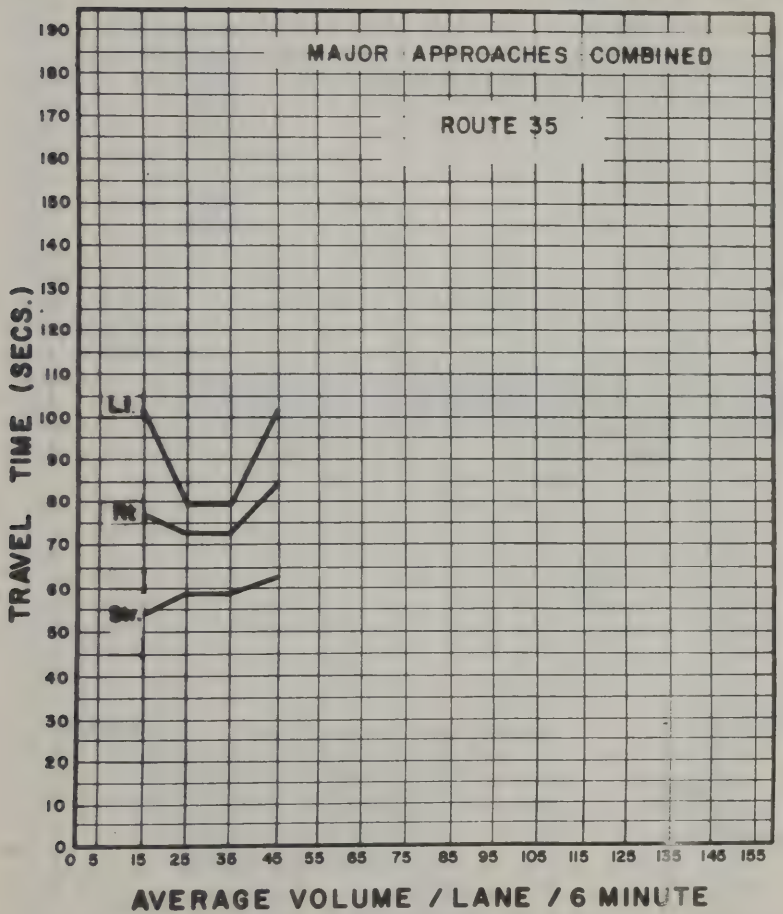
N. J. ROUTE 35 and MAIN STREET
WOODBRIDGE – MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969


ACCIDENT SUMMARY (1962-1964)
TYPE OF ACCIDENT | DAY | NIGHT | TOTAL | FATAL | INJURY | PROPERTY DAMAGE
RIGHT ANGLE | 17 | 14 | 31 | 0 | 18 | 13
REAR END | 32 | 10 | 42 | 0 | 22 | 20
FIXED OBJECT * | 6 | 5 | 11 | 0 | 3 | 8
HEAD-ON | 3 | 0 | 3 | 0 | 0 | 3
PEDESTRIAN | 5 | 0 | 5 | 0 | 5 | 0
LEFT TURN | 6 | 5 | 11 | 0 | 4 | 7
SIDESWIPE | 11 | 1 | 12 | 0 | 0 | 12
OTHER | 1 | 1 | 2 | 0 | 1 | 1
TOTAL | 81 | 36 | 117 | 0 | 53 | 64
= NUMBER OF ACCIDENTS AT EACH LOCATION
* ALSO INCLUDES PARKED CARS
DETAIL
MAIN ST.
N. J. RTE. 35
RAHWAY
PERTH AMBOY
N. J. ROUTE 35
N. PARK DR
S. PARK DR
ROSS ST
JAMES ST
GROVE ST
GREENVILLE ST
BERGEN ST
MAIN ST.
ELMWOOD AVE
COLUMBUS AVE
DIXON AVE
METUCHEN
Residential
Commercial
N. J. RTE. 35
RAHWAY
5500 / 660
1000 / 120
3000 / 360
1500 / 180
7500 / 900
5510 / 660
7800 / 930
990 / 120
790 / 90
4780 / 570
MAIN ST. METUCHEN
1964 AADT
1964 30TH PEAK HOUR
FIG. 17 c
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC
COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)
N. J. ROUTE 35 and MAIN STREET
WOODBRIDGE - MIDDLESEX CO., N. J.
0 100 200 300
SCALE IN FEET
JUNE, 1969

ROUTE 35 AND MAIN STREET



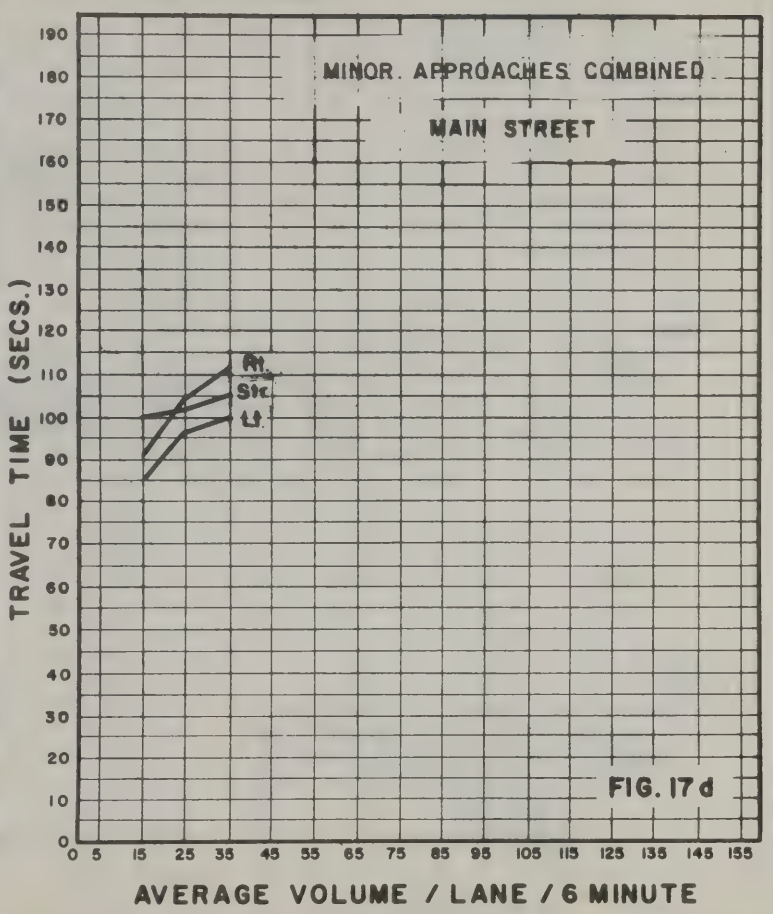


FIG. 17d

ROUTE 35 AND MAIN ST.

Posted Speeds: Route 35 - 35 mph
Main St. - 25 mph

Comments by W. R. Bellis:

This intersection has the lowest average daily volume of any of the 13 signalized intersections studied. Thirty-three percent of the traffic is turning movement traffic, compared with 24 percent for the average traffic signal, and 27 percent for the average of the 30 intersections studied.

Thirty-five percent of the accidents are rear-end accidents, compared to 53 percent for the average traffic signal, and 54 percent for the average of the 30 intersections. Twenty-six percent of the accidents are right-angle accidents, compared to 19 percent for the average traffic signal, and 16 percent for the average of the 30 intersections studied. Thirty percent of the accidents occurred at night, compared to 40 percent for the average traffic signal, and 35 percent for the average of the 30 intersections.

Straight through on the major highway was 21 seconds slower than for a cloverleaf. Right turns from the major highway were 39 seconds slower, and left turns 21 seconds slower than on a cloverleaf. For the movements on the minor roadway, the straight through movement was 65 seconds longer than on a cloverleaf. The right turn was 61 seconds longer, and the left turn was 22 seconds longer than for a cloverleaf. This intersection was one of the least efficient intersections according to the ranking.

Main Street, east of Route 35, is a very heavy shopping district.

PHOTO 18

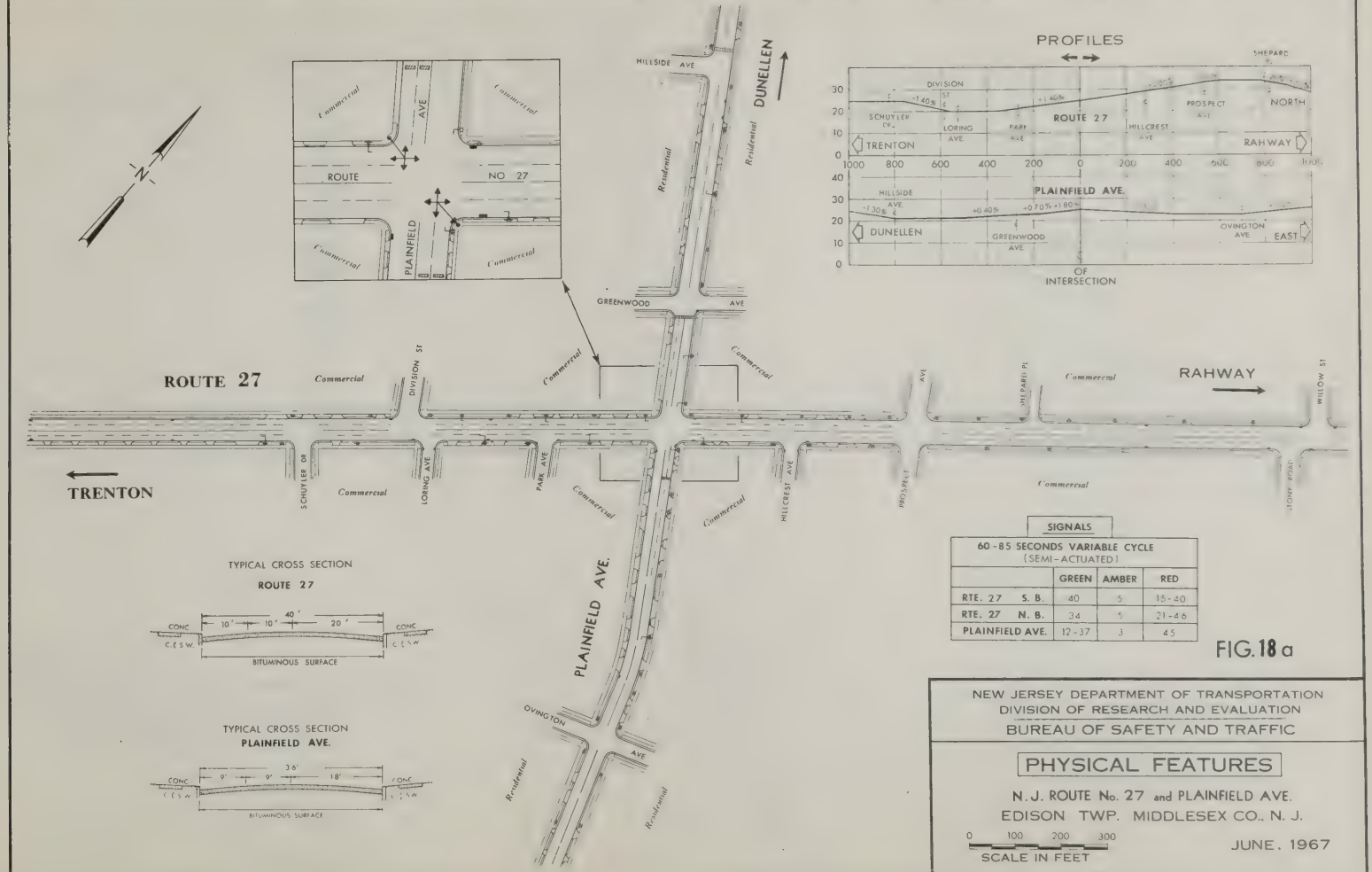
N.J. Route 27 and Plainfield Avenue

Signalized Intersection

Year of Construction: 1955

Photographed 6/1/67 - 1730 hours
500' Altitude, Looking South

Photographed 6/1/67 - 1730 hours
700' Altitude, Looking Northwest



SIGNALS			
60-85 SECONDS VARIABLE CYCLE (SEMI-ACTUATED)			
	GREEN	AMBER	RED
RTE. 27 S. B.	40	5	15-40
RTE. 27 N. B.	34	5	21-46
PLAINFIELD AVE.	12-37	3	45

FIG. 18 a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

N.J. ROUTE No. 27 and PLAINFIELD AVE.
EDISON TWP. MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1967

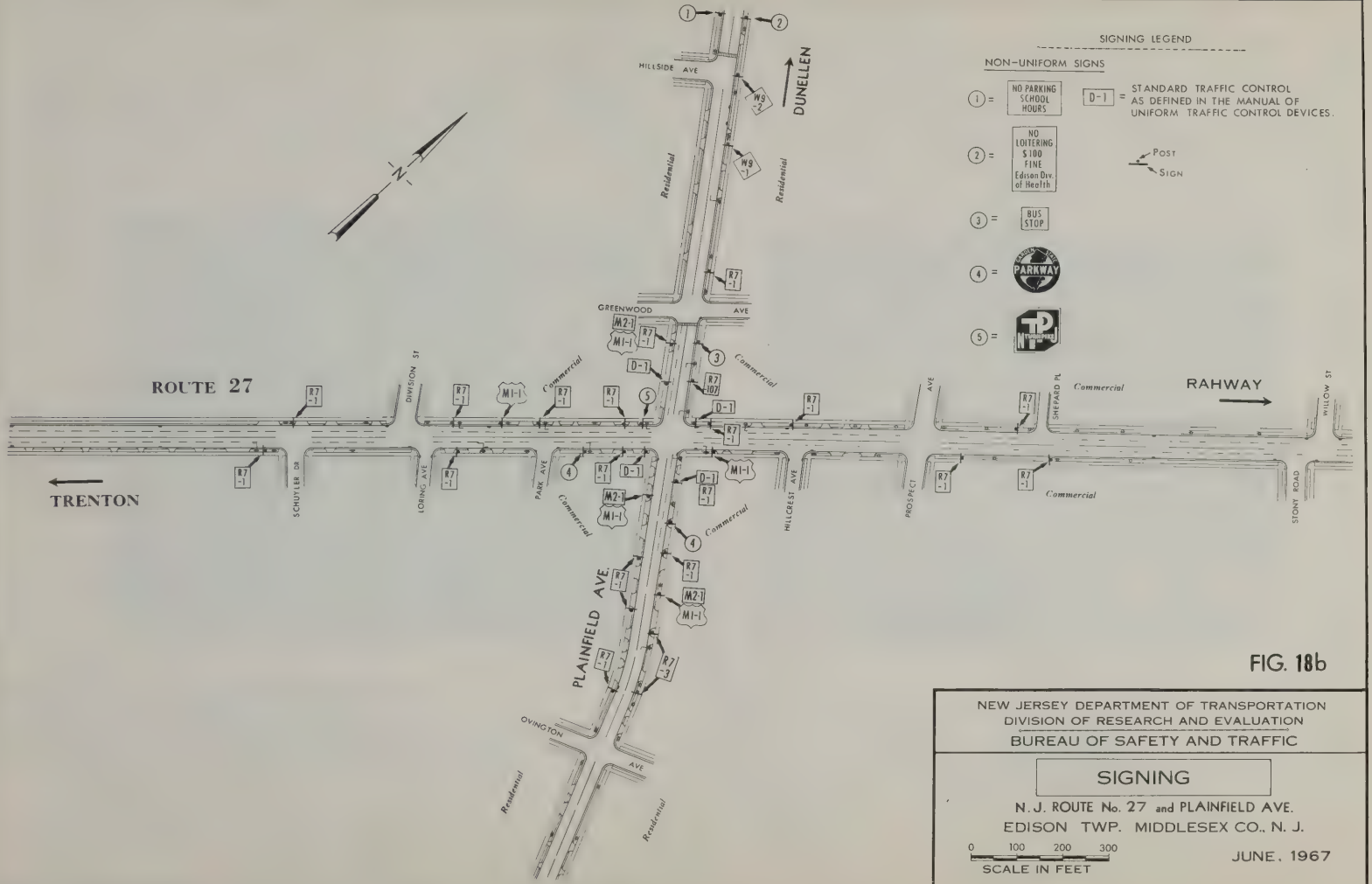


FIG. 18b

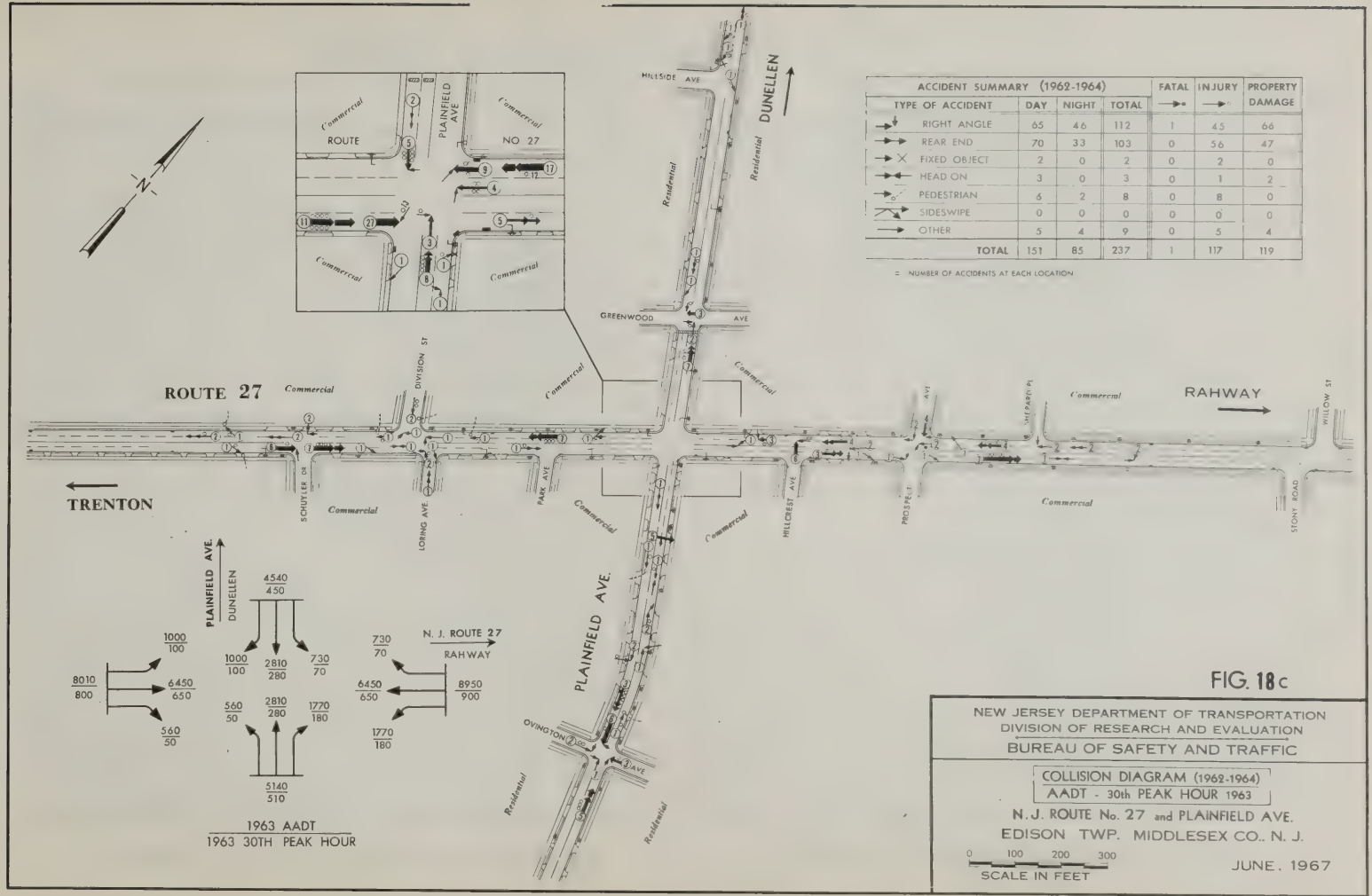
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

N. J. ROUTE No. 27 and PLAINFIELD AVE.
EDISON TWP. MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1967



ACCIDENT SUMMARY (1962-1964)				FATAL	INJURY	PROPERTY
TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	→ •	→ ○	DAMAGE
RIGHT ANGLE	65	46	112	1	45	66
REAR END	70	33	103	0	56	47
FIXED OBJECT	2	0	2	0	2	0
HEAD ON	3	0	3	0	1	2
PEDESTRIAN	6	2	8	0	8	0
SIDESWIPE	0	0	0	0	0	0
OTHER	5	4	9	0	5	4
TOTAL	151	85	237	1	117	119

= NUMBER OF ACCIDENTS AT EACH LOCATION

FIG. 18c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

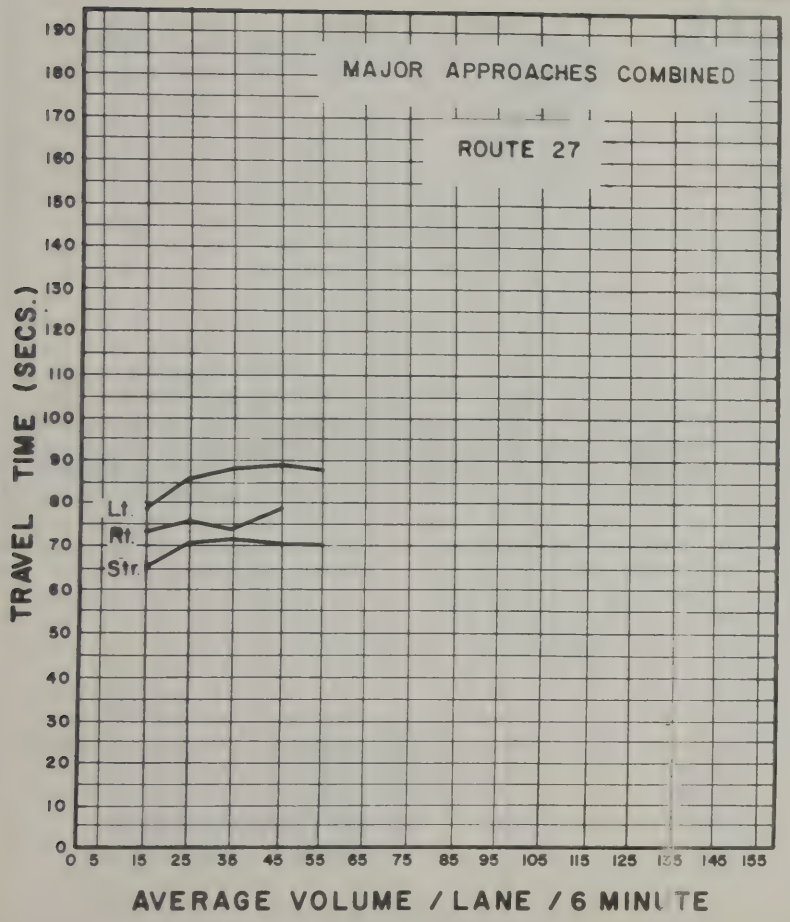
COLLISION DIAGRAM (1962-1964)
AADT - 30th PEAK HOUR 1963

N.J. ROUTE No. 27 and PLAINFIELD AVE.
EDISON TWP. MIDDLESEX CO., N. J.

SCALE IN FEET 0 100 200 300

JUNE, 1967

ROUTE 27 AND PLAINFIELD AVENUE



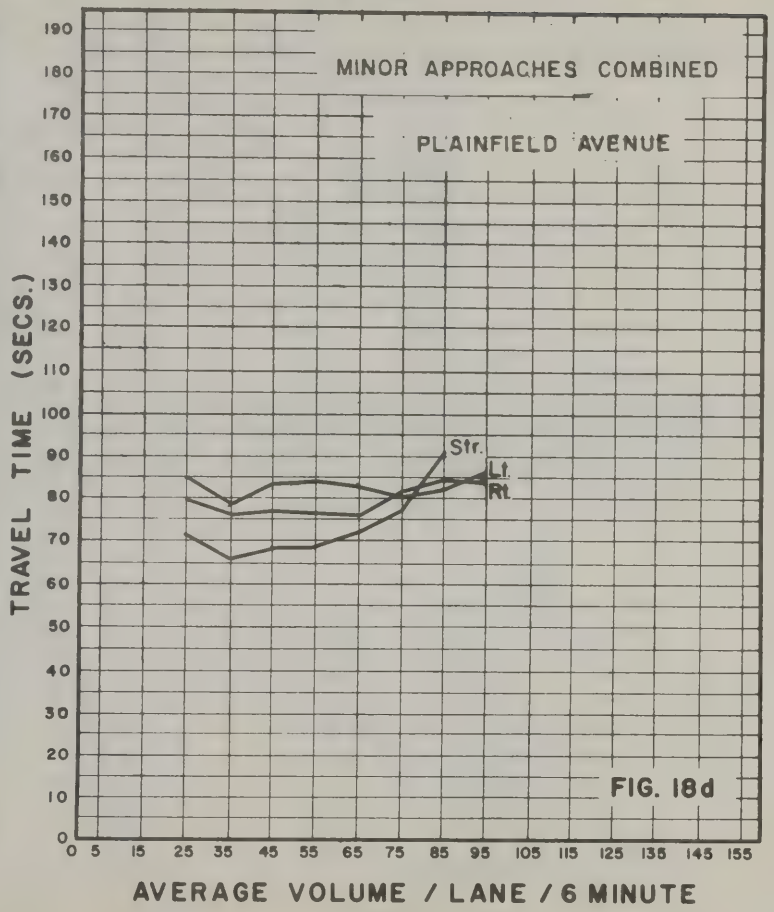


FIG. 18d

ROUTE 27 AND PLAINFIELD AVE.

Posted Speeds: Route 27 - 40 mph
Plainfield Ave. - 35 mph

Comments by W. R. Bellis:

Thirty percent of the traffic is turning traffic, compared with 24 percent for the average of the 13 signalized intersections, and 27 percent for the average of the 30 intersections. The accident and injury rates are the highest of all 30 intersections studied. The accident rate is 2,140 per 100 million vehicle miles, compared to 943 for the average of all 30 intersections studied, and 130 for Route 22 and Thompson Avenue. The injury rate is 1060 compared to 35 injuries per 100 million vehicle miles for Route 22 and Thompson Avenue.

Forty-three percent of the accidents are rear-end accidents, compared with 53 percent for the average of the 13 signalized intersections, and 54 percent for the average of the 30 intersections. There were no sideswipe accidents recorded. Thirty-one percent of the accidents are right-angle accidents, exceeded by only two intersections studied. After Route 1&9 and Bayway Circle, this intersection had the largest number of right-angle accidents of any of the 30 intersections studied. The 31 percent compares with 19 percent for the average of the 13 signalized intersections, and 16 percent for the average of the 30 intersections. Thirty-six percent of the accidents occurred at night, compared with 40 percent for the average of the 13 signalized intersections, and 35 percent for the average of the 30 intersections.

On the major highway, the straight through movement was 30 seconds slower than on a cloverleaf. The right turn was 36 seconds slower, and the left turn 12 seconds slower than on a cloverleaf. On the minor roadway, the straight through movement was 40 seconds slower than on a cloverleaf, the right turn 40 seconds slower, and the left turn 10 seconds slower than on a cloverleaf.

This intersection ranks as one of the most inefficient intersections studied, being outranked by only 2 other intersections.

PHOTO 19

U.S. Route 1-9 and Stiles Avenue

Signalized Intersection

Year of Construction: 1930

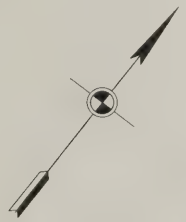
Photographed 8/21/67 - 1715 hours
500' Altitude, Looking South

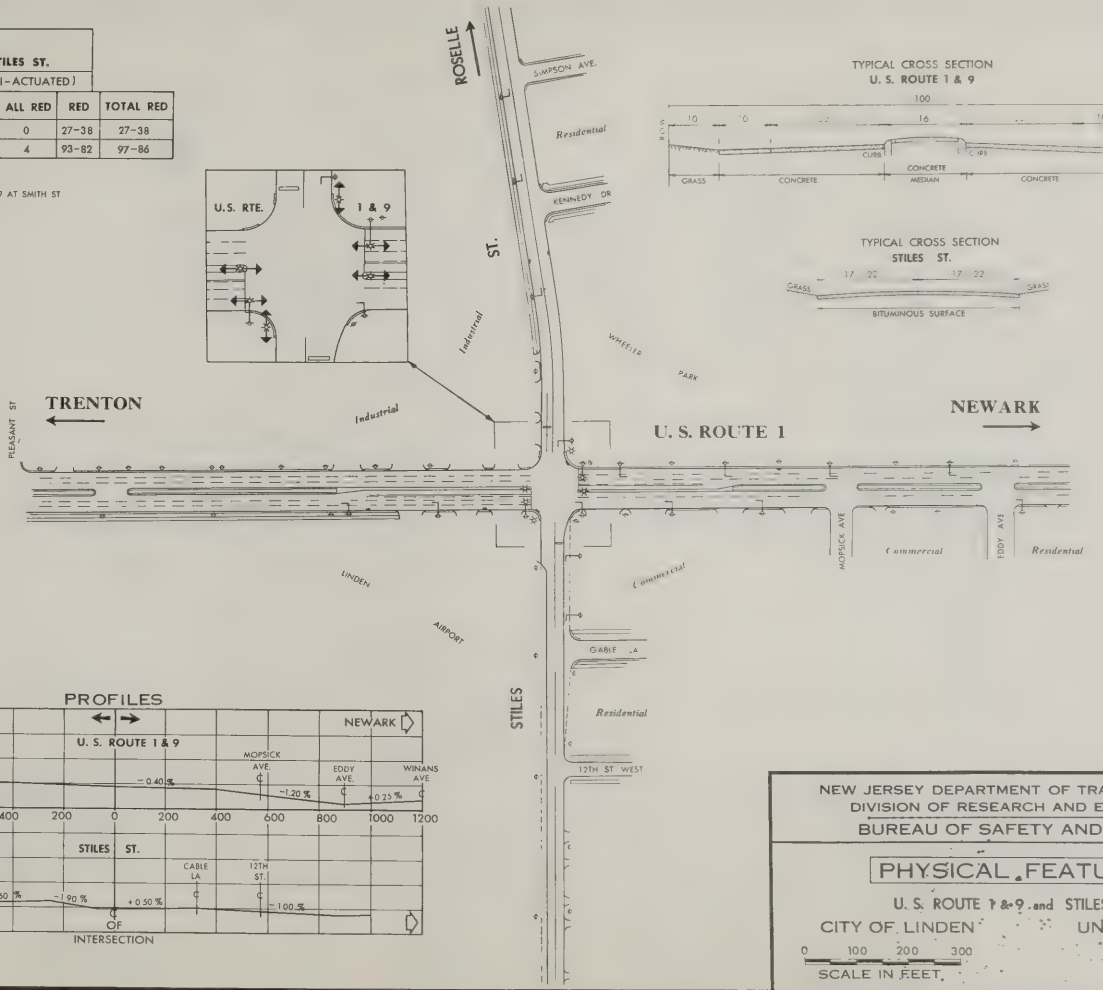
Photographed 8/21/67 - 1715 hours
800' Altitude, Looking West

SIGNALS
U.S. 1 & 9 and STILES ST.
120 SECOND CYCLE (SEMI-ACTUATED)

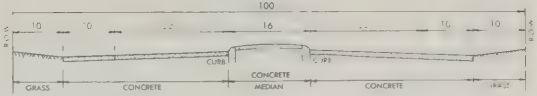
	GREEN	AMBER	ALL RED	RED	TOTAL RED
U.S. 1 & 9	88-77	5	0	27-38	27-38
STILES ST.	20-31	3	4	93-82	97-86

OFFSET NO. 1 = 35 SECONDS
" NO. 2 = 85 "
☆ OFFSET MEASURED FROM BEG. AMBER TO U.S. 1 & 9 AT SMITH ST





TYPICAL CROSS SECTION
U. S. ROUTE 1 & 9



TYPICAL CROSS SECTION
STILES ST.

PROFILES

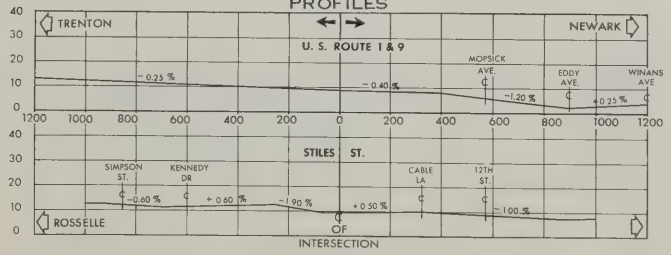


FIG. 19a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE 1 & 9 and STILES ST.
CITY OF LINDEN UNION CO., N. J.

0 100 200 300
SCALE IN FEET.

JUNE, 1969

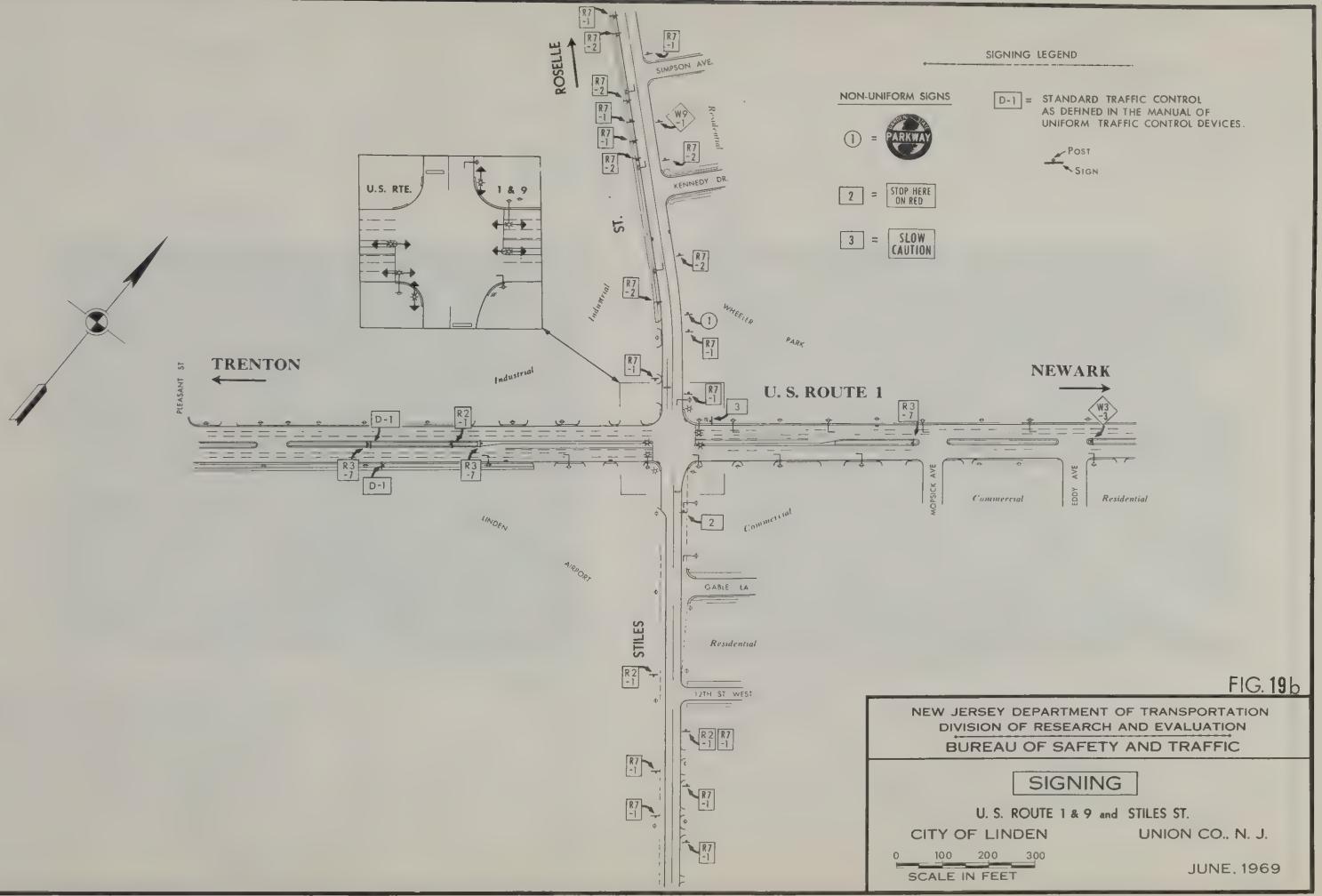


FIG. 19b

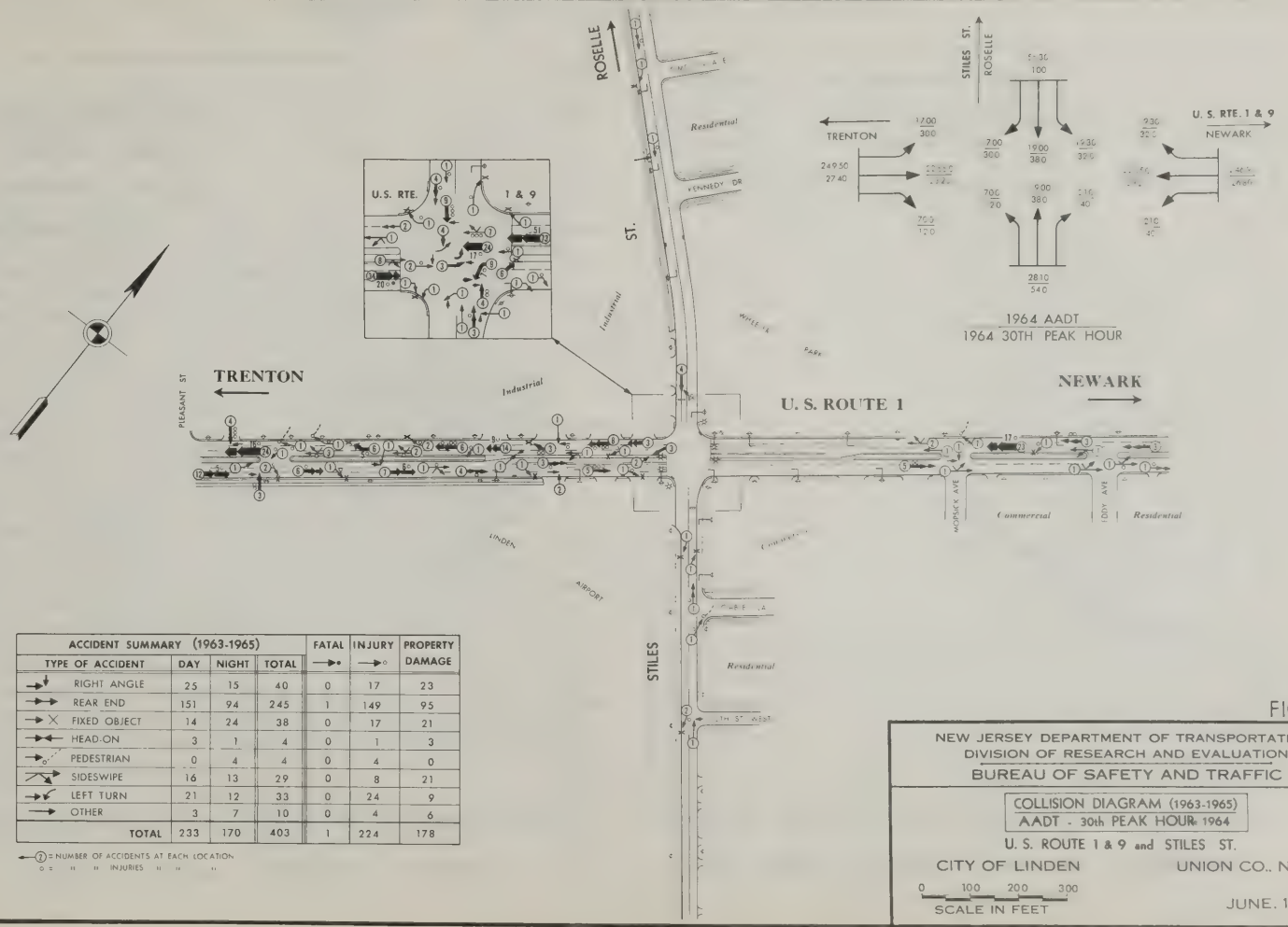
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. ROUTE 1 & 9 and STILES ST.
CITY OF LINDEN — UNION CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969



ACCIDENT SUMMARY (1963-1965) TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	FATAL →•	INJURY →○	PROPERTY DAMAGE
RIGHT ANGLE	25	15	40	0	17	23
REAR END	151	94	245	1	149	95
FIXED OBJECT	14	24	38	0	17	21
HEAD-ON	3	1	4	0	1	3
PEDESTRIAN	0	4	4	0	4	0
SIDESWIPE	16	13	29	0	8	21
LEFT TURN	21	12	33	0	24	9
OTHER	3	7	10	0	4	6
TOTAL	233	170	403	1	224	178

(2) = NUMBER OF ACCIDENTS AT EACH LOCATION
○ = " " INJURIES " "

FIG. 19c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

COLLISION DIAGRAM (1963-1965)
AADT - 30th PEAK HOUR - 1964

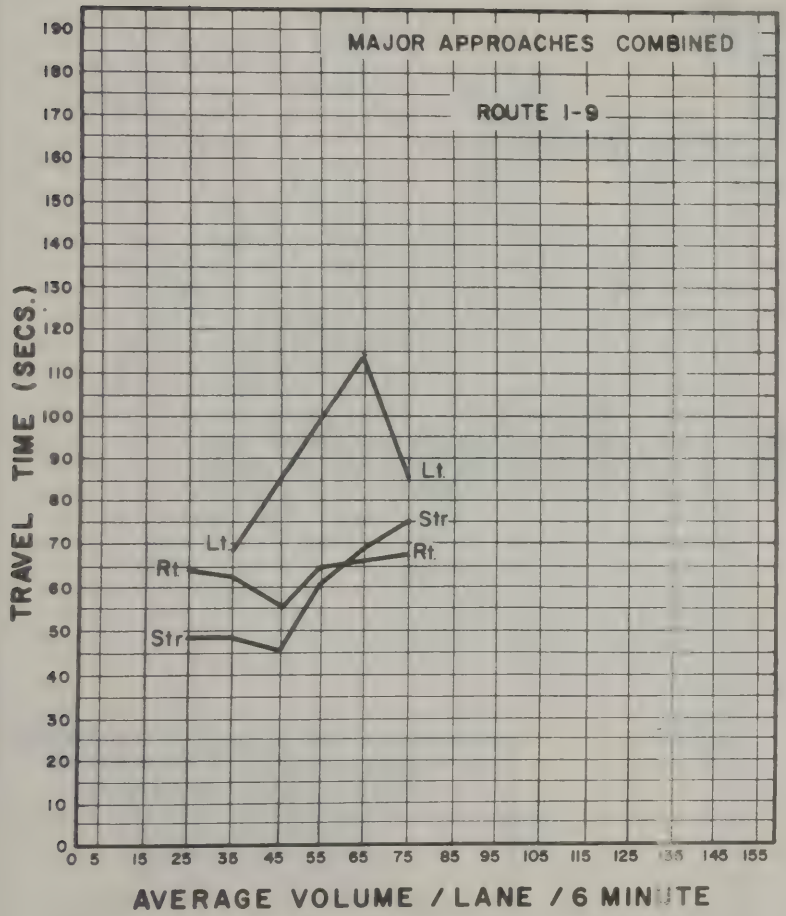
U. S. ROUTE 1 & 9 and STILES ST.

CITY OF LINDEN — UNION CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTE 1-9 AND STILES AVENUE



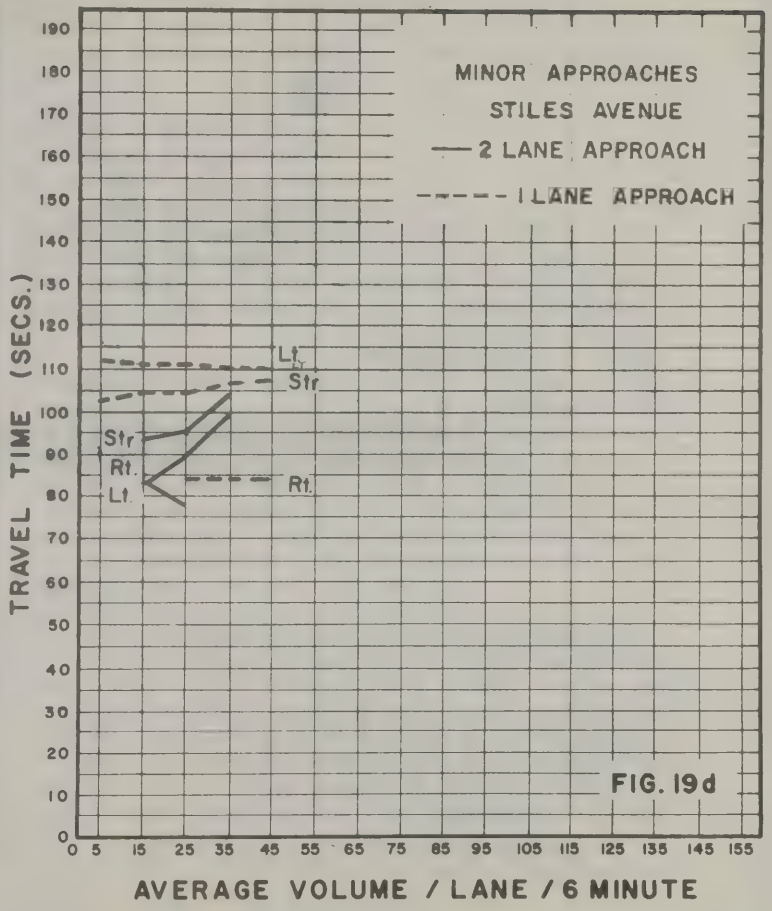


FIG. 19d

ROUTE 1&9 AND STILES ST.

Posted Speeds: Route 1&9 - 45 mph NB/35 mph SB
Stiles St. - 25 mph

Comments by W. R. Bellis:

This intersection has a higher volume than all but two of the other simple right angle intersections. Fifteen percent of the traffic is turning movement traffic, compared to 24 percent for the average of the 13 signalized intersections, and 27 percent for the average of the 30 intersections.

The accident and injury rates are bad. Sixty percent of the accidents are rear-end accidents, compared with 53 percent for the average of the 13 signalized intersections, and 54 percent for the average of the 30 intersections. Nine percent of the accidents are right-angle accidents, compared to 19 percent for the average of the 13 signalized intersections, and 16 percent for the average of the 30 intersections. This is a lower percentage than any of the other signalized intersections. Forty-two percent of the accidents occur at night, compared to 40 percent for the average of 13 signalized intersections, and 35 percent for the average of the 30 intersections. Twenty percent of the accidents occur along southbound Route 1&9 downstream of the intersection.

On the major road, the travel time for the straight through movements is 23 seconds slower than on a cloverleaf. The right turn is 21 seconds slower, and the left turn is 20 seconds slower than on a cloverleaf.

On the minor road, the straight through movement is 60-70 seconds slower than at the cloverleaf. The right turn is 50 seconds slower, and the left turn 15-30 seconds slower than on a cloverleaf.

Note that this intersection has left turn bays in the center island.

PHOTO 20

U.S. Route 1-9 and Wood Avenue

Signalized Intersection

Year of Construction: 1930

Photographed 8/21/67 - 1715 hours
500' Altitude, Looking Northwest

Photographed 8/21/67 - 1715 hours
800' Altitude, Looking Southwest

SIGNALS
U.S. 1 & 9 and CLINTON ST.
120 SECOND CYCLE
(SEMI-ACTUATED)

	PED. GRN.	GREEN	AMBER	ALL RED	RED	TOTAL RED
U.S. RTE. 1 & 9	—	90-77	5	0	25-38	25-38
CLINTON ST.	30	20-33	3	2	95-82	97-84

☆ OFFSET NO. 1 = 61
" NO. 2 = 59
OFFSET- MEASURED FROM BEG. AMBER — SOUTH-BOUND U.S. 1 & 9 TO U.S. 1 & 9 AT SMITH ST

SIGNALS
70 SECOND CYCLE
(FIXED)

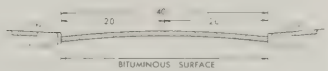
	GREEN	AMBER	RED
WOOD AVE.	38	3	29
12TH. ST., WEST	25	3	42

SIGNALS
U.S. 1 & 9 and WOOD AVE.
120 SECOND CYCLE
(SEMI-ACTUATED)

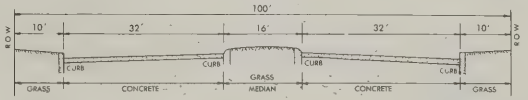
	GREEN	AMBER	ALL RED	RED	TOTAL RED
U.S. 1 & 9	86-71	5	0	29-44	29-44
WOOD AVE.	24-39	3	2	91-76	93-78

☆ OFFSET = 61 SECONDS
OFFSET MEASURED FROM BEG. AMBER TO U.S. 1 & 9 AT SMITH ST

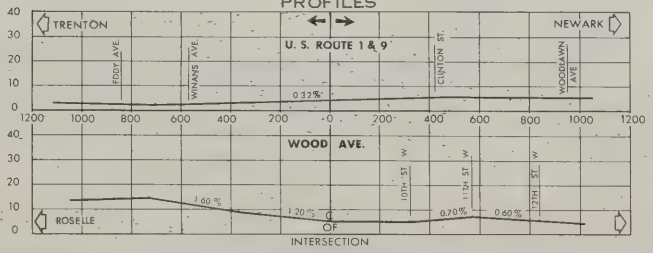
TYPICAL CROSS SECTION
WOOD AVE.



TYPICAL CROSS SECTION
U. S. ROUTE 1 & 9



PROFILES



SIGNALS
U.S. RTE. 1 & 9 and WOODLAWN AVE.
120 SECOND CYCLE
(SEMI-ACTUATED)

TIME	6.0	7 9.8 - 7 3.8	4.8	4.8	2.4	15 - 21	4.8	2.4
U.S. 1 & 9 S.B.	R	G	G	A	R	R	R	R
" N.B.	G	G	A	R	R	R	R	R
WOODLAWN AVE.	R	R	R	R	R	G	A	R

☆ SAME AS U.S. 1 & 9 AND CLINTON ST

FIG. 20a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE 1 & 9 and WOOD AVE.
CITY OF LINDEN — UNION CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

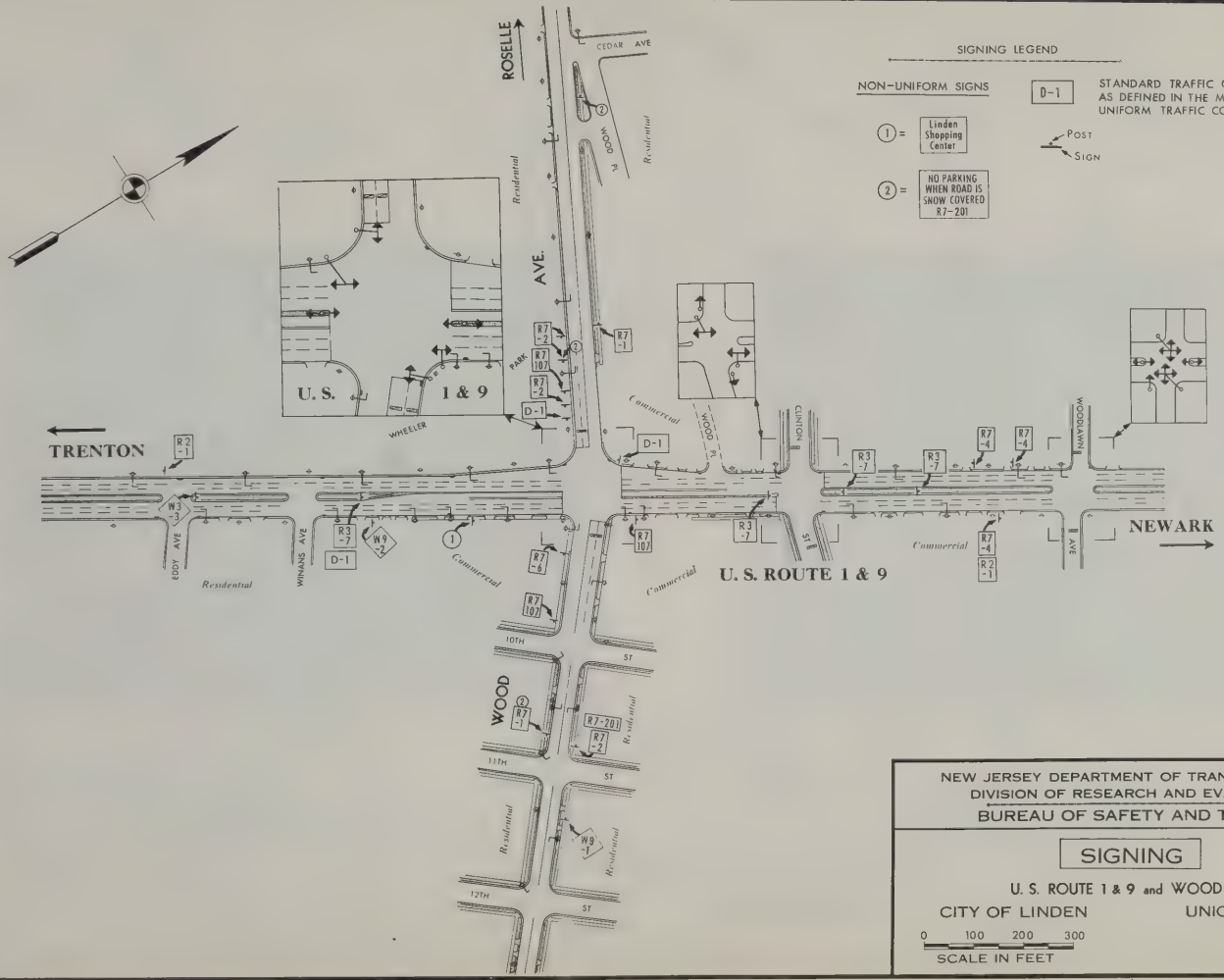


FIG. 20b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

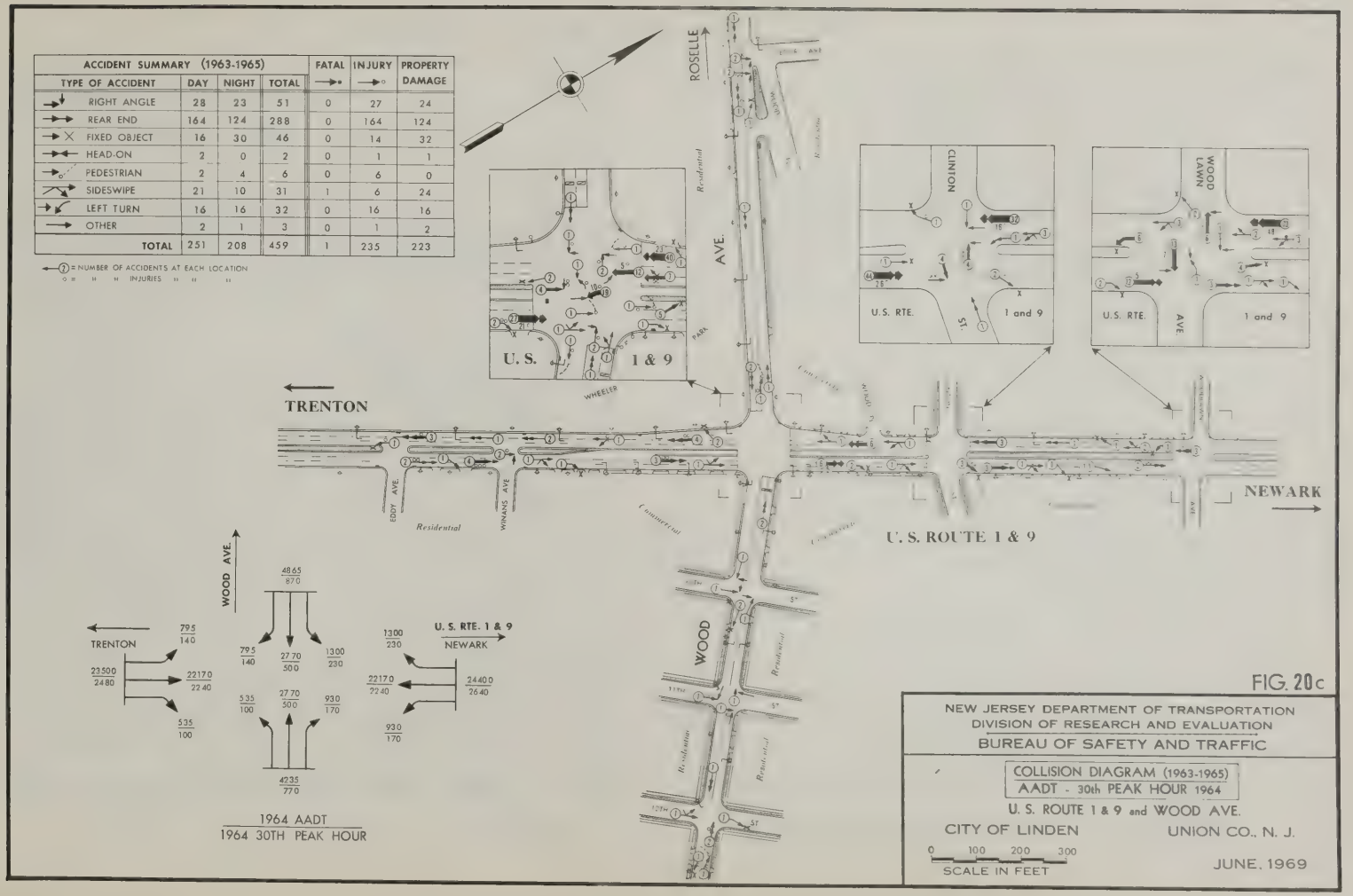
SIGNING

U. S. ROUTE 1 & 9 and WOOD AVE.

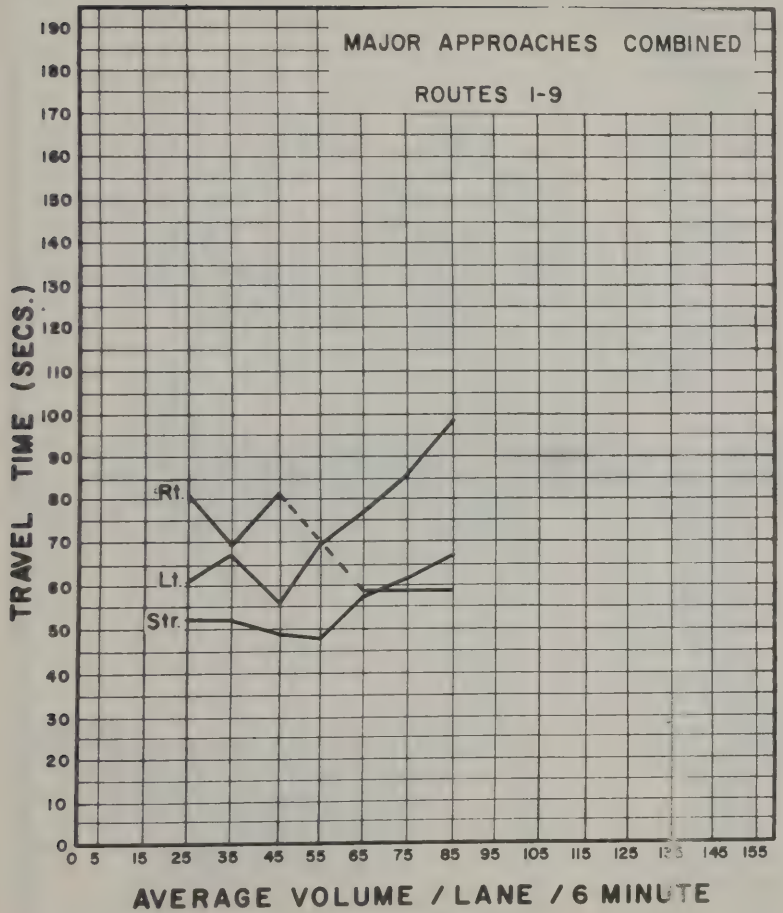
CITY OF LINDEN — UNION CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969


ACCIDENT SUMMARY (1963-1965)
TYPE OF ACCIDENT | DAY | NIGHT | TOTAL | FATAL | INJURY | PROPERTY DAMAGE
RIGHT ANGLE | 28 | 23 | 51 | 0 | 27 | 24
REAR END | 164 | 124 | 288 | 0 | 164 | 124
FIXED OBJECT | 16 | 30 | 46 | 0 | 14 | 32
HEAD-ON | 2 | 0 | 2 | 0 | 1 | 1
PEDESTRIAN | 2 | 4 | 6 | 0 | 6 | 0
SIDESWIPE | 21 | 10 | 31 | 1 | 6 | 24
LEFT TURN | 16 | 16 | 32 | 0 | 16 | 16
OTHER | 2 | 1 | 3 | 0 | 1 | 2
TOTAL | 251 | 208 | 459 | 1 | 235 | 223
= NUMBER OF ACCIDENTS AT EACH LOCATION
= " " INJURIES " " "
ROSELLE
AVE.
U.S. 1 & 9
CLINTON
U.S. RTE. 1 and 9
ST.
WOOD LAWN
AVE.
TRENTON
NEWARK
U. S. ROUTE 1 & 9
EDDY AVE.
WINANS AVE
WHEELER
PARK
WOOD
Residential
Commercial
WOOD AVE.
U. S. RTE. 1 & 9
1964 AADT
1964 30TH PEAK HOUR
FIG. 20c
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC
COLLISION DIAGRAM (1963-1965)
AADT - 30th PEAK HOUR 1964
U. S. ROUTE 1 & 9 and WOOD AVE.
CITY OF LINDEN
UNION CO., N. J.
SCALE IN FEET
JUNE, 1969

ROUTE I-9 AND WOOD AVENUE



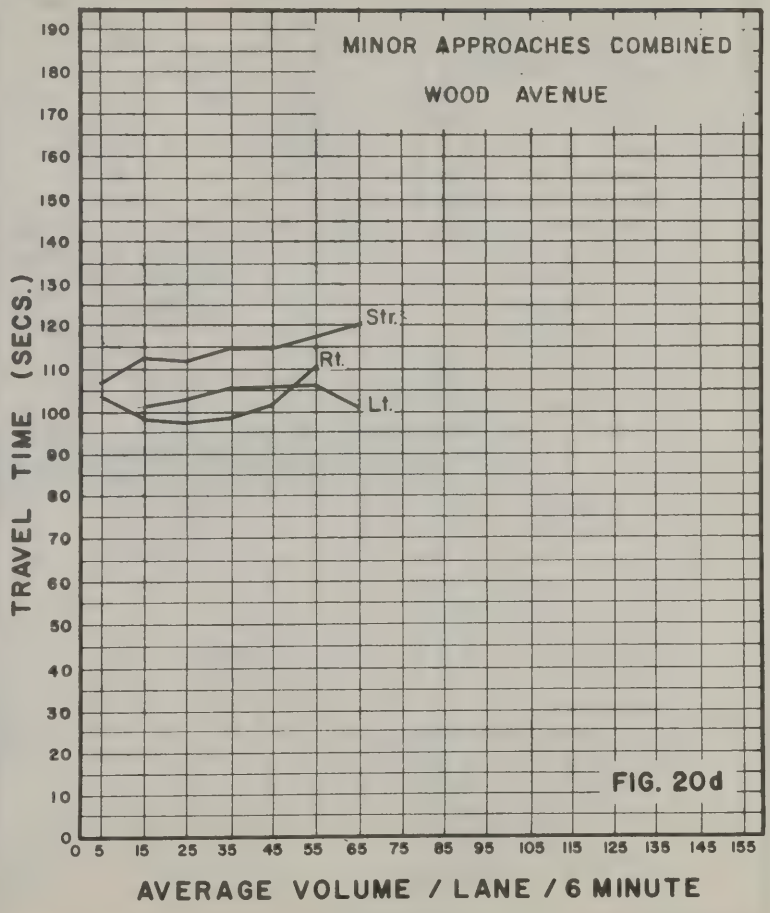


FIG. 20d

ROUTE 1&9 AND WOOD AVE.

Posted Speeds: Route 1&9 - 35 mph
Wood Ave. - 25 mph

Comments by W. R. Bellis:

This intersection carries a very heavy volume for a simple at-grade signalized intersection. Twelve percent of the traffic is turning traffic, compared to 24 percent for the average of the 13 signalized intersections, and 27 percent for the average of the 30 intersections.

The accident and injury rates are very high, exceeded by only one of the 30 intersections studied. Unlike Route 1&9 and Stiles Street, which has one signalized intersection, this location has 4 signalized intersections within the study area. Sixty-two percent of the accidents are rear-end accidents. This is a higher percent than any of the other signalized intersections, except two of the jughandle intersections. It compares with 53 percent for the average of the signalized intersections, and 54 percent for the average of the 30 intersections studied. Eleven percent of the accidents are right-angle accidents, which is very low. We generally think of traffic signals as having a high rate of right-angle accidents. The 11 percent compares with 19 percent for the average of the 13 signalized intersections, and 16 percent for the average of the 30 intersections. Forty-five percent of the accidents are nighttime accidents, compared to 40 percent for the average of the signalized intersections, and 35 percent for the average of all 30 intersections.

For the major road, the straight through travel time is 20 seconds longer than that for a cloverleaf. The right turn is 30 seconds slower, and the left turn is 5 seconds slower than on a cloverleaf.

On the minor road, the straight through movement is 76 seconds slower, the right turn is 64 seconds slower, and the left turn 30 seconds slower than on a cloverleaf.

Note that this intersection has left turn bays on the major highway.

PHOTO 21

N.J. Route 82 and Stuyvesant Avenue

Signalized Intersection

Year of Construction: 1935

Photographed 8/21/67 - 1700 hours
500 ' Altitude, Looking South

Photographed 8/21/67 - 1700 hours
800 ' Altitude, Looking North

SIGNALS
N. J. RTE. 82 and JOHNSTON PL.
120 SECOND CYCLE
(SEMI-ACTUATED)

	GREEN	AMBER	ALL RED	RED	TOTAL RED
N. J. RTE. 82	98-92	4	0	18-24	18-24
JOHNSTON PL.	15-21	3	0	102-96	102-96

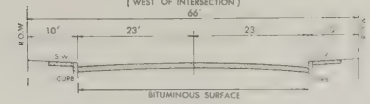
☆ OFFSET = 25 SECONDS
OFFSET MEASURED FROM BEG AMBER TO RTE. 82 AT STUYVESANT AVE.

SIGNALS
N. J. RTE. 82 and BURKE PARKWAY
120 SECOND CYCLE
(SEMI-ACTUATED)

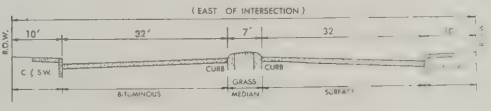
	GREEN	AMBER	ALL RED	RED	TOTAL RED
N. J. RTE. 82	93-82	4	0	23-34	23-34
BURKE PARKWAY	18-29	3	2	97-86	99-88

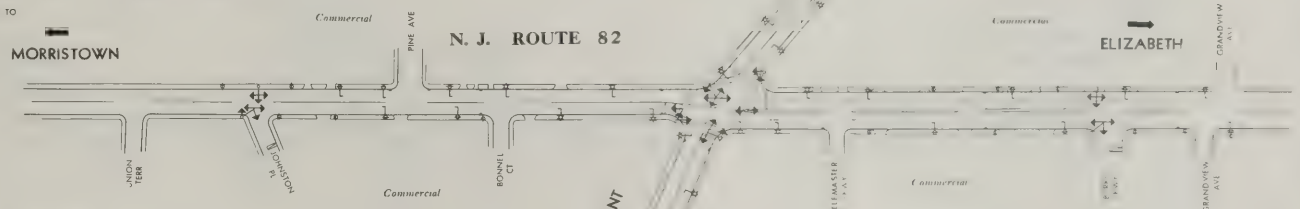
☆ OFFSET = 11 SECONDS
OFFSET MEASURED FROM BEG AMBER TO RTE. 82 AT STUYVESANT AVE.

TYPICAL CROSS SECTION
N. J. RTE. 82
(WEST OF INTERSECTION)

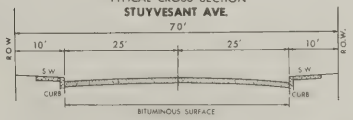


TYPICAL CROSS SECTION
N. J. RTE. 82
(EAST OF INTERSECTION)

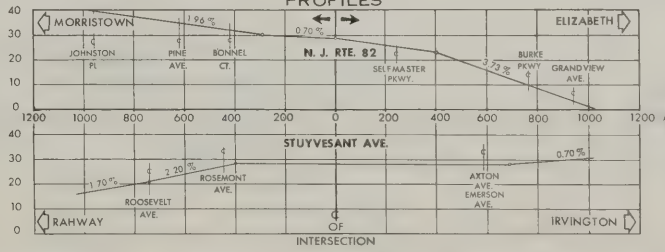




TYPICAL CROSS SECTION
STUYVESANT AVE.



PROFILES



SIGNALS
N. J. RTE. 82 and STUYVESANT AVE.
120 SECOND CYCLE (FIXED)

	GREEN	AMBER	ALL RED	RED	TOTAL RED
N. J. RTE. 82	61.2	3.6	2.4	52.8	55.2
STUYVESANT AVE.	46.8	3.6	2.4	67.2	69.6

☆ OFFSET = 0 SECONDS
OFFSET MEASURED FROM BEG AMBER TO U.S. 1 & 9 AT RTE. 82 AT STUYVESANT AVE.

FIG. 21a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

N. J. ROUTE 82 & STUYVESANT AVE.

UNION TOWNSHIP — UNION CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

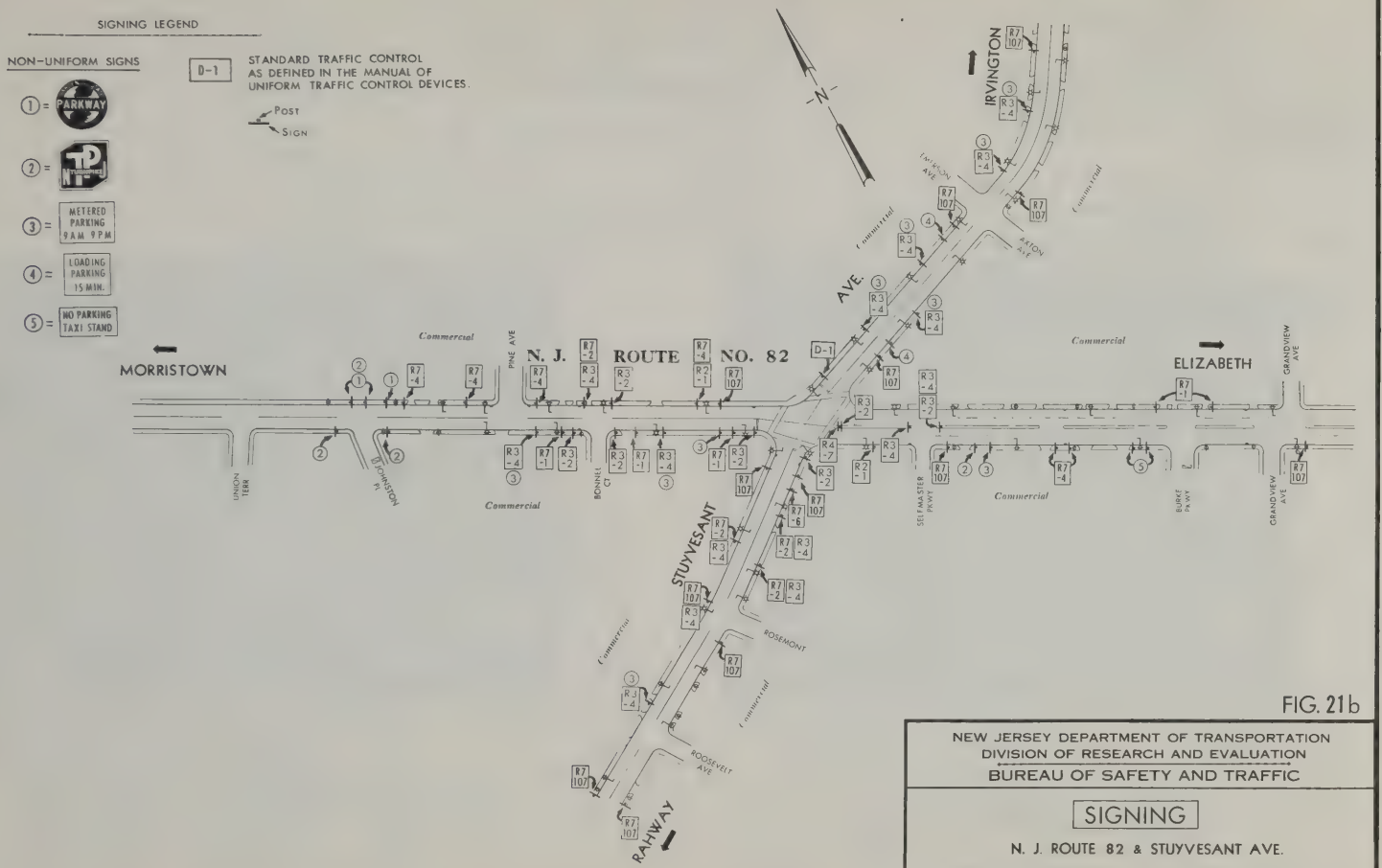


FIG. 21b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

N. J. ROUTE 82 & STUYVESANT AVE.

UNION TOWNSHIP, UNION CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ACCIDENT SUMMARY (1963-1965) TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	FATAL →•	INJURY →○	PROPERTY DAMAGE
RIGHT ANGLE	37	10	47	0	16	31
REAR END	64	38	102	0	66	36
FIXED OBJECT *	11	13	24	0	7	17
HEAD-ON	1	3	4	0	3	1
PEDESTRIAN	6	2	8	0	8	0
SIDESWIPE	12	6	18	0	5	13
LEFT TURN	4	1	5	0	1	4
OTHER	1	0	1	0	0	1
TOTAL	136	73	209	0	106	103

→②← = NUMBER OF ACCIDENTS AT EACH LOCATION

* ALSO INCLUDES PARKED CARS (⊠)

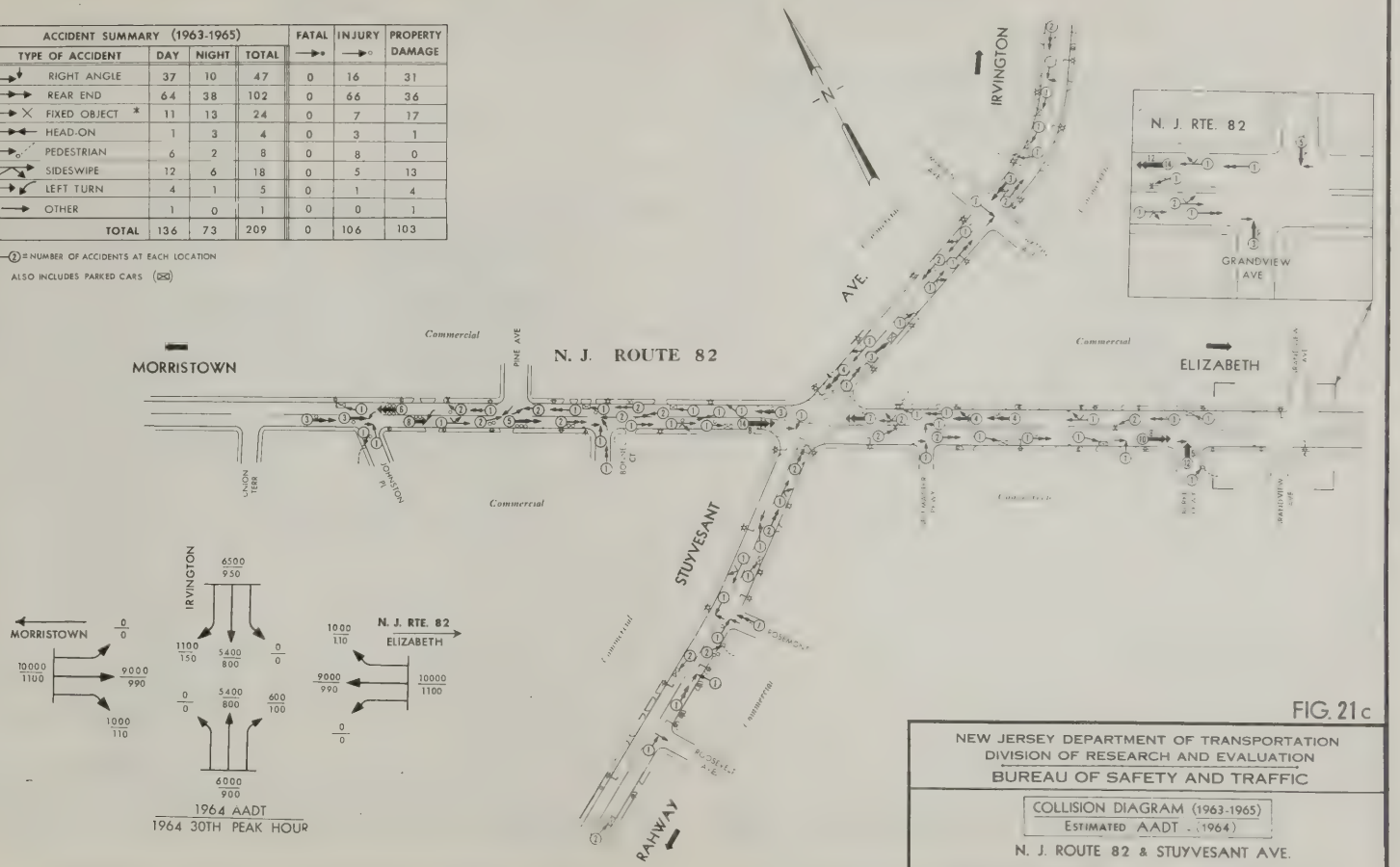


FIG. 21c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

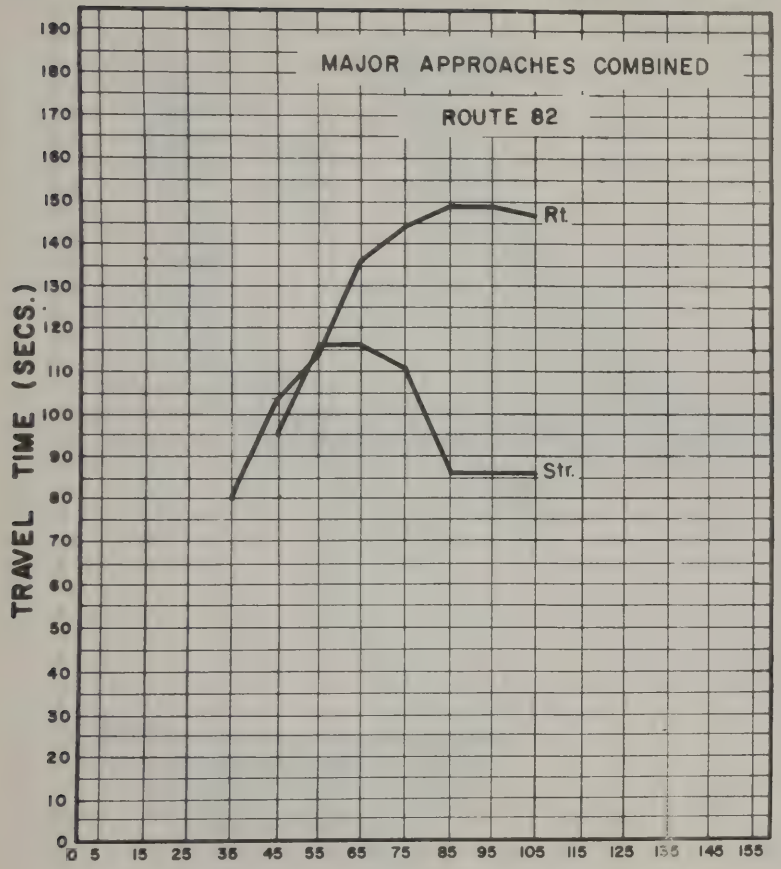
N. J. ROUTE 82 & STUYVESANT AVE.

UNION TOWNSHIP, UNION CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTE 82 AND STUYVESANT AVENUE



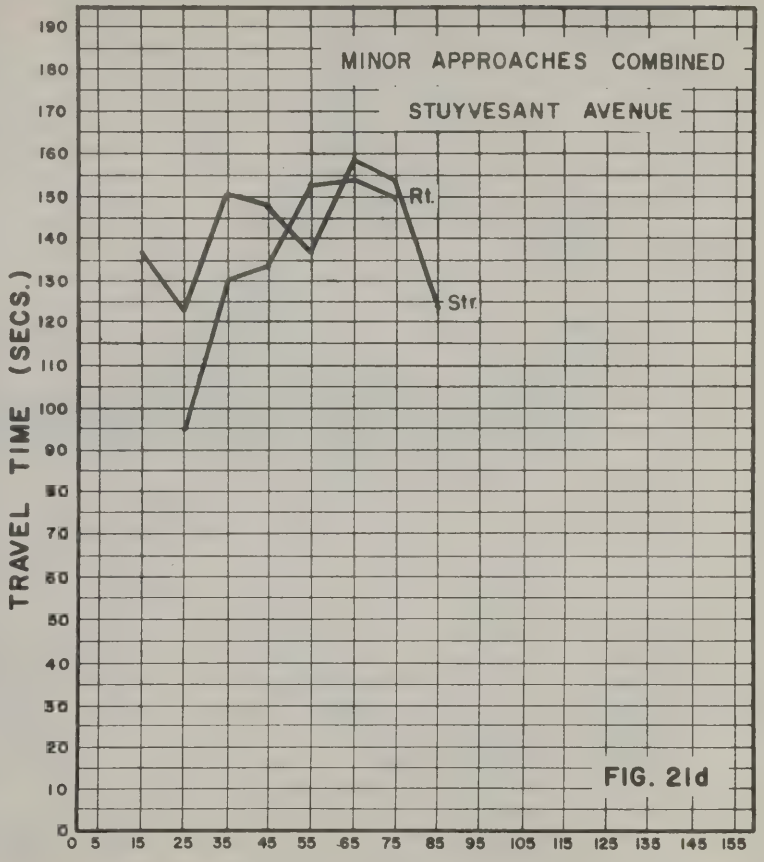


FIG. 21d

ROUTE 82 AND STUYVESANT AVE.

Posted Speeds: Route 82 - 30 mph
Stuyvesant Ave. - 25 mph

Comments by W. R. Bellis:

At this intersection, 11 percent of the traffic is turning traffic, compared to 24 percent for the average of the 13 signalized intersections, and 27 percent for the average of the 30 intersections.

The accident experience is not good. However, 3 legs have intensive shopping activity. Forty-eight percent of the accidents are rear-end accidents, compared with 53 percent for the 13 signalized intersections, and 54 percent for the average of the 30 intersections studied. Twenty-two percent of the accidents are right-angle accidents, compared to 19 percent for the average of the 13 signalized intersections, and 16 percent for the average of the 30 intersections. Thirty-four percent of the accidents occurred at night, compared to 40 percent for the average of the 13 signalized intersections, and 35 percent for the average of the 30 intersections.

For the major highway, the straight through movement requires 64 seconds longer than on a cloverleaf. The right turn requires 74 seconds longer than on a cloverleaf. No left turn movements are allowed. The straight through and the right turn movements are the slowest of any of the intersections studied.

On the minor roadway, the straight through movement requires 104 seconds longer than on a cloverleaf, and is slower than on any of the other intersections studied. The right turn is also the slowest of any intersection studied, requiring 85 seconds longer than on a cloverleaf. Note that this location has two other signalized intersections within the study area.

PHOTO 22

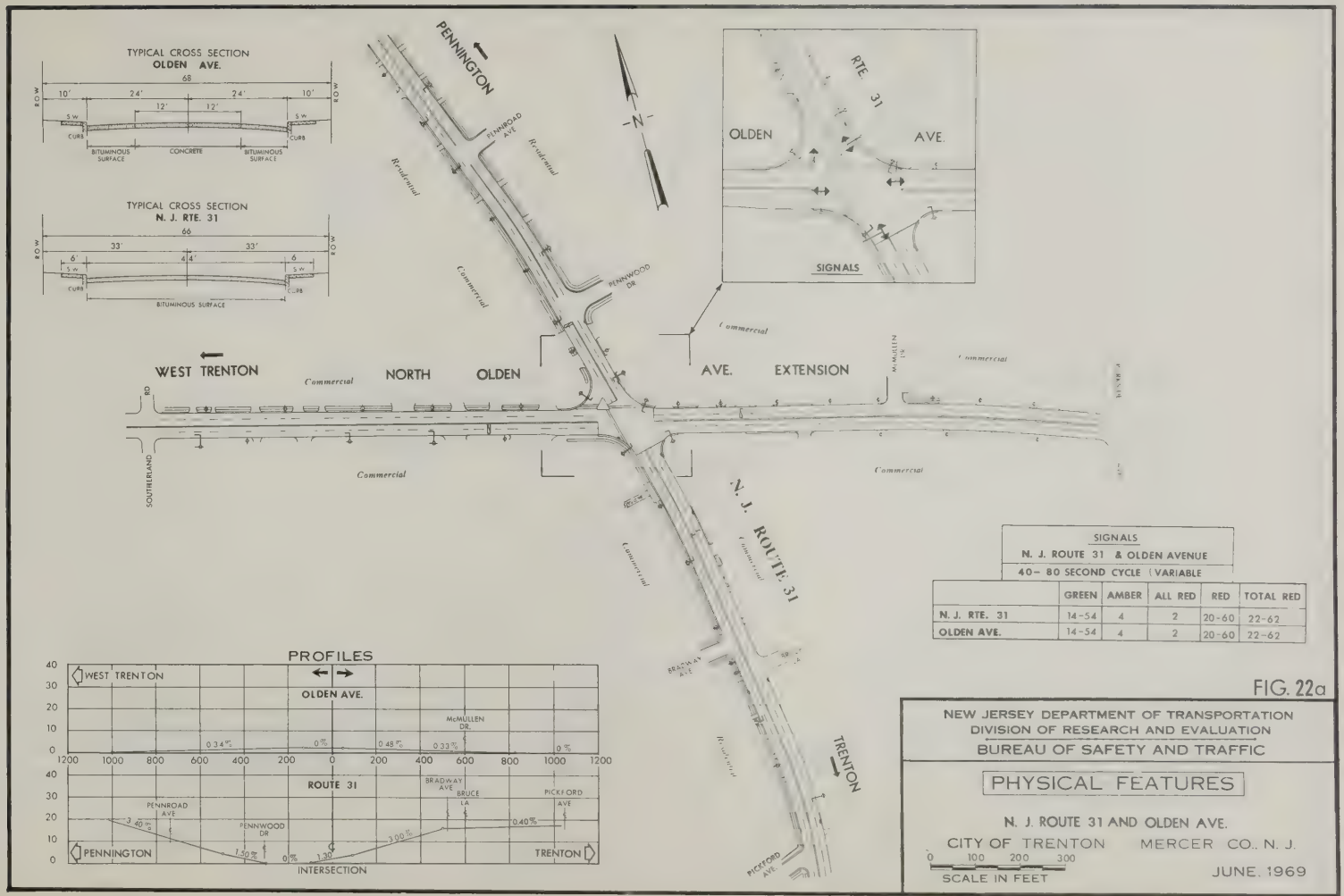
N.J. Route 31 and Olden Avenue

Signalized Intersection

Year of Construction: Circa 1955

Photographed 5/17/68 - 0945 hours
500' Altitude, Looking South

Photographed 5/17/68 - 0945 hours
800' Altitude, Looking West



SIGNALS
N. J. ROUTE 31 & OLDEN AVENUE
40- 80 SECOND CYCLE (VARIABLE

	GREEN	AMBER	ALL RED	RED	TOTAL RED
N. J. RTE. 31	14-54	4	2	20-60	22-62
OLDEN AVE.	14-54	4	2	20-60	22-62

FIG. 22a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

N. J. ROUTE 31 AND OLDEN AVE.
CITY OF TRENTON MERCER CO., N. J.
0 100 200 300
SCALE IN FEET
JUNE, 1969

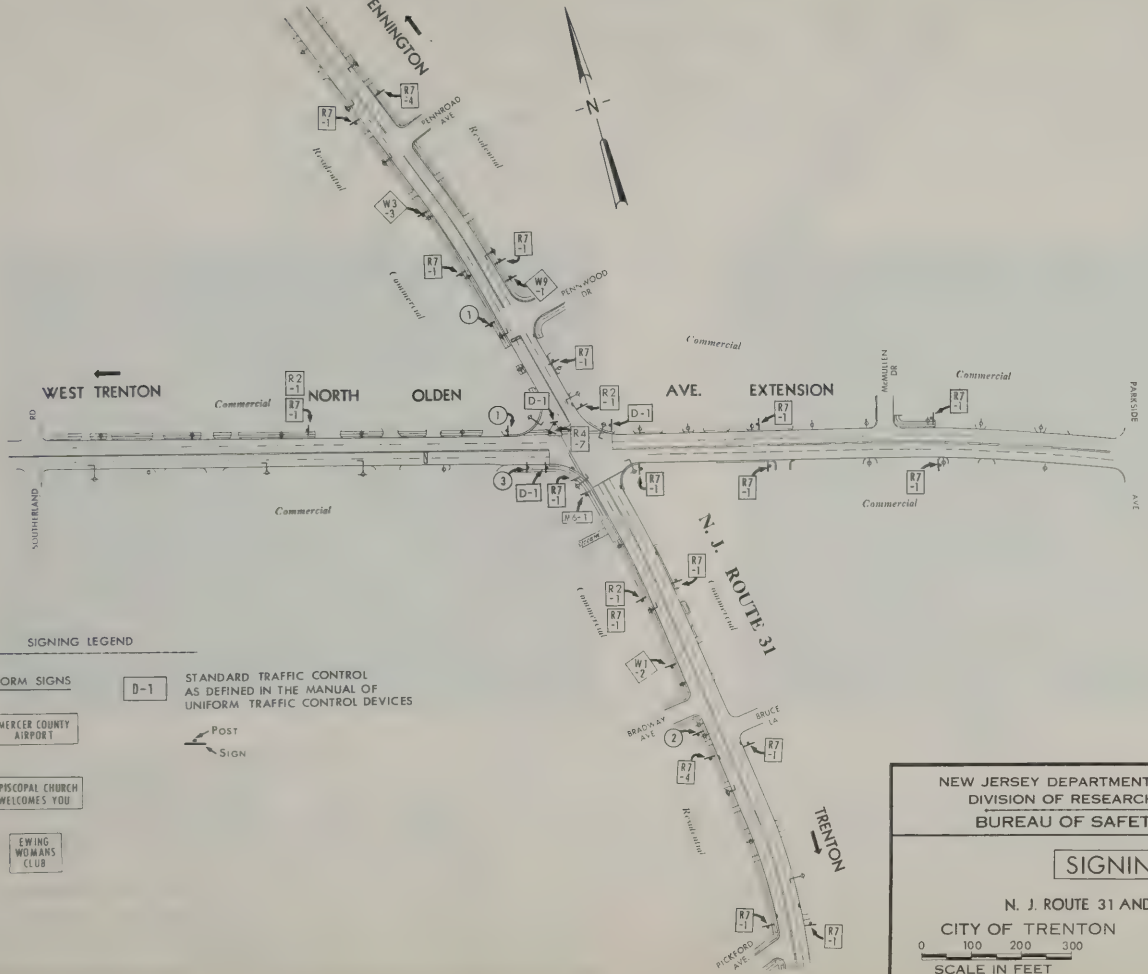


FIG. 22b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

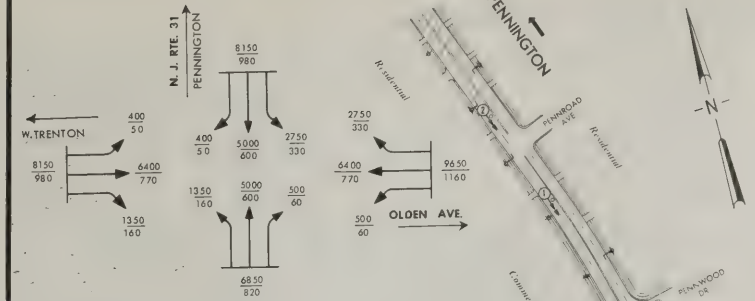
SIGNING

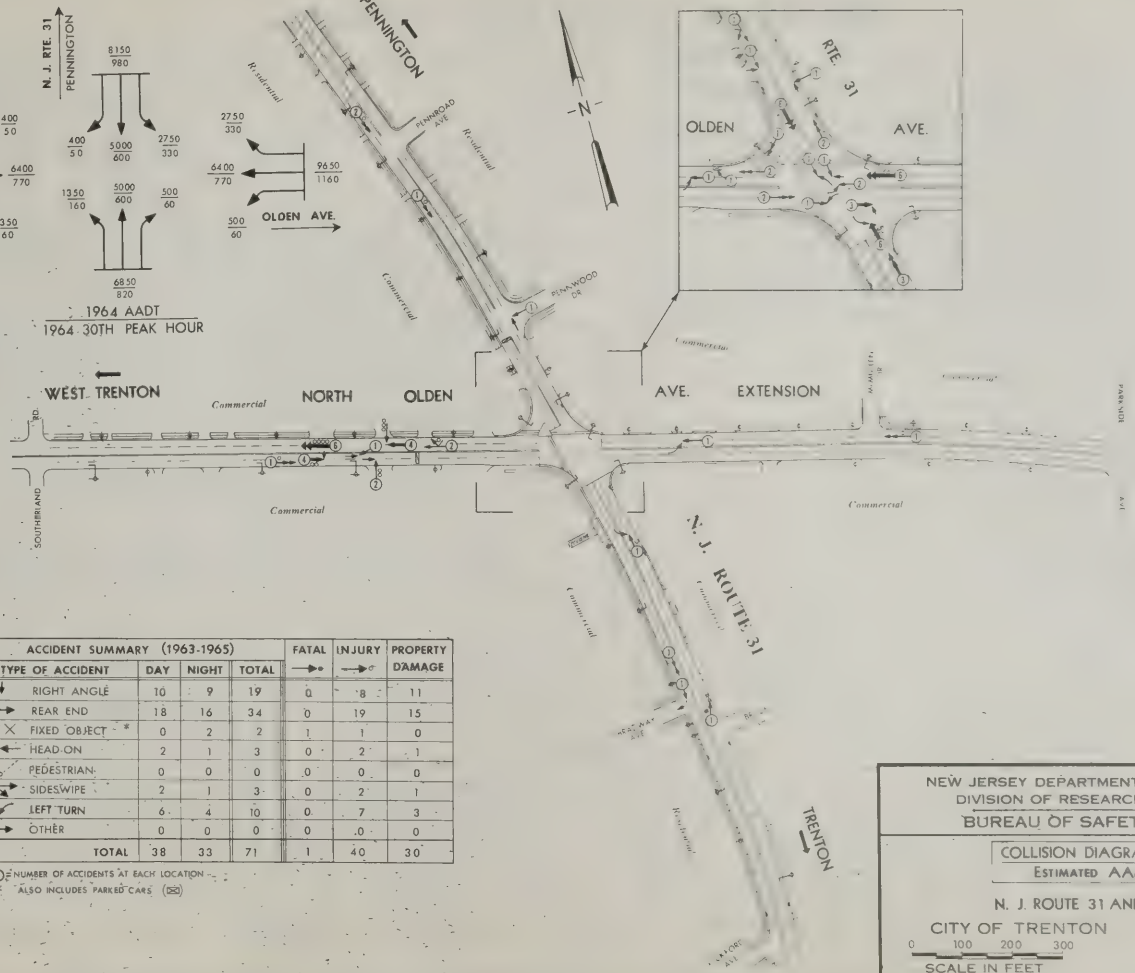
N. J. ROUTE 31 AND OLDEN AVE.

CITY OF TRENTON MERCER CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969





ACCIDENT SUMMARY (1963-1965)				FATAL	INJURY	PROPERTY
TYPE OF ACCIDENT	DAY	NIGHT	TOTAL			DAMAGE
RIGHT ANGLE	10	9	19	0	8	11
REAR END	18	16	34	0	19	15
FIXED OBJECT *	0	2	2	1	1	0
HEAD ON	2	1	3	0	2	1
PEDESTRIAN	0	0	0	0	0	0
SIDESWIPE	2	1	3	0	2	1
LEFT TURN	6	4	10	0	7	3
OTHER	0	0	0	0	0	0
TOTAL	38	33	71	1	40	30

(1) = NUMBER OF ACCIDENTS AT EACH LOCATION
* ALSO INCLUDES PARKED CARS (2)

FIG. 22c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

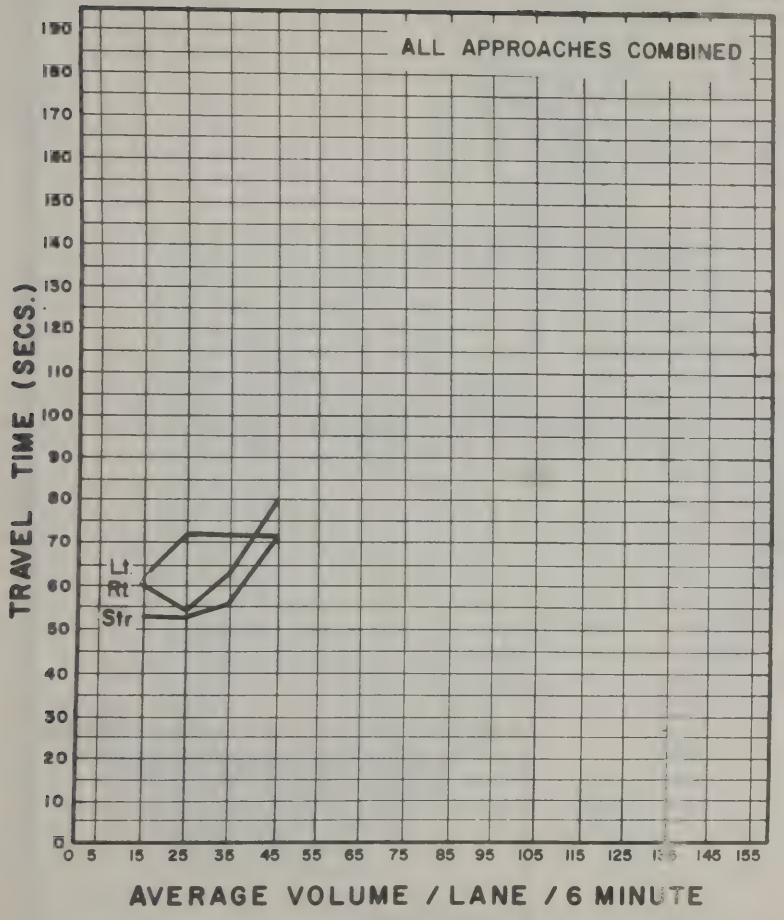
COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

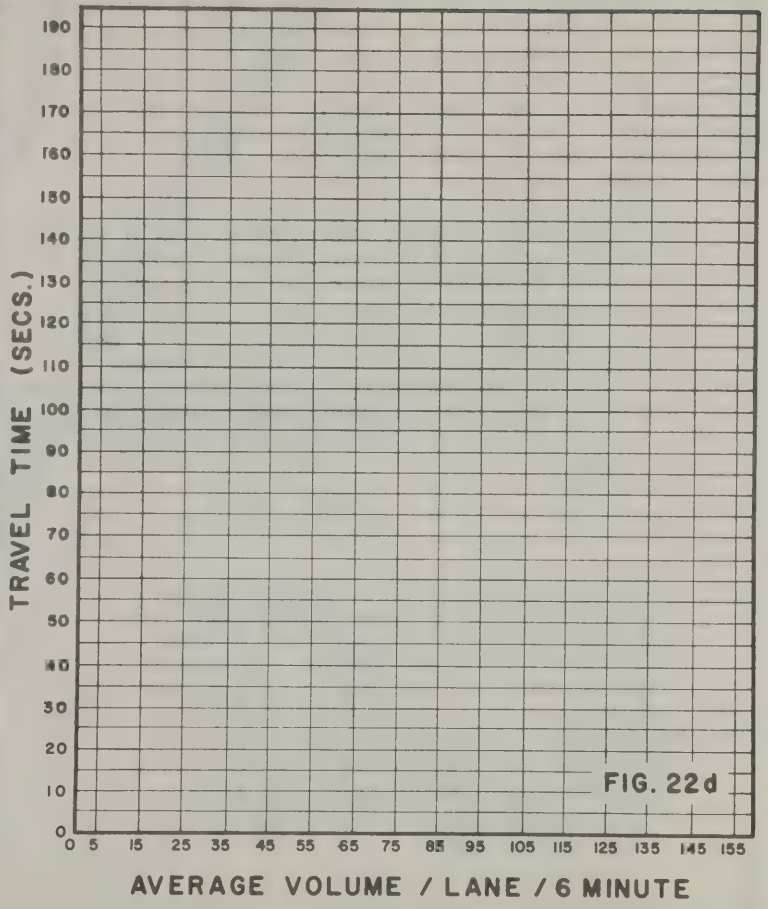
N. J. ROUTE 31 AND OLDEN AVE.
CITY OF TRENTON MERCER CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTE 31 AND OLDEN AVENUE





ROUTE 31 AND OLDEN AVE.

Posted Speeds: Route 31 - 35 mph
Olden Ave. - 40 mph

Comments by W. R. Bellis:

Thirty percent of the traffic is turning traffic, compared to 24 percent for the 13 traffic signals and 27 percent for the 30 locations.

Forty-seven percent of the accidents are rear-end accidents, compared to 53 percent for the average of the 13 signalized intersections, and 54 percent for the average of the 30 intersections. Twenty-six percent of the accidents are right-angle accidents, compared to 19 percent for the average of 13 traffic signals, and 16 percent for the average of the 30 intersections. Forty-six percent of the accidents occurred at night, which is exceeded by only 3 of the 30 intersections studied.

So far as the overall travel time, this intersection is faster than any of the other 12 traffic signal locations. Volume density controlled signals are used.

The time to travel straight through on either roadway is 24 seconds slower than for a cloverleaf. The right turn is 27 seconds slower, and the left turn is 3 seconds faster than on a cloverleaf.

The left turns from all approaches are considerably faster than at the other traffic signals studied. Left turns require 67 seconds, compared to an average for all traffic signals of 97 seconds on the major roads, and 92 seconds on the minor roads.

The straight through movement is also faster than at any of the other traffic signal locations. Sixty-one seconds is required compared to 97 seconds for the average of the 13 signalized locations. It is 24 seconds slower than on a cloverleaf.

I would expect the accident experience to be much higher than that indicated in this study but if the indicated rate is verified, this intersection has a very good efficiency rating for a signalized intersection.

PHOTO 23

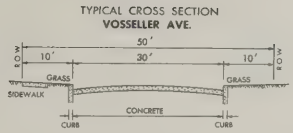
U.S. Route 22 and Voesseller Avenue

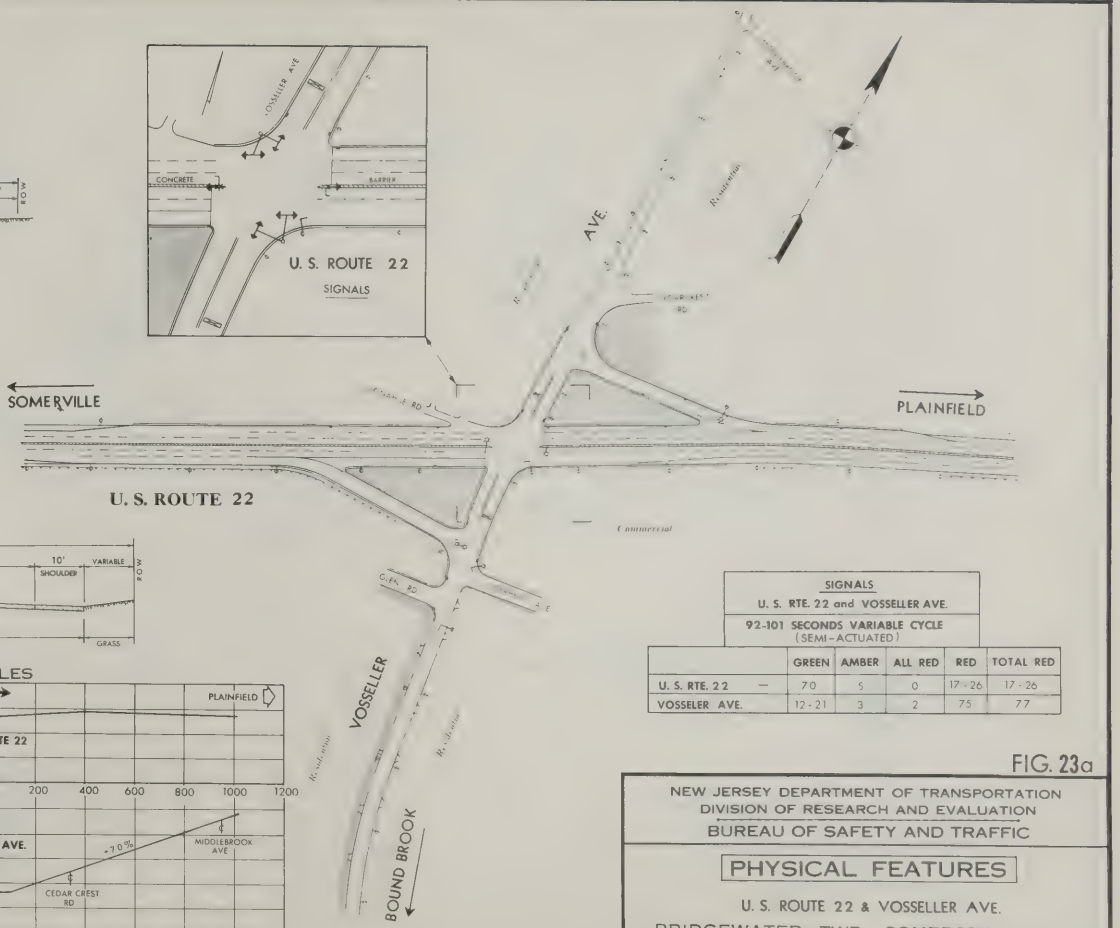
Signalized Jughandle

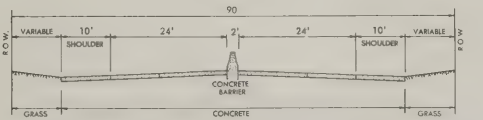
Year of Construction: 1963

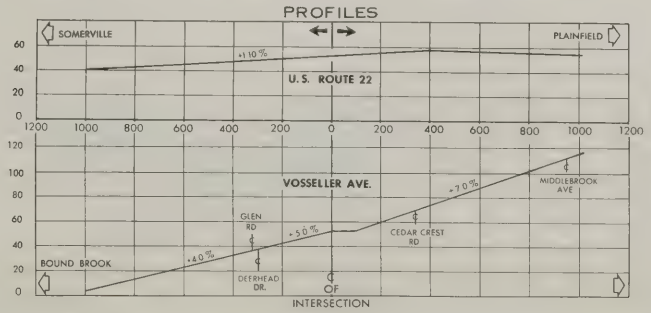
Photographed 8/21/67 - 1645 hours
800' Altitude, Looking Northwest

Photographed 8/21/67 - 1645 hours
800' Altitude, Looking North









SIGNALS U. S. RTE. 22 and VOSSELLER AVE. 92-101 SECONDS VARIABLE CYCLE (SEMI-ACTUATED)					
	GREEN	AMBER	ALL RED	RED	TOTAL RED
U. S. RTE. 22 —	70	5	0	17-26	17-26
VOSSELER AVE.	12-21	3	2	75	77

FIG. 23a

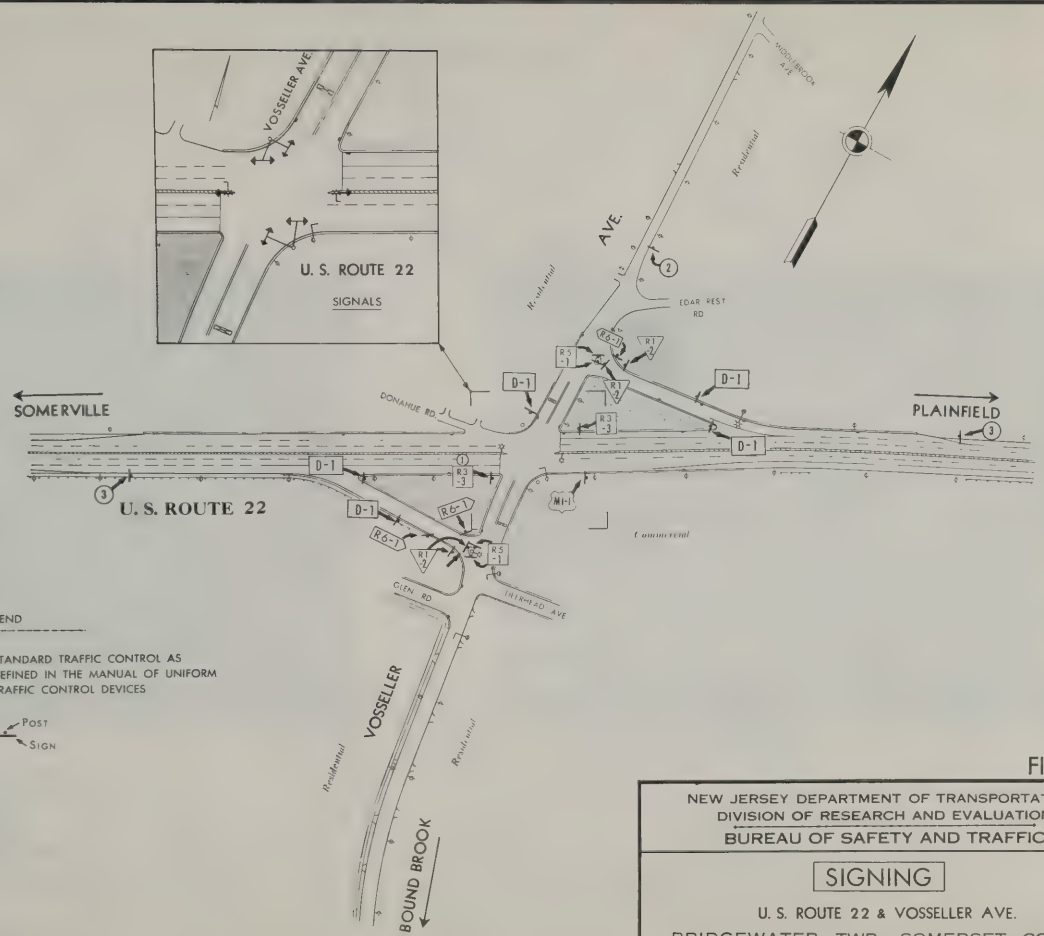
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE 22 & VOSSELLER AVE.
BRIDGEWATER TWP., SOMERSET CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969



SIGNING LEGEND

NON-UNIFORM SIGNS

① = PARKWAY

② = HISTORICAL MARKER

③ = ALL TURNS FROM RIGHT LANE

D-1 = STANDARD TRAFFIC CONTROL AS DEFINED IN THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES

Post / Sign

FIG. 23b

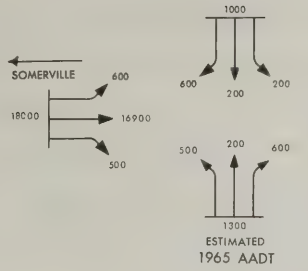
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

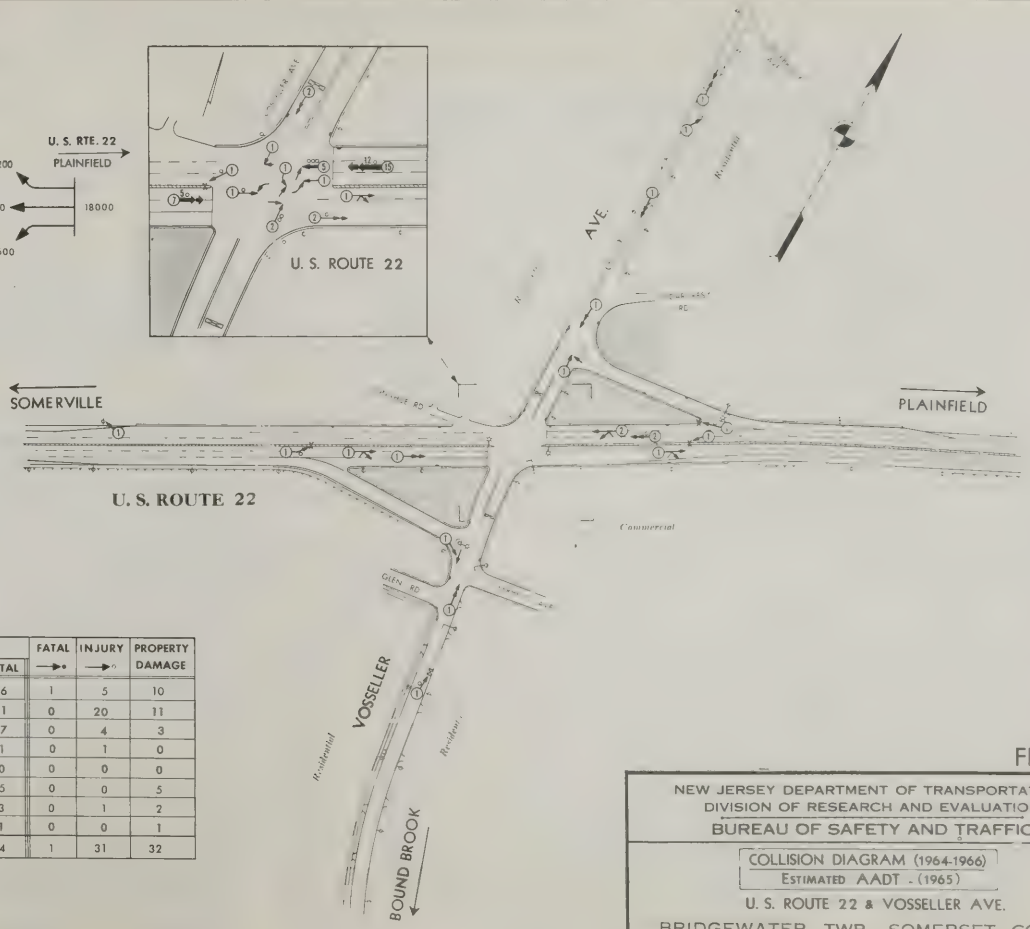
SIGNING

U. S. ROUTE 22 & VOSSELLER AVE.
BRIDGEWATER TWP., SOMERSET CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969





ACCIDENT SUMMARY (1963-1965)				FATAL	INJURY	PROPERTY
TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	→•	→◦	DAMAGE
RIGHT ANGLE	12	4	16	1	5	10
REAR END	22	9	31	0	20	11
FIXED OBJECT *	3	4	7	0	4	3
HEAD-ON	1	0	1	0	1	0
PEDESTRIAN	0	0	0	0	0	0
SIDESWIPE	4	1	5	0	0	5
LEFT TURN	3	0	3	0	1	2
OTHER	1	0	1	0	0	1
TOTAL	46	18	64	1	31	32

(2) = NUMBER OF ACCIDENTS AT EACH LOCATION
* ALSO INCLUDES PARKED CARS (⊠)

FIG. 23c

NEW JERSEY DEPARTMENT OF TRANSPORTATION.
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

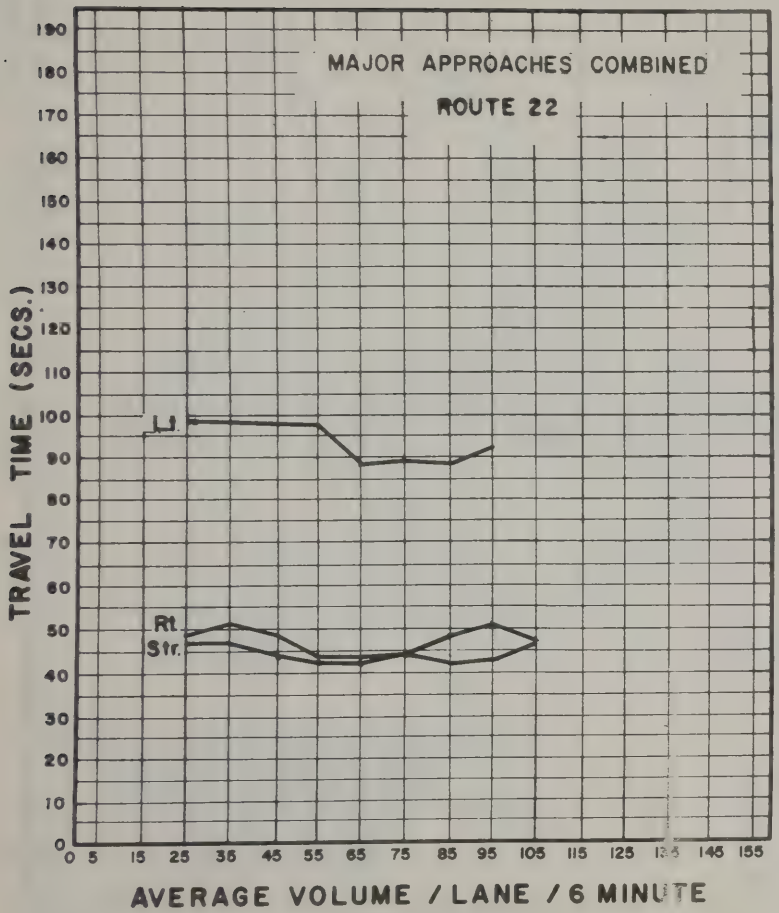
COLLISION DIAGRAM (1964-1966)
ESTIMATED AADT - (1965)

U. S. ROUTE 22 & VOSSELLER AVE.
BRIDGEWATER TWP., SOMERSET CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTE 22 AND VOSSELLER



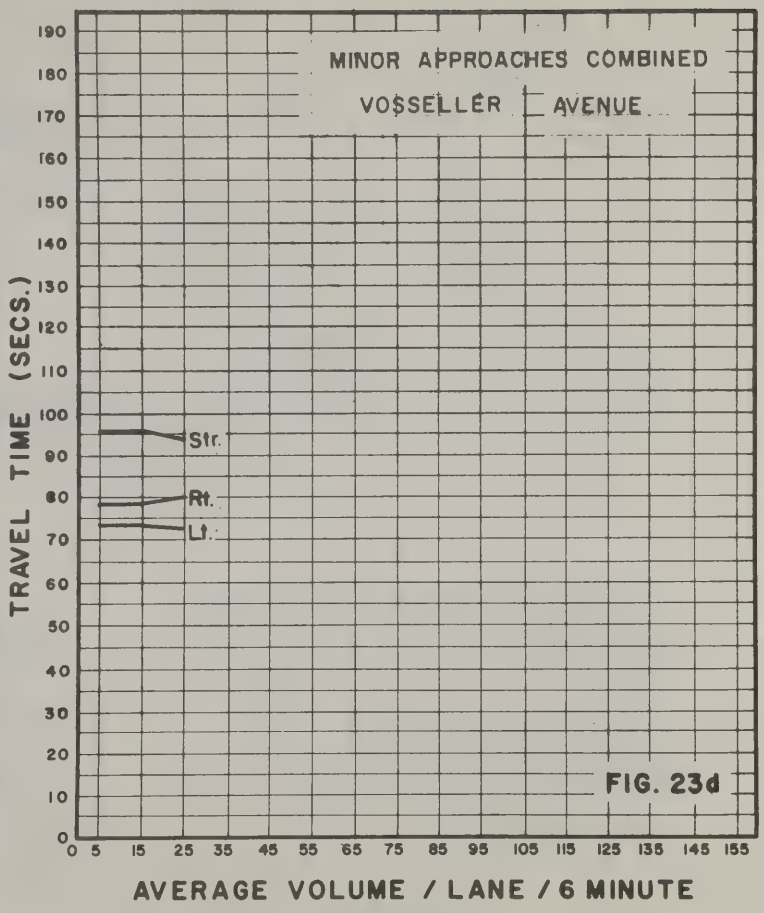


FIG. 23d

ROUTE 22 AND VOSSELLER AVE.

Posted Speeds: Route 22 - 50 mph
Vosseller Ave. - 35 mph

Comments by W. R. Bellis:

Jughandles were installed at this signalized intersection in 1963.

Nine percent of the traffic is turning movement traffic. Only one other intersection studied has a lesser percentage of turning movement traffic. This was Route 22 and Thompson Avenue.

The accident experience is relatively good. Forty-eight percent of the accidents are rear-end accidents, compared to an average of 53 percent for all traffic signals, and 54 percent for all 30 intersections. The 48 percent rear-end accidents compares with 70 percent for Route 1 and Ryders Lane and 72 percent for Route 22 and New Providence Road. These are the other two jughandle intersections studied. The sideswipes were 7 percent of the total accidents at Vosseller Ave., compared to 1 percent at New Providence Road and Ryders Lane. Twenty-five percent of the accidents are right-angle accidents, compared to 19 percent for the average of the 13 signalized intersections studied, and 16 percent for the average of the 30 intersections, and 16 and 17 percent for the other 2 jughandles. Twenty-eight percent of the accidents occurred at night, compared to 40 percent for all signalized intersections studied, and 35 percent for the average of the 30 intersections.

The travel time for the straight through movement on the major highway is faster than for any of the other signalized intersections studied and is 10 seconds longer than on a cloverleaf. The right turn requires 6 seconds longer than on a cloverleaf, and the left turn requires 24 seconds longer. From the minor road, the straight through movement requires 60 seconds longer, and the left turn is made in the same time as on a cloverleaf.

The total volume of traffic using the Vosseller Avenue intersection is smaller than either of the other two jughandles, and also, the minor road traffic is less on Vosseller than on the other two. This may account for the differences in the accident pattern. Considering all movements through the intersection, the overall travel time at this intersection was faster than at the other two jughandles.

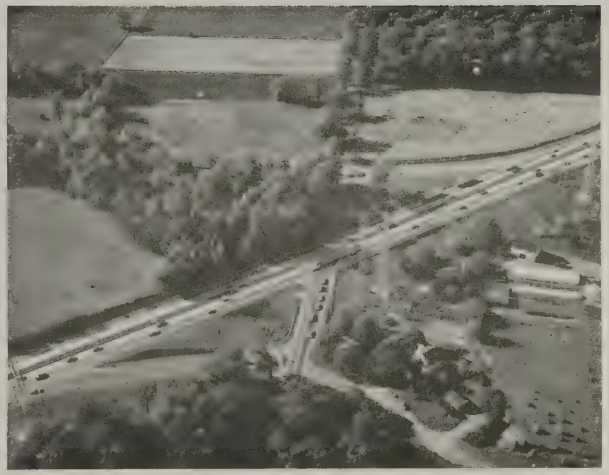
PHOTO 24

U.S. Route 1 and Ryders Lane

Signalized Jughandle

Year of Construction: 1960

Photographed 6/1/67 - 1730 hours
500' Altitude, Looking Southwest



Photographed 6/1/67 - 1730 hours
700' Altitude, Looking West

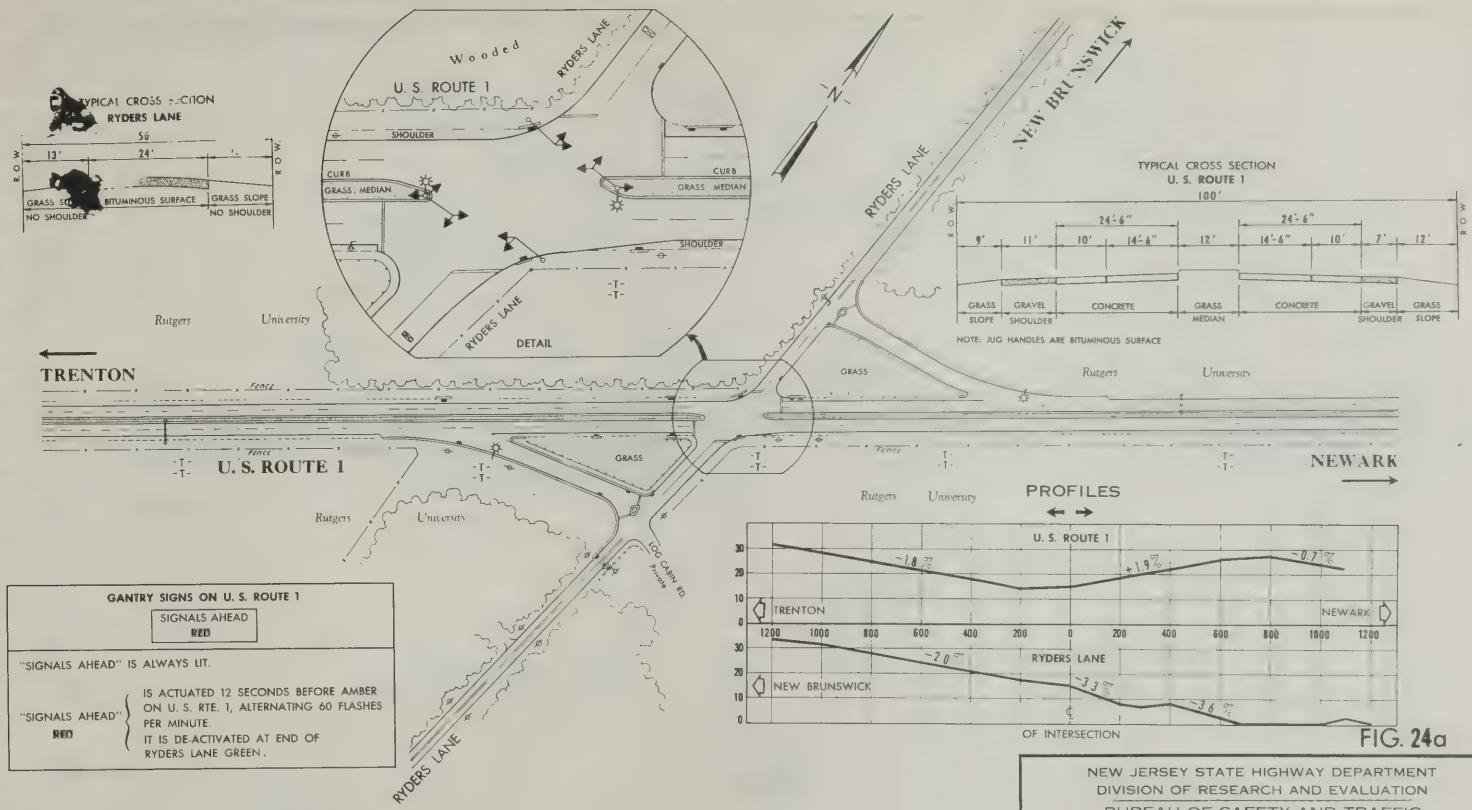


FIG. 24a

GANTRY SIGNS ON U. S. ROUTE 1

SIGNALS AHEAD
RED

"SIGNALS AHEAD" IS ALWAYS LIT.

"SIGNALS AHEAD" RED
- IS ACTUATED 12 SECONDS BEFORE AMBER ON U. S. RTE. 1, ALTERNATING 60 FLASHES PER MINUTE.
- IT IS DE-ACTIVATED AT END OF RYDERS LANE GREEN.

107-127 SECONDS VARIABLE CYCLE
SEMI-ACTUATED

	GREEN	AMBER	ALL RED	RED	TOTAL RED
U. S. ROUTE 1	80	5	2	20-40	22-42
RYDERS LANE	15-35	3	2	87	89

NEW JERSEY STATE HIGHWAY DEPARTMENT
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE No. 1 & RYDERS LANE
NORTH BRUNSWICK TWP. MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

DECEMBER, 1966

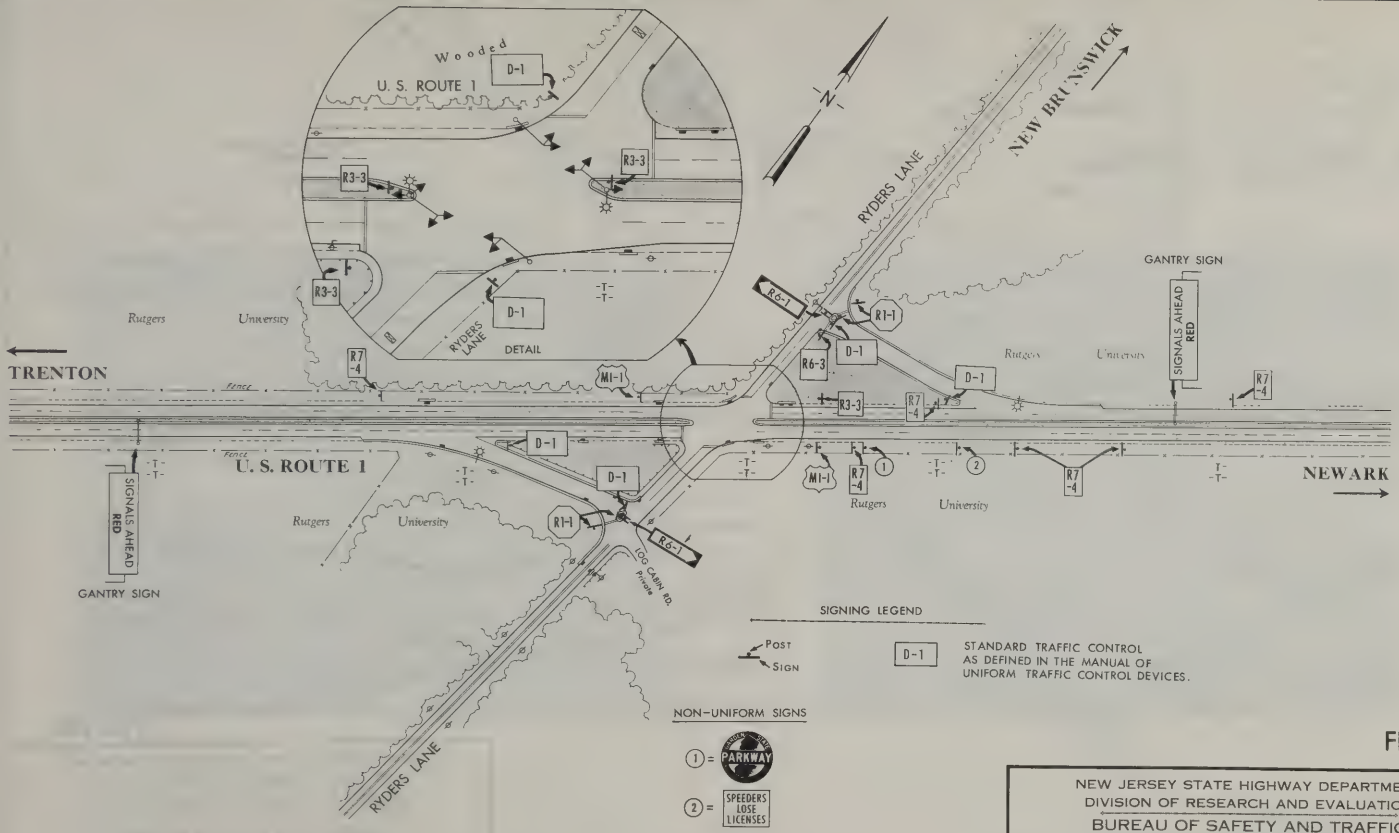


FIG. 24b

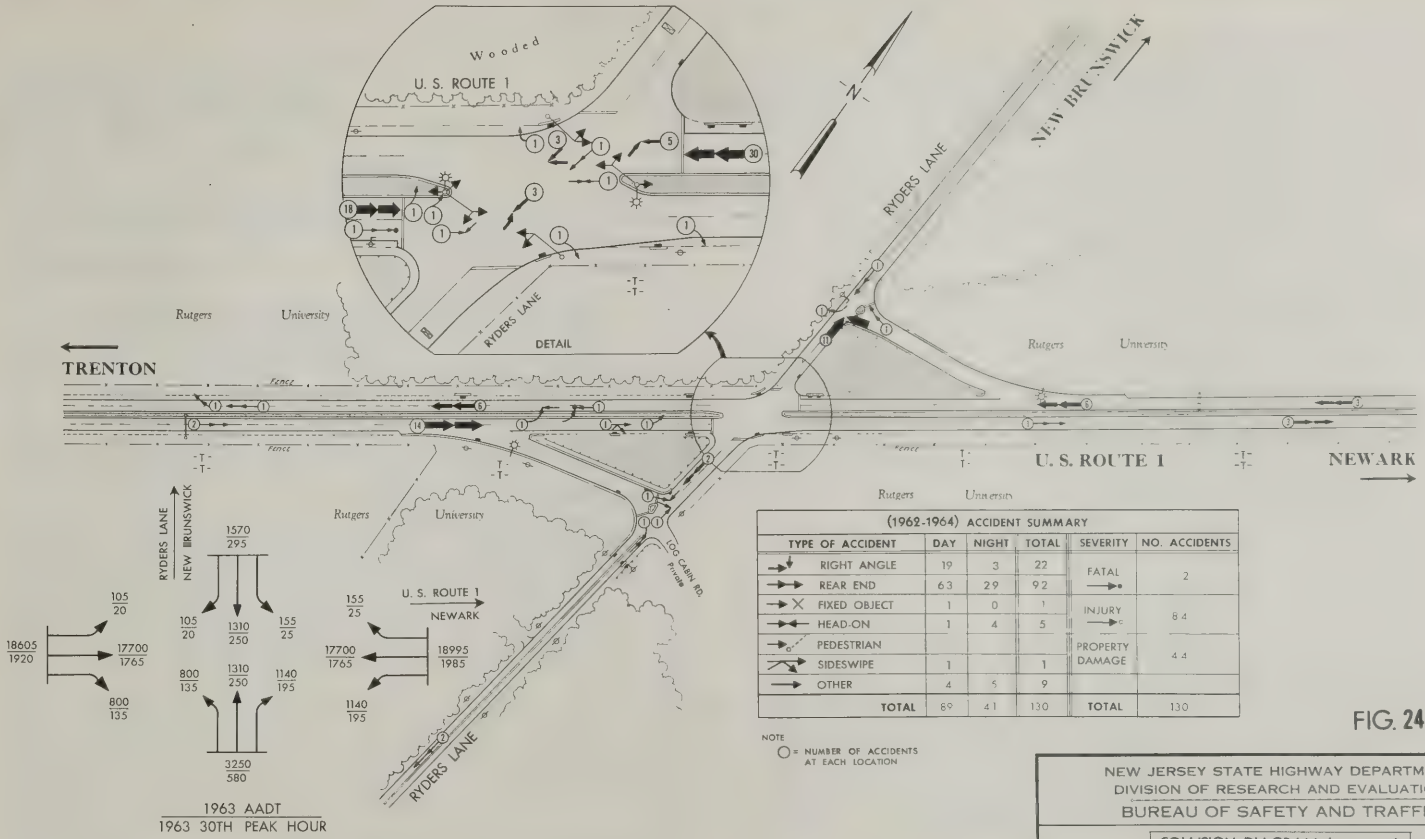
NEW JERSEY STATE HIGHWAY DEPARTMENT
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. ROUTE No. 1 & RYDERS LANE
NORTH BRUNSWICK TWP. MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

DECEMBER, 1966



(1962-1964) ACCIDENT SUMMARY

TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	SEVERITY	NO. ACCIDENTS
RIGHT ANGLE	19	3	22	FATAL	2
REAR END	63	29	92		
FIXED OBJECT	1	0	1	INJURY	84
HEAD-ON	1	4	5		
PEDESTRIAN				PROPERTY DAMAGE	44
SIDESWIPE	1		1		
OTHER	4	5	9		
TOTAL	89	41	130	TOTAL	130

NOTE
○ = NUMBER OF ACCIDENTS AT EACH LOCATION

FIG. 24c

NEW JERSEY STATE HIGHWAY DEPARTMENT
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

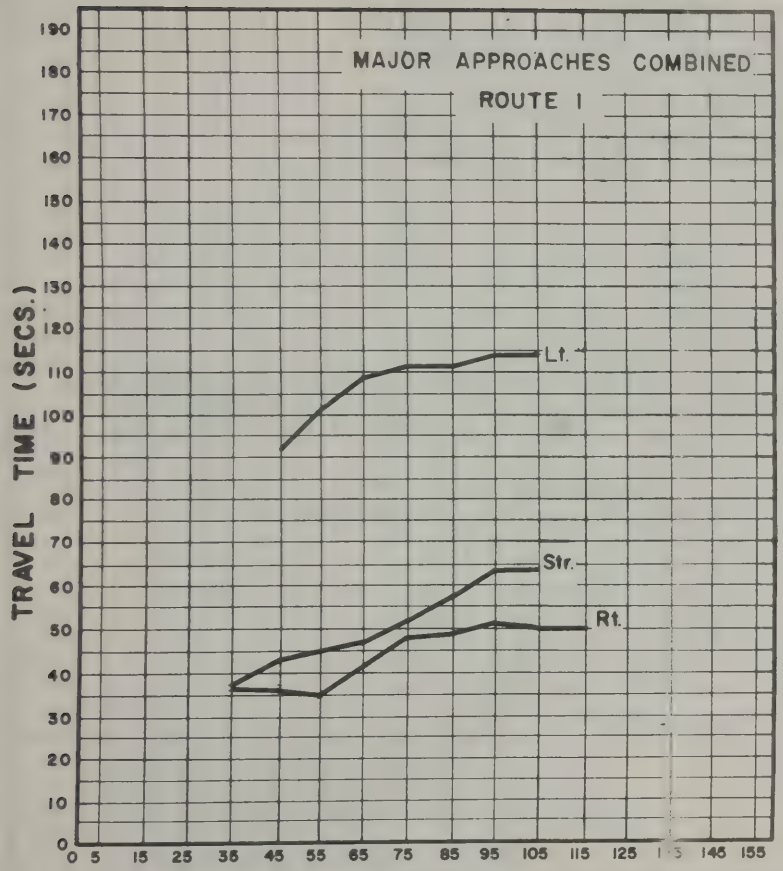
COLLISION DIAGRAM (1962-1964)
AADT - 30th PEAK HOUR 1963

U. S. ROUTE No. 1 & RYDERS LANE
NORTH BRUNSWICK TWP. MIDDLESEX CO., N. J.

0 100 200 300
SCALE IN FEET

DECEMBER, 1966

ROUTE I AND RYDERS LANE



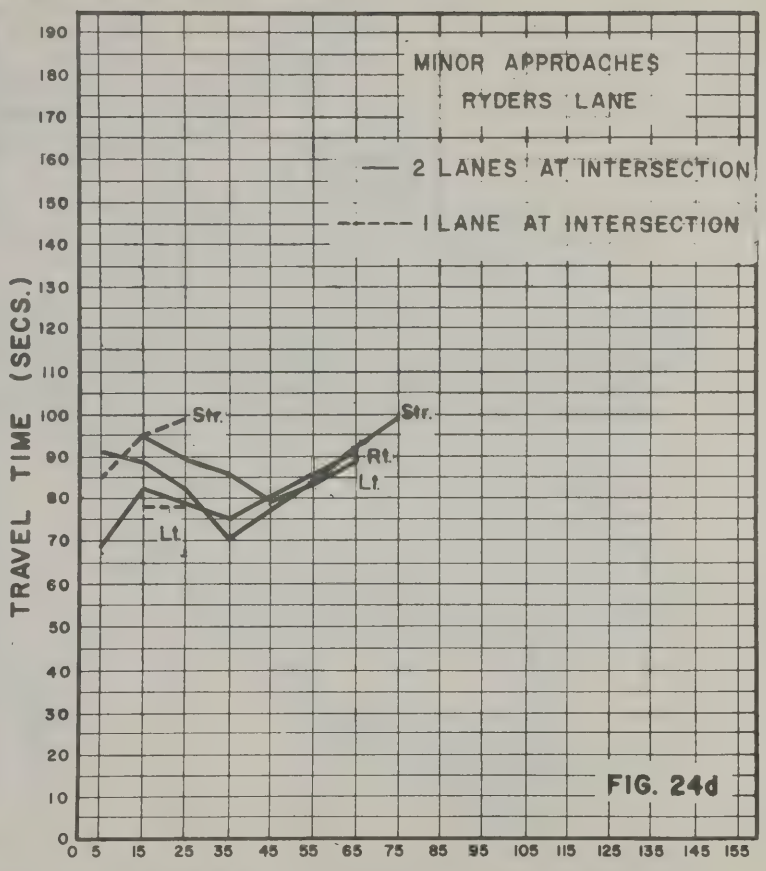


FIG. 24d

ROUTE 1 AND RYDERS LANE

Posted Speeds: Route 1 - 50 mph
Ryders Lane - 35 mph

Comments by W. R. Bellis:

Jughandles were installed at this signalized intersection in 1960. In 1969, it was converted to a full cloverleaf.

Ten percent of the total traffic is turning movement traffic. This equals the turning movement traffic for the jughandle at Route 22 and New Providence Road and almost equals the 9 percent turning movement at the Route 22 and Vosseller Avenue jughandle. The 10 percent compares with 24 percent for the average of the 13 traffic signals, and 27 percent for the average of the 30 intersections.

The accident and injury rates are worse than those at the other two jughandles. Seventy percent of the accidents are rear-end accidents, which is more than at Vosseller Avenue, but about the same as that for the New Providence Road jughandle. It compares with 53 percent for the average of the 13 signalized intersections, and 54 percent for the average of the 30 intersections.

One percent of the accidents are sideswipes, which is equal to that for New Providence Road, and compares with 7 percent at Vosseller Avenue, 8 percent for the average of the 13 signalized intersections, and 11 percent for the average of the 30 intersections.

Right-angle accidents accounted for 16 percent of the total accidents. This is about the same as at New Providence Road, but less than at Vosseller Avenue. It compares with 19 percent for the average of the 13 signalized intersections, and 16 percent for the average of the 30 intersections.

Thirty-one percent of the accidents occurred at night, compared with 40 percent for the average of the 13 signalized intersections, and 35 percent for the average of the 30 intersections.

The straight through movement on the major road was 5 seconds faster than at Vosseller Avenue during off-hours, but 13 seconds slower during peak hours. The average was about 13 seconds slower than that for a cloverleaf. The right turns from the major road are 7 seconds faster during off-hours and 1 second faster during peak hours, compared to Vosseller Avenue. The average right turn took about the same time as that on a cloverleaf. The left turn was slower than at Vosseller Avenue, 3 seconds during the off-hours and 15 seconds during the peak hours. The average was 33 seconds slower than the left turn on the cloverleaf.

The straight through movement from the side road, compared to Vosseller Avenue, was 14 seconds faster during off-hours and 5 seconds slower during peak hours. The average was 53 seconds slower than on a cloverleaf. During off-hours, the right turn was 8 seconds faster than at Vosseller Avenue, but during peak hours 10 seconds slower. The average required 40 seconds longer than at a cloverleaf. During off-hours, the left turn was about the same as at Vosseller Avenue, but about 20 seconds slower during peak hours. The average was 10 seconds slower than the left turn at a cloverleaf.

PHOTO 25

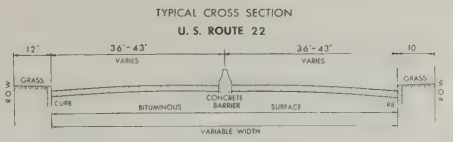
U.S. Route 22 and New Providence Road

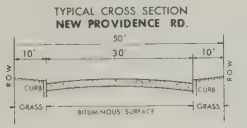
Signalized Jughandle

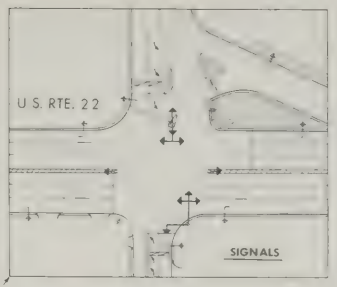
Year of Construction: 1930

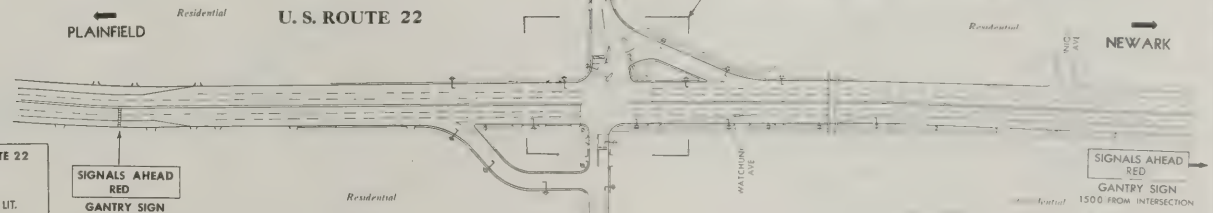
Photographed 8/21/67 - 1645 hours
500' Altitude, Looking South

Photographed 8/21/67 - 1645 hours
500' Altitude, Looking East









GANTRY SIGNS ON U. S. ROUTE 22

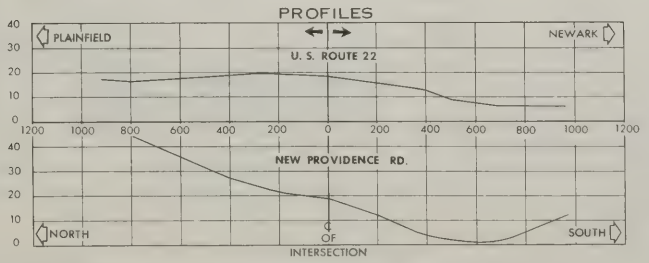
SIGNALS AHEAD
RED

"SIGNALS AHEAD" IS ALWAYS LIT.

IT IS ACTUATED 18 SECONDS BEFORE BEGINNING OF AMBER FOR ROUTE 27 WESTBOUND TRAFFIC.

IT IS ACTUATED 12 SECONDS BEFORE BEGINNING OF AMBER FOR ROUTE 22 EASTBOUND TRAFFIC.

IT IS DE-ACTIVATED AT THE END OF NEW PROVIDENCE ROAD GREEN.



SIGNALS
U.S. RTE. 22
120 SECOND CYCLE
(SEMI-ACTUATED)

	PED. GRN.	GREEN	AMBER	ALL RED	RED	TOTAL RED
U.S. RTE. 22	---	95-74	5 ☆	0	20-41	20-41
NEW PROV. RD.	24	15-36	3	2	100-79	102-81

☆ OFFSET 50 SECONDS
OFFSET MEASURED FROM BEG. AMBER TO U.S. RTE. 22 AT TERRILL RD

FIG. 25a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. RTE. 22 & NEW PROVIDENCE ROAD
MOUNTAINSIDE TWP., UNION CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

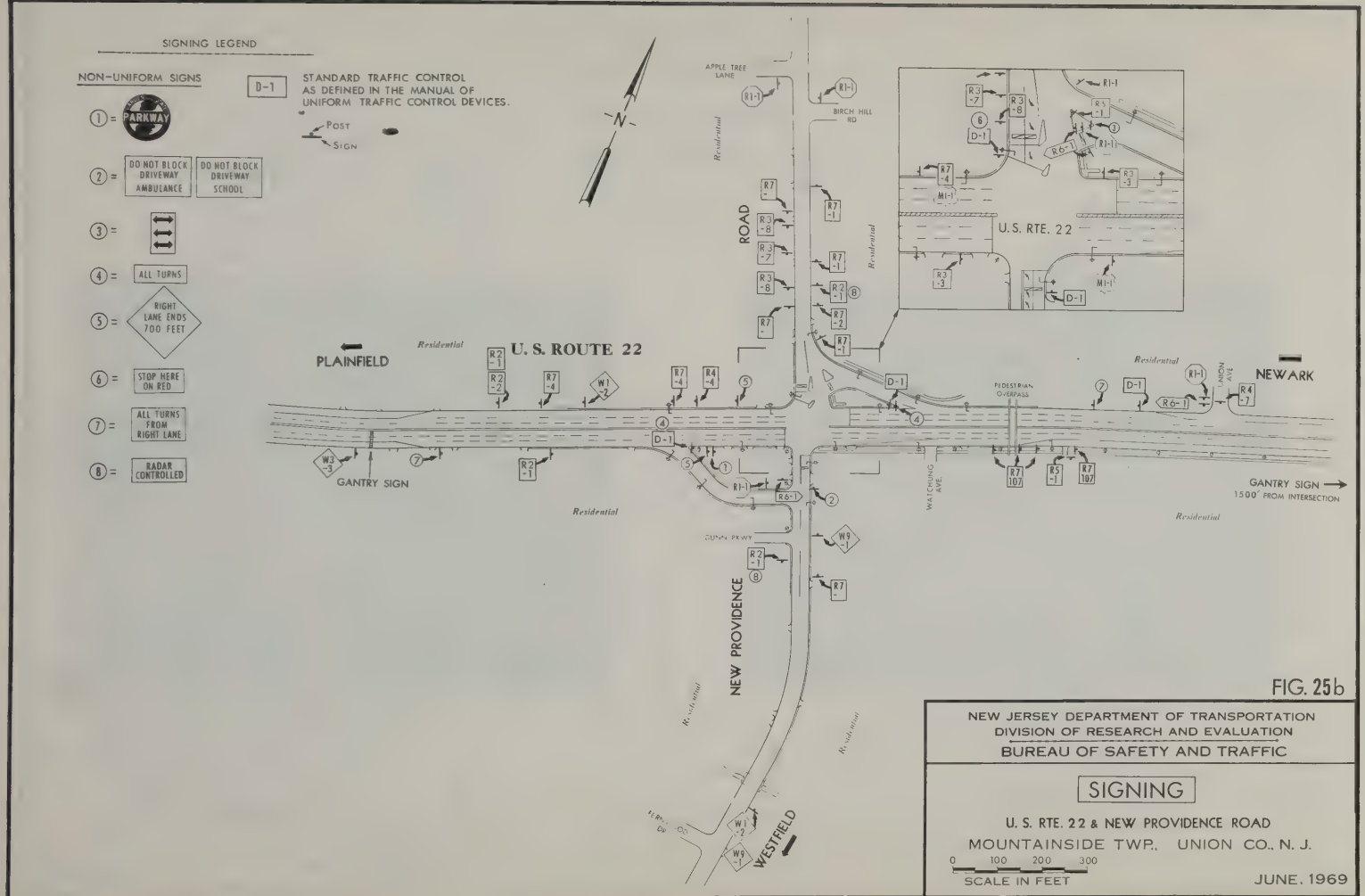


FIG. 25b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. RTE. 22 & NEW PROVIDENCE ROAD
MOUNTAINSIDE TWP., UNION CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ACCIDENT SUMMARY (1963-1965) TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	FATAL →•	INJURY →○	PROPERTY DAMAGE
RIGHT ANGLE	18	10	28	0	11	17
REAR END	80	36	116	0	66	50
FIXED OBJECT *	3	8	11	0	4	7
HEAD-ON	0	0	0	0	0	0
PEDESTRIAN	1	1	2	0	2	0
SIDESWIPE	2	0	2	0	0	2
LEFT TURN	1	1	2	0	1	1
OTHER	0	0	0	0	0	0
TOTAL	105	56	161	0	84	77

←(1)= NUMBER OF ACCIDENTS AT EACH LOCATION

* ALSO INCLUDES PARKED CARS (⊠)

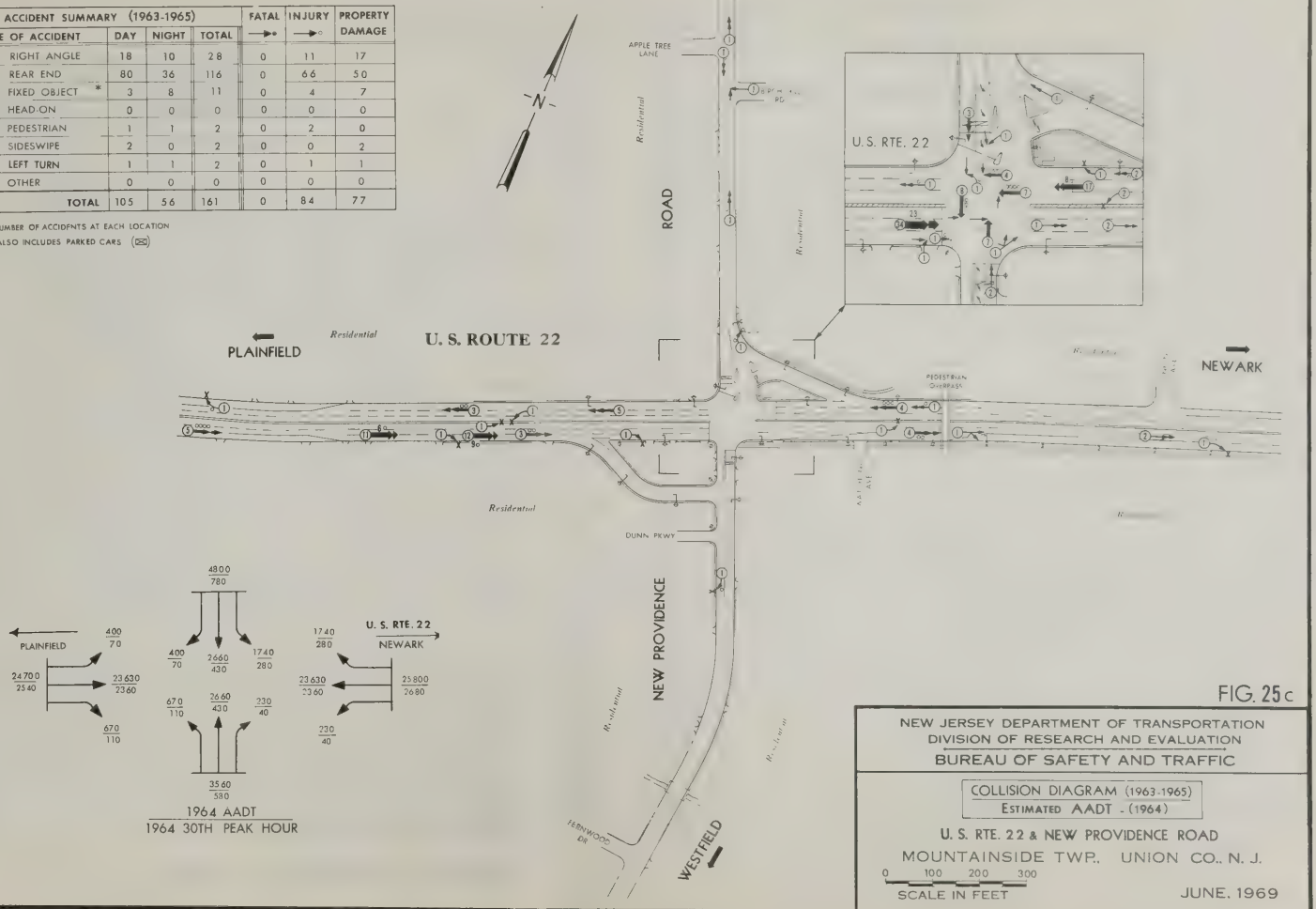


FIG. 25c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

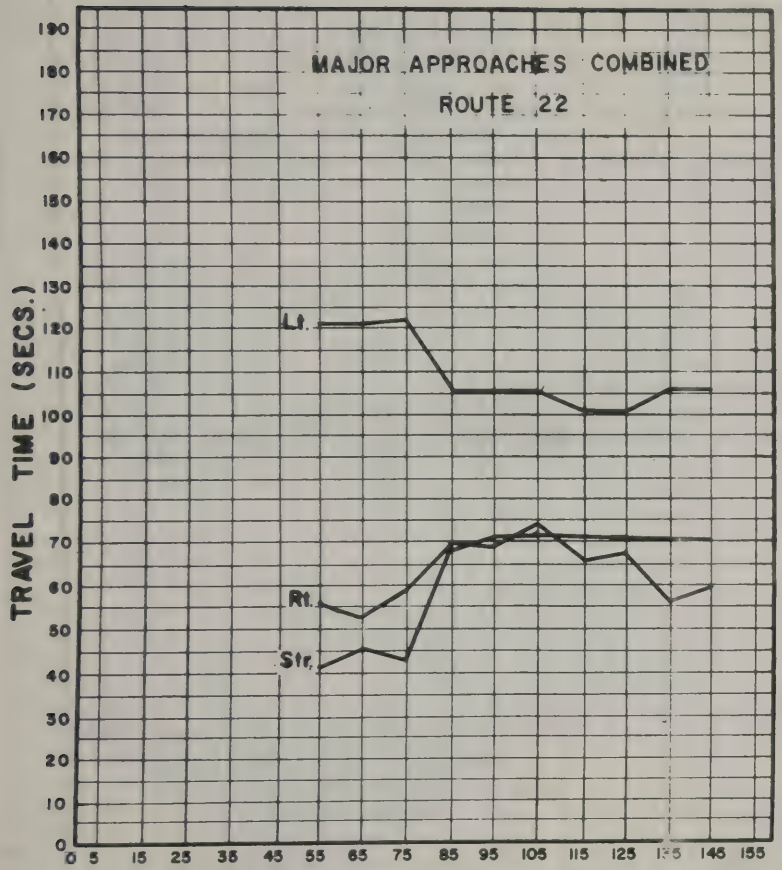
COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

U. S. RTE. 22 & NEW PROVIDENCE ROAD
MOUNTAINSIDE TWP., UNION CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTE 22 AND NEW PROVIDENCE



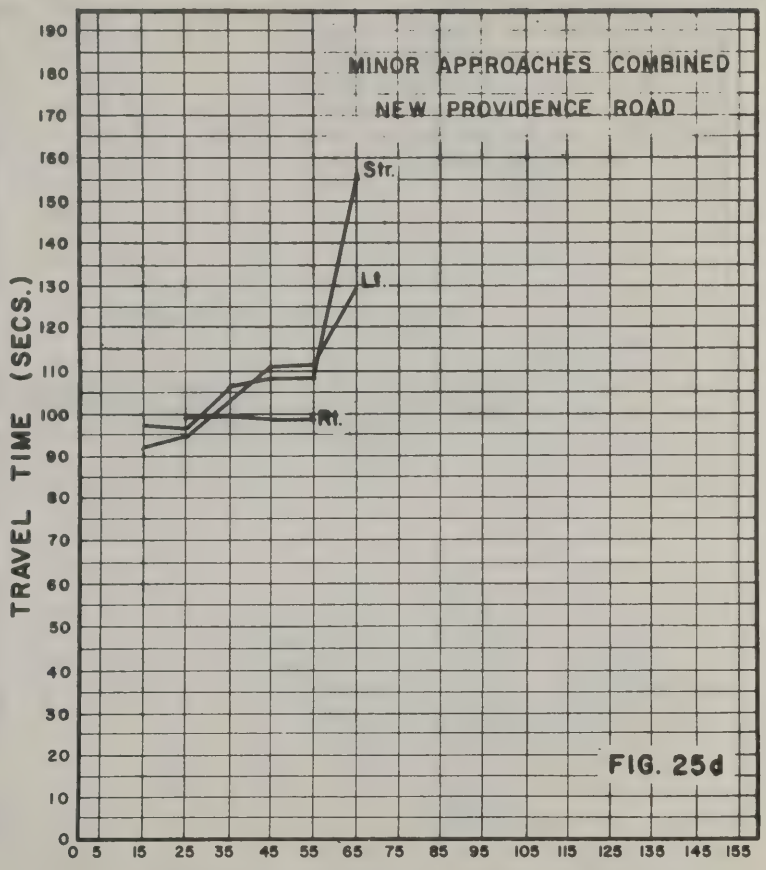


FIG. 25d

ROUTE 22 AND NEW PROVIDENCE ROAD

Posted Speeds: Route 22 - 45 mph
New Providence Rd. - 35 mph

Comments by W. R. Bellis:

At this signalized jughandle intersection, 10 percent of the traffic is turning movement traffic, compared to 24 percent for the average of the 13 signalized intersections, and 27 percent for the average of the 30 intersections. Both the total volume and the turning movement volume are larger than either of the other two jughandle intersections studied.

Seventy-two percent of the accidents are rear-end accidents, exceeded only by the intersection at Routes 4 and 17, a cloverleaf, and compares with 53 percent for the average of the signalized intersections, and 54 percent for the average of the 30 intersections. Only one percent of the accidents are sideswipes, compared with 8 percent for the average of the 13 signalized intersections, and 11 percent for the average of the 30 intersections. Seventeen percent of the accidents are right-angle accidents, compared to 19 percent for the average of the 13 signalized intersections, and 16 percent for the average of the 30 intersections.

For the major highway, the straight through movement is 20 seconds slower than on a cloverleaf, and slower than either of the other two jughandles. The right turn movement requires 23 seconds longer than on a cloverleaf, and the left turn 40 seconds longer than on a cloverleaf. This left turn is slower than either of the other two jughandles studied.

On the side road, the straight through movement requires 89 seconds longer than on a cloverleaf and is slower than either of the other two jughandles studied. During the peak hour, movements are 60 seconds slower than during the off-hour, delays undoubtedly caused by the conflicts with the turning movement traffic. The right turn requires 60 seconds longer than on a cloverleaf, and the left turn 40 seconds longer.

Note that there is a pedestrian overpass close-by.

PHOTO 26

U.S. Route 1 and Washington Avenue

Signalized Through Circle

Year of Construction: 1959

Photographed 5/17/68 - 0915 hours
500' Altitude, Looking West

Photographed 5/17/68 - 0915 hours
800' Altitude, Looking Southwest

SIGNALS
U.S. RTE. 1 & WASHINGTON RD.
90 SECOND CYCLE (FIXED)

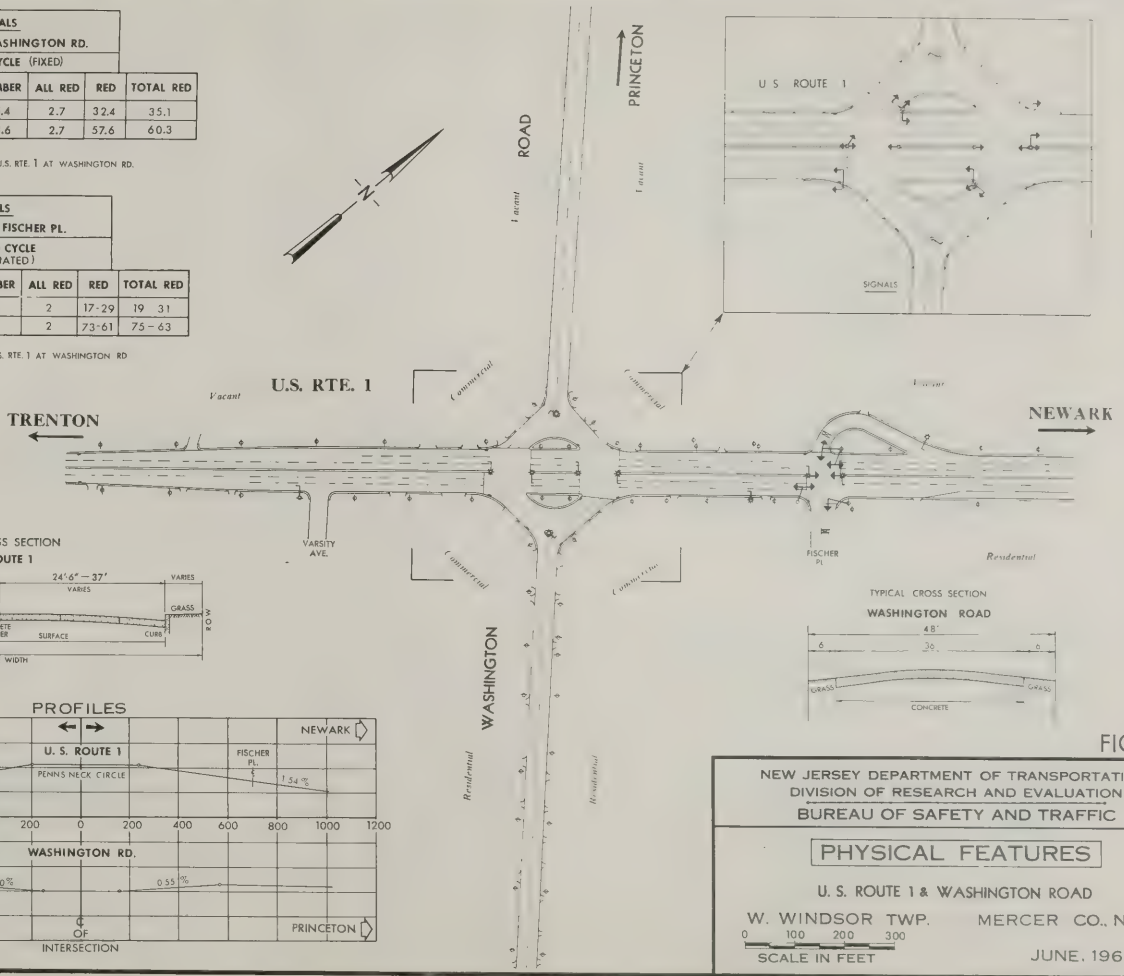
	GREEN	AMBER	ALL RED	RED	TOTAL RED
U. S. ROUTE 1	49.5	5.4	2.7	32.4	35.1
WASHINGTON RD.	26.1	3.6	2.7	57.6	60.3

☆ OFFSET = 0 SECONDS
OFFSET MEASURED FROM BEG. AMBER TO U.S. RTE. 1 AT WASHINGTON RD.

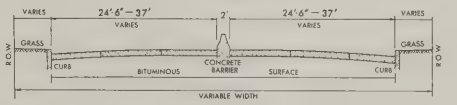
SIGNALS
U. S. RTE. 1 & FISCHER PL.
90 SECOND CYCLE
(SEMI-ACTUATED)

	GREEN	AMBER	ALL RED	RED	TOTAL RED
U. S. RTE. 1	65-53	6	2	17-29	19 31
FISCHER PL.	12-24	3	2	73-61	75-63

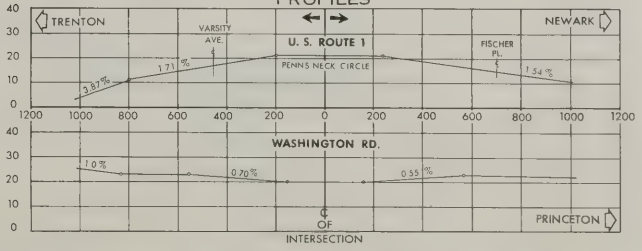
☆ OFFSET = 0 SECONDS
OFFSET MEASURED FROM BEG. AMBER TO U.S. RTE. 1 AT WASHINGTON RD



TYPICAL CROSS SECTION
U. S. ROUTE 1



PROFILES



TYPICAL CROSS SECTION
WASHINGTON ROAD

FIG. 26a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE 1 & WASHINGTON ROAD

W. WINDSOR TWP. MERCER CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

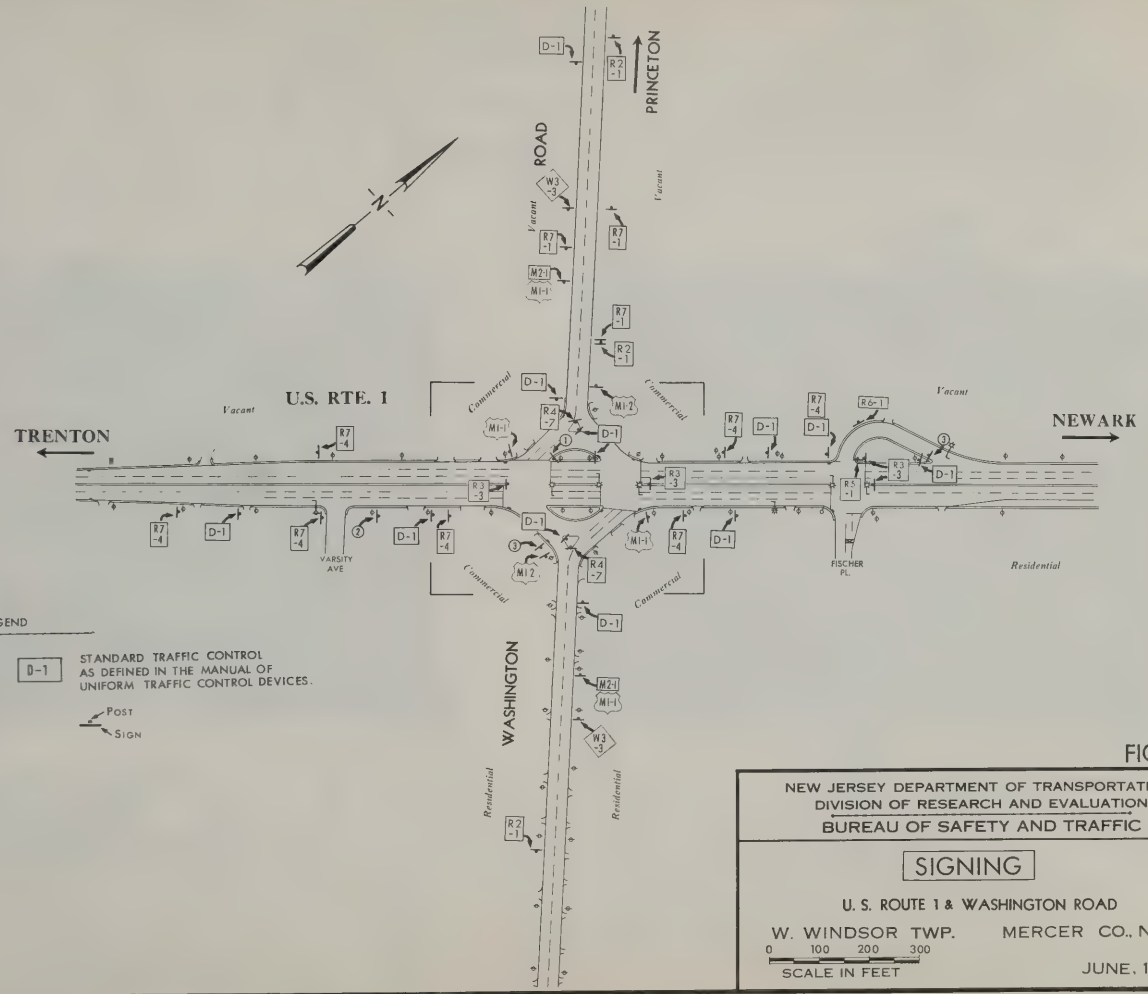


FIG. 26b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. ROUTE 1 & WASHINGTON ROAD

W. WINDSOR TWP. MERCER CO., N. J.

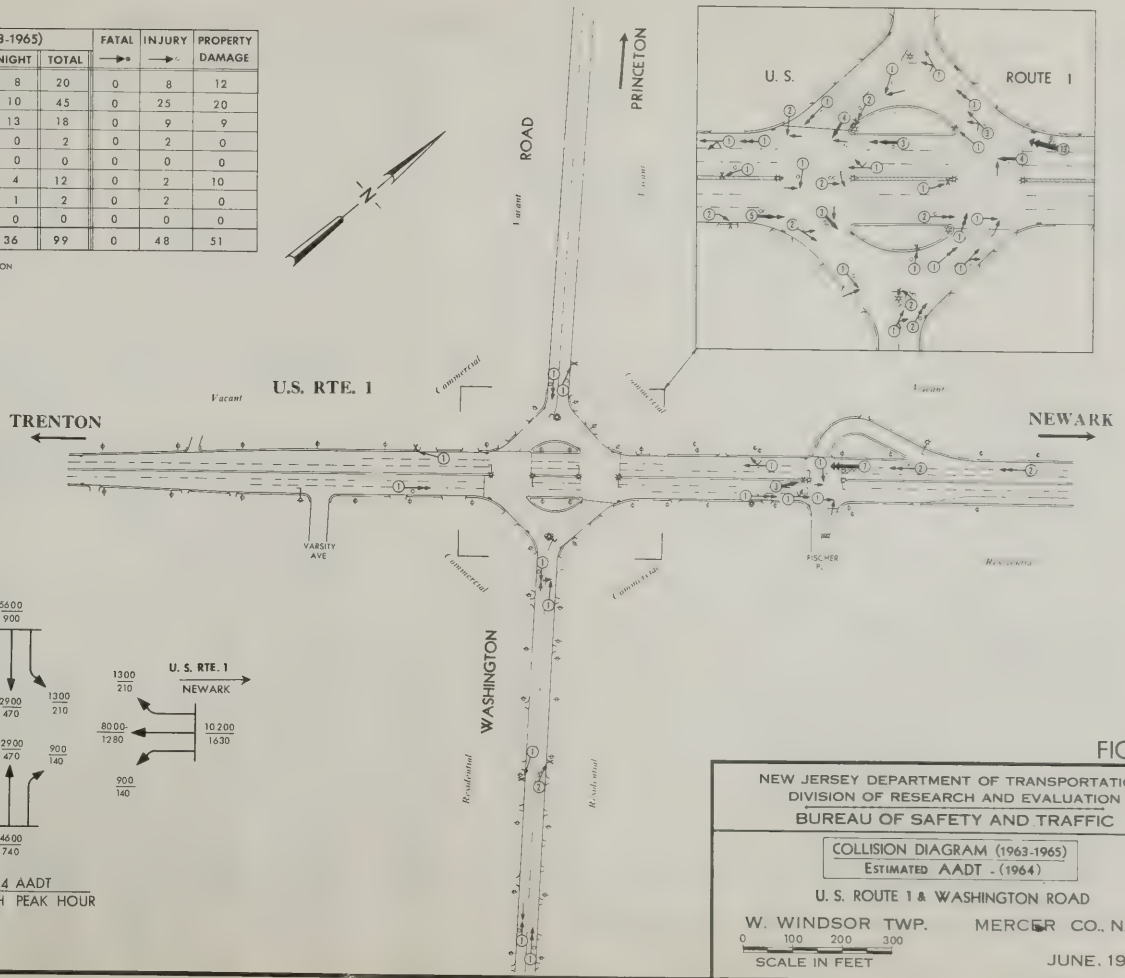
0 100 200 300
SCALE IN FEET

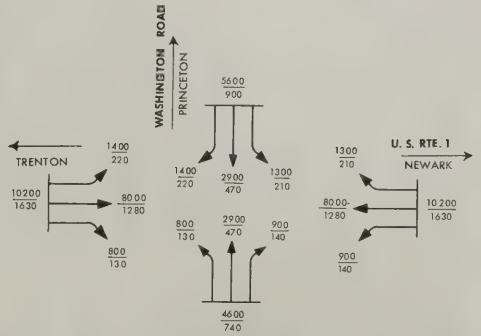
JUNE, 1969

ACCIDENT SUMMARY (1963-1965)				FATAL	INJURY	PROPERTY
TYPE OF ACCIDENT	DAY	NIGHT	TOTAL			DAMAGE
RIGHT ANGLE	12	8	20	0	8	12
REAR END	35	10	45	0	25	20
FIXED OBJECT *	5	13	18	0	9	9
HEAD-ON	2	0	2	0	2	0
PEDESTRIAN	0	0	0	0	0	0
SIDESWIPE	8	4	12	0	2	10
LEFT TURN	1	1	2	0	2	0
OTHER	0	0	0	0	0	0
TOTAL	63	36	99	0	48	51

(2) = NUMBER OF ACCIDENTS AT EACH LOCATION

* ALSO INCLUDES PARKED CARS (⊠)





1964 AADT
1964 30TH PEAK HOUR

FIG. 26c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

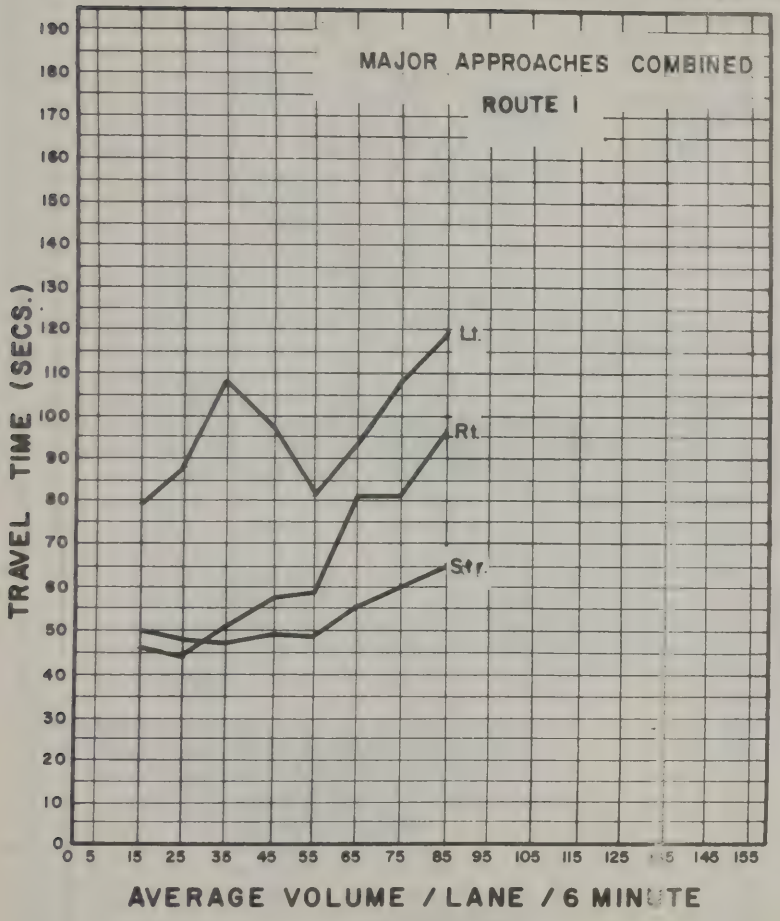
U. S. ROUTE 1 & WASHINGTON ROAD

W. WINDSOR TWP. MERCER CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTE I AND WASHINGTON AVENUE



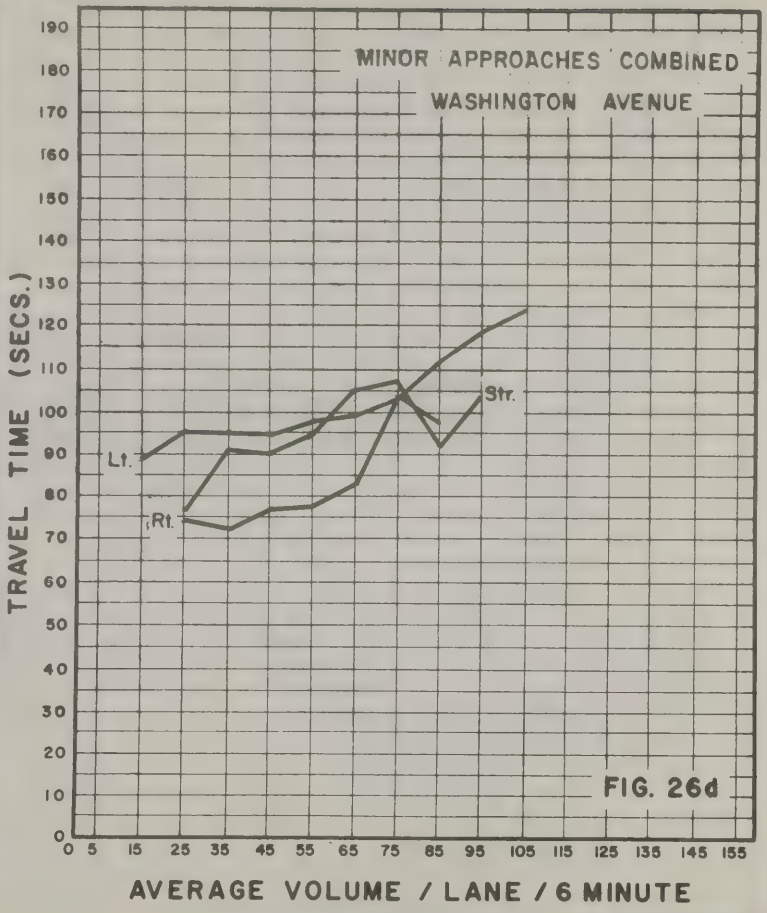


FIG. 26d

ROUTE 1 AND WASHINGTON RD.

Posted Speeds: Route 1 - 50 mph
Washington Ave. - 40 mph

Comments by W. R. Bellis:

This intersection was originally a traffic circle and then converted to a channelized, signalized intersection, by constructing pavement straight through the circle for the major highway.

Twenty-eight percent of the traffic is turning movement traffic, compared with 24 percent for the 13 signalized intersections, and 27 percent for the 30 intersections studied.

Forty-five percent of the accidents are rear-end accidents, compared to 53 percent for the 13 signalized intersections, and 54 percent for the 30 intersections studied. Twelve percent of the accidents are sideswipes. This is the highest sideswipe percentage of the 13 signalized intersections, except for the one at Routes 1&9T and 440. It compares with an average of 8 percent for the 13 signalized intersections, and 11 percent for the average of the 30 intersections. Twenty percent of the accidents are right-angle accidents, compared with 19 percent for the average of the 13 signalized intersections, and 16 percent for the average of the 30 intersections. Thirty-six percent of the accidents are at night, compared to 40 percent for the 13 signalized intersections, and 35 percent for the average of the 30 intersections.

On the major roadway, the straight through movement requires 20 seconds longer than on a cloverleaf. The right turn requires 30 seconds longer, and the left turn 30 seconds longer than on a cloverleaf.

For the minor road, the straight through movements require 54 seconds longer than on a cloverleaf, the right turn 47 seconds longer, and the left turn 36 seconds longer than on a cloverleaf.

Note that this study includes a signalized jughandle close-by the main intersection.

PHOTO 27

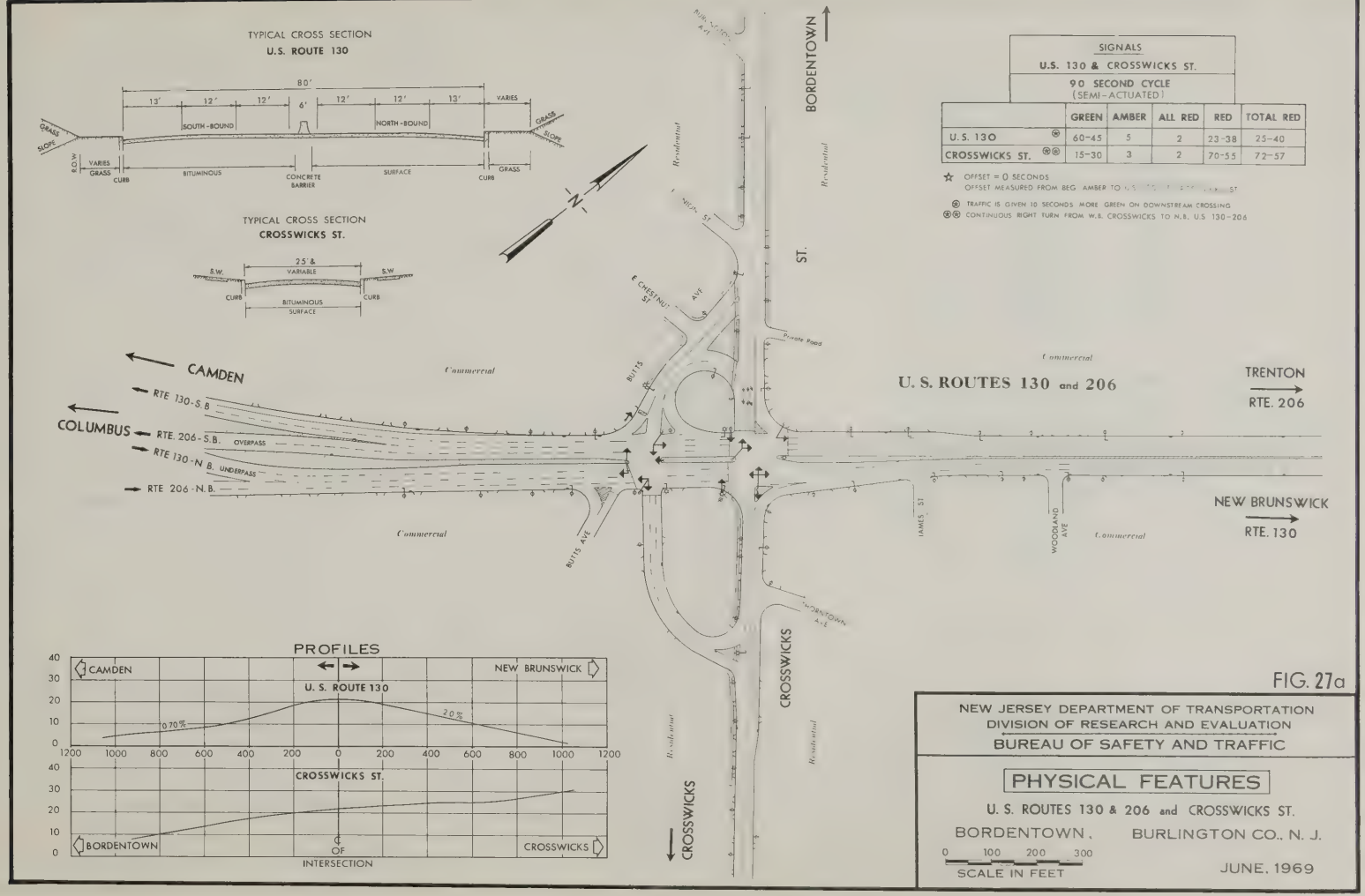
U.S. Routes 130-206 and Crosswicks Avenue

Signalized Reverse Jughandle

Year of Construction: 1962

Photographed 5/17/68 - 0930 hours
500' Altitude, Looking North

Photographed 5/17/68 - 0930 hours
500' Altitude, Looking East



SIGNALS					
U.S. 130 & CROSSWICKS ST.					
90 SECOND CYCLE (SEMI-ACTUATED)					
	GREEN	AMBER	ALL RED	RED	TOTAL RED
U. S. 130 ⊛	60-45	5	2	23-38	25-40
CROSSWICKS ST. ⊛⊛	15-30	3	2	70-55	72-57

☆ OFFSET = 0 SECONDS
OFFSET MEASURED FROM BEG. AMBER TO [illegible] ST

⊛ TRAFFIC IS GIVEN 10 SECONDS MORE GREEN ON DOWNSTREAM CROSSING
⊛⊛ CONTINUOUS RIGHT TURN FROM W.B. CROSSWICKS TO N.B. U.S. 130-206

FIG. 27a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTES 130 & 206 and CROSSWICKS ST.
BORDENTOWN, BURLINGTON CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

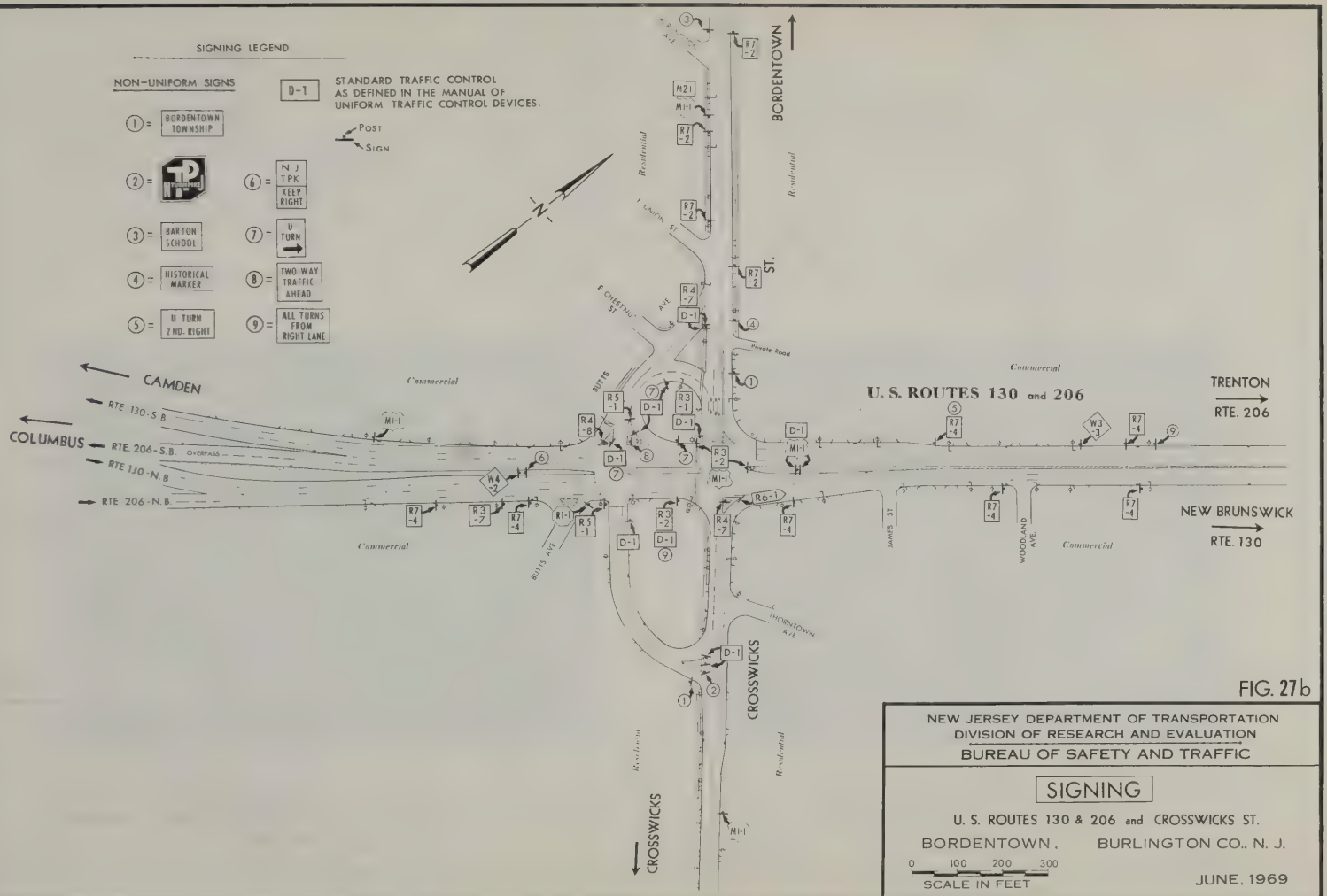


FIG. 27b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. ROUTES 130 & 206 and CROSSWICKS ST.

BORDENTOWN. BURLINGTON CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE. 1969

ACCIDENT SUMMARY (1963-1965)				FATAL	INJURY	PROPERTY
TYPE OF ACCIDENT	DAY	NIGHT	TOTAL			DAMAGE
RIGHT ANGLE	21	12	33	0	14	19
REAR END	15	9	24	0	8	16
FIXED OBJECT *	1	2	3	0	0	3
HEAD-ON	0	0	0	0	0	0
PEDESTRIAN	3	0	3	0	3	0
SIDESWIPE	8	1	9	0	2	7
LEFT TURN	0	0	0	0	0	0
OTHER	2	1	3	0	1	2
TOTAL	50	25	75	0	28	47

(2) = NUMBER OF ACCIDENTS AT EACH LOCATION

* ALSO INCLUDES PARKED CARS (⊠)

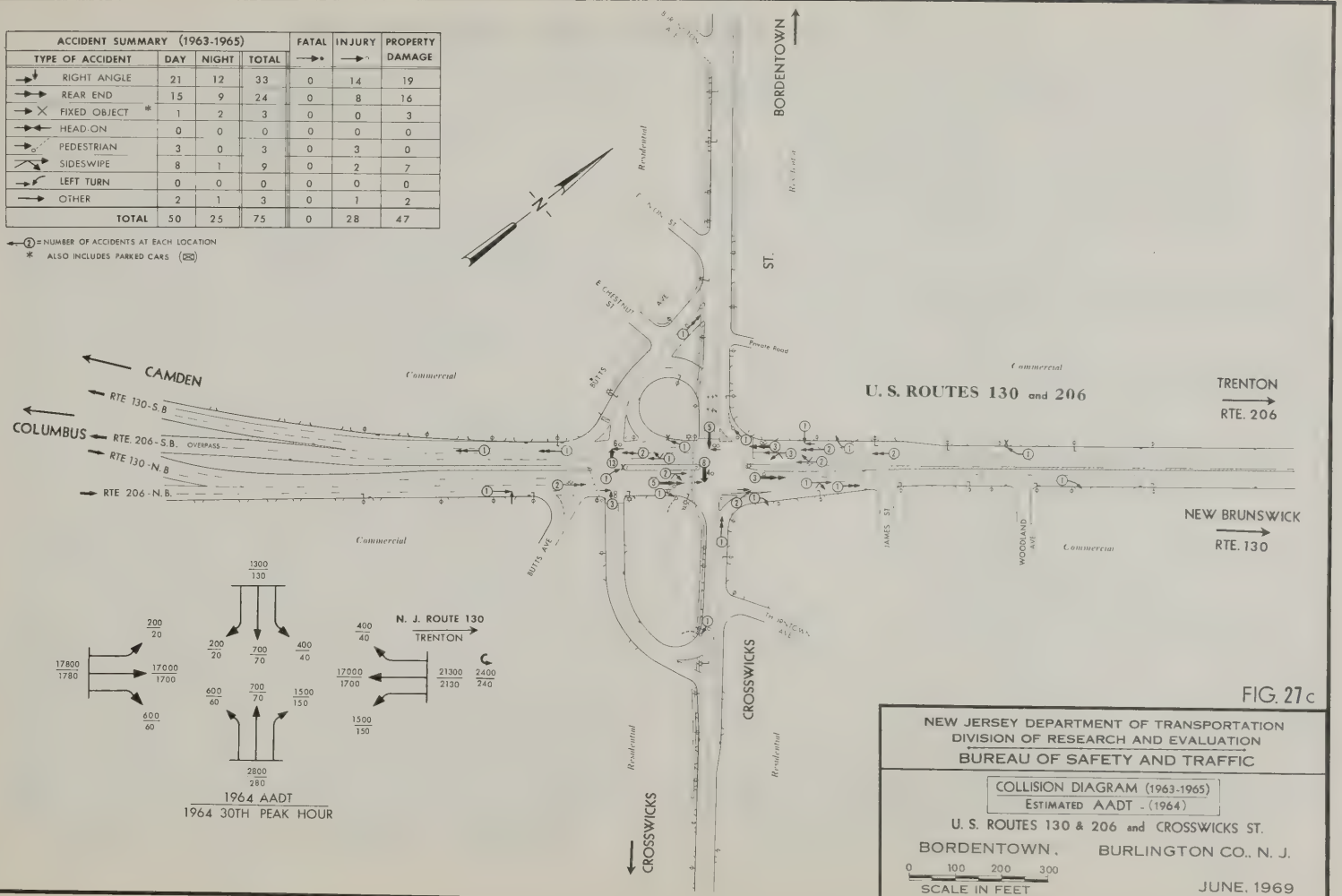


FIG. 27 c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

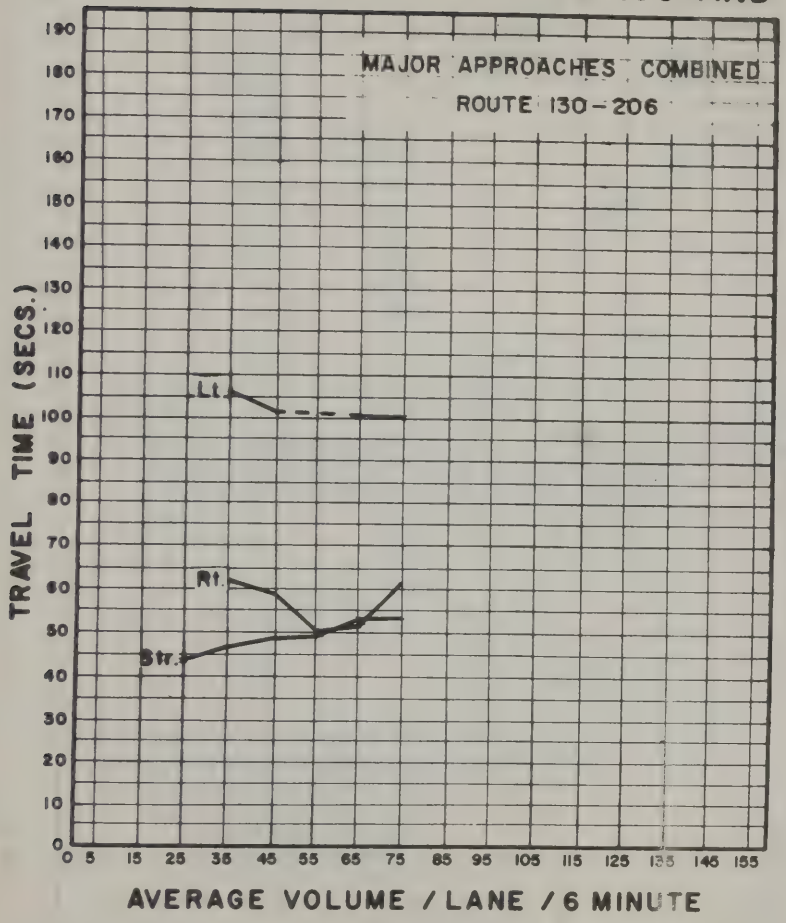
U. S. ROUTES 130 & 206 and CROSSWICKS ST.

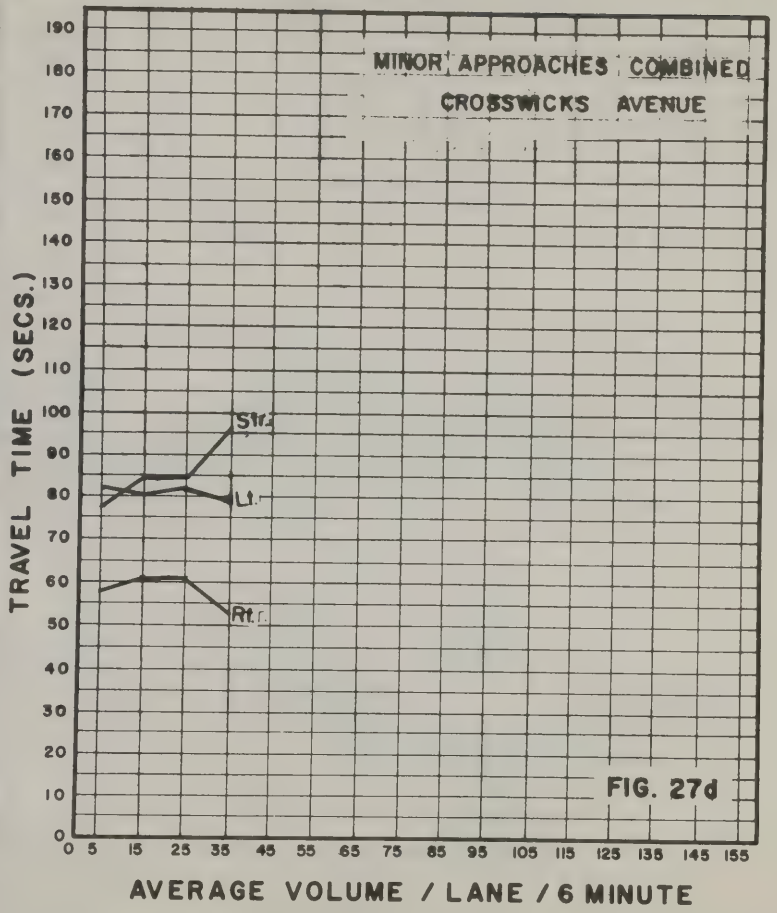
BORDENTOWN, BURLINGTON CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTE 130 AND 206 AND CROSSWICKS





ROUTE 130 & 206 AND CROSSWICKS ST.

Posted Speeds: Route 130 & 206 - 50 mph
Crosswicks St. - 25 mph

Comments by W. R. Bellis:

This type of intersection has been named a reverse jughandle. It requires traffic to pass through the first intersection, then curve to the right through 270°, and then pass through the traffic signal at right angles to the first crossing. This avoids the conflict between the left-turning movement from the major highway and the traffic on the side road. Note that this intersection has a very heavy U-turn movement because of the continuous center barrier on Route 130 & 206.

Including the U-turns, 18 percent of the traffic is turning traffic, compared with 24 percent turning movement for the 13 signalized intersections, and 27 percent for the 30 intersections.

The accident and injury rates indicated are surprisingly low for a signalized intersection. Thirty-two percent of the accidents are rear-end accidents. This is a lower percentage than for any of the other signalized intersections studied, where rear-end accidents accounted for 53 percent of all accidents, and 54 percent for the average of the 30 intersections studied. Twelve percent of the accidents are sideswipes, compared to 8 percent for the average of the 13 signalized intersections, and 11 percent for the average of the 30 intersections. Forty-four percent of the accidents are right-angle accidents, compared with 19 percent for the average of the 13 signalized intersections, and 16 percent for the average of the 30 intersections. Thirty-three percent of the accidents occur at night, compared with 40 percent for the average of the signalized intersections, and 35 percent for the average of the 30 intersections.

On the major highway, the straight through movement requires 22 seconds longer than on a cloverleaf. The right turn requires 16 seconds longer, and the left turn 33 seconds longer than for a cloverleaf.

On the minor road, the straight through traffic requires 50 seconds longer than on a cloverleaf, the right turn 17 seconds longer, and the left turn 10 seconds longer.

This intersection is rated very high in overall efficiency, the best for all of the signalized intersections studied.

PHOTO 28

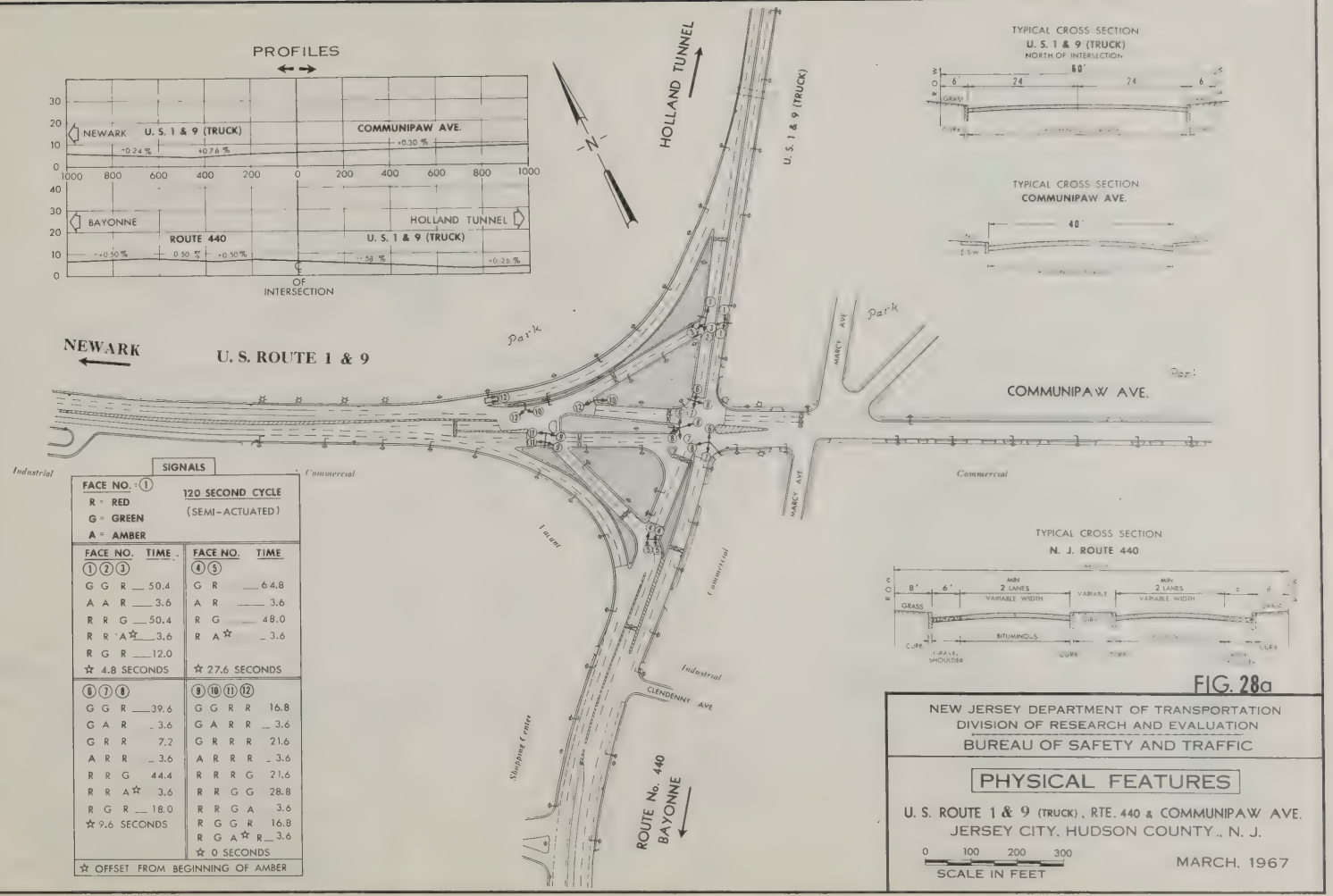
U.S. Route 1-9(T) and Communipaw Avenue

Signalized Channelized Intersection

Year of Construction: 1954

Photographed 6/29/67 - 1600 hours
700' Altitude, Looking West

Photographed 6/29/67 - 1600 hours
500' Altitude, Looking East



SIGNALS

FACE NO. ① — 120 SECOND CYCLE (SEMI-ACTUATED)

R = RED
G = GREEN
A = AMBER

FACE NO. ①②③	TIME	FACE NO. ④⑤	TIME
G G R	50.4	G R	64.8
A A R	3.6	A R	3.6
R R G	50.4	R G	48.0
R R A☆	3.6	R A☆	3.6
R G R	12.0		
☆ 4.8 SECONDS		☆ 27.6 SECONDS	

⑥⑦⑧		⑨⑩⑪⑫	
G G R	39.6	G G R R	16.8
G A R	3.6	G A R R	3.6
G R R	7.2	G R R R	21.6
A R R	3.6	A R R R	3.6
R R G	44.4	R R R G	21.6
R R A☆	3.6	R R G G	28.8
R G R	18.0	R R G A	3.6
☆ 9.6 SECONDS		R G G R	16.8
		R G A☆ R	3.6
		☆ 0 SECONDS	

☆ OFFSET FROM BEGINNING OF AMBER

FIG. 28a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

U. S. ROUTE 1 & 9 (TRUCK), RTE. 440 & COMMUNIPAW AVE.
JERSEY CITY, HUDSON COUNTY, N. J.

0 100 200 300
SCALE IN FEET

MARCH, 1967

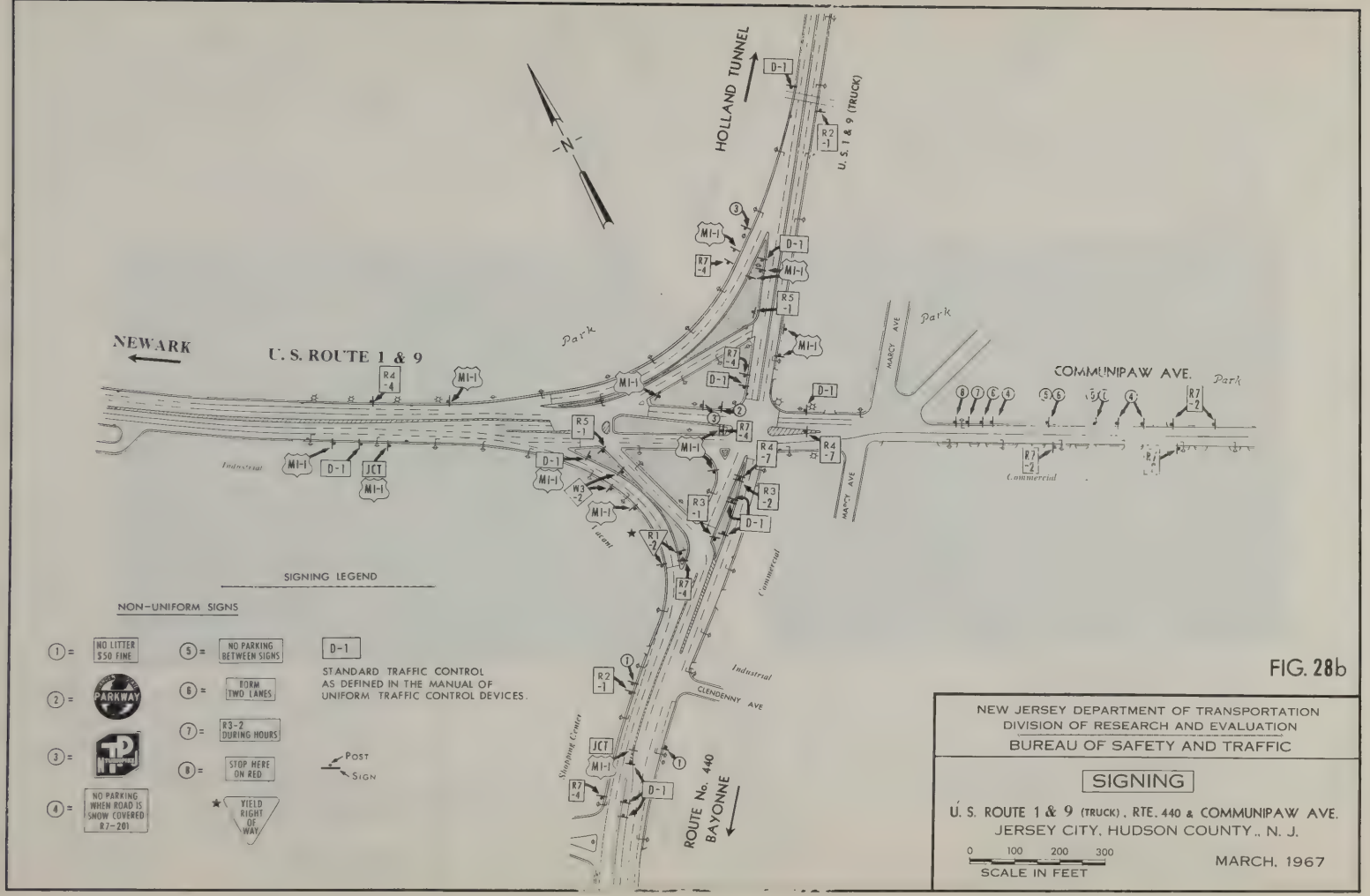


FIG. 28b

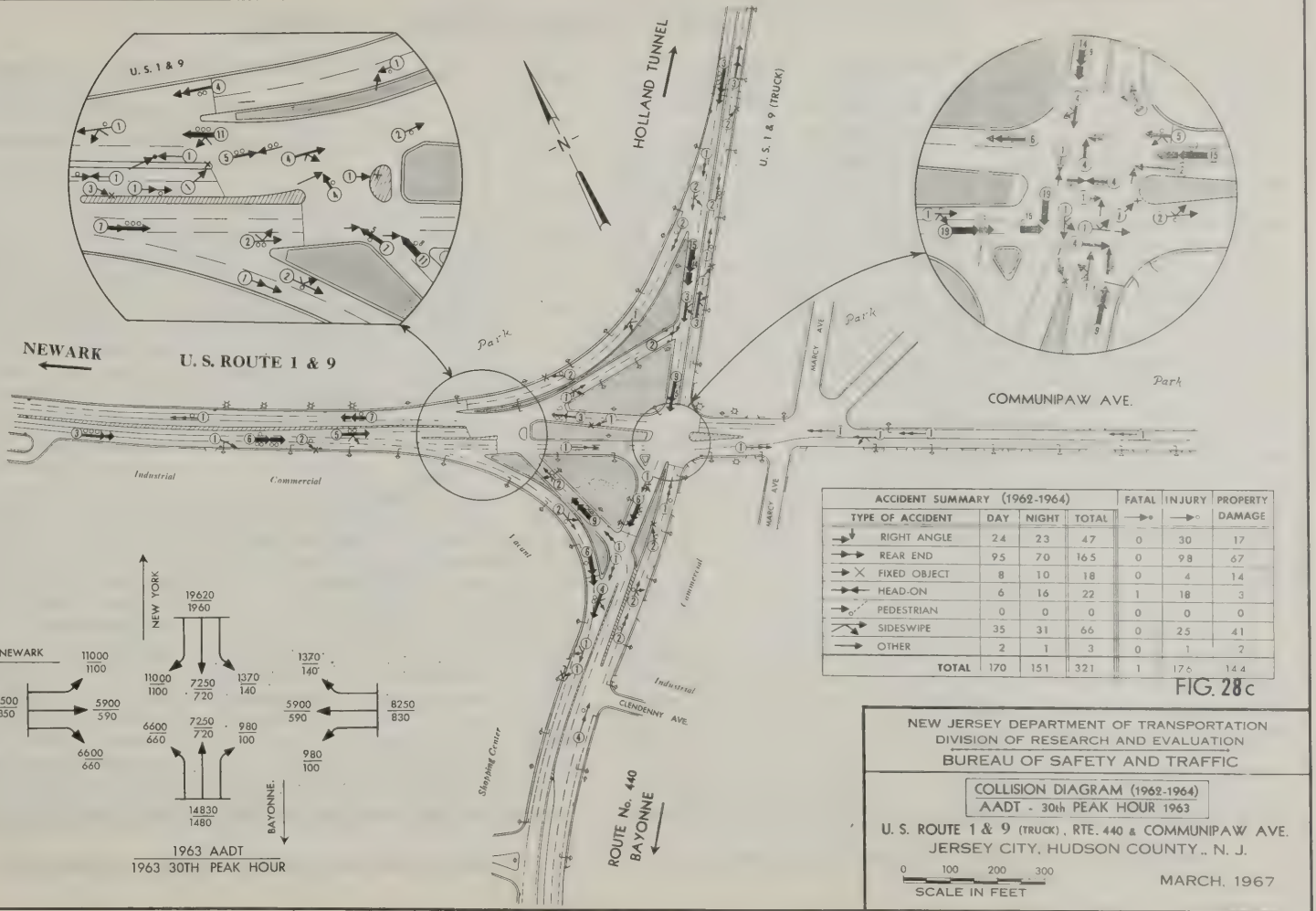
NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

U. S. ROUTE 1 & 9 (TRUCK), RTE. 440 & COMMUNIPAW AVE.
JERSEY CITY, HUDSON COUNTY, N. J.

0 100 200 300
SCALE IN FEET

MARCH, 1967



ACCIDENT SUMMARY (1962-1964)				FATAL	INJURY	PROPERTY
TYPE OF ACCIDENT	DAY	NIGHT	TOTAL			DAMAGE
RIGHT ANGLE	24	23	47	0	30	17
REAR END	95	70	165	0	98	67
FIXED OBJECT	8	10	18	0	4	14
HEAD-ON	6	16	22	1	18	3
PEDESTRIAN	0	0	0	0	0	0
SIDESWIPE	35	31	66	0	25	41
OTHER	2	1	3	0	1	2
TOTAL	170	151	321	1	176	144

FIG. 28c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

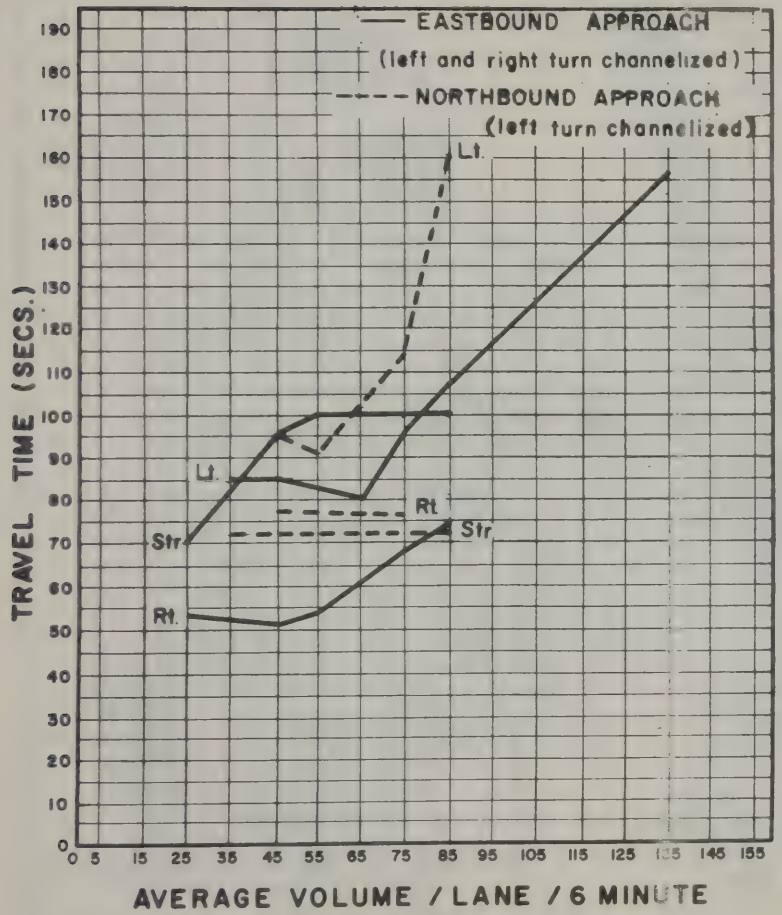
COLLISION DIAGRAM (1962-1964)
AADT - 30th PEAK HOUR 1963

U. S. ROUTE 1 & 9 (TRUCK), RTE. 440 & COMMUNIPAW AVE.
JERSEY CITY, HUDSON COUNTY, N. J.

0 100 200 300
SCALE IN FEET

MARCH, 1967

ROUTE I-9 AND COMMUNIPAW AVENUE



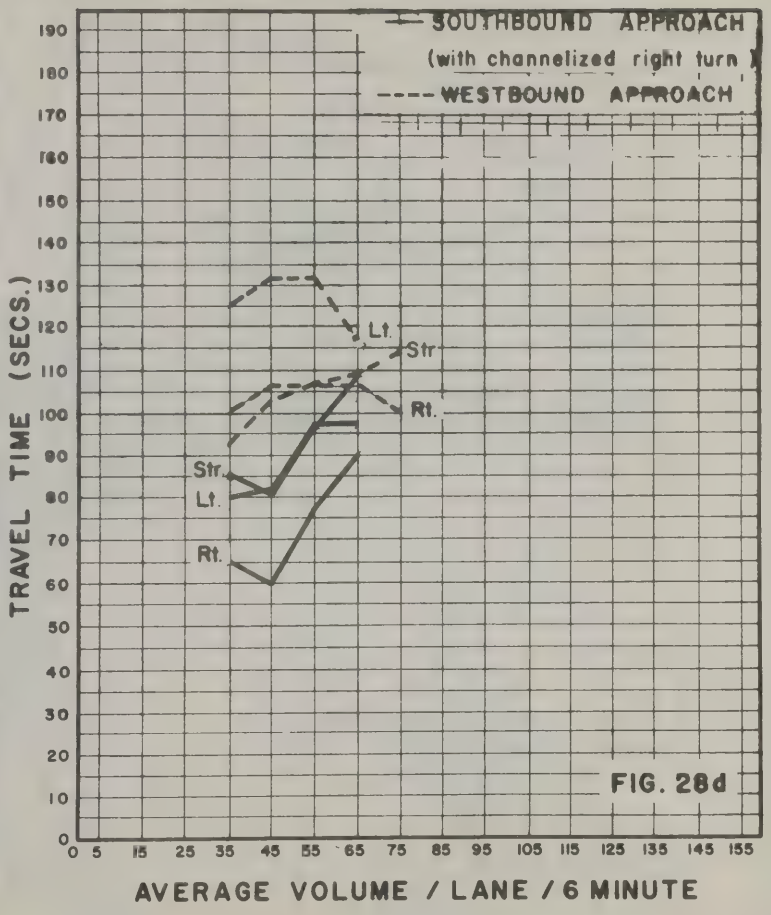


FIG. 28d

ROUTES 1&9T AND 440

Posted Speeds: Route 1&9T - 45 mph
Route 440 - 25 mph

Comments by W. R. Bellis:

This intersection was converted from a right-angle signalized intersection to a channelized intersection in 1949. A report on this intersection appears in Highway Research Board Proceedings for 1951. Route 1&9T was then Route 25 Truck, also called Communipaw Avenue. This intersection has two heavy left turns; the largest volume studied except for 4 grade-separated intersections; and the largest turning movement volume except for that at Routes 4 and 17 cloverleaf. Sixty percent of the traffic is turning movement traffic which is the largest percentage of any of the 30 intersections. The leg towards Newark has 42 percent trucks on a 24-hour basis.

The accident rate is high, exceeded by 9 other intersections, and the injury rate is high, exceeded by only 5 other locations studied. Fifty-one percent of the accidents are rear-end accidents, compared with 53 percent for the signalized intersections, and 54 percent for all intersections studied. Twenty percent of the accidents are sideswipe accidents. This percentage is exceeded by two other intersections, and compares with 8 percent sideswipes for the average of the 13 signalized intersections, and 11 percent for the average of the 30 intersections. Fourteen percent of the accidents are right-angle accidents, compared to 19 percent for the average of the signalized intersections, and 16 percent for the average of the 30 intersections. Forty-seven percent of the accidents occurred at night, compared with 40 percent for the signalized intersections, and 35 percent for the total intersections.

The straight through movement on the major road takes 48 seconds longer than on a cloverleaf. The right turn takes 24 seconds longer, and the left turn 50 seconds longer. During off-hours, this left turn takes about 20 seconds longer than on a cloverleaf, but during the peak hour 80 seconds longer.

For the minor movements, straight through, the travel time is 60 seconds longer than on a cloverleaf, the right turn 45 seconds longer, and the left turn 34 seconds longer. Some minor improvements are under contract at this intersection at the present time.

Note that there are 4 signalized locations within this overall intersection.

PHOTO 29

Broad Street and Front Street

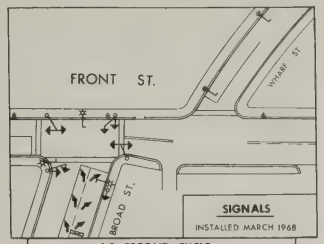
Non-Signalized Intersection

Year of Construction: Circa 1955

Signal Installed in 1968

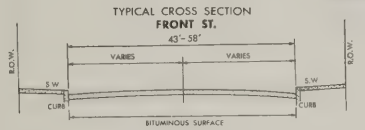
Photographed 5/17/68 - 0845 hours
500' Altitude, Looking North

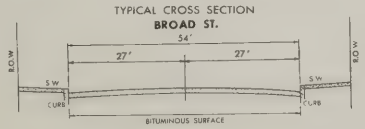
Photographed 5/17/68 - 0845 hours
800' Altitude, Looking North

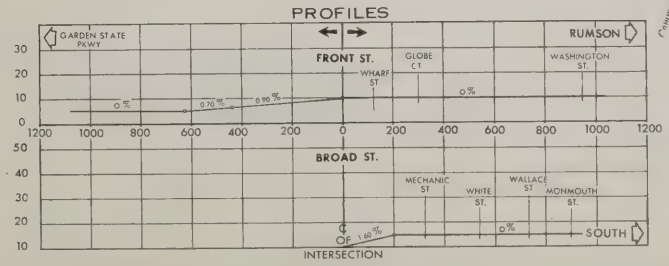


60 SECOND CYCLE
(SEMI-ACTUATED)

	GREEN	AMBER	RED
BROAD ST.	12-24	4	32-44
FRONT ST.	40-28	4	28-16







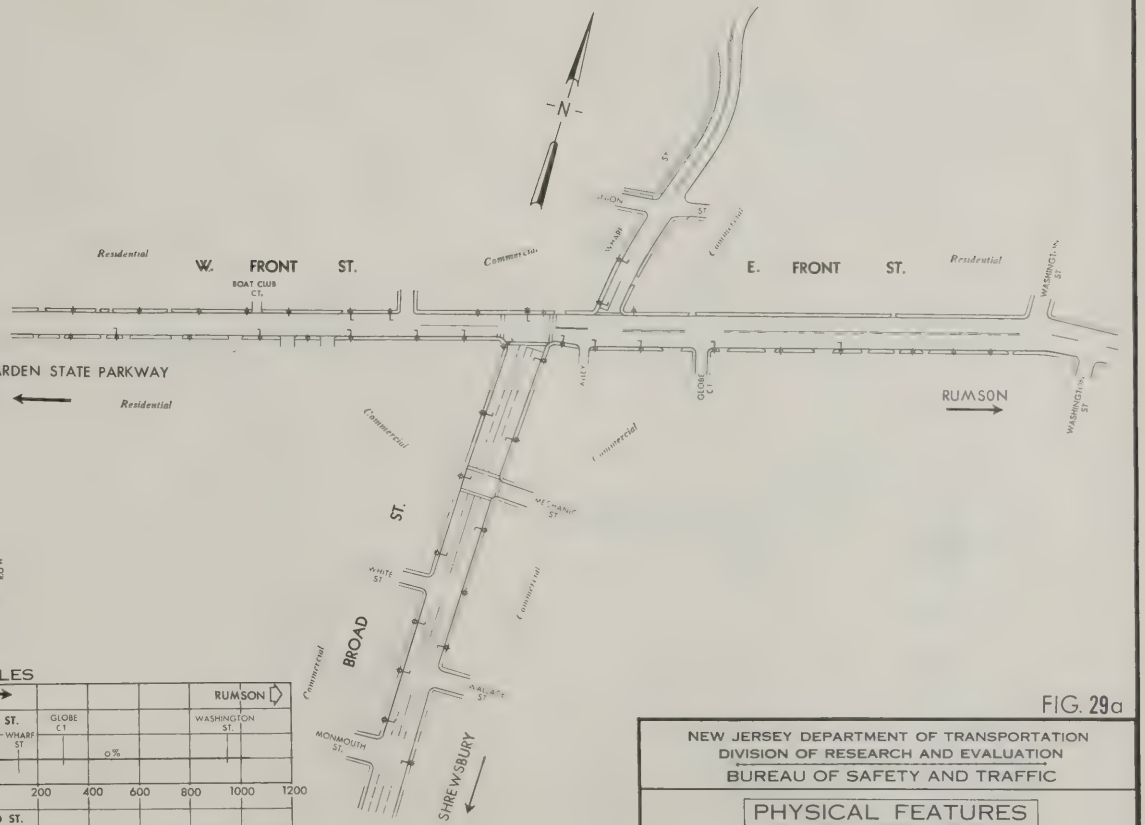


FIG. 29a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

BROAD & FRONT STS.,
RED BANK, MONMOUTH CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE. 1969

SIGNING LEGEND

NON-UNIFORM SIGNS

① = PARKWAY

② = MUNICIPAL PARKING

③ = NO PARKING FIRE LANE

④ = RESERVED FOR DISABLED PERSONS ONLY

⑤ = NO PARKING TAXI STAND

D-1 STANDARD TRAFFIC CONTROL AS DEFINED IN THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.

Post / Sign

FIG. 29b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

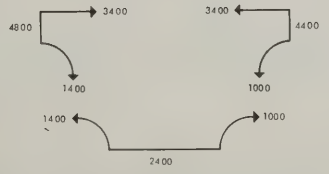
BROAD & FRONT STS.,
RED BANK, MONMOUTH CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ACCIDENT SUMMARY (1963-1965)				FATAL	INJURY	PROPERTY DAMAGE
TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	→•	→○	
RIGHT ANGLE	14	4	18	0	5	13
REAR END	23	5	28	0	11	17
FIXED OBJECT *	9	3	12	0	1	11
HEAD-ON	0	0	0	0	0	0
PEDESTRIAN	7	1	8	0	8	0
SIDESWIPE	1	0	1	0	1	0
LEFT TURN	5	0	5	0	1	4
OTHER	0	0	0	0	0	0
TOTAL	59	13	72	0	27	45

(1) = NUMBER OF ACCIDENTS AT EACH LOCATION
* ALSO INCLUDES PARKED CARS (⊠)



ESTIMATED AADT - (1964)

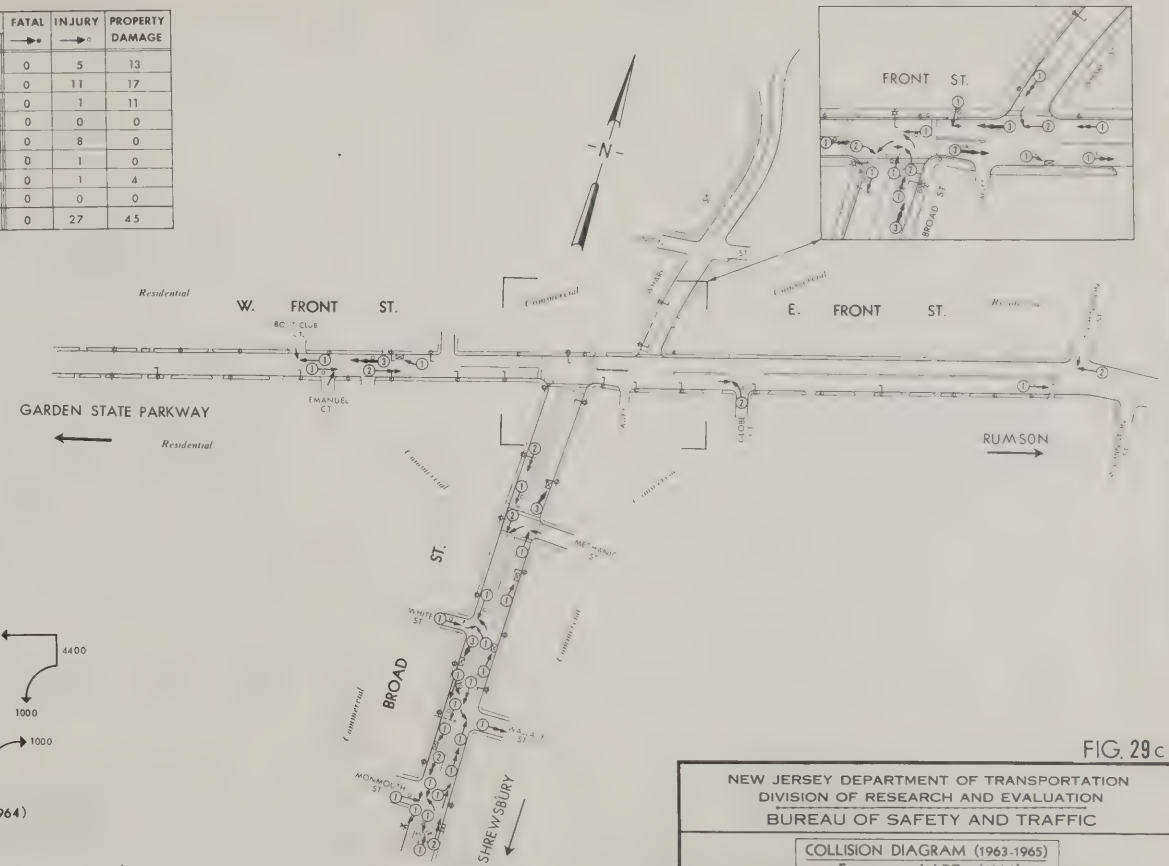


FIG. 29c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

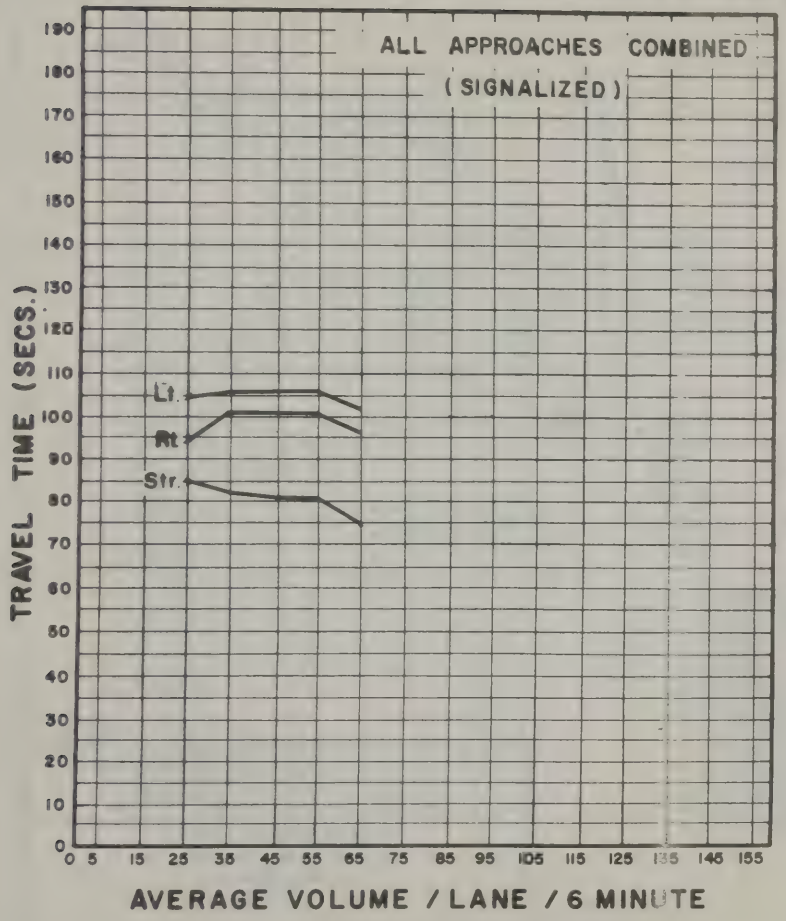
COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

BROAD & FRONT STS.,
RED BANK, MONMOUTH CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

BROAD STREET AND FRONT STREET



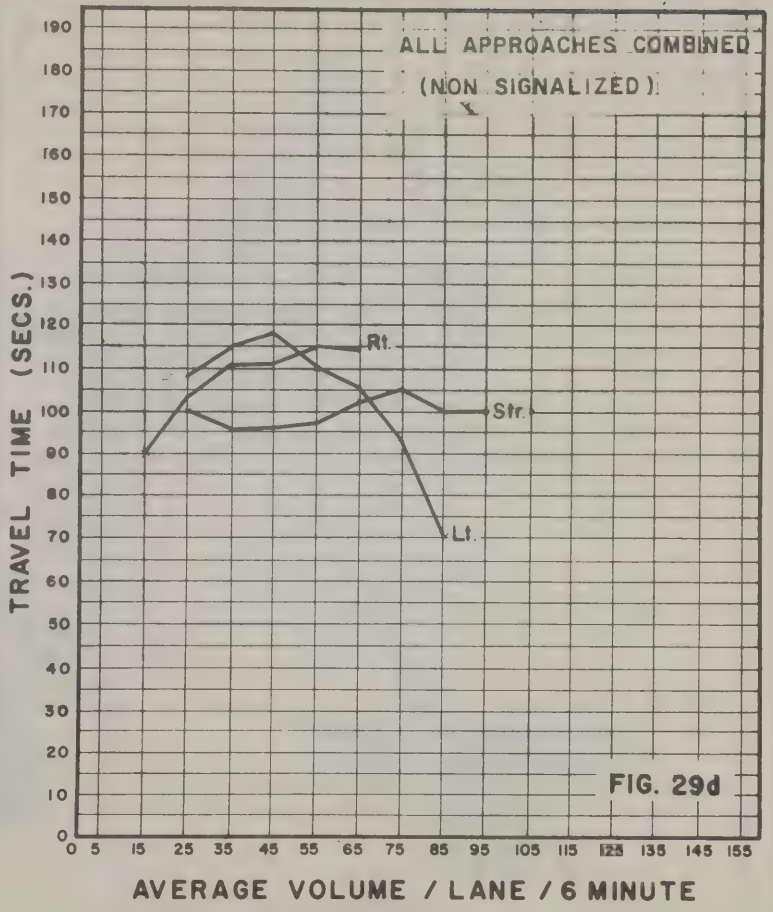


FIG. 29d

BROAD ST. AND FRONT ST.

Posted Speeds: Broad St. - 25 mph
Front St. - 25 mph

Comments by W. R. Bellis:

This intersection has the second lowest traffic volume of all 30 intersections studied. Forty-one percent of the traffic is turning movement traffic, compared to 27 percent for the average of the 30 intersections.

The accident and injury rates are quite high. However, 2 legs have intense shopping activities. Thirty-eight percent of the accidents are rear-end accidents, compared to 54 percent for the average of the 30 intersections. One percent of the accidents are sideswipes, compared to 11 percent for the average of the 30 intersections. Twenty-five percent are right-angle accidents, compared to 16 percent for the average of the 30 intersections. Eighteen percent of the accidents occurred at night, compared to 35 percent for the average of the 30 locations studied. This is the second smallest nighttime percentage of the 30 intersections studied.

Before the signal was installed, the straight through movement required 43 seconds longer than on a cloverleaf. The right turn required 57 seconds longer and the left turn 34 seconds longer than on a cloverleaf.

After signal installation, the straight through movement required 63 seconds longer than on a cloverleaf, the right turn 62 seconds longer, and the left turn 24 seconds longer than on a cloverleaf.

PHOTO 30

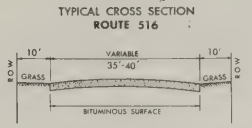
Route 516 and Harmany Road

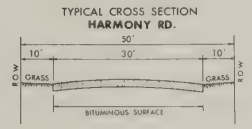
Non-Signalized Intersection

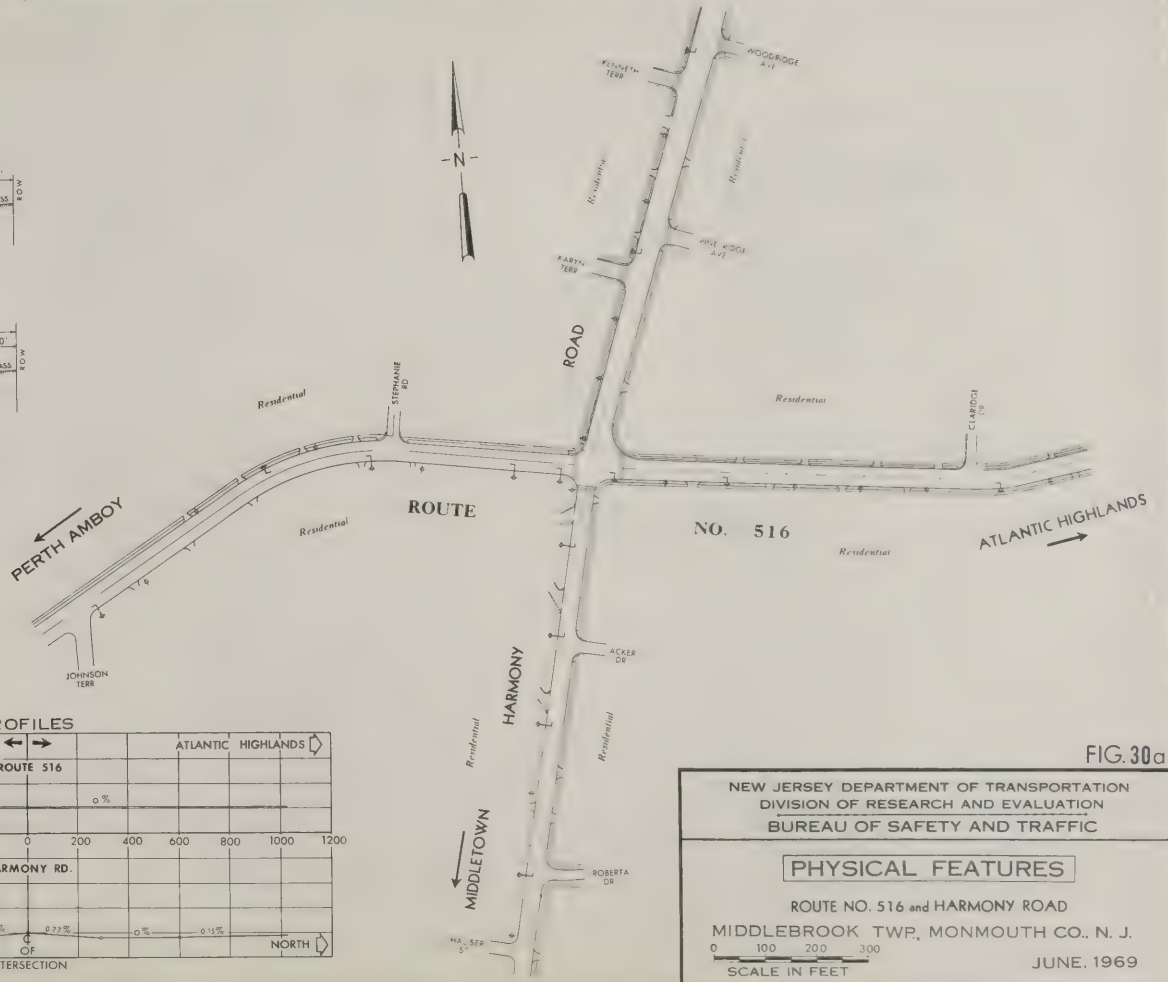
Year of Construction: Circa 1955

Photographed 5/17/68 - 0845 hours
500' Altitude, Looking East

Photographed 5/17/68 - 0845 hours
800' Altitude, Looking West







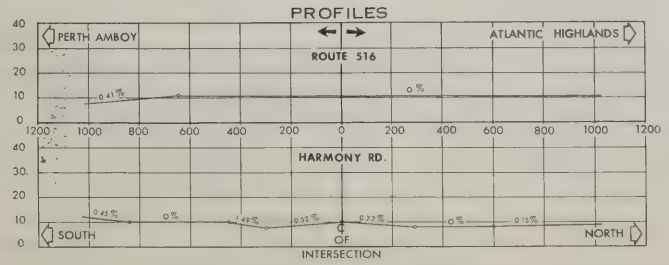


FIG. 30a

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

PHYSICAL FEATURES

ROUTE NO. 516 and HARMONY ROAD
MIDDLEBROOK TWP, MONMOUTH CO., N. J.
0 100 200 300
SCALE IN FEET
JUNE, 1969

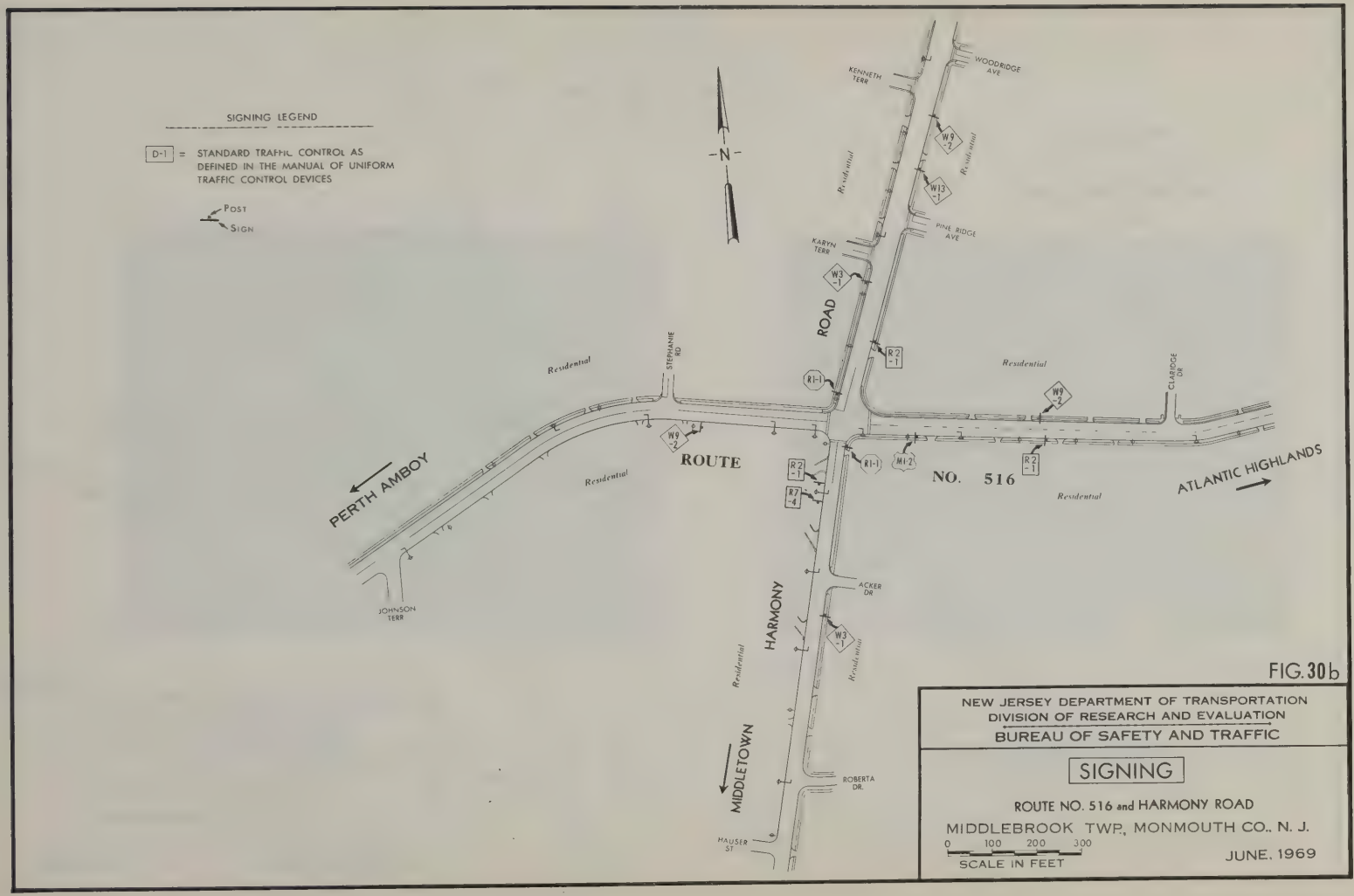


FIG. 30b

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

SIGNING

ROUTE NO. 516 and HARMONY ROAD
MIDDLEBROOK TWP., MONMOUTH CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ACCIDENT SUMMARY (1963-1965)				FATAL	INJURY	PROPERTY
TYPE OF ACCIDENT	DAY	NIGHT	TOTAL	→•	→○	DAMAGE
RIGHT ANGLE	9	2	11	1	6	4
REAR END	0	0	0	0	0	0
FIXED OBJECT *	1	2	3	0	2	1
HEAD-ON	0	0	0	0	0	0
PEDESTRIAN	0	0	0	0	0	0
SIDESWIPE	2	1	3	0	1	2
LEFT TURN	2	0	2	0	1	1
OTHER	0	1	1	0	1	0
TOTAL	14	6	20	1	11	8

(2) = NUMBER OF ACCIDENTS AT EACH LOCATION

* ALSO INCLUDES PARKED CARS (⊠)

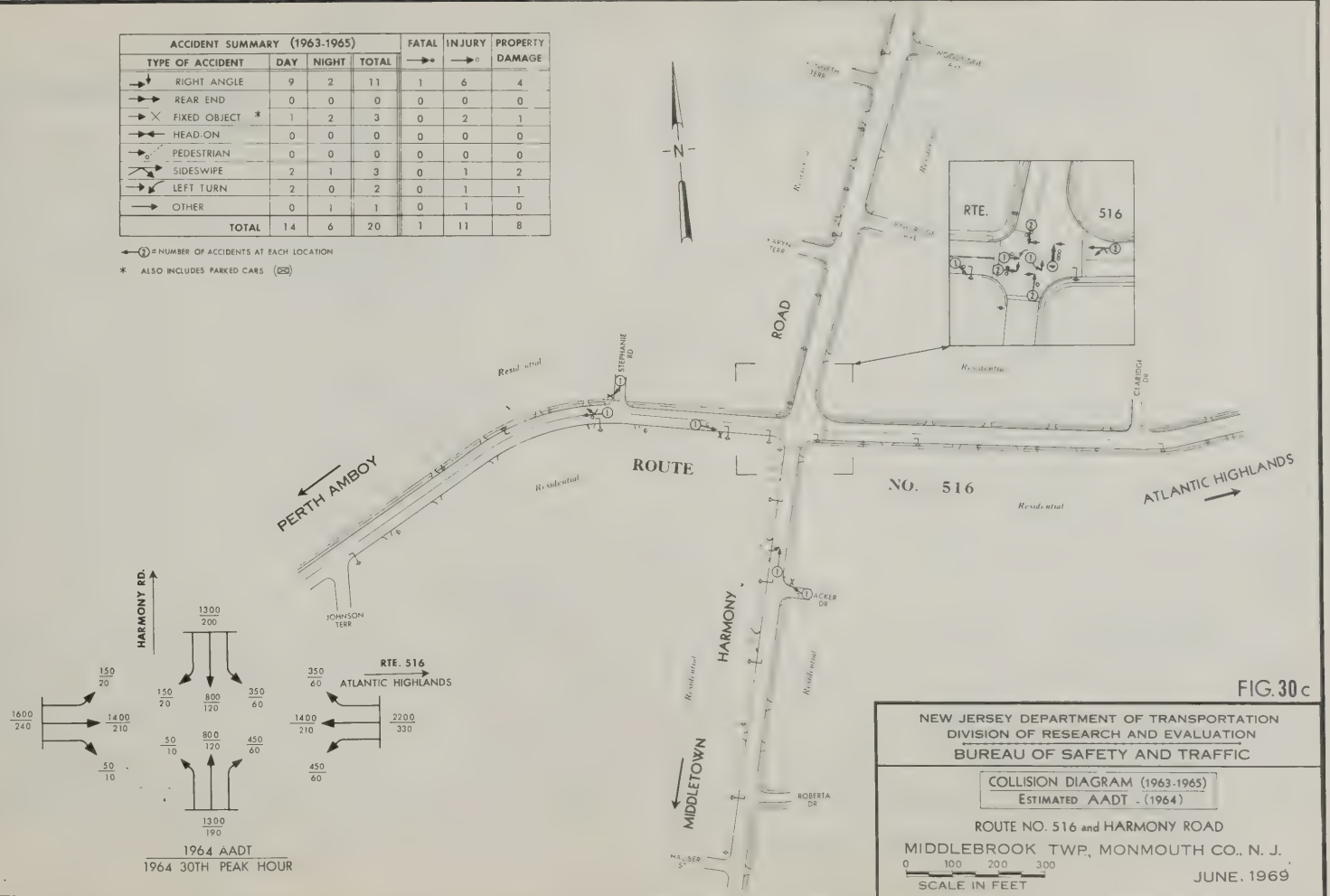


FIG. 30 c

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND EVALUATION
BUREAU OF SAFETY AND TRAFFIC

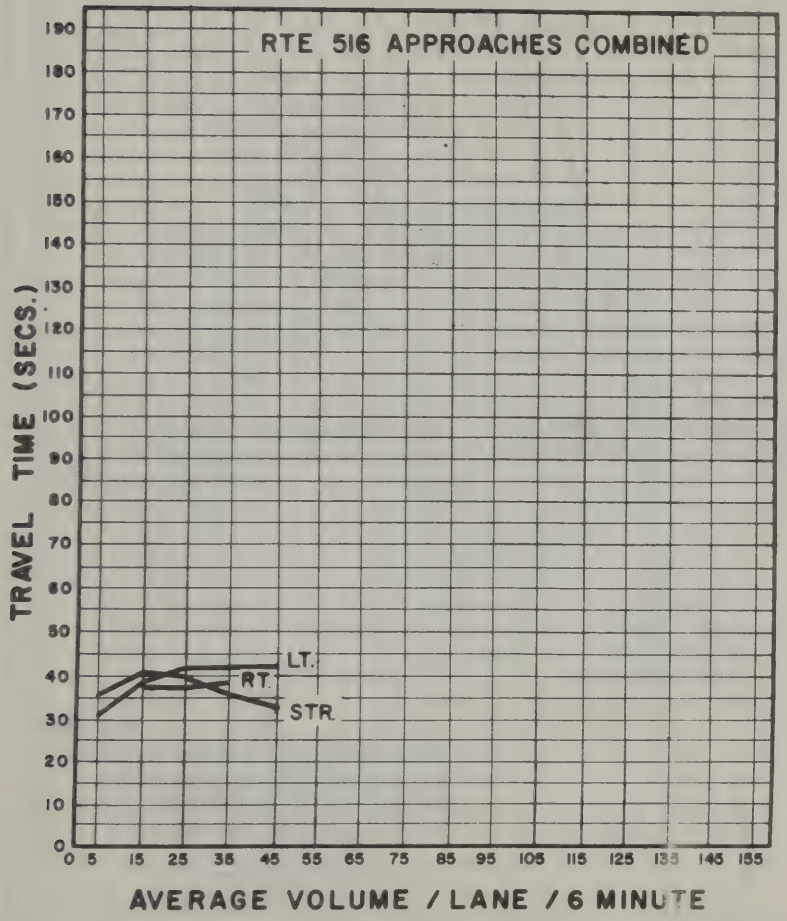
COLLISION DIAGRAM (1963-1965)
ESTIMATED AADT - (1964)

ROUTE NO. 516 and HARMONY ROAD
MIDDLEBROOK TWP., MONMOUTH CO., N. J.

0 100 200 300
SCALE IN FEET

JUNE, 1969

ROUTE 516 & HARMONY ROAD



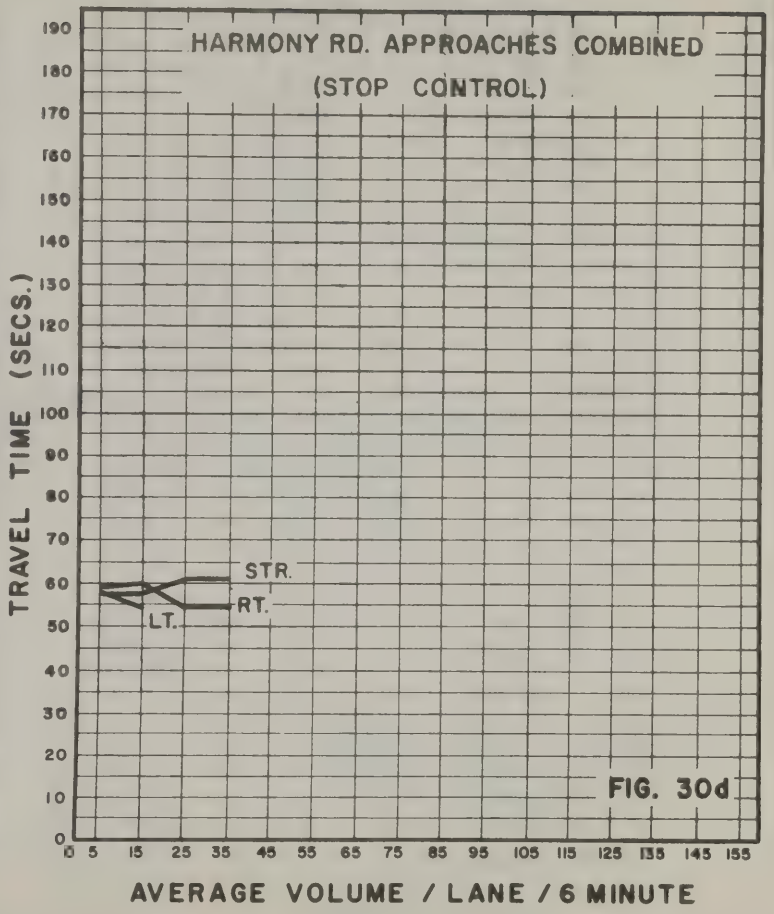


FIG. 30d

ROUTE 516 AND HARMONY RD.

Posted Speeds: Route 516 - 35 mph
Harmony Rd. - 25 mph

Comments by W. R. Bellis:

This unsignalized at-grade intersection has the lowest volume of all 30 locations studied. It also has the smallest turning movement volume, which is 31 percent of the total traffic, compared to 27 percent for the average of the 30 intersections studied.

There were only a total of 20 accidents recorded in the three years of the study. This is the smallest number of accidents of any of the 30 intersections. There were no rear-end accidents, 15 percent of the accidents were sideswipes, and 55 percent were right-angle accidents. This compares with 16 percent right-angle accidents for the average of the 30 intersections. Thirty percent of the accidents were at night, which compares to 35 percent for the average of the 30 intersections.

On the major highway, the straight through movement is slightly faster than that for a cloverleaf. The right turn is also slightly faster, and the left turn is 33 seconds faster than on a cloverleaf. The left turns are the fastest, and the right turns are the second fastest of all the intersections studied.

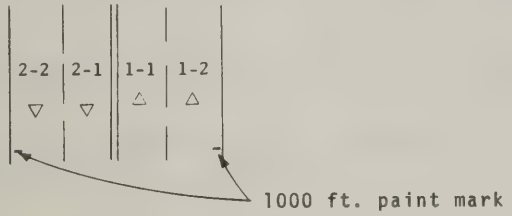
For the minor highway, the straight through movement is 23 seconds slower than on a cloverleaf. The right turn movement is 17 seconds slower, and the left turn is 14 seconds faster than on a cloverleaf. This left turn is faster than any of the other minor road left turns studied.

APPENDIX A

TRAVEL TIME STUDY PROCEDURE

FIELD PROCEDURE

At each of the thirty sites, paint markings were placed 1000' from the point of intersection of the roadways on each of the legs. Measurements were made with a measuring wheel. All inbound stations were given odd numbers and outbound stations even numbers and each lane itself was numbered. A man was assigned to each lane. For example:



Data were collected without tape recorders in 1966 and with tape recorders in 1967-1968. Kodak timers were utilized to take time to the nearest second. This equipment was calibrated prior to each study hour. For each car or truck passing a man's station, the last three digits of the license plate and time of passing were recorded. When the license plate was not recorded because of large volume or changing of tape on the recorder, a miss "X" or "T-X" (truck miss), was recorded. In addition, a State vehicle traversed the intersection, timing all movements. These times were later compared to the times collected by each of the observers.

PERSONNEL

College students temporarily employed for the summer were utilized as traffic data collectors. Supervision was furnished by an Assistant Engineer.

EQUIPMENT

1966 - Clip boards, legal size pads, Kodak timers.

1967 - Tape recorders and Kodak timers.

SCHEDULE

1-US Rte 1 & Milltown Rd New Brunswick Twp Middlesex Co.	Tues. 7/7/66 Weather: clear, warm Time Schedule: A
2-US Rte 1 & NJ Rte 18 New Brunswick Middlesex Co.	Tues. 8/2/66 Weather: overcast, light rain in p.m. Time Schedule: A
3-NJ Rtes 4 & 17 Paramus Borough Bergen Co.	Thurs. 8/4/66 Weather: clear, warm Time Schedule: C
4-US Rte 1&9 & Rt 35 Woodbridge Twp. Middlesex Co.	Thurs. 7/14/66 Weather: hot, overcast Time Schedule: A
5-US Rte 9 & C.R. 516 Madison Twp. Middlesex Co.	Mon. 6/26/67 Weather: fair, warm Time Schedule: D
6-US Rte 9 & C.R. 514 Woodbridge Middlesex Co.	Thurs. 7/27/68 Weather: warm, fair Time Schedule: D
7-NJ Rte 17 & Farview Ave. Rochelle Park Bergen Co.	Fri. 7/21/67 Weather: fair, warm Time Schedule: D
8-NJ Rte 17 & Passaic Ave. Rochelle Park Bergen Co.	Wed. 7/19/67 Weather: fair, warm Time Schedule: D
9-US Rte 22 & Thompson Ave. Bridgewater Twp. Somerset Co.	Tues.8/8/67 Weather: fair, mild Time Schedule: D
10-US Rte 22 & Bloy Ave. Hillside Union Co.	Fri. 8/4/67 Weather: cloudy Time Schedule: D
11-NJ Rtes 35 & 440 Perth Amboy Middlesex Co.	Thurs. 6/30/66 Weather: hot, humid Time Schedule: A
12-US Rt 1 & Green St. Woodbridge Middlesex Co.	Tues. 7/28/66 Weather: overcast, light rain Time Schedule: B
13-US Rtes 1 & 130 New Brunswick Middlesex Co.	Mon. 8/14/67 Weather: fair, mild Time Schedule: D
14-US Rte 1&9 & Bayway Ave. Elizabeth Union Co.	Thurs. 7/21/66 Weather: clear, warm Time Schedule: A
15-US Rte 206&White Horse Ave. Trenton Mercer Co.	Thurs. 7/13/67 Weather: fair, mild Time Schedule: D
16-NJ Rte 35 & Smith St. Perth Amboy Middlesex Co.	Wed. 7/5/67 AM & Noon only Tues. 8/22/67-PM only Rerun due to bridge opening Weather: fair, mild both days Time Schedule: D

SCHEDULE (Cont.)

17-NJ Rte 35 & Main St. (C.R. 514) Woodbridge Middlesex Co.	Fri. 7/7/67 Weather: fair, mild Time Schedule: D
18-NJ Rte 27&Plainfld Ave. Edison Twp. Middlesex Co.	Tues. 7/26/66 Weather: hot, humid Time Schedule: A
19-US Rte 1&9&Stiles Ave. Linden Union Co.	Wed. 8/2/67 Weather: fair, warm Time Schedule: D
20-US Rte 1&9&Wood Ave. Linden Union Co.	Fri. 8/8/67 Weather: fair, mild Time Schedule: D
21-NJ Rt 82 & Stuyvesant Union Union Co.	Wed. 6/28/67 Weather: fair, mild Time Schedule: D
22-NJ Rte 31 & Olden Ave. Trenton Mercer Co.	Thur.&Fri.8/10-11/67 Weather: AM 8/10 fair PM 8/11 fair Time Schedule: D
23-US Rte 22 & Vosseller Bridgewater Twp. Somerset Co.	Tues. 7/25/67 Weather: cloudy, rain Time Schedule: D
24-US Rte 1&Ryders Lane North Brunswick Twp. Middlesex Co.	Tues. 7/12/66 Weather: hot, humid Time Schedule: A
25-US Rte 22&New Providence Rd,Mountainside Union Co.	Mon. 7/17/67 Weather: warm, humid Time Schedule: D
26-US Rt 1 & Washington Ave. Princeton Mercer Co.	Tues. 7/11/69-AM & Noon Mon. 8/21/67 -PM only Rerun Due to Rain Weather: rain Time Schedule: D
27-US Rte 206&130-Crosswicks Ave. Bordentown Burlington Co.	Wed. 8/16/67 Weather: fair, warm Time Schedule: D
28-US Rte 1&9 Truck & Communipaw Jersey City Hudson Co.	Mon. 7/31/68 Weather: fair, mild Time Schedule: D
29-Broad St. & Front St. Red Bank Monmouth Co.	Before Sig:Tues.6/20/67 Weather: cloudy,cool After Sig:Wed.7/31/68 Weather: cloudy, warm Time Schedule Before & After: D
30-C.R.516 & Harmony Rd. Middlebrook Twp. Monmouth Co.	Thurs. 6/22/69 Weather: clear, dry Time Schedule: D

TIME SCHEDULES

A	B	C	D
7-9 a.m.	8-9 a.m.	7-9 a.m.	7:30-8:30 a.m.
11-Noon	12-2 p.m.	11-Noon	12:30-1:30 p.m.
2-3 p.m.	4-6 p.m.	2-3 p.m.	4:30-5:30 p.m.
4-6 p.m.		4-5 p.m.	

OFFICE PROCEDURE

The data sheets were coded, submitted to the computer center to be punched and sorted and then matched by a license plate matching program. The program matched every vehicle for each inbound lane to all exit lanes, and grouped the matches by six-minute time intervals, using the time at the inbound station. The average travel times for cars and trucks were listed separately with a minimum and maximum time for both cars and trucks for each movement. For a one-hour study period, there are ten average travel times for both cars and trucks.

At this point the data were edited to delete errors. An inspection of the mean, minimum and maximum times was made for reasonableness. Since all individual vehicle travel times making up the average six-minute travel time are not available, one or perhaps both the maximum and minimum were removed. Sometimes an entire time period had to be deleted.

The first step considered in the presentation of the data was to plot volume vs. travel time for cars, trucks and for all traffic. Generally, the result of the plot was a relatively constant travel time to a heavy volume condition, at which point the travel time became very erratic.

In an effort to explain some of the variation, it was next decided to plot travel time as the dependent variable against seven independent variables (lane volume, truck percentage, percentage of left turns, percentage of right turns from right lane, volume from left, opposite and right approaches). This method was shown in a preliminary report presenting ten of the study sites. Coefficients of determination were low with large standard errors of the estimated travel time.

Perhaps using the same seven independent variables was incorrect. Sample data were then analyzed choosing what were considered appropriate indepen-

dent variables. Again, low R^2 and large standard errors of estimates were found.

The presentation of the travel time data is shown in the figures with each of the 30 sites of the study.

Program for License Plate Matching

Purpose: This program prints out the average time it takes for vehicles to pass between preset points in an intersection of four legs. Travel times for each inbound lane are given for all possible movements through the intersection. The average times are classified separately for cars and commercial vehicles, and the maximum and minimum times between points are similarly presented.

Method: Travel times are determined by matching the license plates which have been field-recorded at the intersection. If these characters are identical for an approach and exit point, and the difference in time between the two points is within the range from twenty seconds to five minutes, this event is recorded as a match and the travel time is stored. This procedure continues until all the data for a given period (one or two hours) have been computer-read.

Besides being classified according to vehicle type, output is further broken down into six-minute intervals. Thus, for a one-hour study, there are ten average travel times for cars and for trucks, one for each six-minute period.

Input (Punched Cards): Location points on the intersection are punched in Cols. 1-2, lane number in Col. 4, vehicle type in Col. 6, license plate characters in Cols. 11-13, time passing the point in Cols. 18-23 (military time to nearest second), and date in Cols. 28-31.

FIELD PROCEDURE CRITIQUE

The field procedures for collecting travel times were exhaustive and disappointing in the inherent errors. A delay in delivery of tape recording equip-

ment necessitated using large numbers of field data collectors during the summer of 1966. License plate digits and times were recorded on legal size pads. Heavy volumes presented many misses and incorrect recording of plates. In addition, personnel took fewer Kodak times during heavy volume conditions. Thus, interpolation of times was necessary. In addition, trucks have multiple plates and an entering station may record one plate while an exiting station another, thus losing the truck travel time.

Although the Kodak times were calibrated as often as possible, some clocks lost or gained time throughout the study hours and times had to be adjusted on a moving scale.

The following summer the tape recorders were utilized. Each man then became his own timer and collector. Mechanical bugs were present in the form of enormous consumption of batteries, broken tapes, etc. The same previously mentioned errors of Kodak timers and truck travel times were present.

The only travel times which we felt could be relied on were those of the State car traversing the movements within the intersection. All stations were adjusted and connected in this manner. The method of sampling travel times by using State cars was given strong consideration. It was felt that a heavy saturation of cars for a full day or two would be sufficient to get enough travel times for each movement.

In addition, manual volume counts would have been made during the study on all legs and ramps. This would have been more accurate than the volume and turning movements of the universe sampled. Six-minute volumes were estimated using the number of plates and misses on each approach. Turning movements were based on license plate matches. As only 30-50% of the universe at each site was matched by

this method, turning movements as well as volumes, are not as accurate as a volume and turning count made manually. Arguments against this method were that the State car would represent only one type of driver (a college summer employee) and would not give truck travel times. However, as it turned out, truck travel times were insufficient by the method used. It is felt that State car times were more accurate and were used as checks for all adjustments. In addition to accuracy, the sample car method would have been less costly in computer operations, and would have facilitated a speedy completion of the final report.

APPENDIX B

ACCIDENT ANALYSIS

ACCIDENT DATA COLLECTION & PRESENTATION FORMAT

Traffic accident data were furnished by the New Jersey Motor Vehicle Division for a three-year period for the thirty intersections studied. These data are shown both pictorially and in tabular form on the "Collision Diagrams" for each intersection.

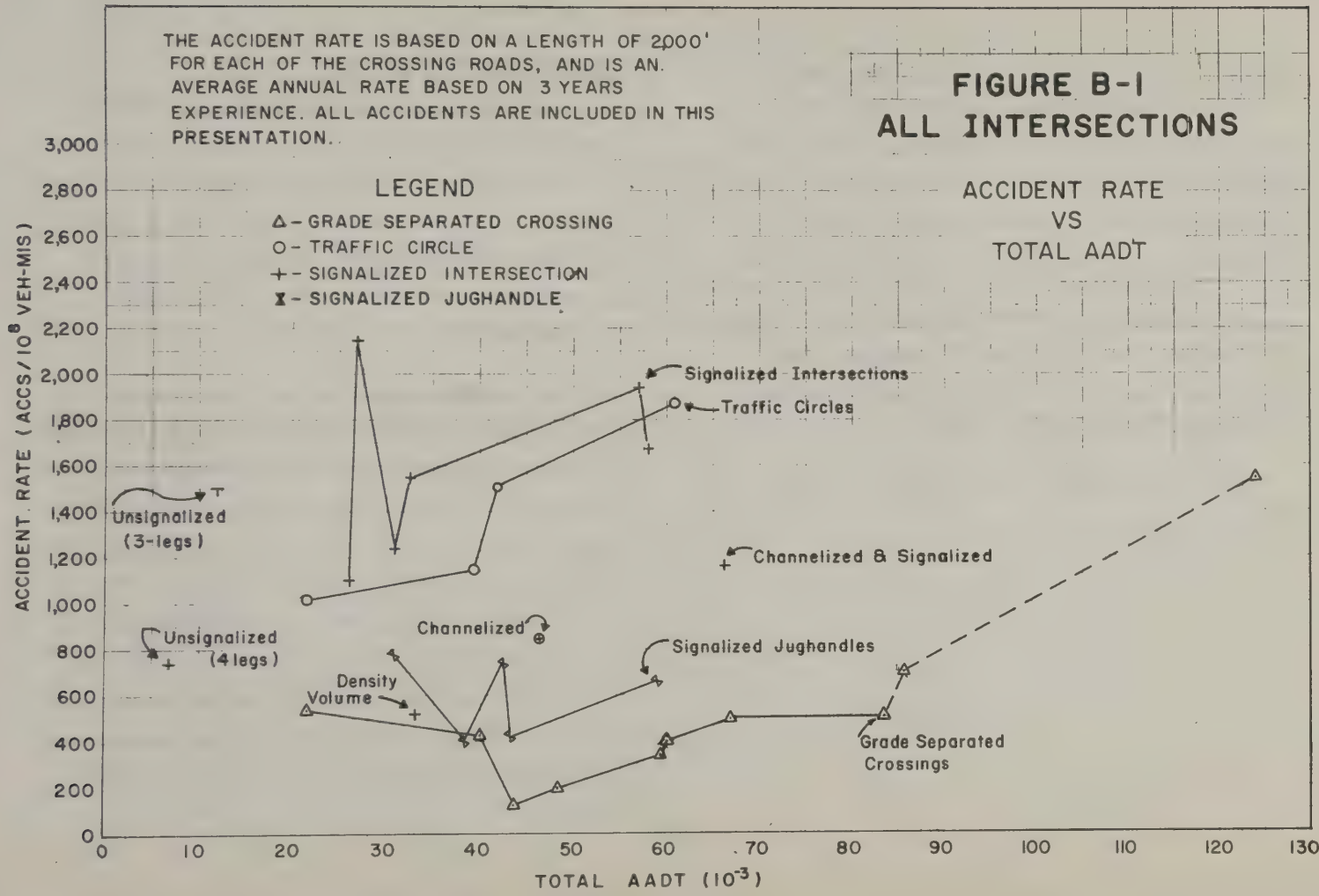
By utilizing the standardized drawing of each intersection, exact location of accidents, their type (rear-end, side-swipe, etc.) and the number of each type of accident is shown.

The accident type is tabulated by severity and night or day.

GENERAL ACCIDENT ANALYSIS

Overall accident comparisons of intersections are readily apparent on a "serviced volume" basis. The refinements of turning movements, cycle lengths, phasing, etc., are covered in more detail in the following sections of this report. Three year accident data are averaged to eliminate annual fluctuations.

Fig. B-1 illustrates the accident rate vs. the total serviced AADT for grade-separated crossings, signalized intersections, signalized jughandles and traffic circles. The data presented in this figure cover 2000' of each crossing roadway, hence, include the accidents occurring from the crossing of all roads in that 2000 ft. This presentation is weighted against signalized intersections in built-up areas where several crossings usually occur, and favors the grade-separated interchanges, where there is usually only one crossing within 2000 ft.


THE ACCIDENT RATE IS BASED ON A LENGTH OF 2000' FOR EACH OF THE CROSSING ROADS, AND IS AN AVERAGE ANNUAL RATE BASED ON 3 YEARS EXPERIENCE. ALL ACCIDENTS ARE INCLUDED IN THIS PRESENTATION.
FIGURE B-1
ALL INTERSECTIONS
ACCIDENT RATE VS TOTAL AADT
LEGEND
Δ - GRADE SEPARATED CROSSING
O - TRAFFIC CIRCLE
+ - SIGNALIZED INTERSECTION
X - SIGNALIZED JUGHANDLE
ACCIDENT RATE (ACCS/ 10^6 VEH-MIS)
TOTAL AADT (10^{-3})
Signalized Intersections
Traffic Circles
Unsignalized (3-legs)
Channelized & Signalized
Unsignalized (4 legs)
Channelized
Signalized Jughandles
Density Volume
Grade Separated Crossings
0
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000
2,200
2,400
2,600
2,800
3,000
10
20
30
40
50
60
70
80
90
100
110
120
130

Taking into consideration this plethora of crossings in 2000' at signalized intersections, consideration is given only to the accidents occurring on the immediate approaches or within the confines of the crossing, merging or diverging of the two roadways in Fig. B-2. Because of the point location rather than length location of accidents, Fig. B-2 illustrates the average accident frequency per year as opposed to the average accident rate shown in Fig. B-1. The most dramatic difference in the presentations of data (in Figs. B-1 and B-2), is the position of the accident experience for signalized intersections. It is obvious that a greater frequency of at-grade crossings, rather than other type crossings, within 2000' of roadway, accounts for the high accident rate.

Neither of the above presentations is helpful when attempting to relate a specific design to accident frequency. Traffic movements differ from one interchange to another, emphasizing a difference in exposure (conflicts) for similar type movements. It is this difference in exposure that must be determined before a comparison of interchanges or designs can be made. The derivation of an index (conflicts or exposure) for each type interchange is developed in the following sections.

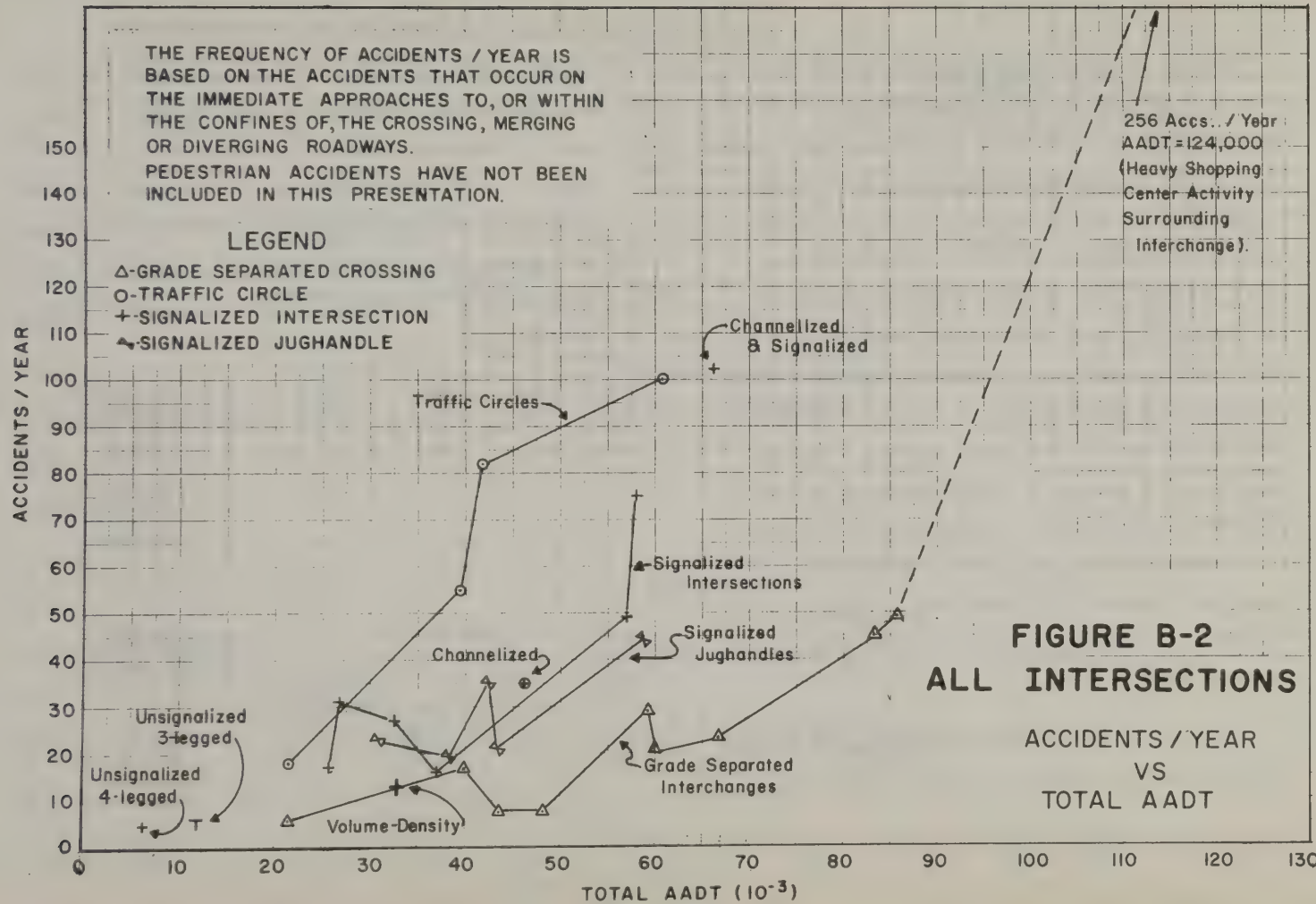


FIGURE B-2
ALL INTERSECTIONS

ACCIDENTS / YEAR
VS
TOTAL AADT

SIGNALIZED AT-GRADE INTERSECTIONS

Accidents at signalized intersections are considered in two steps, on the approach and within the intersection.

1. Accidents on Approach to Signal:

For accidents on the approach to an intersection, we initially tried a multiple regression technique with five independent variables:

X_1 = number of combinations of any two vehicles conflicting within the length of time of a cycle.

Using Fig. B-4, we can graphically interpret the number of conflicts per cycle. Enter the chart with known cycle length, come down to AADT, come across to combination curve and read down to the number of conflicts.

X_2 = left turn conflicts, which are the multiple of the AADT of left turn and straight through movements/10^6.

X_3 = right turn conflicts.

X_4 = number of lanes on approach (not at the intersection).

X_5 = speed limit on the approach.

The dependent variable Y = number of accidents per year.

The resulting regression equation yielded an error of estimate of 3.42, with an R^2 of 0.802. The error of estimate was judged to be too large and the use of the regression equation resulted in large errors for many low volume approaches.

Subsequently, the approaches were grouped into four categories:

a) Isolated - no upstream signals within a mile of the intersection (30 samples).

b) Approaches, with vehicles platooned by upstream signal, in good progression with downstream signal (7 samples).

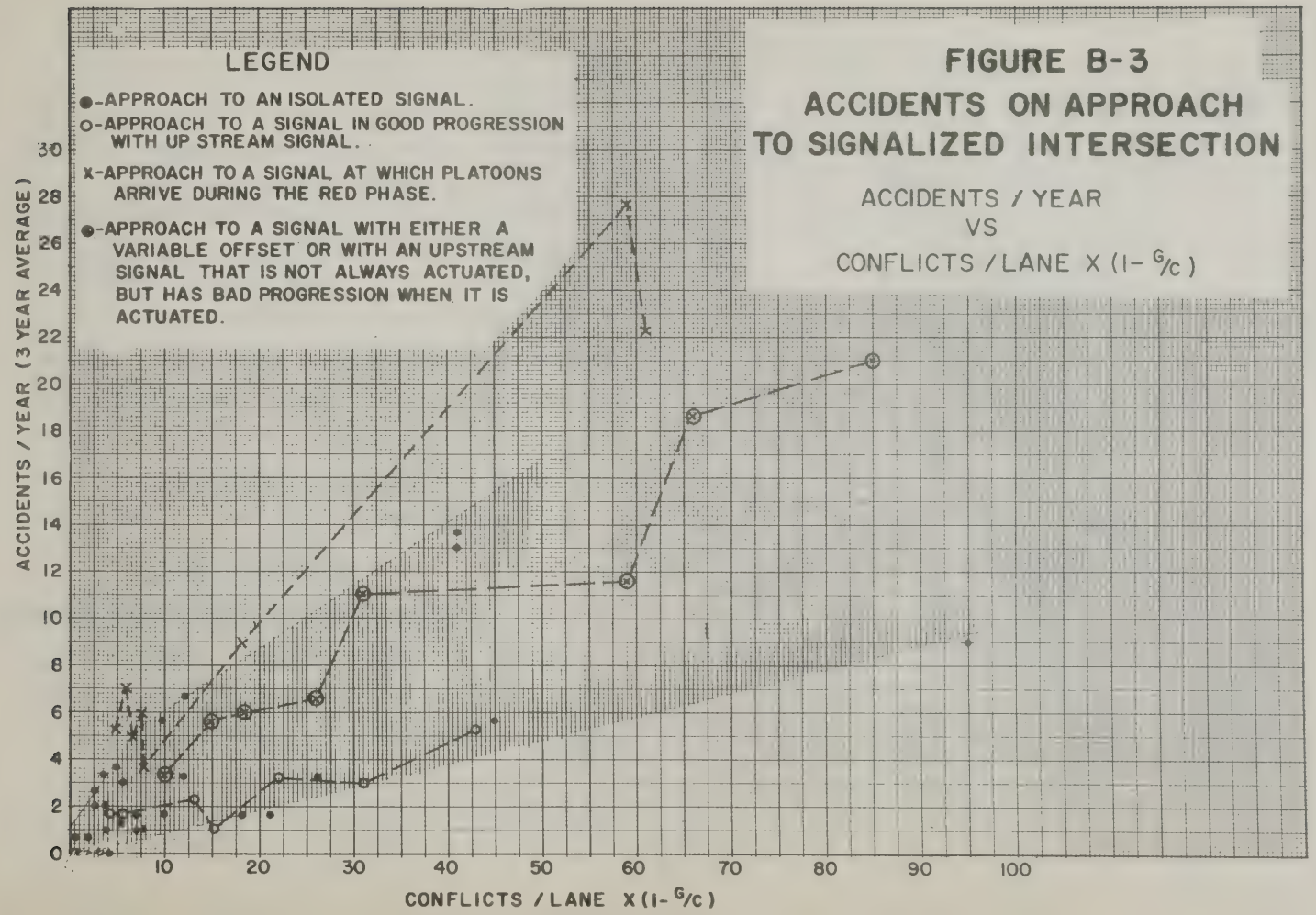
c) Approaches, with vehicles platooned by upstream signal, in bad progression with downstream signal (platoon arrives during red phase) (8 samples).

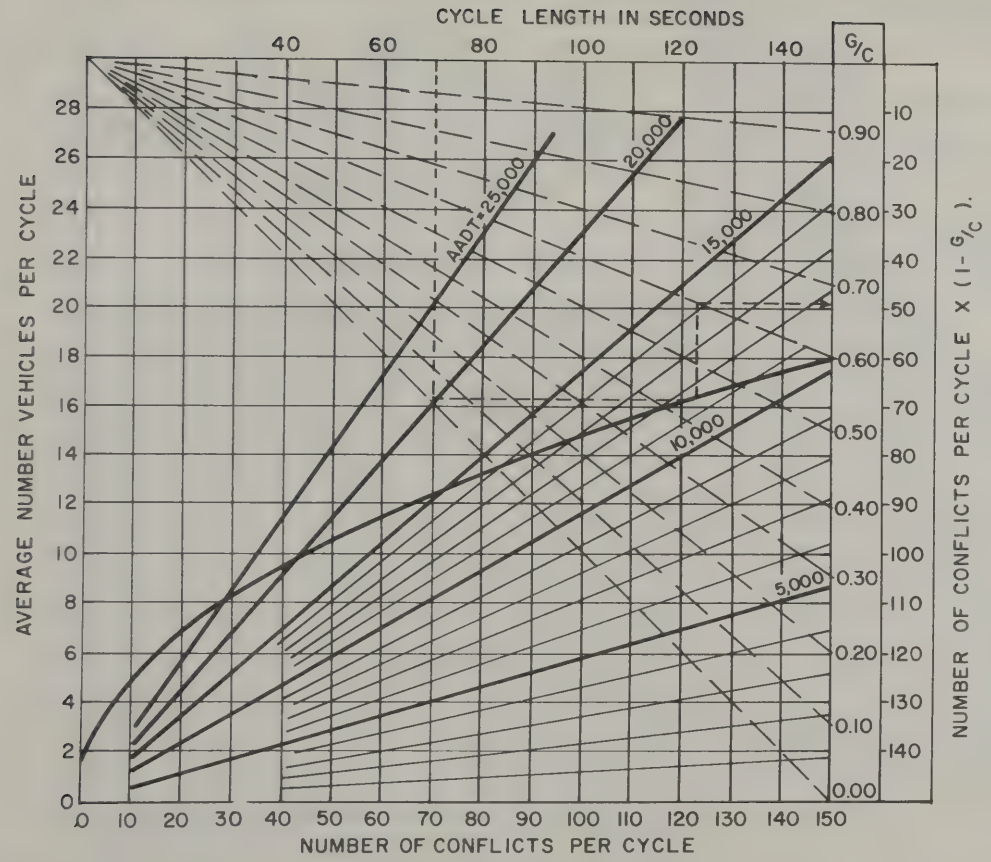
d) Approaches where the upstream signal either has a variable offset with downstream signal and

vehicles are platooned, or the upstream signal is not always actuated (8 samples).

A total of 53 approaches were used for a plot of the total number of accidents (rear-end, side-swipe and fixed object on the approach) against the AADT. No clear distinction between the categories was evident. Hence, the cycle length was used to determine the average number of vehicles arriving per cycle for each approach. Assuming that accidents are the result of the conflict of two vehicles, even though the result may be a single vehicle accident, the number of combinations of two vehicles per cycle was computed. Another method would have been to compute the number of combinations of two vehicles per red phase. However, this would have resulted in very small numbers and would require an accuracy of estimated approach AADT difficult to acquire. Nonetheless, the number of combinations of two vehicles per cycle is an attempt to quantify those vehicles that have been platooned by cycle. This number is then further refined by multiplying by the proportion of the red phase per cycle. For any cycle length, approach AADT, and G/C, Fig. B-4 will yield the number of conflicts per cycle x (1 - G/C).

This quantity is then divided by the number of lanes on the approach to yield the final value against which accidents are plotted. Fig.B-3 clearly distinguishes the non-isolated approach categories. As may be expected, the approaches on a good progressive signal system have the fewest accidents and the approaches on a bad progressive system have the most accidents. The approaches of isolated signals show a wide range for accident experience that may have to be further refined by signal type (fixed, semi-actuated), composition of traffic, turn restrictions, grades, land use activity, or many other factors.


LEGEND
●-APPROACH TO AN ISOLATED SIGNAL.
○-APPROACH TO A SIGNAL IN GOOD PROGRESSION WITH UP STREAM SIGNAL.
X-APPROACH TO A SIGNAL AT WHICH PLATOONS ARRIVE DURING THE RED PHASE.
●-APPROACH TO A SIGNAL WITH EITHER A VARIABLE OFFSET OR WITH AN UPSTREAM SIGNAL THAT IS NOT ALWAYS ACTUATED, BUT HAS BAD PROGRESSION WHEN IT IS ACTUATED.
FIGURE B-3
ACCIDENTS ON APPROACH TO SIGNALIZED INTERSECTION
ACCIDENTS / YEAR
VS
CONFLICTS / LANE X (1- G/C)
ACCIDENTS / YEAR (3 YEAR AVERAGE)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
10
20
30
40
50
60
70
80
90
100
CONFLICTS / LANE X (1- G/C)



EXAMPLE:

70" CYCLE

20,000 AADT - APPROACH VOLUME

0.60 G/C

CONFLICTS PER CYCLE

$\times (1 - G/C) = 51$

FIGURE B-4
SIGNALIZED INTERSECTIONS

NUMBER OF CONFLICTS PER CYCLE X (1 - G/C).

Two further comments can be made about Fig. B-3. First, if we consider that some approaches are on good progressive systems, where few vehicles will be stopped or slowed by the red phase, we should not multiply the entire number of conflicts per lane by the red phase.

All vehicles arriving in the period of time of a cycle are not stopped, only the red phase portion of them are stopped. Hence, the "conflicts/lane x (1-G/C)" quantity will be larger than that reflected by Fig. B-3 for the approaches on good progressive systems. In effect, the lower dashed line will shift to the right.

Finally, it must be remembered that many of the intersections included in the study are semi-actuated. While the main road may experience very high volumes, the crossroad volumes could be very low. Since the signal retains a green indication for the main road until actuation by the crossroad, fewer crossroad actuations will result in fewer potential conflicts on the main road. Quantifying this variable for past years is not possible, but it may help to explain some of the variation in data shown in Fig. B-3.

2. Accidents within the Intersection:

Ninety percent of the total number of accidents within the intersections of the study locations were right-angle and left-turn accidents. Hence, only these types are considered in the following analysis:

Type Accident	% of Total
Right-Angle	53.5
Left-Turn	36.4
Side-swipe	5.9
Pedestrian	2.1
Head-On	1.6
Rear-End	0.5

Of the 13 signalized intersections, data were used from 12 in the initial analysis; one site has a volume-density controller with a cycle range of 40" - 120".

The potential for an accident, involving vehicles from streams crossing each other, may be expected to be some function of the volumes of each stream. The sum of the AADT of the conflicting streams, and the multiple of these streams, appear to be the most basic forms this function can take.

Applying this approach to the left-turn accidents, Fig. B-5 illustrates the differences that exist in accident experience for the number of lanes a left turning vehicle must cross to make this maneuver. The range of conflict is in proportion to the number of lanes and the accident experience appears to be directly related to both the conflict and the number of lanes the left turning vehicle must cross. The trend lines on this figure are hand-drawn because of limited data. Left turns are prohibited at one site and on two of the approaches of each of the five jughandle intersections.

Neither form of the previously mentioned conflicts gave a clear trend for right-angle accidents. In the form of a summary, the following table shows the frequency of crossing streams experiencing a number of right-angle accidents per year (based on a 3-year average).

Number of Accidents/Year	Number of Crossing Streams
0	9
0.33	11
0.67	6
1.00	3
1.33	8
1.67	4
2.00	3
2.33	2
2.67	2
3.00	1

The crossing streams occur at fixed and semi-actuated controlled intersections; they are comprised of streams from 1 to 3 lanes and crossing roads of 1

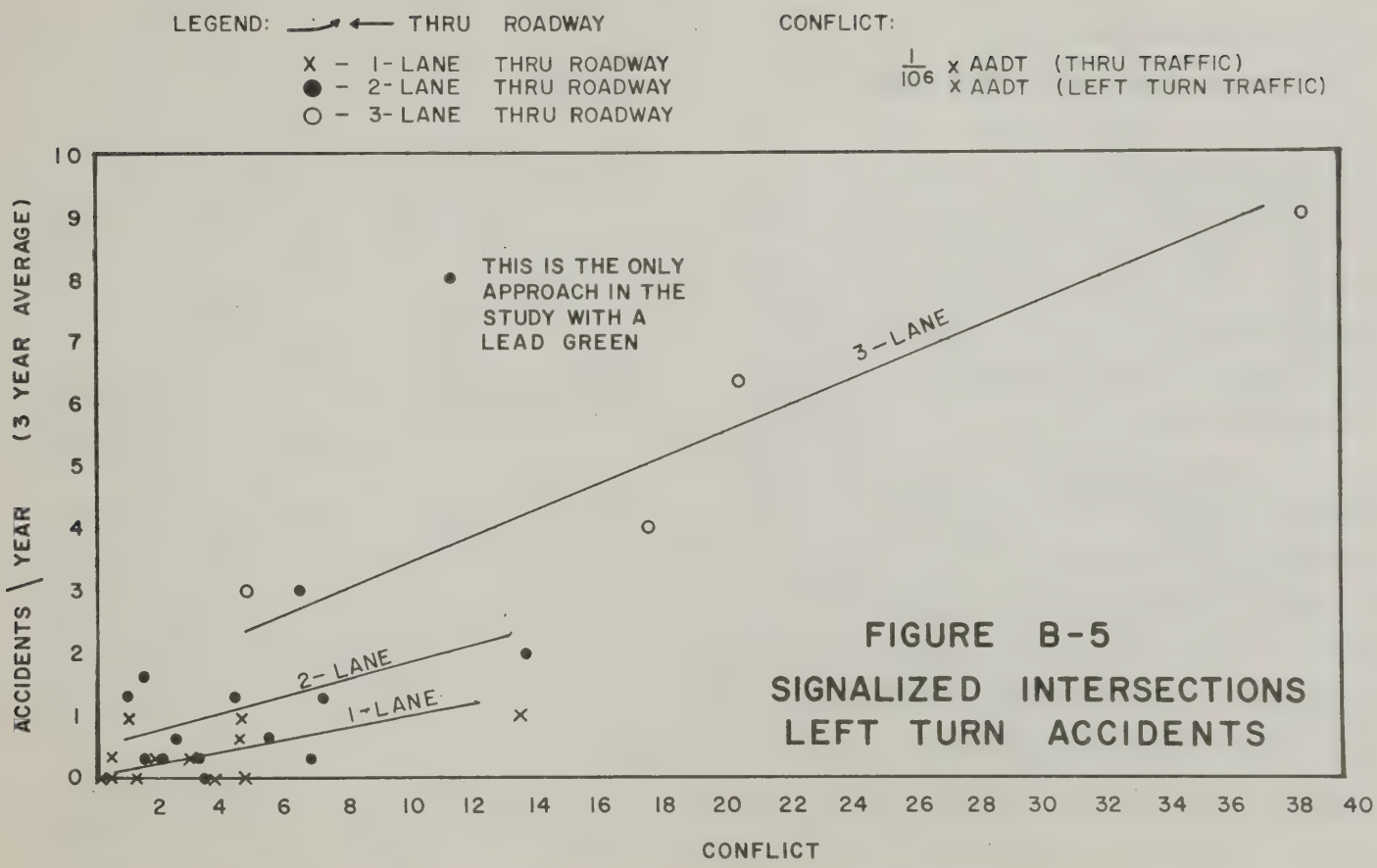


FIGURE B-5

SIGNALIZED INTERSECTIONS

LEFT TURN ACCIDENTS

and 2 lanes. The range in volume is from 1000 vehicles per day per stream to 23,000 vehicles. These are but a few of the variables which must be considered in determining the accident experience. Overall, of the 49 crossings in this study, the average number of right-angle accidents per year is less than 1, which is less than 4 right-angle accidents at an intersection. Of those intersections where injury accident data are available, approximately 55% of all right-angle accidents resulted in an injury to one or more people.

Pedestrian accident experience can be expected to be directly proportional to the pedestrian activity (crossings) at an intersection. Many of the intersections in this study have very light pedestrian movements, hence of the 13 intersections studied, only 4 had one or more pedestrian accidents within the intersection itself. The highest pedestrian accident experience occurred at U.S. Route 1&9 and Wood Avenue (site 20), where there were 4 accidents in a three-year period.

TRAFFIC CIRCLES

1. Accidents Within Circle

A theoretical path of travel for vehicles on a circle was determined (Fig. B-6). Basically, a driver will travel the left lane(s), and will weave to the right in the quadrant of the circle just prior to his point of exit. The multiple of the conflicting volumes are summated for a quadrant and tabulated with the number of accidents in the quadrant. Conflict Index = 10^{-6} (multiple of crossing, merging, or diverging AADT).

Graphically, the accident experience on the traffic circles studied in this report is shown in Fig. B-6. A detailed analysis of accidents by type was not considered feasible for the quadrant. With five possible conflicts per quadrant, matching accidents and conflict index would be impossible.

The proportion of injury accidents to total accidents decreases with an increase in the conflict index. However, the total number of accidents in a quadrant increases rapidly beyond a conflict index of 100.

The shape of traffic circles and the accompanying number of lanes on the circle and the length of weave area between entry and exit points, varies considerably. The four traffic circles used in this study have two lanes in all quadrants and the weave areas vary in length from 200' to 450'. Two factors that may be the most important in explaining the variation in accident experience, for the study locations, are the proportion of slower moving vehicles within each quadrant and the choice of some circle traffic to yield, allowing entering traffic to have the right-of-way. (New Jersey law gives circle traffic the right-of-way.)

2. Accidents on Approach to Circle

The frequency of accidents on the approaches

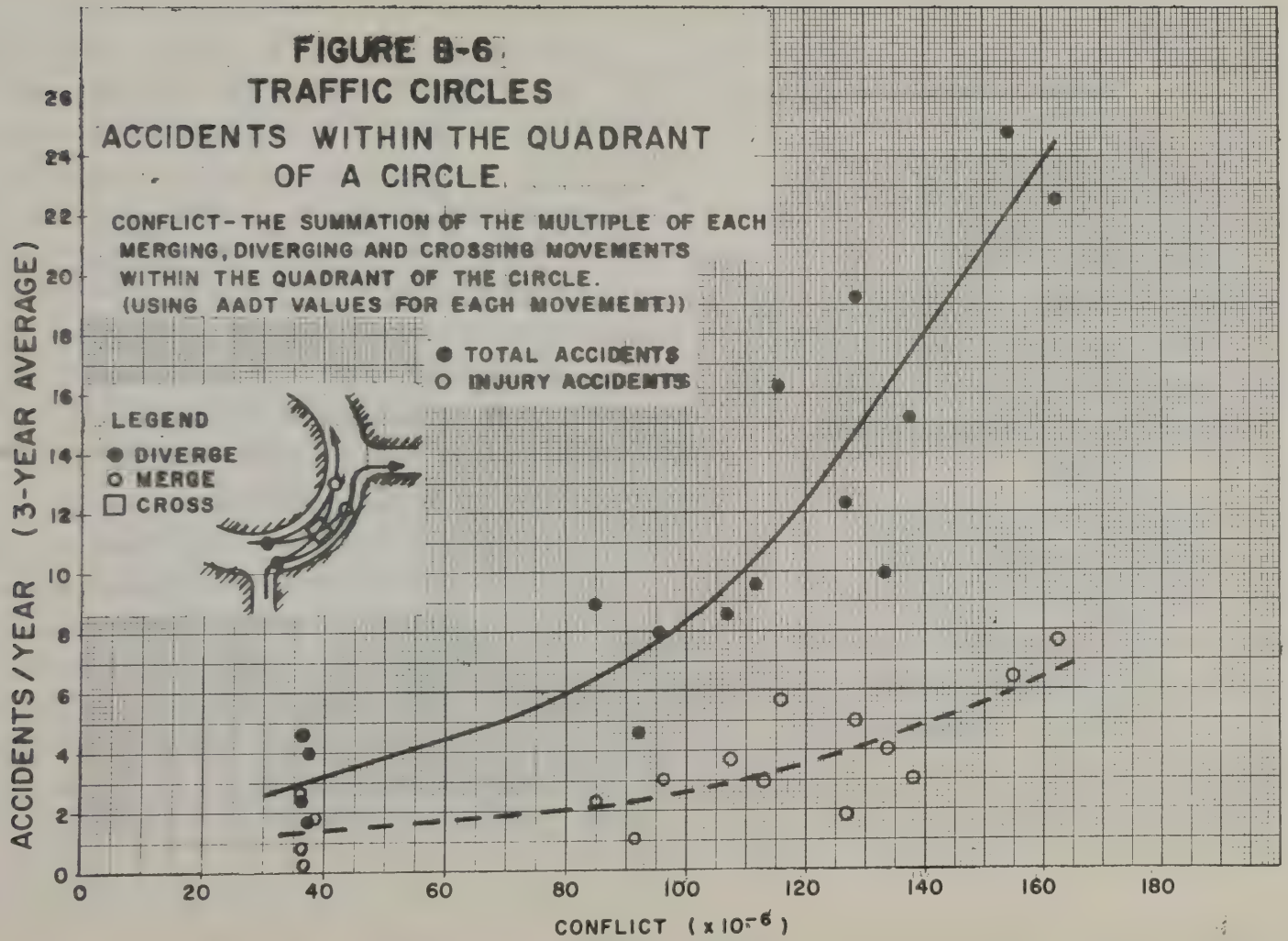


FIGURE B-6
TRAFFIC CIRCLES
ACCIDENTS WITHIN THE QUADRANT OF A CIRCLE
CONFLICT - THE SUMMATION OF THE MULTIPLE OF EACH MERGING, DIVERGING AND CROSSING MOVEMENTS WITHIN THE QUADRANT OF THE CIRCLE. (USING AADT VALUES FOR EACH MOVEMENT))
● TOTAL ACCIDENTS
○ INJURY ACCIDENTS
LEGEND
● DIVERGE
○ MERGE
□ CROSS
ACCIDENTS / YEAR (3-YEAR AVERAGE)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
0
20
40
60
80
100
120
140
160
180
CONFLICT (x 10⁻⁶)

to traffic circles is apparently related to the AADT approach volume per lane and the control (either implied or posted) at the point of entry to the circle. Several approaches have no posted control (yield sign), but the drivers on these circles have given the right-of-way to the heaviest volume movements. Fig. B-7 distinguishes these groups by specifying curves for yield and no-yield.

On the U.S. Rtes. 1&130 circle, over 50% of the accidents on the Rte. 1 approaches involves only one vehicle. Skid tests made on these approaches show roadway surface to be in the "poor-unsafe" category. This may partially explain why accidents on this approach are disproportionately above the no-yield group (the category into which the approach accidents should fall).

The traffic signals on the N.J. Rte. 439 approaches to the U.S. Rte. 1&9 (Bayway) circle are synchronized with the Rte. 1&9 approaches. In effect, the traffic on the perpendicular legs are entering the circle at different times during the 120 sec. cycle. The minor leg approaches at this circle (N.J. Rte. 439) are thereby more accurately classified with the no-yield group.

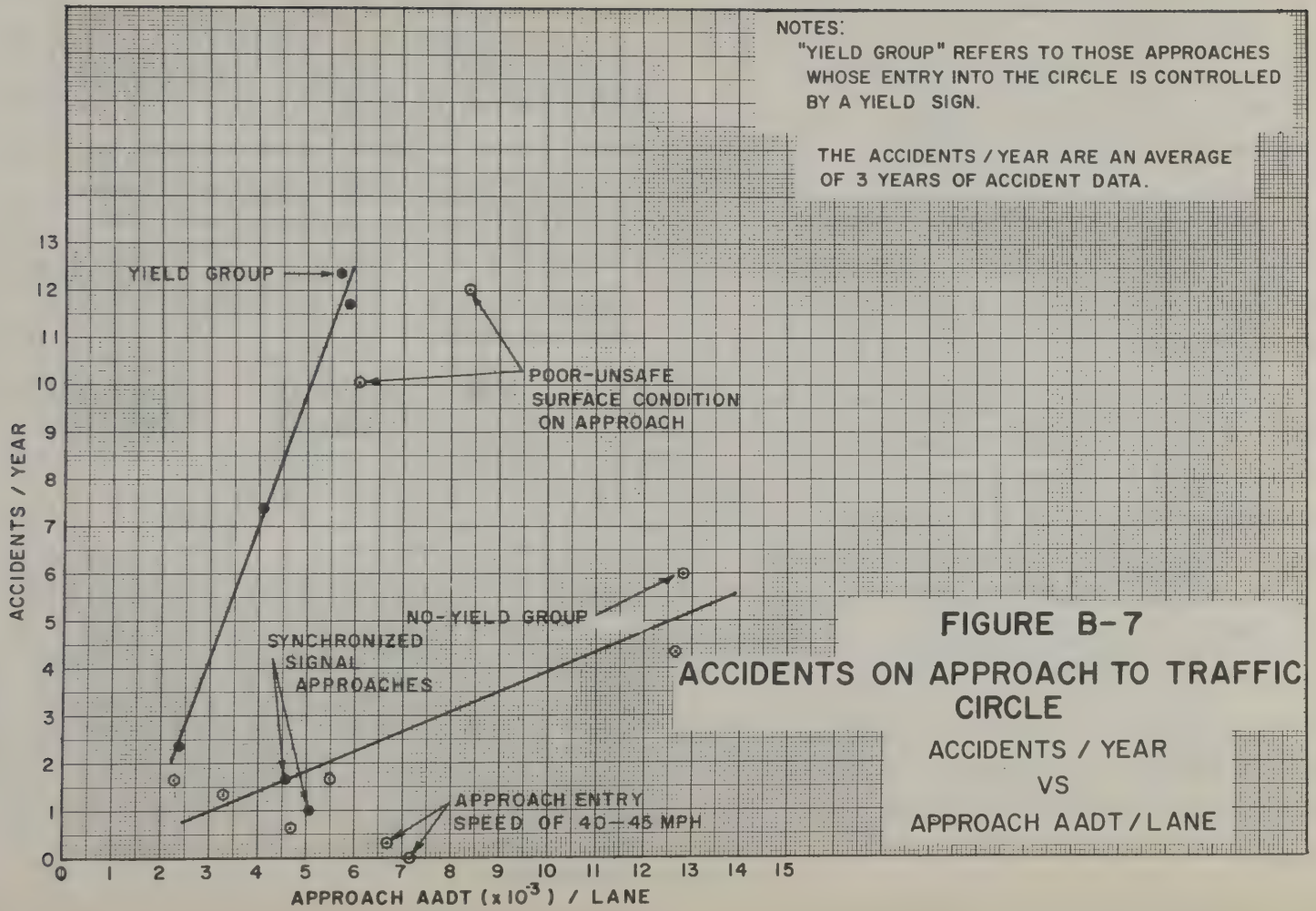


FIGURE B-7

ACCIDENTS ON APPROACH TO TRAFFIC CIRCLE

ACCIDENTS / YEAR
VS
APPROACH AADT / LANE

GRADE-SEPARATED INTERCHANGES

There are seven different configurations to the grade-separated interchanges studied in this report (see Fig. B-8). At these interchanges there are six common points of conflict for which accident experience has been compiled (see Figs. B-9 thru B-14):

1. At diverging points for outer connectors (B-9)
2. At diverging points for loop ramps (B-10)
3. At merging points of outer connectors (B-11)
4. At merging points of loop ramps (B-12)
5. At diverging points of a crossing maneuver (B-13)
6. At crossing points (B-14)

However, there are still many differences that exist between interchanges for any of these common conflict points. For the first three enumerated above, there are the two widely separated groups for the angle of diverge or merge. Some traffic movements are made onto ramps with relatively flat angles, while other ramps make angles of close to 90° with the through roadway.

Other differences are in the number of lanes of through roadway, speed limits, turning movement, trucks, existence and length of acceleration and deceleration lanes, vertical and horizontal alignment of through roadway, etc.

Overall, the grade-separated interchanges studied in this report, and their associated ramps, cannot be classified as having full access control. The speed limit for all the major roads, of the 10 sites studied, is 50 mph; the ramp speeds are governed by a wide range of radii, none of which exceeds 300 feet.

Specific analysis of the accident experience follows, but because of the limitation on data, no trend lines have been mathematized.

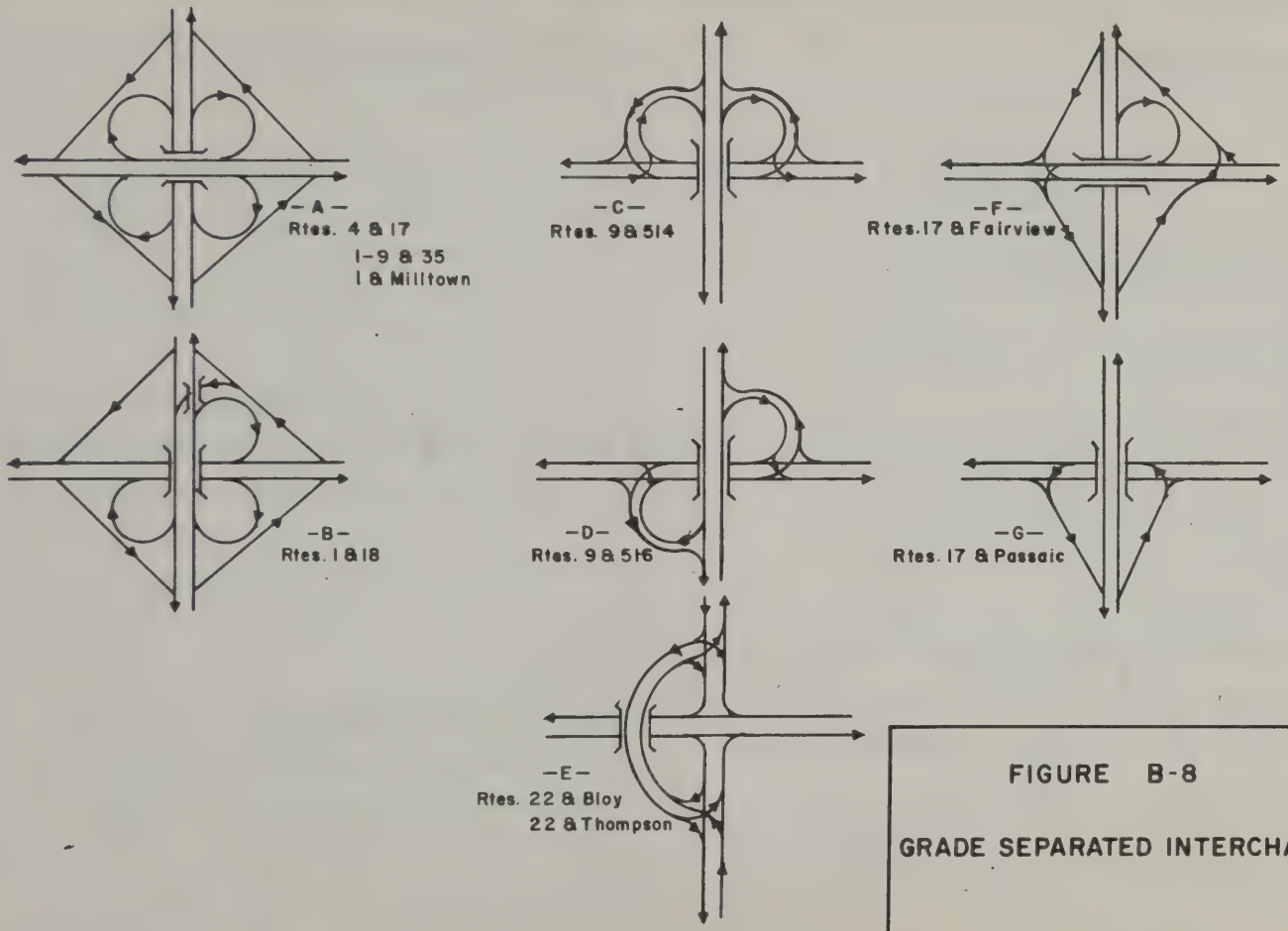


FIGURE B-8

GRADE SEPARATED INTERCHANGES

1. Accidents at the diverge to outer connectors (Fig. B-9)

There are 30 ramp terminals that fall in this category and 11 of them make connections of approximately 90° with the through roadway. The data for the two groups are overlapping, yielding an expected upward trend of accidents for increasing conflict. Two ramps fall outside of the region covered by the trend line: one has a long deceleration lane and the other is at an interchange of heavy shopping center activity.

2. Accidents at the diverge to loop ramps (Fig. B-10)

There are 22 ramps that are in this category in this study. Besides the two major classifications of these ramps by angle of exit, there are the other groupings by weave area and number of lanes in the weave area. In all, the 22 ramps are separated into six groups, which precludes the use of trend lines for this presentation. However, the data of each group have been connected for more legibility. Again, it is difficult to distinguish between groups, except for the data points at interchanges with heavy shopping center activity.

3. Accident experience at the merge of outer connectors and the through roadway (Fig. B-11)

With 31 ramps in this category and eight separate groupings (angle of merge, acceleration lane, added lane, etc.), the data thin out to very few samples for any one group. Trend lines are again meaningless. There are only two groups with 7 or more samples each, and both have one sample which is "out-of-line" with the rest of the group. The ramps at the interchange with heavy shopping center activity are again very high in accident experience.

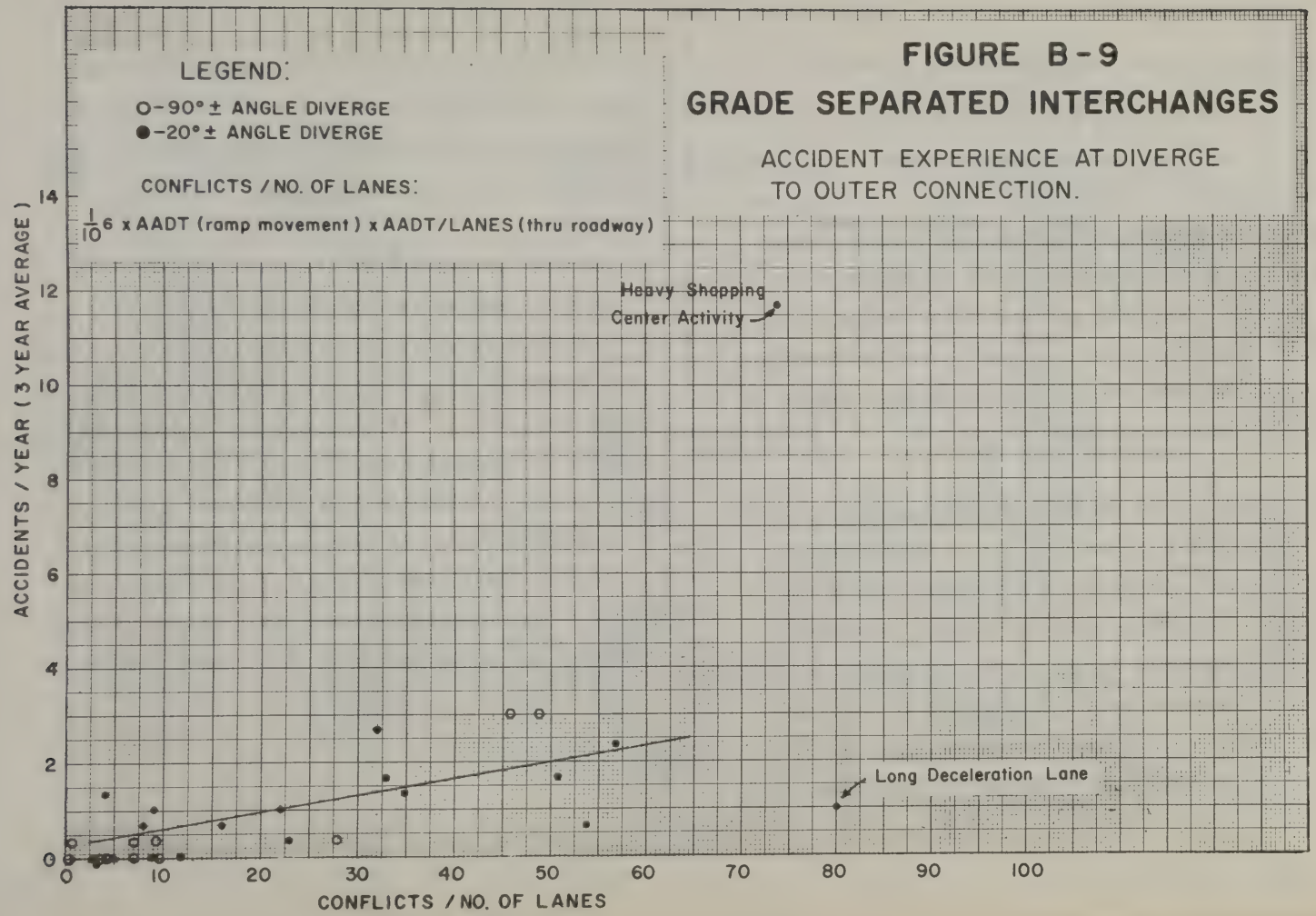


FIGURE B-9
GRADE SEPARATED INTERCHANGES
ACCIDENT EXPERIENCE AT DIVERGE TO OUTER CONNECTION.
LEGEND:
O-90° ± ANGLE DIVERGE
●-20° ± ANGLE DIVERGE
CONFLICTS / NO. OF LANES:
1/10 6 x AADT (ramp movement) x AADT/LANES (thru roadway)
Heavy Shopping Center Activity
Long Deceleration Lane
ACCIDENTS / YEAR (3 YEAR AVERAGE)
CONFLICTS / NO. OF LANES
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
80
90
100

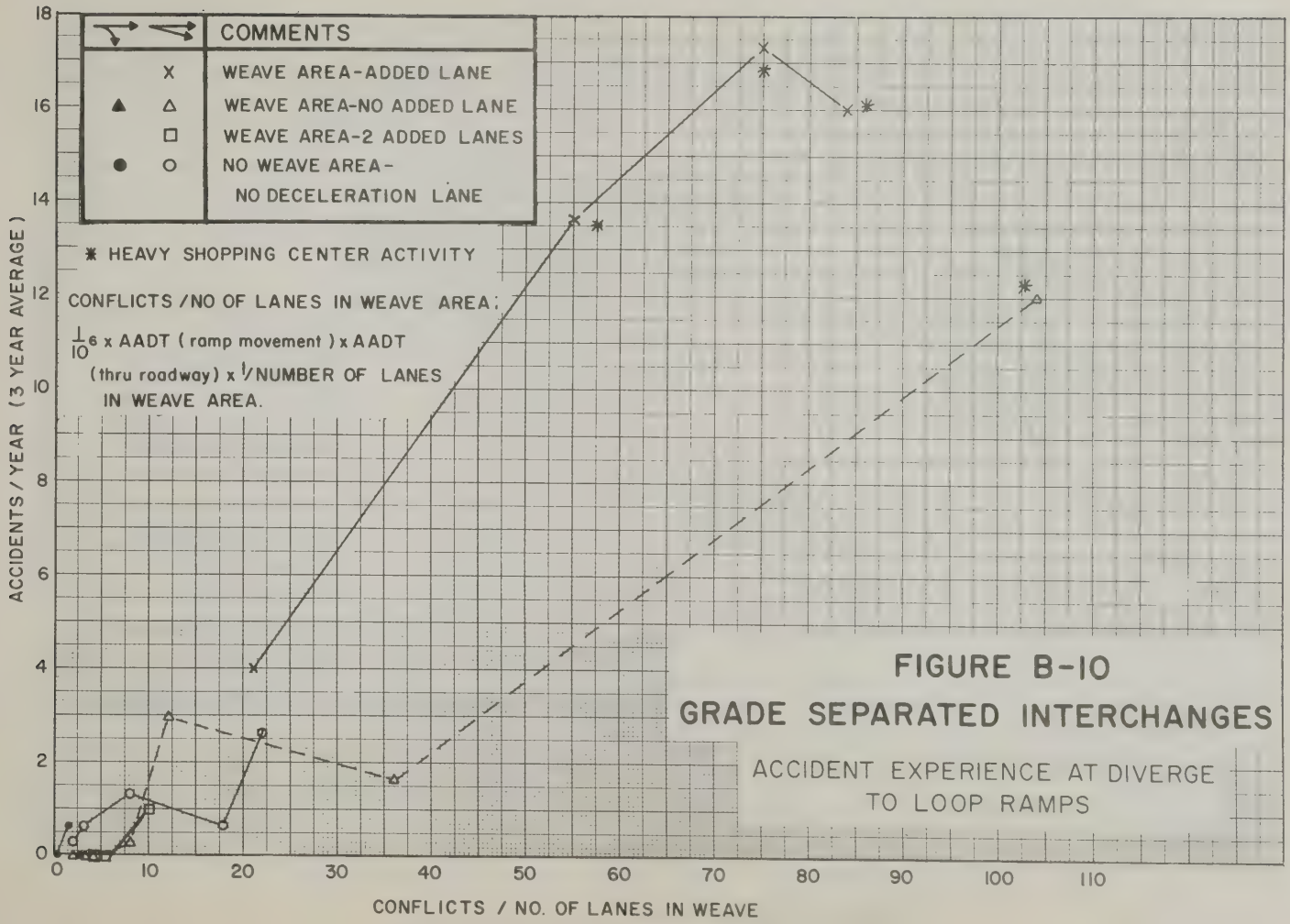


FIGURE B-10

GRADE SEPARATED INTERCHANGES

ACCIDENT EXPERIENCE AT DIVERGE TO LOOP RAMPS

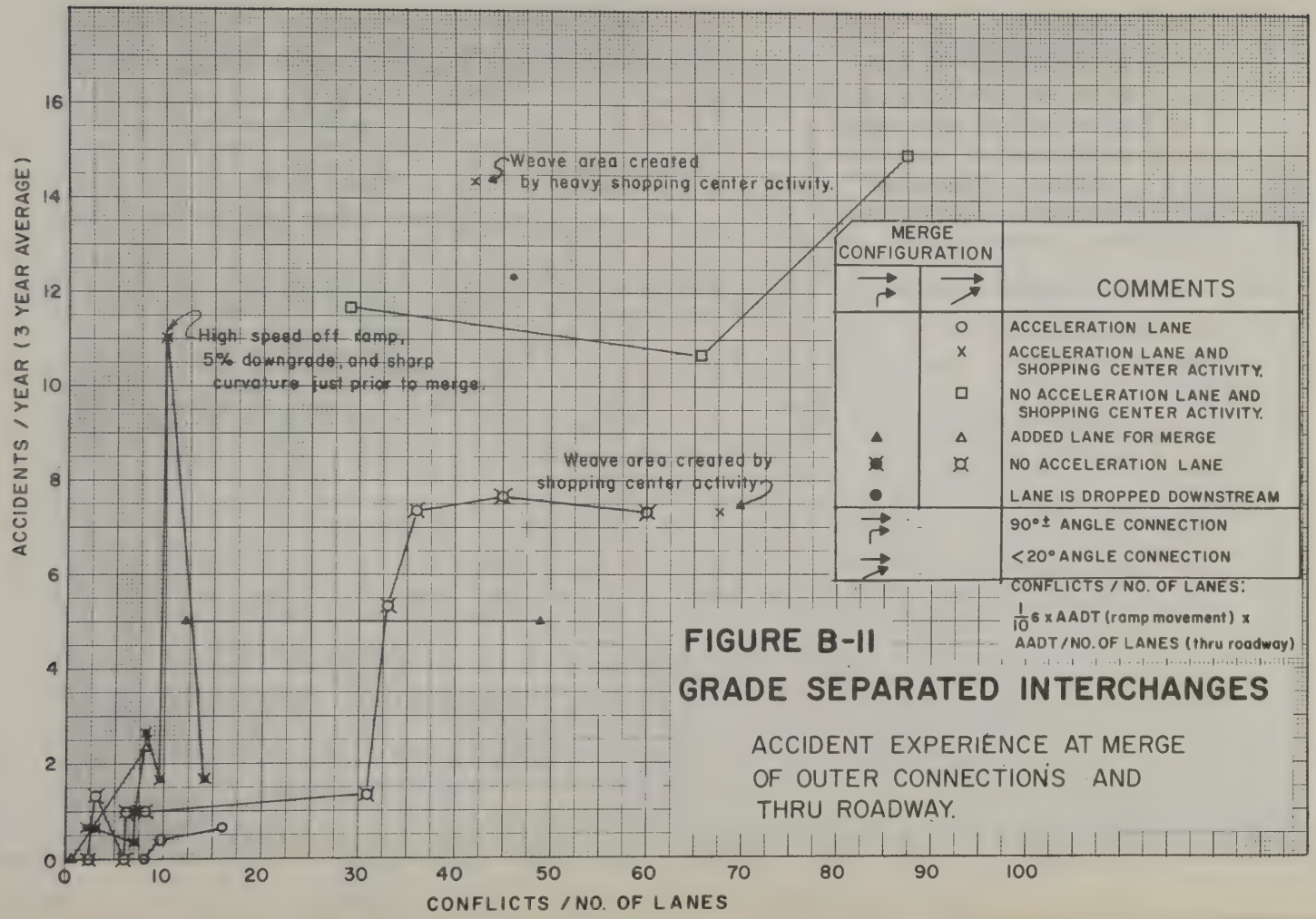


FIGURE B-11

GRADE SEPARATED INTERCHANGES

ACCIDENT EXPERIENCE AT MERGE OF OUTER CONNECTIONS AND THRU ROADWAY.

4. Accident experience at the merge of the loop ramps and the through roadway (Fig. B-12)

Twenty-five ramps fall into this category. There are 5 groups made up of weave and no-weave areas, with and without added lanes, and heavy shopping center activity. No discernible difference is noted between any of the groups, except those ramps at interchanges of heavy shopping center activity.

Generally, accident experience at these conflict points is very low.

5. Accident experience at the diverge points prior to a crossing maneuver (Fig. B-13)

There was an average of only 3 accidents per year for the combined 11 points of conflict in this category. Study sites 5 through 10 depict these locations on the minor road at the terminal points of the ramps. The directional 30th peak hour volumes on these minor roads (for the year 1964) ranged from 200-700 vph.

6. Accident experience at the crossing points for ramp access or egress (Fig. B-14)

Evident from the figure, there was an average of one accident per 3-year period for a ramp in this category. Again, there is no trend in accident occurrence for increasing conflict. However, the frequency of accidents appears to be greater for the traffic exiting the ramp onto the minor road than for the traffic entering the ramp from the minor road. The ramp exiting traffic has two directions to consider on the minor road, whereas the traffic entering the ramp has only one flow to consider.

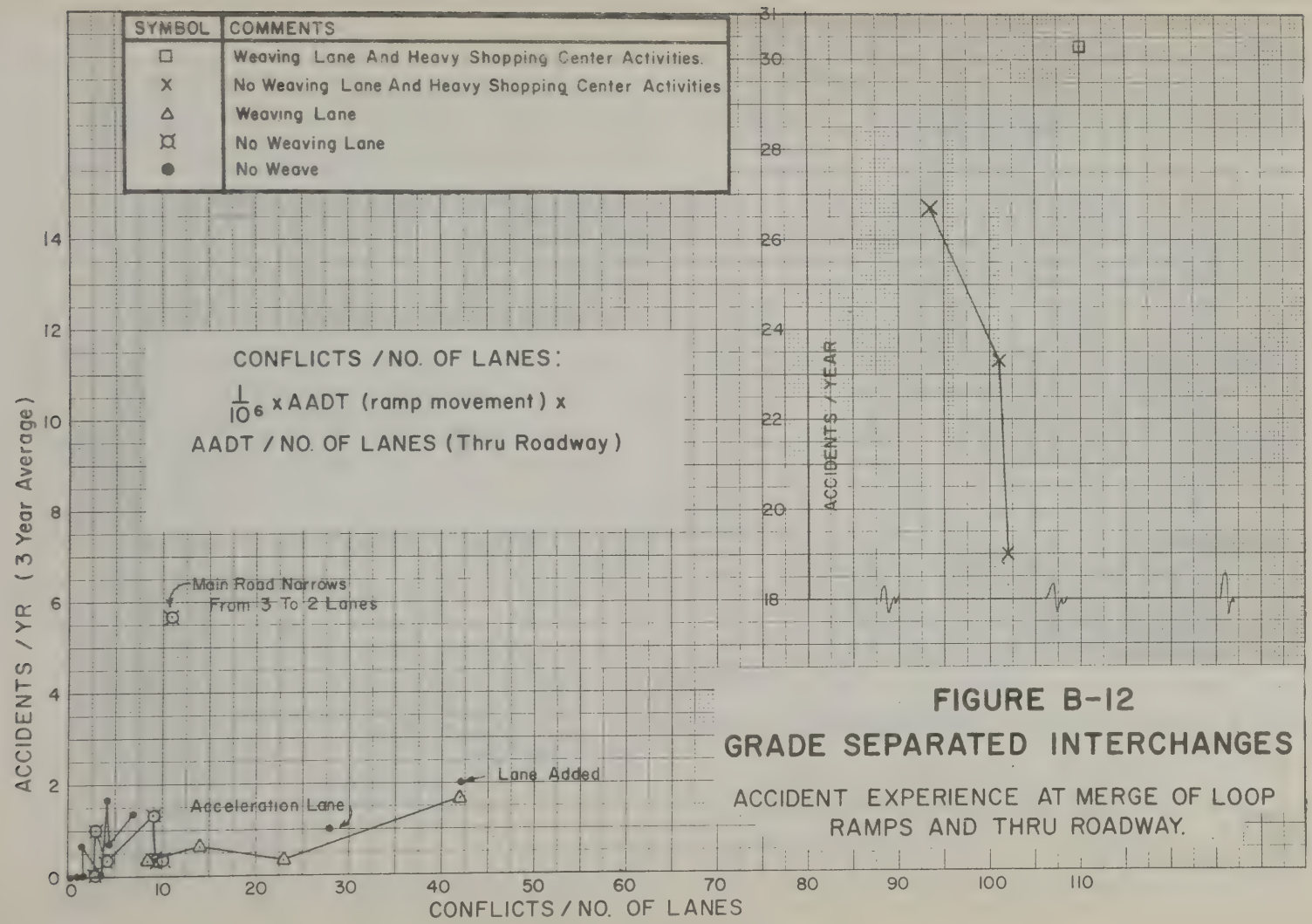


FIGURE B-12

GRADE SEPARATED INTERCHANGES

ACCIDENT EXPERIENCE AT MERGE OF LOOP RAMPS AND THRU ROADWAY.

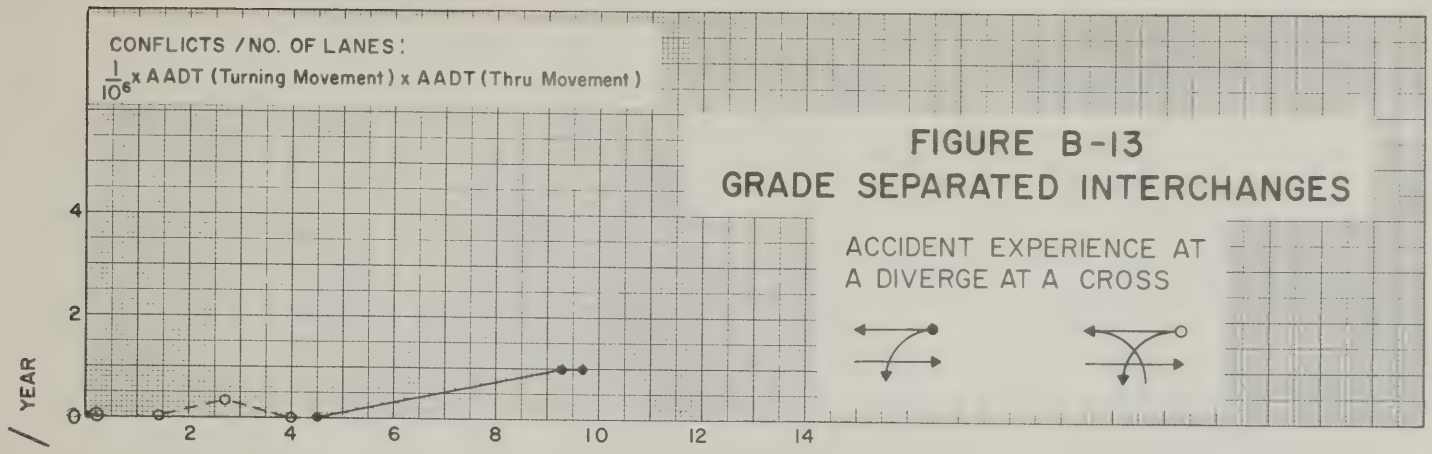


FIGURE B-13
GRADE SEPARATED INTERCHANGES

ACCIDENT EXPERIENCE AT
A DIVERGE AT A CROSS

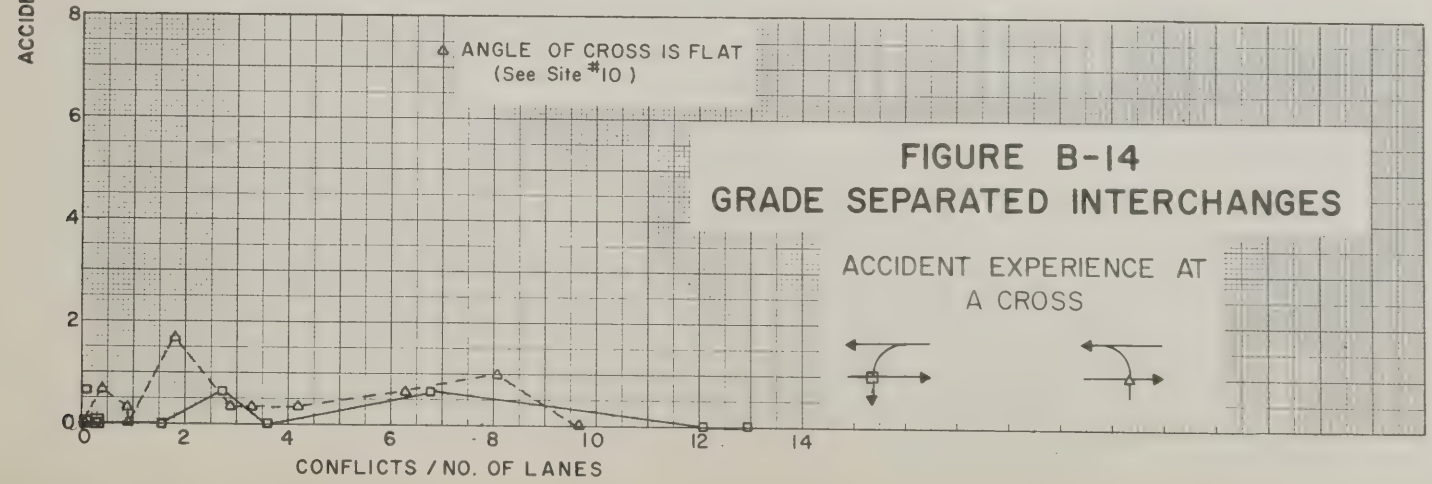


FIGURE B-14
GRADE SEPARATED INTERCHANGES

ACCIDENT EXPERIENCE AT
A CROSS

APPENDIX C

SUMMARY

Methods of comparing intersection designs are numerous and many times subjective. Although a rather simple approach will be presented here, it should be noted that factors such as land costs, land use of abutting properties, and terrain may have more influence on the choice of design than the accident experience of similar designs, vehicle turning movements and travel times.

In this summary, the only distinction made between intersections is the general type of design: cloverleaf, partial cloverleaf, circle, signal, no signal. The refinements of each design are not included, while a basic ranking system for all 30 intersections is presented.

The items covered in the ranking of the intersections are:

1. total volume (Table 1)
2. total turn volume (Table 1)
3. percent of turn volume to total volume (Table 1)
4. total accident rate (Table 1)
5. injury rate (Table 1)
6. unweighted travel times for all movements (Tables 3 and 4)

The final ranking of an intersection is based on the unweighted average of the rankings for a combination of the above mentioned items.

One of these items, the accident rate, is based on the accidents occurring over 2000' of each roadway, hence, includes many accidents unrelated to the particular intersection under study. The proportion of the "unrelated" accidents will be larger for the signalized locations than for the grade-separated interchanges. Another discrepancy exists in exposure. The proportion of traffic movements, both to and from the two roads under study, that are made within 1000' of the actual intersection, are again greater for the signalized locations than for the grade-separated locations. The approach volume used for exposure is only the volume measured at the intersection of the two roads under study. But each of these aspects are peculiar to the individual

designs, i.e., the accident experience along 2000' of signalized and at-grade roads could be expected to be representative of the entire length of the facility, provided the frequency of crossroads and land use were similar. This is in contrast to the partial or full access-controlled roadways on which we find the grade-separated interchanges. On these facilities the accident experience per unit length of road is higher in the interchange areas than along the other sections. Hence, the accident experience indicated in Table 1 may be representative for the signalized roads, but high for the grade-separated roads. In any case, the rates shown are comparisons for similar lengths of roadway.

Table 2 lists particular information on the accidents for each site. This is useful in making the comparison between sites.

Tables 5 and 6 show the study intersection rankings by item, and by order of ranking, respectively.

It is obvious that the cloverleaf is the most efficient, but even this can fail when traffic exceeds a volume which is the capacity of the intersection. Above this volume, the accident and injury rates are very high and the travel times become as great as some of the lesser design types. Grade-separated interchanges with ramps in two quadrants are also quite efficient, following the cloverleaf type. The selection of these two types is a function of the turning movement volume. For instance, the average percentage turning movement for the four cloverleafs studied was 39, whereas it was 16 percent for the 6 partial cloverleafs.

The accident rates, for the traffic circles and signalized intersections studied, were not good. The ten grade separations, on the average, had a

higher percentage of rear-end accidents than did the traffic signals studied, which in turn were higher than the average traffic circle, which was higher than the average non-signalized intersection. Traffic circles had the highest percentage of side-swipe accidents. Non-signalized, simple, right-angle intersections had the highest percentage of right-angle accidents, with the cloverleafs having the smallest percentage.

Although the cloverleaf left turn requires a longer travel distance, the average travel time is still faster than the left turn made by other type designs, except for semi-directional or directional movements. The one example of semi-directional movement indicates that this is up to 20 seconds faster than that for the loop ramp at a cloverleaf. A directional movement would be still faster.

TABLE 1 - RANKINGS OF AADT, TURNS, % TURNS AND ACCIDENT RATES

		1963 AADT		TOT. TURNS				RATE/100 MVM			
		T.VOL.	RK.	VOL.	RK.	%	RK.	ACC.	RK.	INJ.	RK.
CLOVER-LEAFS	RT. 1 & MILLTOWN RD.	48220	12	13200	8	27	16	200	2	85	2
	RT. 1 & RT. 35	59200	8	13800	7	23	17	385	3	220	6
	RT. 1 & RT. 18	83400	3	38600	3	46	5	515	9	220	6
	RT. 4 & RT. 17	123940	1	60120	1	48	3	1555	26	745	26
	TOTAL	314760		125720		39					
PARTIAL CLOVER-LEAFS	RT. 22 & THOMPSON AVE. (1)	44000	14	2800	29	6	30	130	1	35	1
	RT. 9 & RT. 514 (1)	39800	18	11200	12	28	13	425	7	235	9
	RT. 9 & RT. 516 (1)	21300	28	3200	28	15	22	535	11	285	10
	RT. 17 & FARVIEW AVE. (1)	59700	7	12400	10	21	18	400	4	205	5
	RT. 17 & PASSAIC AVE. (1)	66800	4	9200	15	14	24	495	8	225	8
	RT. 22 & BLOY AVE. (1)	85600	2	14000	6	16	20	695	13	290	11
	TOTAL	317200		52800		16					
CIRCLES	RT. 35 & RT. 440	21380	27	7580	21	35	7	1020	18	530	21
	RT. 1 & GREEN ST.	39350	19	11290	11	28	13	1150	20	510	19
	RT. 1 & RT. 130 (1)	41800	17	13200	8	31	9	1510	24	520	20
	RT. 1&9 & BAYWAY	60800	6	10200	13	16	20	1875	28	610	24
	TOTAL	163330		42270		25					
SIGNALS	RT. 22 & VOSSELLER AVE.(2)	38300	20	3800	26	9	29	400	4	195	4
	RT. 1 & RYDERS LA.	42420	16	4400	25	10	27	740	14	480	17
	RT. 1&9T & RT. 440	66200	5	39900	2	60	1	1170	21	640	25
	RT. 31 & OLDEN AVE. (1)	32800	21	10000	14	30	11	520	10	295	12
	RT. 35 & MAIN ST. (1)	25580	26	8560	18	33	8	1100	19	500	18
	RT. 35 & SMITH ST. (1)	30600	23	14400	5	47	4	1240	22	605	23
	RT. 1&9 & STILES ST. (1)	57980	10	9080	16	15	22	1670	27	930	28
	RT. 1&9 & WOOD AVE. (1)	57000	11	7120	22	12	25	1935	29	990	29
	RT. 27 & PLAINFIELD	26640	25	8120	19	30	11	2140	30	1060	30
	RT. 82 & STUYVESANT	32500	22	3700	27	11	26	1550	25	790	27
	RT. 22 & NEW PROVIDENCE (1)	58860	9	6080	23	10	27	660	12	340	14
	RT. 1 & WASHINGTON RD.	30600	23	8800	17	28	13	780	16	380	15
	RT. 130 & CROSSWICKS	43200	15	7800	20	18	19	420	6	160	3
	TOTAL	542680		131760		24					
NO SIGNALS	RT. 516 & HARMONY RD. (1)	6400	30	2000	30	31	9	740	14	410	16
	BROAD ST. & FRONT ST. (1)	11600	29	4800	24	41	6	1500	23	560	22
	RT. 206 & WHITE HORSE (1)	46200	13	26000	4	56	2	850	17	315	13
	TOTAL	64200		32800		51					
	GRAND TOTAL	1402170		385350		27		28285		13,365	
	AVG.	46739		12845		27		943		446	

(1) = 1964 VOLUMES
(2) = 1965 VOLUMES

TABLE 2 - RANKINGS OF TOTAL ACCIDENTS AND ACCIDENTS BY TYPE

		ACC.		REAR END				SIDESWIPE				RT. ANGLE				NIGHT			
		NO.	RK.	NO.	RK.	%	RK.	NO.	RK.	%	RK.	NO.	RK.	%	RK	NO	RK.	%	RK.
CLOVER-LEAFS	RT. 1 & MILLTOWN RD.	40	3	19	3	47	13	4	8	10	17	6	5	15	10	13	4	32	11
	RT. 1 & RT. 35	95	11	59	15	62	26	18	20	18	25	3	2	3	2	39	14	41	23
	RT. 1 & RT. 18	177	20	101	20	57	24	32	26	18	25	2	1	1	1	61	19	34	14
	RT. 4 & RT. 17	799	30	704	30	88	30	17	19	2	6	24	15	3	2	219	30	27	5
	TOTAL	1111		883		79		71		6		35		3		332		29	
PARTIAL CLOVER-LEAFS	RT. 22 & THOMPSON	24	2	6	2	25	2	0	1	0	1	3	2	12	8	8	3	33	12
	RT. 9 & RT. 514	70	6	38	10	54	21	6	11	8	13	14	8	20	15	28	8	40	22
	RT. 9 & RT. 516	47	4	23	4	48	15	5	9	10	17	3	2	6	4	5	1	10	1
	RT. 17 & FARVIEW AVE.	99	12	53	14	53	20	10	15	10	17	24	15	24	20	38	13	38	21
	RT. 17 & PASSAIC AVE.	137	16	70	17	51	18	6	11	4	7	36	20	26	23	33	9	24	4
	RT. 22 & BLOY AVE.	247	24	135	25	54	21	19	22	8	13	55	28	22	18	74	23	30	7
	TOTAL	624		325		52		46		7		135		21		186		29	
CIRCLES	RT. 35 & RT. 440	91	10	24	5	26	3	6	11	6	9	19	11	20	15	48	16	52	29
	RT. 1 & Green St.	188	21	102	21	54	21	53	27	28	29	13	7	6	4	69	20	36	17
	RT. 1 & RT. 130	261	25	74	18	28	5	53	27	20	27	49	25	18	13	57	18	21	3
	RT. 1&9 & BAYWAY	472	29	176	27	37	8	145	30	30	30	87	30	18	13	171	28	36	17
	TOTAL	1012		376		37		257		25		168		16		345		34	
SIGNALS	RT. 22 & VOSSELLER AVE.	64	5	31	8	48	15	5	9	7	11	16	9	25	21	18	6	28	6
	RT. 1 & RYDERS LA.	130	15	92	19	70	28	1	3	1	3	22	14	16	11	41	15	31	10
	RT. 1&9T & RT. 440	321	26	165	26	51	18	66	29	20	27	47	22	14	9	151	26	47	28
	RT. 31 & OLDEN AVE.	71	7	34	9	47	13	3	6	4	7	19	11	26	23	33	9	46	27
	RT. 35 & MAIN ST.	117	14	42	11	35	7	12	16	10	17	31	18	26	23	36	11	30	7
	RT. 35 & SMITH ST.	157	17	59	15	37	8	14	18	8	13	47	22	29	26	87	25	55	30
	RT. 1&9 & STILES ST.	403	27	245	28	60	25	29	24	7	11	40	21	9	6	170	27	42	24
	RT. 1&9 & WOOD AVE.	459	28	288	29	62	26	31	25	6	9	51	26	11	7	208	29	45	26
	RT. 27 & PLAINFIELD AVE.	237	23	103	23	43	11	0	1	0	1	73	29	31	28	86	24	36	17
	RT. 82 & STUYVESANT	209	22	102	21	48	15	18	20	8	13	47	22	22	18	73	22	34	14
	RT. 22 & NEW PROVIDENCE	161	18	116	24	72	29	2	5	1	3	28	17	17	12	56	17	34	14
	RT. 1 & WASHINGTON RD.	99	12	45	12	45	12	12	16	12	21	20	13	20	15	36	11	36	17
	RT. 130 & CROSSWICKS	75	9	24	5	32	6	9	14	12	21	33	19	44	29	25	7	33	12
	TOTAL	2503		1346		53		202		8		474		19		1020		40	
NO SIGNALS	RT. 516 & HARMONY RD.	20	1	0	1	0	1	3	6	15	23	11	6	55	30	6	2	30	7
	BROAD ST. & FRONT ST.	72	8	28	7	38	10	1	3	1	3	18	10	25	21	13	4	18	2
	RT. 206 & WHITE HORSE	163	19	45	12	27	4	26	23	15	23	54	27	33	27	72	21	44	25
	TOTAL	255		73		28		30		11		83		32		91		35	
	GRAND TOTAL	5505		3003		54		606		11		895		16		1974		35	
	AVG.	183.5		100.1				20.2				29.8				65.8			

TABLE 3 - RANKINGS OF MEDIAN TRAVEL TIMES FOR MAJOR ROAD APPROACHES

		6 MIN. LANE VOL.	STRAIGHT (SEC)				RIGHT (SEC)				LEFT (SEC)				AVG.
			MIN	MAX	MED	RK	MIN	MAX	MED	RK	MIN	MAX	MED	RK	RK
CLOVER-LEAFS	RT. 1 & MILLTOWN RD.	5-105	35	40	37	3	35	43	39	3	60	90	75	8	4
	RT. 1 & RT. 35	15-125	35	40	37	3	36	43	40	5	66	74	70	5	3
	RT. 1 & RT. 18	15-145	35	40	37	3	31	39	35	1	65	80	72	7	2
	RT. 4 & RT. 17	35-145	33	45	39	8	35	110	72	22	56	100	78	12	13
	TOTAL	5-145	35	41	37		34	59	46		62	86	74		
PARTIAL CLOVERLEAFS	RT. 22 & THOMPSON	35-105	32	42	37	3	34	44	39	3	69	81	75	8	4
	RT. 9 & RT. 514	25-105	32	38	35	1	66	83	75	24	80	86	83	13	11
	RT. 9 & RT. 516	25-115	36	40	38	7	67	78	72	22	70	70	70	5	8
	RT. 17 & FARVIEW	35-145	36	84	60	18	39	83	61	12	76	98	87	15	15
	RT. 17 & PASSAIC	35-145	35	88	61	20	40	84	62	14	89	115	102	21	20
	RT. 22 & BLOY AVE.	35-145	35	145	90	27	59	80	69	19	94	120	107	25	27
	TOTAL	25-145	34	73	54		51	75	63		80	95	87		
CIRCLES	RT. 35 & RT. 440	15-105	49	49	49	11	42	64	53	10	56	68	62	3	6
	RT. 1 & GREEN ST.	35- 75	40	41	40	9	39	46	42	6	73	81	77	10	7
	RT. 1 & RT. 130	25-115	56	68	62	22	62	68	65	17	80	96	88	16	20
	RT. 1&9 & BAYWAY	35- 75	64	135	100	28	80	122	101	28	100	124	112	26	29
	TOTAL	15-115	52	73	63		56	75	65		77	92	85		
SIGNALS	RT. 22 & VOSSELLER	25-105	42	51	46	10	42	51	46	8	89	99	94	19	10
	RT. 1 & RYDERS LA.	35-115	37	64	50	12	35	50	42	6	92	114	103	22	12
	RT. 1&9T & RT. 440	25-135	70	100	85	26	51	77	64	16	80	160	120	28	26
	RT. 31 & OLDEN AVE.	15- 45	52	71	61	20	55	80	67	18	62	72	67	4	13
	RT. 35 & MAIN ST.	15- 45	54	63	58	16	73	85	79	26	80	102	91	17	23
	RT. 35 & SMITH ST.	15- 85	63	140	101	29	78	140	109	29	100	142	121	29	30
	RT. 1&9 & STILES ST.	25- 75	45	75	60	18	55	68	61	12	69	115	92	18	17
	RT. 1&9 & WOOD ST.	25- 85	48	67	57	15	59	81	70	20	55	99	77	10	15
	RT. 27 & PLAINFIELD	15- 55	65	71	68	23	74	79	76	25	79	89	84	14	25
	RT. 82 & STUYVESANT	35-105	86	116	101	29	80	149	114	30	-	-	-	-	23
	RT. 22 & NEW PROVIDENCE	55-145	41	71	56	13	53	74	63	15	101	122	111	27	20
	RT. 1 & WASHINGTON RD.	15- 85	47	65	56	13	44	96	70	20	79	120	100	20	19
	RT. 130 & CROSSWICKS	25- 75	44	54	59	17	50	62	56	11	100	106	103	22	18
	TOTAL	15-145	53	78	66		58	84	71		82	112	97		
NO SIGNALS	RT. 516 & HARMONY RD.	5- 45	33	40	36	2	37	38	37	2	31	43	37	1	1
	BROAD & FRONT STS.	25- 65	75	85	80	25	94	101	97	27	102	106	104	24	28
	RT. 206 & WHITE HORSE	35- 95	57	80	68	23	44	60	52	9	38	43	40	2	8
	TOTAL	5- 95	55	68	61		58	66	62		57	64	60		

TABLE 4 - RANKINGS OF MEDIAN TRAVEL TIMES FOR MINOR ROAD APPROACHES

		6 MIN. LANE VOL.	STRAIGHT (SEC)				RIGHT (SEC)				LEFT (SEC)				AVG.
			MIN	MAX	MED	RK	MIN	MAX	MED	RK	MIN	MAX	MED	RK	RK
CLOVER-LEAFS	RT. 1 & MILLTOWN RD.	5-105	35	40	37	1	35	43	39	2	60	90	75	11	5
	RT. 1 & RT. 35	15-125	35	40	37	1	36	43	40	3	66	74	70	5	2
	RT. 1 & RT. 18	15-145	35	40	37	1	31	39	35	1	65	80	72	7	2
	RT. 4 & RT. 17	45-125	31	107	69	12	35	130	77	14	60	125	92	17	14
	TOTAL	5-145	34	57	45		34	64	48		63	92	77		
PARTIAL CLOVERLEAFS	RT. 22 & THOMPSON	5- 35	50	54	52	7	52	62	57	7	74	74	74	10	7
	RT. 9 & RT. 514	25- 85	45	54	50	5	56	58	57	7	74	80	77	13	8
	RT. 9 & RT. 516	25-105	40	45	43	4	40	45	42	4	59	66	62	2	4
	RT. 17 & FARVIEW	25- 75	47	52	50	5	-	-	-	-	61	72	66	3	1
	RT. 17 & PASSAIC	25- 65	61	71	66	11	71	86	78	15	84	105	95	20	16
	RT. 22 & BLOY	5- 95	59	91	75	13	56	117	86	20	91	100	95	20	20
	TOTAL	5-105	50	61	56		55	74	64		74	83	78		
CIRCLES	RT. 35 & RT. 440	15-115	51	66	58	8	42	64	53	6	62	92	77	12	9
	RT. 1 & GREEN ST.	25- 65	77	82	80	16	45	45	45	5	66	76	71	6	11
	RT. 1 & RT. 130	15- 55	75	83	79	15	54	60	57	7	96	96	96	23	15
	RT. 1&9 & BAYWAY	15- 85	110	140	125	28	99	105	102	25	117	133	125	29	30
	TOTAL	15-115	78	93	85		60	68	64		85	99	92		
SIGNALS	RT. 22 & VOSSELLER	5- 25	94	95	95	22	78	80	79	16	72	73	73	8	16
	RT. 1 & RYDERS LA.	5- 75	80	100	90	20	70	90	80	17	70	90	80	14	19
	RT. 1&9T & RT. 440	35- 75	80	115	97	23	60	106	83	19	80	132	106	25	22
	RT. 31 & OLDEN AVE.	15- 45	52	71	61	10	55	80	67	12	62	72	67	4	9
	RT. 35 & MAIN ST.	15- 35	100	105	102	26	91	112	101	24	85	100	92	17	22
	RT. 35 & SMITH ST.	15-105	79	82	80	16	101	105	103	27	99	114	106	25	26
	RT. 1&9 & STILES ST.	15- 45	94	108	101	25	84	100	92	22	78	112	95	20	22
	RT. 1&9 & WOOD ST.	5- 65	106	120	113	27	98	110	104	28	101	106	103	24	28
	RT. 27 & PLAINFIELD	25- 95	66	91	78	14	76	85	80	17	79	86	82	16	18
	RT. 82 & STUYVESANT	15- 85	124	159	141	30	95	154	125	29	-	-	-	-	21
	RT. 22 & NEW PROVIDENCE	15- 65	96	156	126	29	99	100	100	23	92	130	111	28	29
	RT. 1 & WASHINGTON	15-105	76	107	91	21	72	103	87	21	89	124	106	25	22
	RT. 130 & CROSSWICKS	5- 35	78	96	87	19	53	61	57	7	79	82	80	14	13
	TOTAL	5-105	86	108	97		80	99	89		82	102	92		
NO SIGNALS	RT. 516 & HARMONY	5- 35	58	61	60	9	54	60	57	7	54	59	56	1	6
	BROAD & FRONT STS.	15- 95	95	105	100	24	90	115	102	25	70	118	94	19	26
	RT. 206 & WHITE HORSE	25- 95	50	120	85	18	72	80	76	13	68	79	73	8	12
	TOTAL	5- 95	68	95	82		72	85	78		64	84	74		

TABLE 5 - RANKING OF ALL SITES

		1	2	3	4	5	6	COMBINED RANK							
		VOL.	TURN VOL.	TURN %	ACC RATE	INJ RATE	TRAV TIME	(123456) TOT.	(123456) RK.	(1246) TOT.	(1246) RK.	(246) TOT.	(246) RK.	(1256) TOT.	(1256) RK.
CLOVER-LEAFS	RT. 1 & MILLTOWN RD.	12	8	16	2	2	4	44	3	26	3	14	3	26	3
	RT. 1 & RT. 35	8	7	17	3	6	2	43	2	20	2	12	2	23	2
	RT. 1 & RT. 18	3	3	5	9	6	1	27	1	16	1	13	1	13	1
	RT. 4 & RT. 17	1	1	3	26	26	14	71	7	42	5	41	10	42	6
PARTIAL CLOVERLEAFS	RT. 22 & THOMPSON	14	29	30	1	1	5	80	11	49	10	35	7	49	9
	RT. 9 & RT. 514	18	12	13	7	9	10	69	6	47	9	29	5	49	9
	RT. 9 & RT. 516	28	28	22	11	10	6	105	20	73	20	45	15	72	17
	RT. 17 & FARVIEW	7	10	18	4	5	8	52	4	29	4	22	4	30	4
	RT. 17 & PASSAIC	4	15	24	8	8	18	77	8	45	6	41	10	45	8
	RT. 22 & BLOY	2	6	20	13	11	25	77	8	46	8	44	14	44	7
CIRCLES	RT. 35 & RT. 440	27	21	7	18	21	7	101	17	73	20	46	16	76	23
	RT. 1 & GREEN ST.	19	11	13	20	19	9	91	14	59	14	40	9	58	12
	RT. 1 & RT. 130	17	8	9	24	20	17	95	15	66	16	49	18	62	15
	RT. 1&9 & BAYWAY	6	13	20	28	24	30	121	25	77	23	71	27	73	18
SIGNALS	RT. 22 & VOSSELLER	20	26	29	4	4	13	96	16	63	15	43	13	63	16
	RT. 1 & RYDERS LA.	16	25	27	14	17	15	114	24	70	17	54	21	75	21
	RT. 1&9T & RT. 440	5	2	1	21	25	26	80	11	54	11	49	18	58	12
	RT. 31 & OLDEN AVE.	21	14	11	10	12	12	80	11	57	13	36	8	59	14
	RT. 35 & MAIN ST.	26	18	8	19	18	24	113	23	87	27	61	23	86	27
	RT. 35 & SMITH ST.	23	5	4	22	23	29	106	21	79	25	56	22	80	25
	RT. 1&9 & STILES ST.	10	16	22	27	28	19	122	26	72	19	62	24	73	18
	RT. 1&9 & WOOD ST.	11	22	25	29	29	21	137	29	83	26	72	28	83	26
	RT. 27 & PLAINFIELD	25	19	11	30	30	21	136	28	95	28	70	26	95	28
	RT. 82 & STUYVESANT	22	27	26	25	27	23	150	30	97	29	75	29	99	29
	RT. 22 & NEW PROVIDENCE	9	23	27	12	14	27	112	22	71	18	62	24	73	18
	RT. 1 & WASHINGTON RD.	23	17	13	16	15	20	104	19	76	22	53	20	75	21
	RT. 130 & CROSSWICKS	15	20	19	6	3	15	78	10	56	12	41	10	53	11
NO SIGNALS	RT. 516 & HARMONY RD.	30	30	9	14	16	3	102	18	77	23	47	17	79	24
	BROAD & FRONT STS.	29	24	6	23	22	28	132	27	104	30	75	29	103	30
	RT. 206 & WHITE HORSE	13	4	2	17	13	11	60	5	45	6	32	6	41	5

TABLE 6 - RANKING OF ALL SITES

(1,2,3,4,5,6)		(1,2,4,6)		(2,4,6)		(1,2,5,6)	
INTERSECTION	RK.	INTERSECTION	RK.	INTERSECTION	RK.	INTERSECTION	RK.
RT. 1 & RT. 18	1	RT. 1 & RT. 18	1	RT. 1 & RT. 18	1	RT. 1 & RT. 18	1
RT. 1 & RT. 35	2	RT. 1 & RT. 35	2	RT. 1 & RT. 35	2	RT. 1 & RT. 35	2
RT. 1 & MILLTOWN	3	RT. 1 & MILLTOWN	3	RT. 1 & MILLTOWN	3	RT. 1 & MILLTOWN	3
RT. 17 & FARVIEW	4	RT. 17 & FARVIEW	4	RT. 17 & FARVIEW	4	RT. 17 & FARVIEW	4
RT. 206 & WH. HORSE	5	RT. 4 & RT. 17	5	RT. 9 & RT. 514	5	RT. 206 & WH. HORSE	5
RT. 9 & RT. 514	6	RT. 206 & WH. HORSE	6	RT. 206 & WH. HORSE	6	RT. 4 & RT. 17	6
RT. 4 & RT. 17	7	RT. 17 & PASSAIC	6	RT. 22 & THOMPSON	7	RT. 22 & BLOY	7
RT. 22 & BLOY	8	RT. 22 & BLOY	8	RT. 31 & OLDEN	8	RT. 17 & PASSAIC	8
RT. 17 & PASSAIC	8	RT. 9 & RT. 514	9	RT. 1 & GREEN	9	RT. 22 & THOMPSON	9
RT. 130 & CROSSWICKS	10	RT. 22 & THOMPSON	10	RT. 4 & RT. 17	10	RT. 9 & RT. 514	9
RT. 31 & OLDEN	11	RT. 1&9T & RT. 440	11	RT. 17 & PASSAIC	10	RT. 130 & CROSSWICKS	11
RT. 22 & THOMPSON	11	RT. 130 & CROSSWICKS	12	RT. 130 & CROSSW'KS	10	RT. 1&9T & RT. 440	12
RT. 1&9T & RT. 440	11	RT. 31 & OLDEN	13	RT. 22 & VOSSELLER	13	RT. 1 & GREEN	12
RT. 1 & GREEN	14	RT. 1 & GREEN	14	RT. 22 & BLOY	14	RT. 31 & OLDEN	14
RT. 1& RT. 130	15	RT. 22 & VOSSELLER	15	RT. 9 & RT. 516	15	RT. 1 & RT. 130	15
RT. 22 & VOSSELLER	16	RT. 1 & RT. 130	16	RT. 35 & RT. 440	16	RT. 22 & VOSSELLER	16
RT. 35 & RT. 440	17	RT. 1 & RYDERS	17	RT. 516 & HARMONY	17	RT. 9 & RT. 516	17
RT. 516 & HARMONY	18	RT. 22 & NEW PROV.	18	RT. 1 & RT. 130	18	RT. 1&9 & STILES	18
RT. 1 & WASHINGTON	19	RT. 1&9 & STILES	19	RT. 1&9T & RT. 440	18	RT. 22 & NEW PROV.	18
RT. 9 & RT. 516	20	RT. 9 & RT. 516	20	RT. 1 & WASHINGTON	20	RT. 1&9 & BAYWAY	18
RT. 35 & SMITH	21	RT. 35 & RT. 440	20	RT. 1 & RYDERS LA.	21	RT. 1& WASHINGTON	21
RT. 22 & NEW PROV.	22	RT. 1&9 & WOOD	22	RT. 35 & SMITH	22	RT. 1 & RYDERS LA.	21
RT. 35 & MAIN	23	RT. 1&9 & BAYWAY	23	RT. 35 & MAIN	23	RT. 35 & RT. 440	23
RT. 1 & RYDERS LA.	24	RT. 516 & HARMONY	23	RT. 22 & NEW PROV.	24	RT. 516 & HARMONY	24
RT. 1&9 & BAYWAY	25	RT. 35 & SMITH	25	RT. 1&9 & STILES	24	RT. 35 & SMITH	25
RT. 1&9 & STILES	26	RT. 1 & WASHINGTON	26	RT. 27 & PLAINF'LD	26	RT. 1&9 & WOOD	26
BROAD & FRONT STS	27	RT. 35 & MAIN	27	RT. 1&9 & BAYWAY	27	RT. 35 & MAIN	27
RT. 27 & PLAINF'LD	28	RT. 27 & PLAINFIELD	28	RT. 1&9 & WOOD	28	RT. 27 & PLAINFIELD	28
RT. 1&9 & WOOD	29	RT. 82 & STUYVESANT	29	RT. 82 & STUYVESANT	29	RT. 82 & STUYVESANT	29
RT. 82 & STUYVESANT	30	BROAD & FRONT STS.	30	BROAD & FRONT STS	29	BROAD & FRONT STS	30

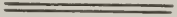
APPENDIX D

LEGEND FOR PHYSICAL FEATURES PLAN

Grass Area 

Mast Arm Signal Installation 

Signal Installation on Pole 

Curbing 

Curb Opening 

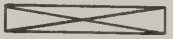
Edge of Shoulder

Edge of Pavement 

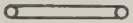
Light Pole 

Public Utility Pole 

Public Utility Pole with Light 

8 Ft. Pressure Vehicle Detector 

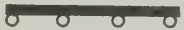
Catch Basin 

Gantry Sign 

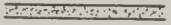
Edge of Woods 

Transmission Tower 

Fence 

Guardrail 

Concrete Median 

Median Barrier 

Land Use - Com. - Commercial Development
Und. - Undeveloped
Vac. - Vacant
Res. - Residential
Shp. Ctr. - Shopping Center
Ind. - Industrial

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