cameras has provided an accurate and efficient method for obtaining information on driver-reaction and traffic movements. It has made possible the recording of sufficient data to define the actual paths of vehicles, even at locations where they are made to swerve to avoid apparent traffic hazards. It is hoped that the procedures which have been described can be used to add to the information already available, for use by design engineers and traffic engineers, in the advancement of highway safety.

Acknowledgments

The writer wishes to thank Mr. Warren S. Quimby and Mr. Walter B. Wilson, members of the Joint Highway Research Staff, for their help in developing these methods for obtaining traffic data. Some of the equipment was designed and constructed by Mr. Quimby, and Mr. Wilson helped to establish the accuracy of the data by developing direct comparisons with data obtained by other methods. Mr. R. E. Peterson, staff photographer aided in the photographic work, and is responsible for the illustrations using superimposed negatives.

PURPOSE, ANALYSIS AND APPLICATION, ORIGIN AND DESTINATION SURVEY, MILWAUKEE METROPOLITAN AREA

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Department of Public Works,
City of Milwaukee

SYNOPSIS

Costly traffic delays, congestion, and hazards exist in Milwaukee as in other urban areas. The installation of traffic signals has paralleled motor vehicle registration. Few of these installations help traffic flow but rather retard it in the interest of safety. New routes are being constructed with center parkways, streets are being widened, etc., but the accident rate does not decline and there is still serious congestion.

Speeds on existing arterial streets and expressways were studied. Downtown speeds averaged 10 mph in a zone with a 25 mph speed limit while expressway speeds averaged 31.5 mph in a 30 mph zone. A check on specific sections of downtown arterial streets and a section of expressway carrying similar traffic but with no cross traffic, showed the expressway to have the very significant advantages of a 2½ to 1 speed ratio, a 1 to 20 accident ratio, and a 1 to 30 injury ratio.

The cost of operation of motor vehicles in traffic was studied. A check disclosed that the average Milwaukee driver makes approximately four stops and loses 56 sec. in each mile of downtown artery travel. At 25 mph a vehicle making no stops gets 6 mi per gal more mileage than one making four stops.

The Milwaukee origin and destination survey was undertaken to determine if expressways would be economically justifiable by the volumes of traffic expected. For computing comparative data between expressways and improved existing streets a speed ratio of 2 to 1 (35 to 17.5 mph) was chosen and a minimum volume to justify expressway construction was established as 30,000 vehicles per day.

Several alternate north-south routes were studied in detail and three were determined to be adequate for the needs of traffic. Other considerations such as right of way cost, the existence of an adequate bridge etc. led to the selection of one route (over Sixteenth St.) for the principal north-south artery. The east-west route was chosen (over Highland Ave.) in the same manner. A belt route around the downtown business area and radiating feeders to interregional highways etc. are also recommended.

Milwaukee, as most other cities, owes its location to the fact that it was a logical transportation center for water-borne traffic. The city's three rivers provided a natural harbor where passengers and cargoes could be transferred from ship to land transport. Railroads were built to connect the interior with lake shipping and soon superseded water transportation, except for large bulk cargo shipments, such as coal and gasoline.

Today, automobile and motor transport have supplemented both of those systems to such an extent that they are now one of the most essential factors in our cultural and economic life and at the same time one of our greatest problems. This means of transportation has been superimposed upon a street and highway system inadequate for the purpose and now presents a situation of immense volumes of passenger automobiles, delivery trucks, transport trucks, buses, street cars, and pedestrians intercepting similar substantial volumes on the same level at frequent intervals.

Even between intersections, a smooth flow of traffic rarely occurs as automobiles and trucks back into and come out of parking spaces, driveways, and alleys, while public transportation vehicles load and discharge passengers—often at the expense of all other moving traffic.

For 25 years Milwaukee has most diligently and intensively applied the familiar three E's (Engineering, Enforcement, and Education) to this ever-increasing problem. The Milwaukee Safety Commission, organized as far back as 1920, has done an oustanding job in coordinating those activities and keeping Milwaukee well out in front in the traffic safety field.

Traffic signals have been installed at most of the important intersections and at many unimportant ones, the rate of installation practically paralleling the increase in motor vehicle registration, with more installations contemplated as soon as materials are available. Relatively few of those new installations, however, will help vehicle traffic flow, and in many instances will actually retard it to favor safety. The conflict between traffic safety and facility is definitely making itself felt more and more. Most main traffic thoroughfares already have clusters of traffic signals in the business districts bordering those highways, many of which are hindrances to moving traffic. The removal of those controls is virtually impossible because of local business and pedestrian demands. Unfortunately, many planning and city officials still think that no matter what the block lengths, spacings between signals, roadway widths, or traffic volumes, full street capacity at any desired speed is possible if the traffic signals are properly synchronized.

Large numbers of traffic or safety islands have been installed in the Milwaukee Area, probably on a greater scale than in any other American city. It is a well-known fact that at many intermediate intersections between signalized locations vehicle traffic flows constantly in one direction or the other, and the pedestrian is at a great disadvantage. Traffic islands for pedestrians have been installed at such intersections so that pedestrians can leave the curb when there is a break in the traffic flow on the near half of the roadway and cross in safety to the traffic island, wait there until a similar break in traffic occurs in the opposite direction. Also at signalized intersections, extensive use has been made of the traffic island as a place of refuge for pedestrians caught between traffic light changes, as well as to channelize vehicular traffic.

All new important traffic arteries are being constructed with center parkways wherever it is possible to do so, in order to separate traffic moving in opposite directions. Roadways and streets are being widened at a rapid rate to relieve congestion.

Milwaukee also has a fine Police Department, good safety education and publicity, and excellent engineering and construction cooperation. In fact, all of the three E's have been liberally applied in Milwaukee so that the community ought to be able to look forward to the traffic safety which is to be desired.

In conjunction with the trip data to be obtained in the Origin and Destination Survey, it was decided for purposes of comparison to make a study of the travel conditions then existing. The most important of all travel considerations is traffic safety, and the gauge most often used for comparative purposes is the number of motor vehicle traffic fatalities per 100,000 population or per 10,000 registered motor vehicles. Figure 1 shows Milwaukee's traffic fatalities compared with motor vehicle registration over a 25-yr period. It will be noted that from 1921 through 1926, the motor vehicle fatalities increased in direct proportion to the motor vehicle registration; then from 1926 through 1938 (a period of 12 yr), the annual motor vehicle fatalities steadily decreased while the motor vehicle registration steadily increased. That amounted to a drop in motor vehicle fatalities from a peak of 115 in 1926 to 41 in 1938 (a decrease of almost two-thirds) with an all-time low of 31 in 1944, which was a year of many travel restrictions. From 1938 to and including 1946, however, The leveling off of the fatality rate since 1938 is very vividly shown and the trend is unmistakable. With our present techniques it is certainly indicated that Milwaukee has about reached an irreducible minimum rate in motor vehicle fatalities on a registration basis.

The trends in three other cities and also

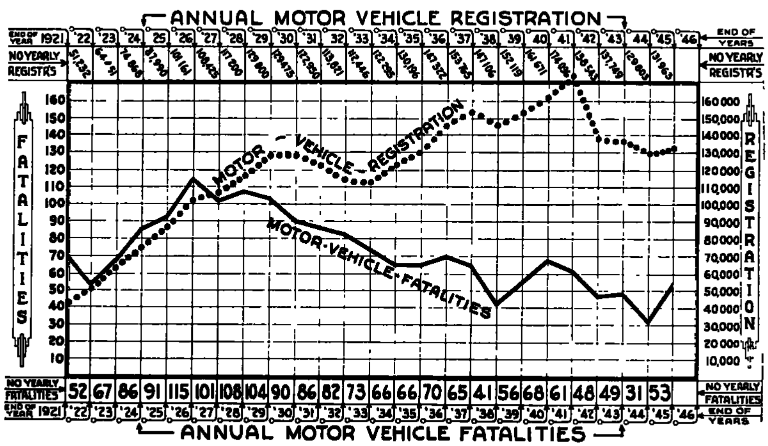

Figure 1. Motor Vehicle Registration and Fatalities—Milwaukee, Wis.

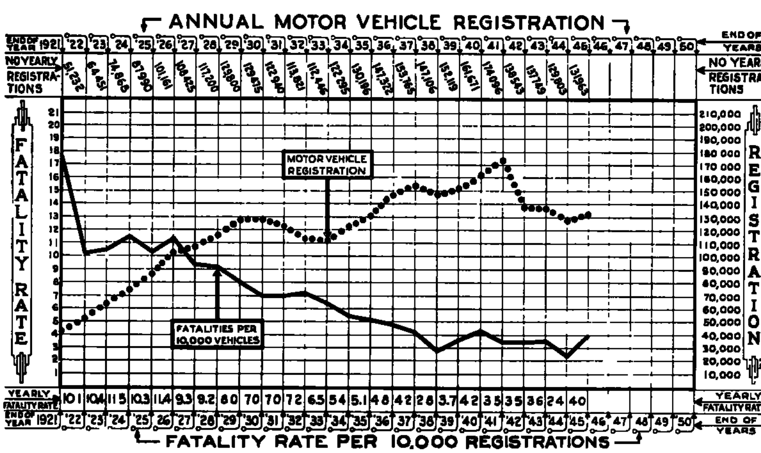

Figure 2

there has been no further downward trend, in fact, the average for these years is considerably higher than the 1938 figure.

The best comparison, however, is shown on the motor vehicle registration rate basis in Figure 2 where the motor vehicle fatality rate in fatalities per 10,000 registered vehicles is compared with the motor vehicle registration.

in the national average for a period of 15 yr are shown in Figure 3. This shows not only a leveling off of the traffic fatality curves in all of those cities in recent years, the same as in Milwaukee, but there is also a close grouping around the national average as safety efforts and practices have become more intensified and uniform in the various cities. It is definitely indicated that the national average is also heading toward an irreducible minimum of not less than ten fatalities to 100,000 population.

Conceivably, travelling speeds could, of course, be drastically reduced but such a move would be extremely unpopular and would greatly nullify the advantages of using an automobile. It appears, therefore, that under existing conditions where safety depends primarily on the regard of motorists and pedestrians for the welfare of one another and has the extremely variable human factor as the foundation of safety progress, the limits have very nearly been reached. Traffic conditions arouse different responses in different individuals. To some persons the noises, sudden movements, and volumes of traffic are stimuli for redoubled caution. Others confronted by those same conditions, consciously or otherwise undergo severe nervous tension and mental strain.

The second item checked was the travel time or equivalent average overall speeds on arterial streets ranging from the congested conditions in the central retail area to the relatively free-flowing traffic on Lake Shore Drive, S. Chase Ave., and on the viaducts over the Menomonee Valley. All test runs were made in non-hazardous weather and were approximately equally divided between rush-hour and non-rush-hour trips. Figure 4 shows the results of those checks, with speeds on streets in the central business area averaging 10 mi per hr with a 25-mi per hr speed limit to the other extreme of over 31.5 mi per hr on the 35th St. Viaduct and S. Chase Ave, both of which have 30-mi speed limits and expressway characteristics in many respects. The average speed of all trips on all streets for the entire arterial system was 17.5 mi per hr. With the anticipated increase in postwar traffic, that average speed may decrease.

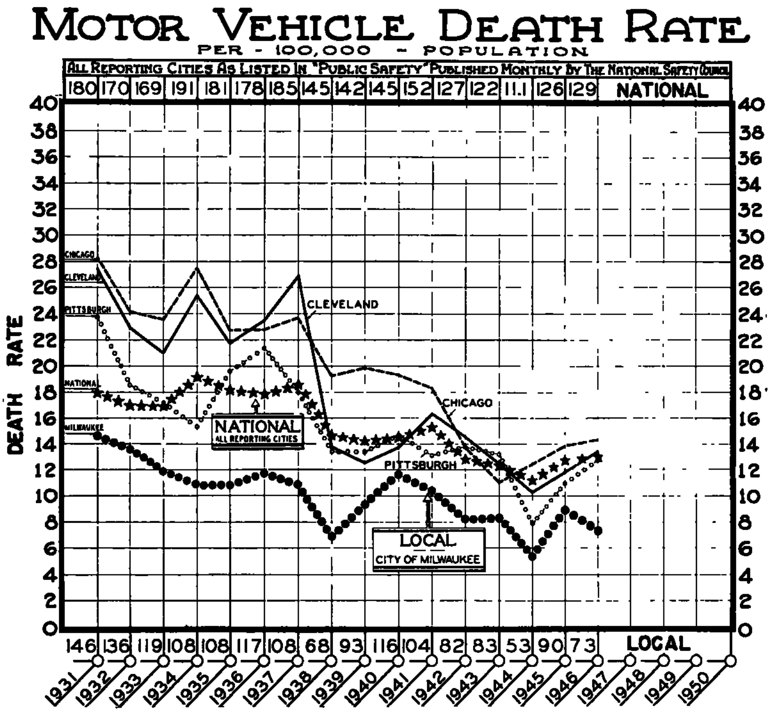

Figure 3

The higher maintained speeds on the streets with expressway characteristics led to an investigation and comparison of the accident record of those streets with that of standard city streets with intersecting cross traffic. Thirty-fifth St. offered an unusual opportunity

FLOATING SPEED CHECK
PASSENGER CARS

RUSH AND NON-RUSH HOUR COMBINED; ALL DELAYS INCLUDED

OCTOBER 1945 TO MARCH 1946 — 343 NON-RUSH HOUR TRIPS (9 AM TO 4 PM) 325 RUSH HOUR TRIPS (7-9 AM & 4-6 PM). 73.50 MILES OF ROADWAY. — NON-HAZARDOUS WEATHER

* DENOTES STREETS POSTED WITH 30 M.P.H. SIGNS. ALL OTHER STREETS 25 M.P.H.-NOT POSTED WITH SIGNS.

NO.	STREET	DESCRIPTION	AVERAGE SPEED
*1	35TH ST. VIADUCT	NORTH END TO SOUTH END	31.6 M.P.H.
*2	S. CHASE AVENUE	S. 4TH ST. TO E. MANITOBA ST.	31.5 M.P.H.
*3	LINCOLN MEMORIAL DR.	NORTH END TO SOUTH END	28.6 M.P.H.
*4	27TH ST. VIADUCT	NORTH END TO SOUTH END	27.9 M.P.H.
*5	16TH ST. VIADUCT	NORTH END TO SOUTH END	25.3 M.P.H.
*6	S. 27TH STREET	W. EVERGREEN LANE TO W. EUCLID AV.	24.2 M.P.H.
*7	E. & W. CAPITOL DR.	N. PIERCE ST TO N 38TH ST.	22.6 M.P.H.
8	6TH ST. VIADUCT	NORTH END TO SOUTH END	22.1 M.P.H.
9	S. 6TH ST.-S. CHASE-S. HOWELL AV.	SOUTH END OF VIADUCT TO E LAYTON AV.	22.1 M.P.H.
10	W. ST. PAUL AVENUE	N. 7TH ST. TO N. 28TH ST.	22.1 M.P.H.
11	W. CLYBOURN STREET	N. 7TH ST. TO N 28TH ST.	21.3 M.P.H.
12	N. PROSPECT AVENUE	N. MARYLAND AV. TO N. MARSHALL ST.	20.8 M.P.H.
*13	E. & W. OKLAHOMA AVE.	S. PINE AV. TO S. 28TH ST.	20.7 M.P.H.
14	N. HOLTON ST.-N. VAN BUREN ST.	E CAPITOL DR. TO E. WISCONSIN AV.	19.3 M.P.H.
15	W. WISCONSIN AVENUE	N. 11TH ST. TO N. 36TH ST.	19.2 M.P.H.
16	W. CENTER STREET	N. 2ND ST. TO N 36TH ST.	18.9 M.P.H.
17	W HIGHLAND AVENUE	N. 8TH ST. TO N. 29TH ST.	18.6 M.P.H.
18	E. & W. LINCOLN AVENUE	S. MOUND ST TO S. 28TH ST.	18.6 M.P.H.
19	W. NORTH AVENUE	N. 2ND ST. TO N. 49TH ST.	18.1 M.P.H.
20	S. 1ST ST.-S. KINNICKINNIC AV.	E. SEEBOTH ST. TO S. CLEMENT AV.	18.0 M.P.H.
21	W NATIONAL AVENUE	S. BARCLAY ST. TO S. 37TH ST.	17.4 M.P.H.
22	N. 20TH STREET	W. HADLEY ST. TO W. KILBOURN AV.	17.3 M.P.H.
23	E & W KILBOURN AVE.	N. JEFFERSON ST. TO N. 8TH ST.	17.0 M.P.H.
24	N. TEUTONIA AV.-N. 12TH ST.	W LOCUST ST. TO W WELLS ST.	16.8 M.P.H.
25	E. & W. STATE STREET	N. JEFFERSON ST. TO N. 8TH ST.	16.2 M.P.H.
26	N. 27TH STREET	W. HADLEY ST. TO W. ST PAUL AV.	15.7 M.P.H.
27	N. 7TH ST-N. 8TH ST.	W. HADLEY ST. TO W CLYBOURN ST.	15.7 M.P.H.
28	N. MILWAUKEE ST.-E PITTSBURGH AV.	E HIGHLAND AV. TO S. 1ST ST.	15.6 M.P.H.
29	W. VLIET STREET	N 9TH ST TO N. 28TH ST.	15.4 M.P.H.
30	S. 16TH STREET	S. END OF VIADUCT TO W. WINDLAKE AV.	15.3 M.P.H.
31	N. GREEN BAY AV.-N. 3RD ST.	N. 7TH ST. TO W MICHIGAN ST.	14.2 M.P.H.
32	N. 16TH STREET	W. LLOYD ST. TO N. END OF VIADUCT	13.9 M.P.H.
33	W. FOND DU LAC AVENUE	W. WALNUT ST. TO N. 36TH ST.	13.8 M.P.H.
34	E. & W. JUNEAU AVENUE	N. JEFFERSON ST. TO N. 8TH ST.	13.7 M.P.H.
35	N. 35TH STREET	W. LISBON AV. TO N. END OF VIADUCT	13.4 M.P.H.
36	N. PLANKINTON AV.-S. 2ND ST.	W. HIGHLAND AV. TO W. PITTSBURGH AV.	12.9 M.P.H.
37	N. WATER STREET	E. HIGHLAND AV TO E. SEEBOTH ST	11.7 M.P.H.
38	N. 6TH STREET	W. VLIET ST. TO N. END OF VIADUCT	11.2 M.P.H.
39	E & W. CLYBOURN STREET	N. JEFFERSON ST. TO N. 8TH ST.	10.4 M.P.H.
40	E. & W. MICHIGAN STREET	N. JEFFERSON ST. TO N. 8TH ST.	10.3 M.P.H.
41	E. & W. WISCONSIN AVENUE	N. JEFFERSON ST. TO N. 8TH ST.	9.3 M.P.H.

NOTE: NUMBERS [1] THRU [3] ARE LOCAL EXAMPLES APPROACHING EXPRESSWAY CHARACTERISTICS

AVERAGE OF ALL ROUTES 17.5 MILES PER HOUR

SCALE: 0 5 10 MILES PER HOUR

Figure 4

for traffic accident and injury comparisons. The accident record of the 35th St. Viaduct (which is ⅝ mi in length) was compared with contiguous sections of 35th St. carrying approximately the same amount and kind of traffic but intercepted at frequent intervals by cross traffic and with the usual street parking interferences. Comparison of the accident, injury, and fatality records showed astounding differences. Comparisons of two of these standard city street sections with the viaduct section for the year 1941 are shown in Figure 5 and Table 1. These facts surely indicate that a key to greater traffic safety, as well as facility, appears to have been found.

With an accident ratio of 20 to 1, an injury ratio of 30 to 1, and a speed ratio of 1 to 2½ on the standard street sections compared to the viaduct section, it appears that better basic travel conditions at least for the most important major arterial traffic should be sought. Anything that the three E's have accomplished thus far does not come close to such figures and the future certainly holds forth very little encouragement that such figures can ever be approached, unless cross-traffic interference is eliminated. Two objects cannot occupy the same space at the same time, and when competition for that space is largely based on human judgment and behavior, accidents appear to be inevitable.

A further check also shows that the limited-access highway has proven highly successful in a number of metropolitan areas. The six-lane depressed Davison Expressway through Highland Park in Detroit carries over 32,000 vehicles per day expeditiously and safely and will connect with a 34-mi system of expressways proposed in that city. New York has an extensive system of expressways, parkways, tunnels, and bridges, while in California between Los Angeles and Pasadena, the Arroyo Seco Parkway is in operation with similar success. A comparison of traffic accidents and travel speeds on the latter with the corresponding performance on Figueroa Street at ground level shows the very decided advantages of expressway design. As indicated in Figure 6, injury accidents on a vehicle-mile basis on the Arroyo Seco Parkway in 1941 were only one-tenth as numerous as on Figueroa St. in Los Angeles. On this expressway, traffic moves at an average speed of better than 40 mph as compared to a little more than 17 mph on Figueroa St. It is, therefore, apparent that present types of city thoroughfares alone cannot provide a satisfactory degree of safety for large volumes of motorists and pedestrians because of the multiplicity of movements to be performed in the same place at the same time. By contrast, wherever traffic operations are simple and without conflicting traffic movements or turbulence, an improvement in safety is the result.

A check was also made on the cost of operation of motor vehicles. Owing to the frequent stopping and starting of motor vehicles while being driven in urban areas, the cost of operation is substantially higher than in rural areas. In order to determine the number of stops which motorists normally made while driving on local traffic arteries, the operation of numerous vehicles was checked and the stops and delays recorded. This traffic flow interruption study disclosed that the average Milwaukee driver makes nearly four (3.8) stops per mi and that in each such mile he loses an average of 56 sec, or almost one min in stops because of traffic congestion and controls, public transit vehicles, and pedestrians.

TABLE 1

	Accidents	Injuries	Fatalities	Average Speed
				mi per hr
Street Section A	142	30	1	13 5
Street Section B	143	32	0	13.5
Viaduct Section	7	1	0	31 8

The effect of stops and starts on the gasoline requirements of an average type of passenger car at various speeds is shown in Figure 7 which was developed by Iowa State College. At a speed of 25 mph and four stops the mileage obtained was nearly six mi per gal less than it was with no stops. When the speed was 30 mph, the mileage was seven mi per gal less with four than with no stops. To the loss of gasoline mileage must be added the extra wear and tear on tires and the engine, caused by four stops and accelerations in each mile. Combining the costs of gasoline and tires, the Iowa State College tests show that stop-and-go driving costs two and two-thirds times as much as driving at a steady maintained speed. Costs of interrupted driving would register still higher if a value were placed on the driver's time and that of the vehicle, as should be done, at least in the case of commercial operations.

Street widening, intersection control, one-way streets, traffic islands, and the other usual improvements intended to solve the traffic problem appear to be but minor and temporary expedients and are merely putting off the day when more drastic solutions and methods will have to be put into effect.

The by-passing of traffic approaching a city was also considered as a possible method of lessening congestion and improving safety. Such approaching traffic is composed of vehicles bound for the city and those that could avoid the city. To the extent that the latter now use urban streets, their transfer to appropriate external by-pass routes would relieve existing congestion on the city streets. The relief thus obtainable, however, is not as great as is generally assumed.

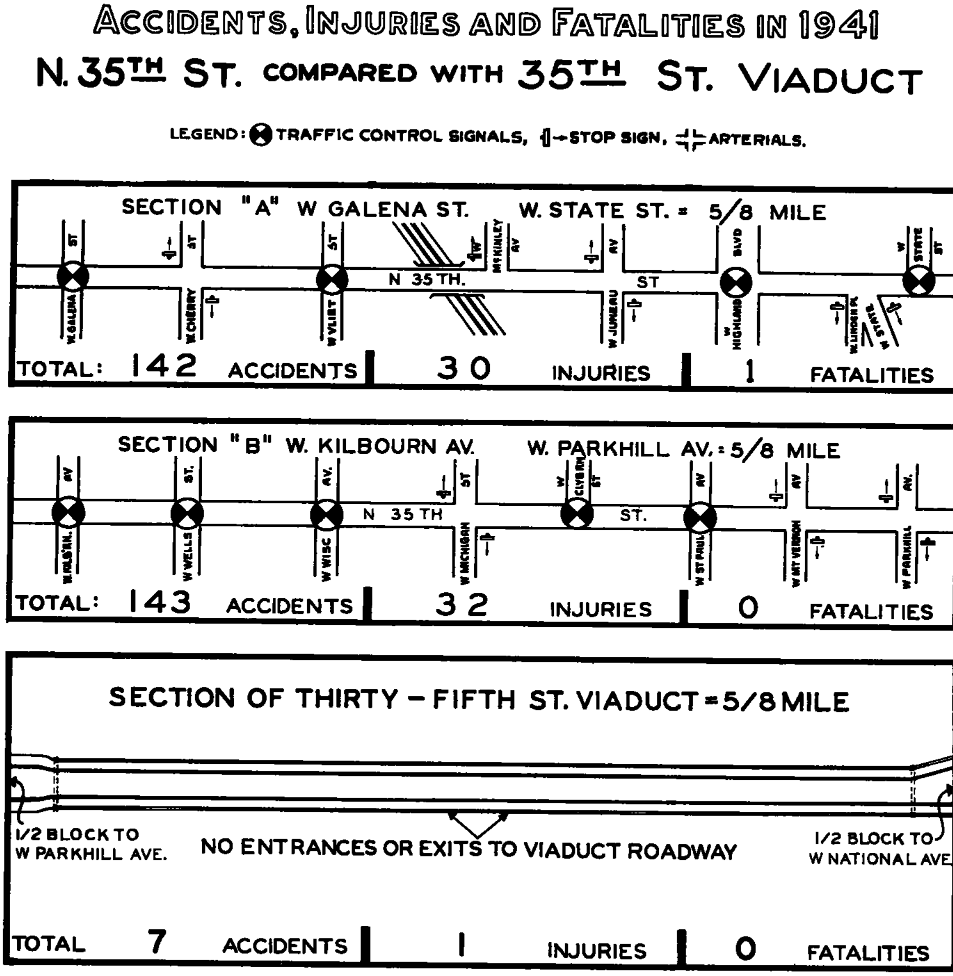

Figure 5

A prewar study made by the Public Roads Administration (Fig. 8) shows for traffic approaching cities of various sizes, the average proportion that must enter because it is bound for the city and the proportion that could avoid such a city if suitable by-pass facilities were provided. In very small communities of 2,500 population or less the number of vehicles passing through but which could by-pass the community, is approximately 50 percent of the total. This percentage decreases as the size of the city increases until for a city of over 500,000 it is only 4.2 percent which is a very inconsiderable figure. In general, the larger the city, the greater is the proportion of traffic which is concerned with destinations within the city. Small communities, therefore, can substantially benefit from by-passes, while large communities must develop efficient

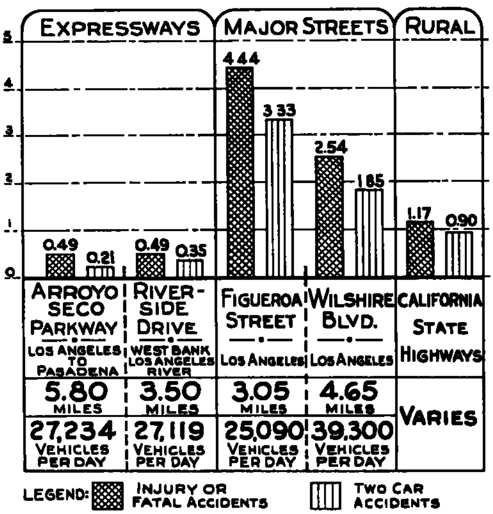

Figure 6. Accidents per Million Vehicle Miles in California on Major Streets Compared with Expressway Types—1941 Data—Peak Year—Data from *California Highways and Public Works,* July, 1945

traffic facilities within their boundaries if the major traffic movements are to be served in a satisfactory manner.

To the average city engineer the use of the limited-access highway has been a dream with the application confined to short distances in a few of the largest cities. Its cost seemed entirely beyond the realm of financial possibility of general application in urban areas with high land values and congested real estate developments. The federal interest in, and the implication of financial participation in municipal traffic problems as evidenced in the "Toll Roads and Free Roads" report of 1939 encouraged bolder thinking and the thought that some day some way would be found to make a major operation possible which would convey traffic safely, expeditiously, and economically into and through a city under or over local cross streets without conflict. The "Inter-Regional Highway" report of 1944 crystallized this thinking in concluding that the interregional highway system

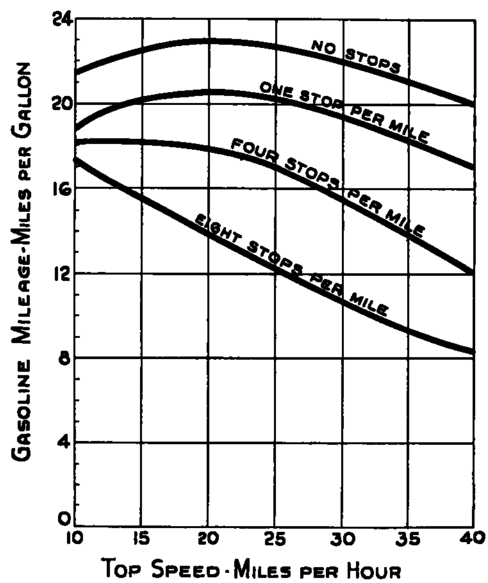

Figure 7. Gasoline Consumption when Frequent Stops are Necessary—Chart reproduced from a report by R. A. Moyer (1940).

must incorporate routes leading directly into and out of the larger cities, while the Highway Act of 1944 provided the implementation of this bolder approach as a possible and practical method for the coordinated improvement of traffic facilities in urban areas.

Up until this time solutions of street traffic problems were based primarily on increasing the capacity of and improving traffic movements on individual streets. Those improvements were usually based on studies of traffic volume counts on a particular street with some allowances for future requirements. The flow map (Fig. 9) and individual traffic counts were the basic data from which designs were evolved and the developments were primarily improvement of existing street patterns.

The concept of limited-access streets and expressways immediately forsakes the existing street pattern and cuts through the city without respect to it. That fundamental change of treatment immediately indicates the necessity of additional fundamental data from which to plan and design expressways. The interest is no longer in the traffic volumes on individual streets, but rather a question of where do the people come from and where do they wish to go, irrespective of current

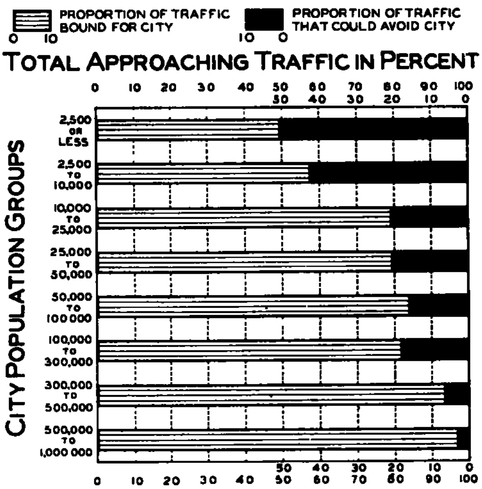

Figure 8. Indicated Utility of By-Passes for Relieving Urban Traffic Pressures—from "Interregional Highways", House Document No. 379, 78th Congress, 2nd Session

stıeet layouts. The natural evolution of this quest for a different kind of data brought into being the origin and destination traffic survey.

Milwaukee's chief interest in and the main purpose of its origin and destination survey was frankly to ascertain whether sufficient traffic would be generated to warrant expressway developments, to determine where such expressways should be located, if needed, and to indicate the general location of surface arteries and feeders which should be improved and developed.

The flow map showing the vehicle traffic volumes on the various traffic facilities begs the question, "Why does traffic flow in the indicated pattern?" The obvious answer is that it must use the facilities furnished and accommodate its routes to fit these facilities. In contrast to this the lines of desired travel (Fig. 10 and 11) as developed by the origin-destination study entirely disregard the street pattern and portray the travel wishes of the driver. These fundamental data indicate the general direction of needed improvements with further refinement desirable to more definitely determine route locations.

As a further general application of these data a center of trip origins and destinations was located at the point of intersecting axes about which all trips are in balance (Fig. 12). The population center of the city at intervals over a period of years was superimposed on on this chart seeking possible relationship between trip and population centers from which future shifts in traffic patterns might be fore-seen when compared with the migration of the population center.

The specific application of the survey data was the detailed analysis of proposed expressway routes to determine if they would attract traffic volumes warranting expressway construction and to compare each route with the others to determine which facility would furnish the greatest service (Fig. 13, 14, and 15). Travel time was the basis of computation. The floating speed check (Fig. 4) indicates an average speed on the city's streets of 17.5 mph which was used as the base speed except where modified by trips using streets of other speeds as shown in Figure 4. The expressway speed was assumed to be twice the base speed or 35 mph. Any trip that could be made from origin to destination using a portion of the expressway without increasing the travel time even though the route traversed was more circuitous, was assumed to use the expressway. This method of differentiation is decidedly conservative; the speed of 35 mph is low for expressway travel and such factors as relief of driver tension and other attractive features of moving in free flowing traffic are not emphasized by this method of computation.

There is little information available for determining minimum traffic volumes warranting expressway construction, inasmuch as there are so many local economic, topographic and physical factors involved. However,

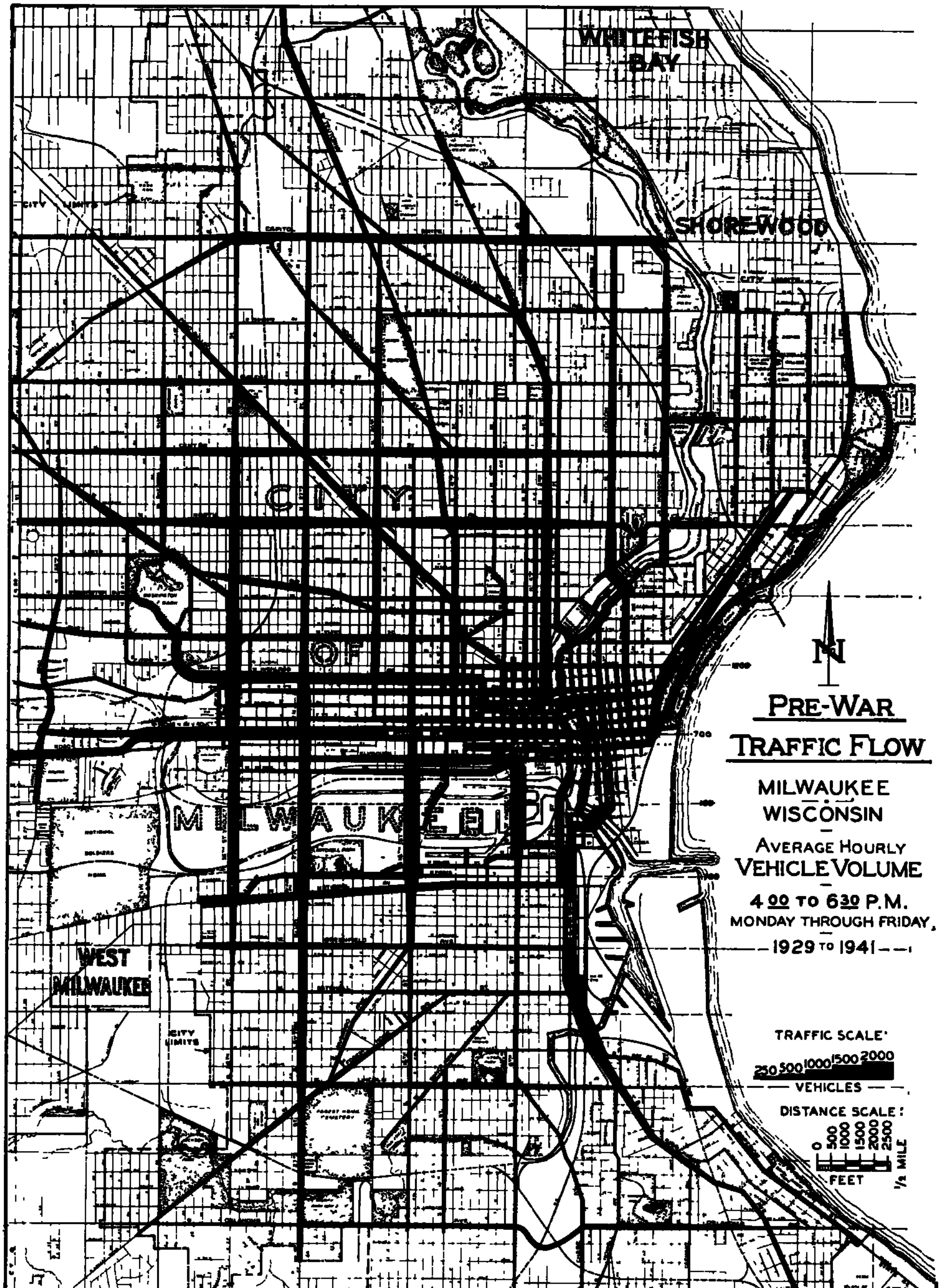
WHITEFISH BAY
SHOREWOOD
CITY
OF
MILWAUKEE
WEST MILWAUKEE
N
PRE-WAR
TRAFFIC FLOW
MILWAUKEE
WISCONSIN
AVERAGE HOURLY
VEHICLE VOLUME
4 00 TO 6 30 P.M.
MONDAY THROUGH FRIDAY,
1929 TO 1941
TRAFFIC SCALE
250 500 1000 1500 2000
VEHICLES
DISTANCE SCALE:
0 500 1000 1500 2000 2500
FEET
1/2 MILE

Figure 9

from a study of the traffic capacities of various types of street development and of traffic volumes now being carried on existing expressways such as the Arroyo Seco Parkway in Los Angeles, and the Davison Expressway and the maximum sections in excess of 50,000. These figures are week-day average daily traffic flow based on 1946 summer traffic.

The expressway system (Fig. 16) as recommended consists of a belt route around the

Figure 10. Daily Travel of Autos and Trucks—200 Trips and Over—Average Mon through Fri—24-hr Basis—181,530 Trips Illustrated (43 percent of Total)

in Detroit, a volume of 30,000 vehicles per day appears to be a reasonable minimum justifying expressway construction. Four of the six proposed routes show average daily volumes in excess of 30,000 vehicles per day downtown business area from which expressways radiate to the north, south, and west and make convenient connections with the interregional highway system and other federal and state highways. The north street of the belt route utilizes the present Kilbourn Ave. which is a wide modern street which was originally designed as a by-pass around the downtown area but which has developed into an important distributor street for access to the downtown business area. Its major present use consists of short trips on portions of the street to enable drivers to approach as close as possible to their destination before entering the downtown congestion. Its inclusion in the major belt route will not materially change its use but will increase its utility for its present function. The east leg includes a highway overpass and a railroad underpass and also provides a long needed entrance from the northeast to the south portion of downtown by way of the south boundary route which will be elevated for its entire length; including two railway grade separations and a double decked bascule

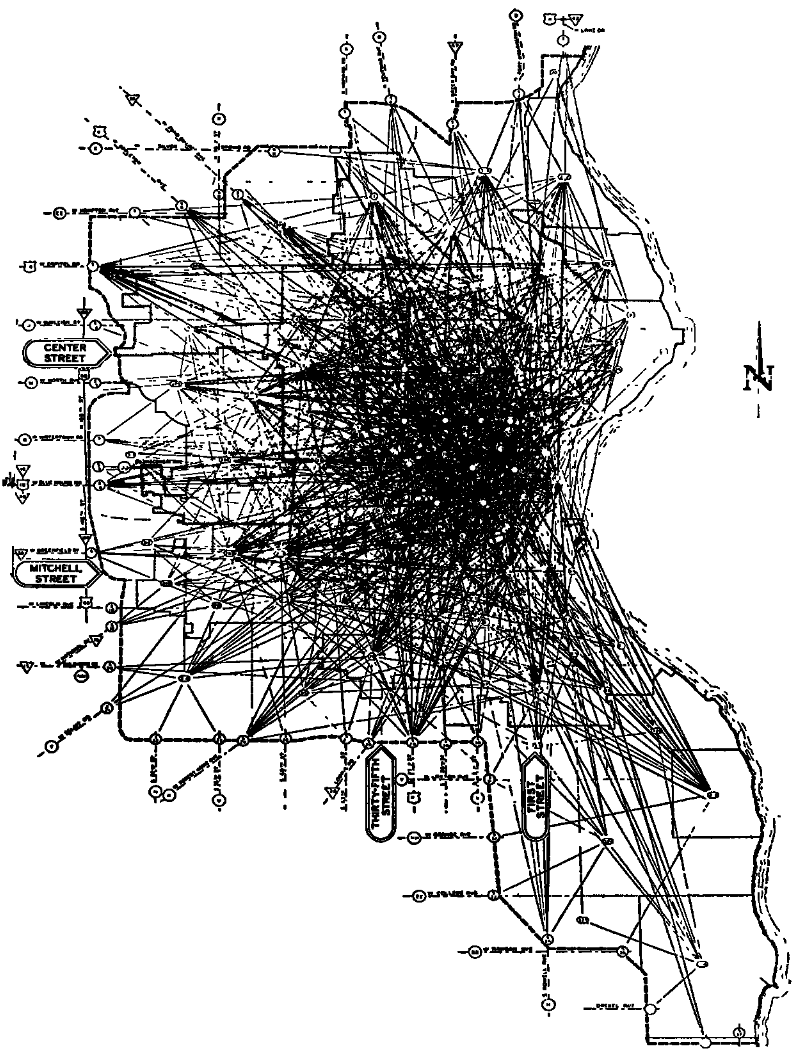

Figure 11. Daily Travel of Autos and Trucks—67 to 199 Trips—Average Mon through Fri—24-hr Basis—151,036 Trips Illustrated (36 percent of Total)

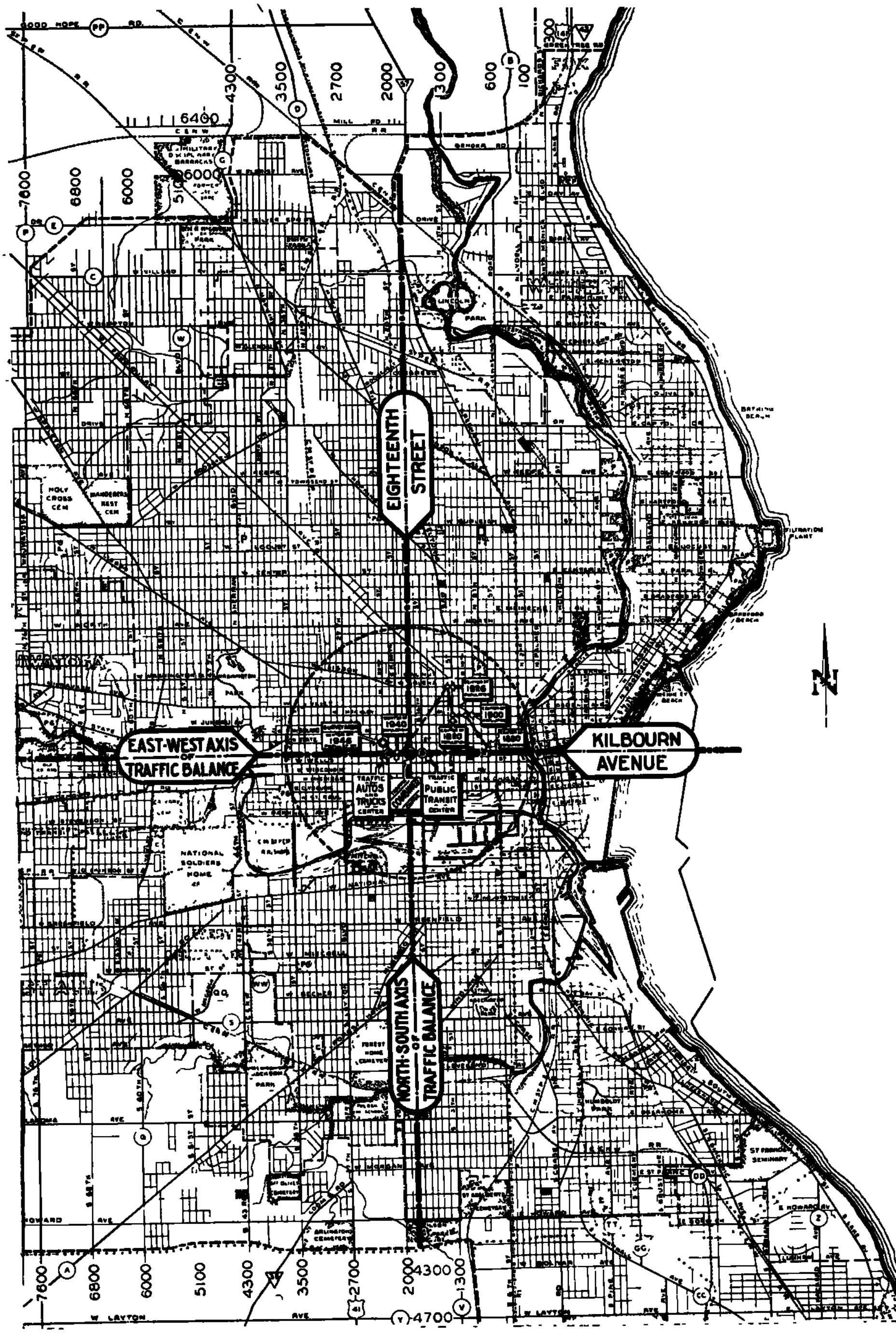

Figure 12. Traffic and Population Centers

bridge over the Milwaukee River. Suitable ramps to the surface streets will provide needed access.

will encourage the reduction of individual trips within the downtown area to their shortest possible length and it will also provide

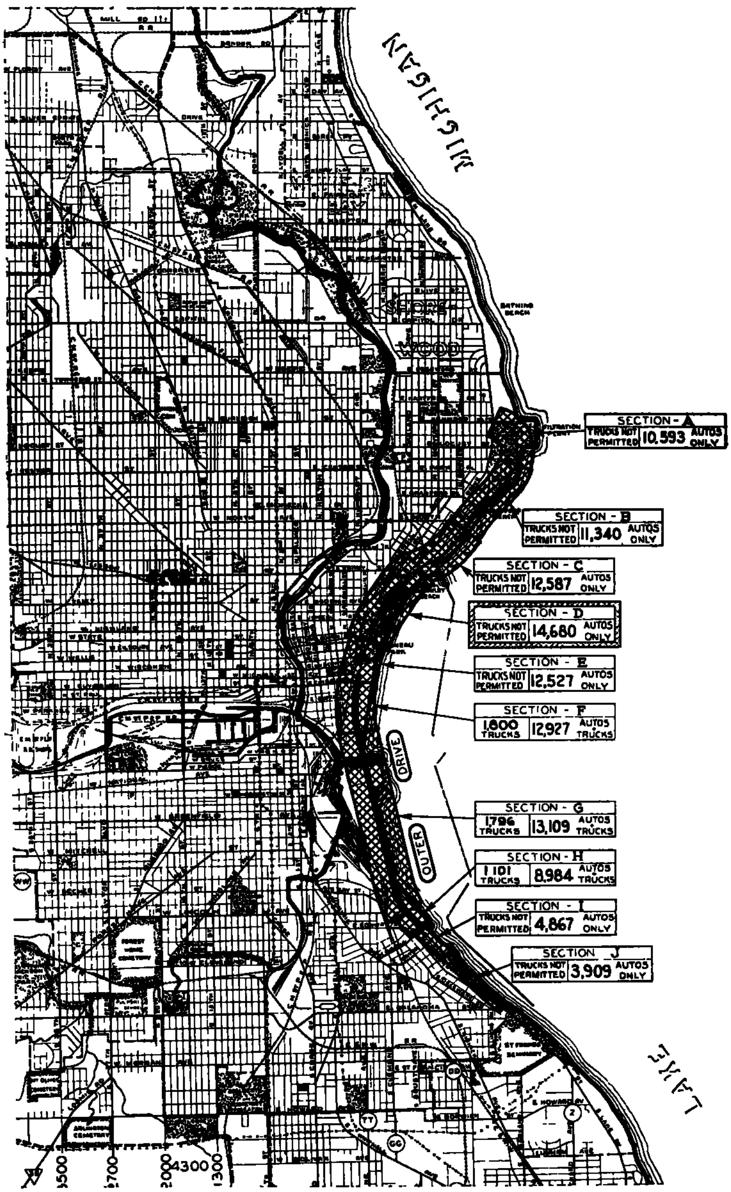

Figure 13. Daily Potential Use by Autos and Trucks—Outer Drive

The entire belt route will serve the same dual purpose as the present Kilbourn Ave except that it will be much more effective. It

an attractive means of by-passing traffic which now passes through downtown for the purpose of getting from one side to

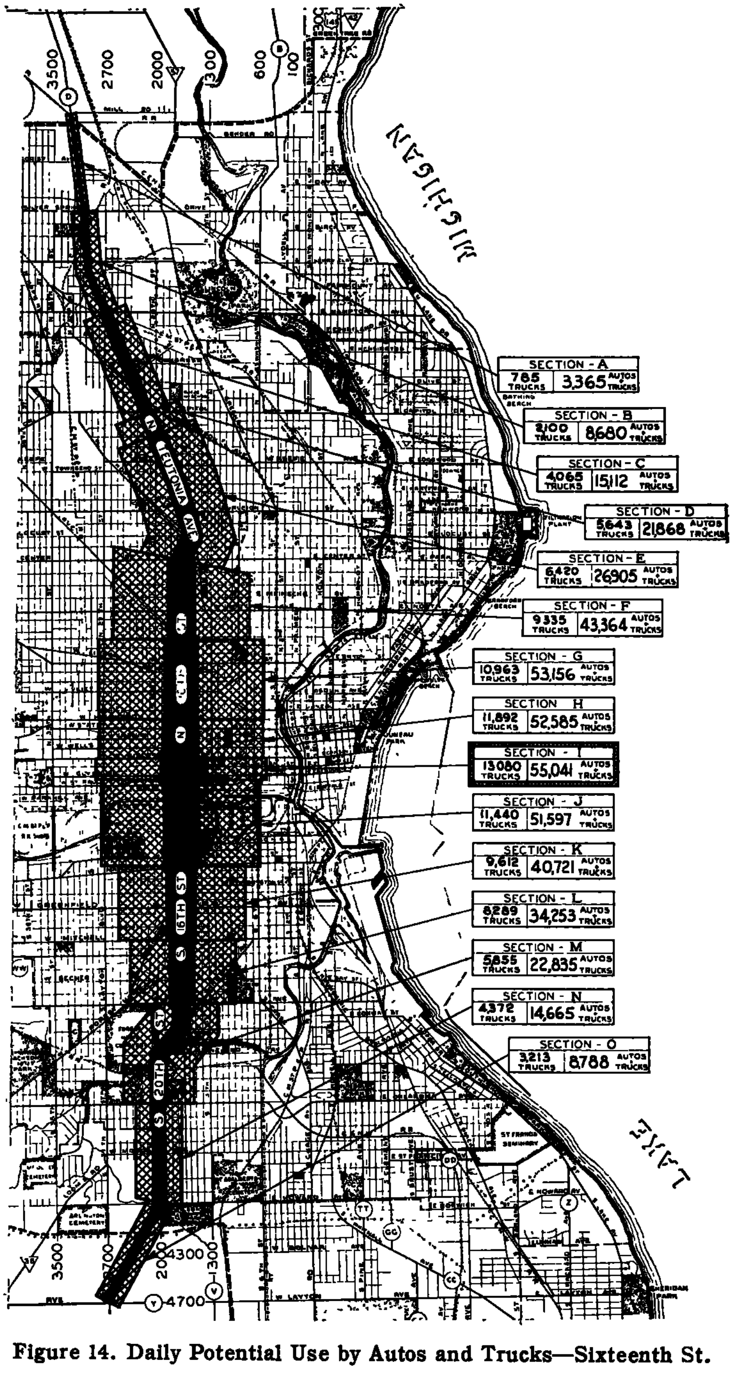

Figure 14. Daily Potential Use by Autos and Trucks—Sixteenth St.

the other without any objective within the area.

The determination of the location of the north-south expressway resulted from the study of five possible routes, viz; Lake Shore or "Outer Drive", Inner Drive, Sixth St., Eleventh St. and Sixteenth St.

A detailed traffic analysis was made of all of the routes except Eleventh St. which was omitted as unnecessary. The anticipated traffic volumes on the Sixth St. and the Sixteenth St. routes were within two percent of each other and the Eleventh St. traffic volume would be practically identical.

In the consideration of the Outer Drive route, a negative value of the origin-destination survey immediately became evident. This route has enjoyed several years of public discussion and has won strong support. The analysis demonstrated that its construction could not be justified as a major traffic artery. The expenditure of some twenty million dollars for this improvement must be predicated on other values than its traffic carrying potentiality. The traffic volume attracted to the Inner Drive also fell below the 30,000 vehicle per day minimum.

With practically identical traffic volumes on the remaining three routes it was evident that factors other than traffic volumes must determine the ultimate selection. Each of these routes would of necessity cross the industrial Menomonee River valley on a viaduct about one-half mi in length. The present Sixth St. viaduct is inadequate, there is no viaduct at Eleventh St. The present Sixteenth St. viaduct is a modern structure with a 56-ft roadway and can be included in the expressway system at a saving of several million dollars when compared to the other locations. The Sixth St. route has the disadvantage of passing directly through the downtown area. The Eleventh St. route passes through several important local business areas and also would necessitate right-of-way acquisition of portions of several large industrial developments which would not only be expensive to buy but would also seriously damage or entirely destroy the

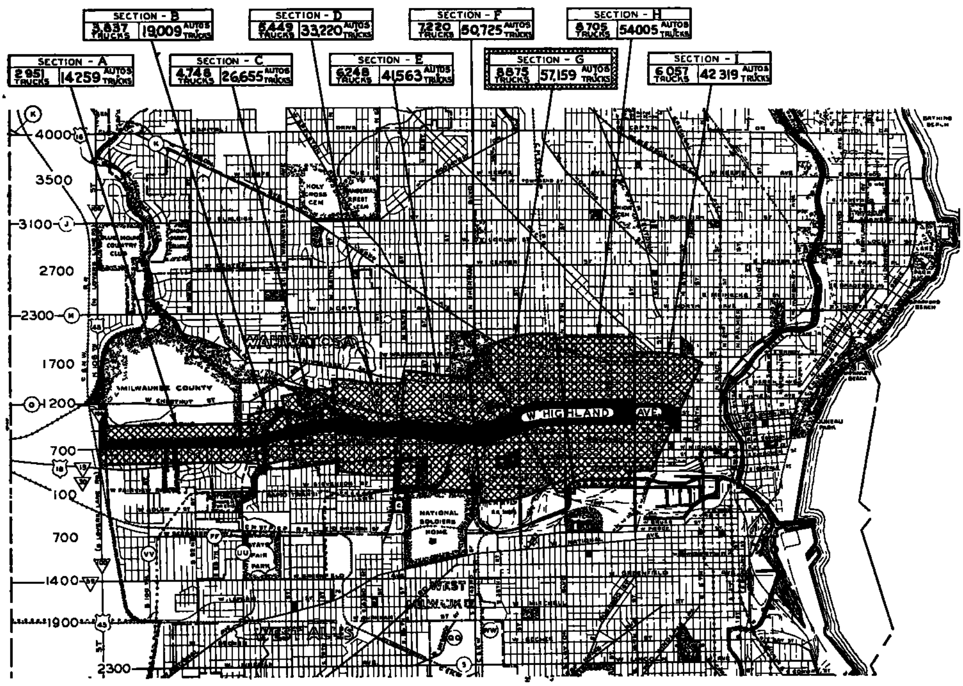

Figure 15. Daily Potential Use by Autos and Trucks—W. Highland Ave.

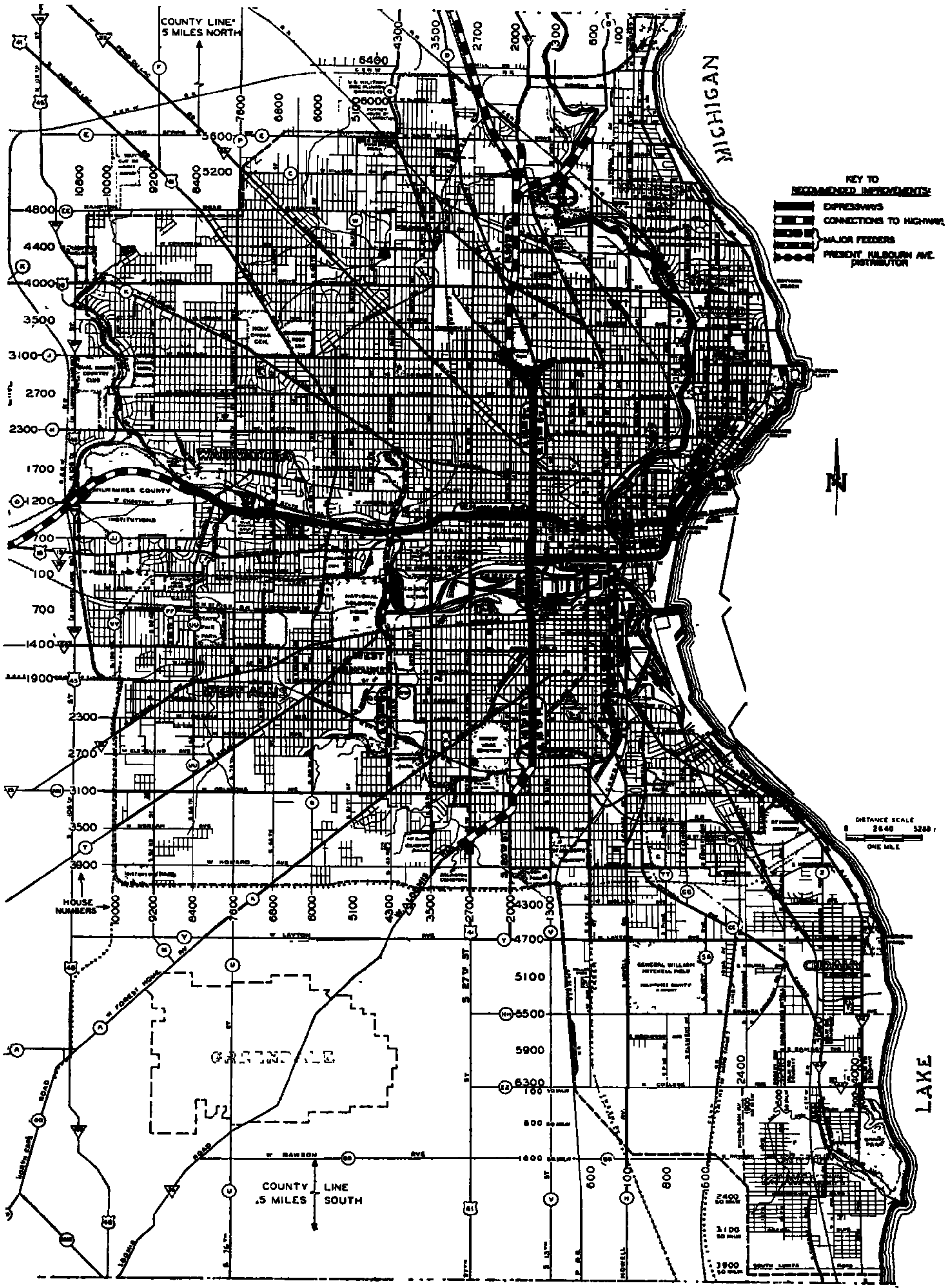

Figure 16. Recommended Expressway System and Major Feeders

remaining portion of these lands for their present use.

The Sixteenth St. location is almost entirely in residential areas, many of which are old and decadent. Right-of-way costs are moderate and the possibilities of redevelopment of these neighborhoods to take advantage of the expressway generated benefits are present. Its usefulness is spread over a large part of the city because it passes close to important local business areas without entering any of them and thereby increases the trade area tributary to them. This route also makes the best connection to the federal and state highway system.

The general location of the east-west expressway route was fairly obvious. The immediate location of the eastern end was determined by right-of-way costs and the western end was controlled by some key topographical features.

To one familiar with the local situation a study of the flow map (Fig. 9) and the chart of traffic desire lines (Fig. 10) is illuminating. It was from the interpretation of these two maps, considered jointly, that the major feeder street plan was developed. Referring again to Figure 10, it is apparent that an east-west expressway location could not provide for the traffic volume flowing north of west from the downtown area and at the same time serve the traffic demands to the southwest and West Allis, an important industrial suburb of Milwaukee. The location chosen lies between these two objectives and for the expressway to become most effective some means of bringing these traffic volumes to it had to be planned. Local topographical and land use conditions influenced the choice of 43rd St. as a major north-south feeder; the analysis would have been the same, however, if local conditions had indicated the selection of some other nearby parallel street. The eastward traffic flow from West Allis will be intercepted at 43rd St. and carried north to feed into the east-west expressway and thence carried downtown. The flow map shows considerable traffic flow to downtown from the northwest quadrant of the city via the grid street system and a few diagonal streets. The expressway system makes no direct provision for this important traffic volume but an extension of the 43rd St. feeder north of the east-west expressway so as to tap several of the important streets will allow the southwestern half of this quadrant of the city to enter the expressway system by this route. The northeastern half of the quadrant will flow east to the north-south expressway, thus serving this large area without constructing an expressway to the northwest.

Returning to Figure 10, a large traffic volume is shown toward east of north of downtown, but Figure 9 indicates little congestion in this area except on Prospect Ave, the diagonal street parallel to the lake shore. It will also be noted that there are a number of streets over which this traffic is distributed. In spite of this large volume an expressway is not the indicated solution. The widening and repaving of a street parallel to Prospect Ave in combination with a few improved connections will adequately solve the traffic problem of this area.

The flow map shows a broad band of traffic leading directly south from downtown, South First St. This street suffers from the worst traffic congestion of any street in the city, however Figure 10 does not indicate traffic desires of material magnitude. Again the solution is the widening and repaving of a parallel street, South Second St. South Second St. now carries only 30 percent as much traffic as South First St. The traffic from the southwest side of the city which now flows eastward to South First St. and thence north to downtown will be siphoned onto the Sixteenth St. expressway or on South Second St. and then South First St. should be adequate to handle all of the traffic originating in the southeastern part of the city.

The analysis of the origin-destination survey indicates that the recommended expressway system, together with the major feeder streets will adequately serve as the trunk of Milwaukee's street system to which will be added additional connections as conditions warrant. An orderly development of this plan and the relating of general street improvements to it will provide Milwaukee with a satisfactory street traffic system for many years to come.