private enterprise alone may not be able to find cheap enough money for off-street terminals, because of previous records of failures or low returns from ill-advised investments in terminals.

The Union Square garage in San Francisco represents a realistic approach to a solution of the terminal parking problem, wherein the city made the site in Union Square available at a token rental of only $5,000 a year, and where the financing was done with private funds from enterprises benefited by the facility, together with Reconstruction Finance Corporation money. In 25 years, however, when this money is all paid back out of garage earnings, the garage will be turned over to the City of San Francisco becoming then a wholly owned municipal facility. A plan has been advanced in Detroit for the construction of off-street parking space under Washington Boulevard. But it is not necessary to go underground, I cite these cases simply as examples of forthright action against the parking problem.

There is wanted almost everywhere a broader public understanding of the real functions performed in a municipal community by the right kind of parking terminals, in the right places, to obtain the most effective utilization of urban highway transportation in the community interest. The job of educating the public on the subject of parking terminals might well be the first assignment of the parking agency.

# APPLICATION OF ORIGIN AND DESTINATION TRAFFIC DATA IN PLANNING HIGHWAY FACILITIES FOR GREATER KANSAS CITY

By John M. Picton, *Chief Planning Engineer; City Plan Commission, Kansas City, Missouri*

## SYNOPSIS

The Origin and Destination Traffic Survey of Greater Kansas City was a joint activity of the Public Roads Administration, the State Highway Departments of Kansas and Missouri and the two Kansas Cities

The data relate to 260,000 daily transit passenger trips, internal movements of 198,000 automobiles and 76,000 trucks and 63,000 external automobile trips.

Segregation of various types of trips was necessary to facilitate study. The heavier movements indicate generally the pattern of major desire lines with the intermediate and lighter movements showing a dispersal to all zones. Combined major desire lines emphasize the importance of radial and cross town movements

With these data population distribution can be related to employment in major business and industrial areas The patterns of the residence location of workers in these areas of major employment discloses much information of value in highway and transit planning.

Relating the 1944 mode of travel to pre-war or post-war conditions shows that 21 per cent of future potential passenger car trips represent transit passengers during the war who stated they would be using their own private means of conveyance when restrictions on new cars, tires and gasoline were terminated. Some of these and 13 per cent of potential passenger car drivers who were automobile passengers might be transit passengers if given improved and faster transit service Also, mid town sections have many workers in central business districts and adjacent sections who might be reached with modernized transit service.

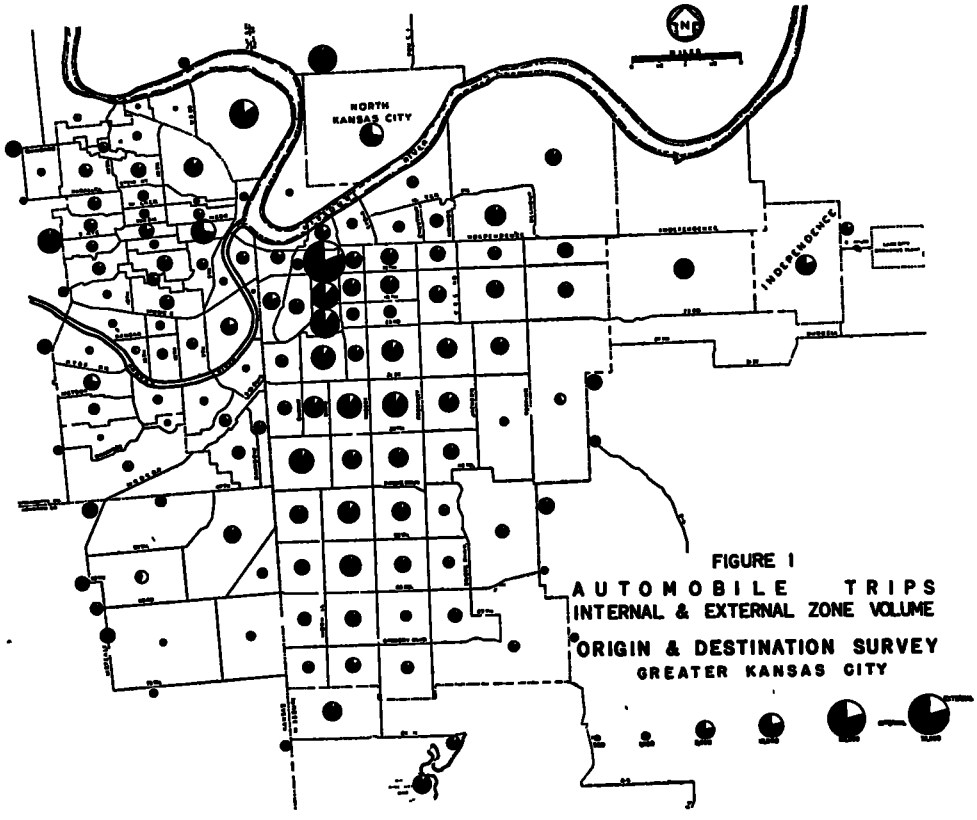
The large passenger car volumes anticipated on sections of proposed urban express highways show that provision for mass transportation vehicles should be incorporated in the design of express highways if vehicle volumes are to be

reduced to the point where downtown parking facilities can adequately handle the load. This and improvement of transit service to attract many more passengers and retain many of the present transit passengers will be necessary to reduce tremendously increased expenditures required for the provision of off-street parking facilities and additional street space required for additional traffic movements.

Studies now progressing, based on origin and destination data, indicate the interstate express highway system will facilitate traffic movements but many additional express highways will be needed to serve adequately urban traffic movements of the future.

The Greater Kansas City traffic survey was conducted by the Missouri State Highway Department and the State Highway Commission of Kansas in cooperation with the Public Roads Administration and the cities of Kansas City, Kansas and Kansas City, Missouri. The survey covered the entire metropolitan area called "Greater Kansas City," including four cities and four counties in Kansas and Missouri. Transit officials, city traffic engineers and the staffs of the City Planning Commissions assisted State and Federal highway engineers in obtaining information of maximum value.

The purpose of the survey was to provide several different types of data applicable to the many problems encountered in planning a balanced coordinated transportation system for the safe and convenient movement of goods and persons into and through the urban metropolitan area. Major traffic desire patterns are essential in selecting the best possible locations for interstate express highways to be financed by Federal and State funds. Also,



these desire patterns for the movement of automobile and truck traffic may be compared with actual traffic flow to indicate the extent to which existing facilities must be augmented and improved to serve adequately present and future traffic demands.

A balanced local transportation system depends to a large extent upon mass transportation facilities for the rapid movement of large numbers of persons. Patterns indicating the desires of people using local transportation facilities are necessary to determine reroutings and other improvements needed in the local transit system As adequate terminal facilities in areas of business and industrial concentration are essential, the survey obtained information on parking experience.

The method used in obtaining internal passenger car traffic data was based upon a 5 per cent home interview sample, carefully preselected on a geographical basis. This was supplemented by a 10 per cent sample of truck movements, and both were carefully expanded and tested with relation to traffic counts at control points. In this manner the survey accuracy was tested and found to be within the limited standard deviations expected. External traffic data obtained by the two State highway departments were used to complete the picture.

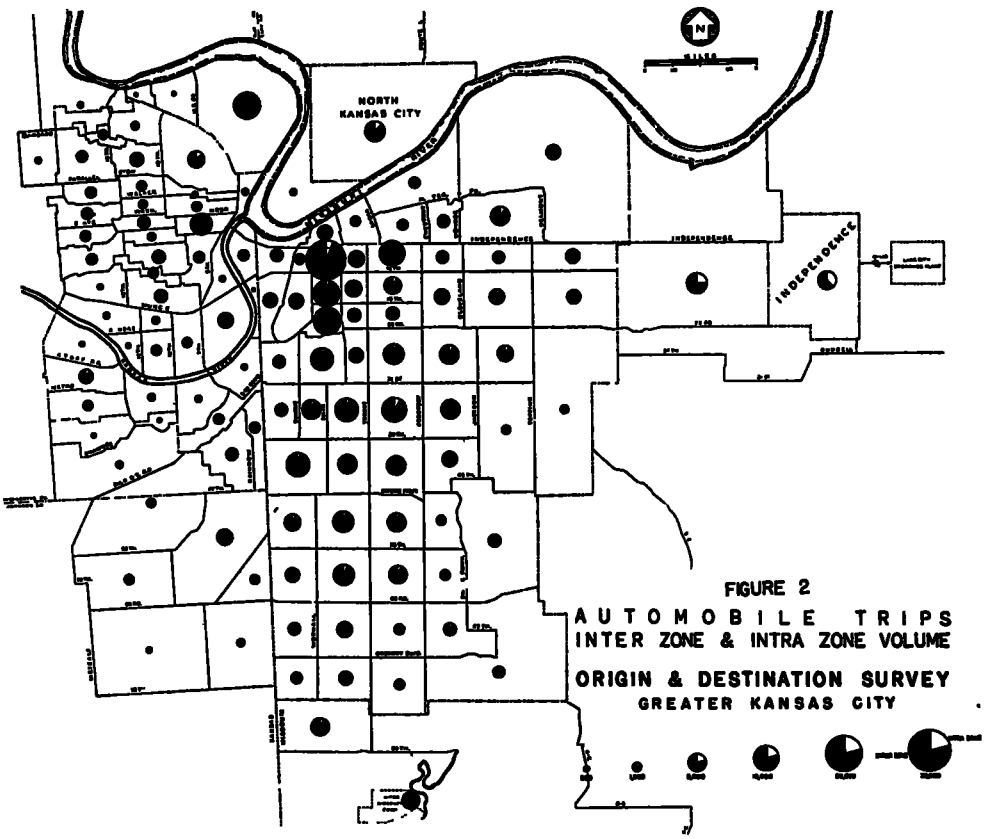



FIGURE 2
AUTOMOBILE TRIPS
INTER ZONE & INTRA ZONE VOLUME
ORIGIN & DESTINATION SURVEY
GREATER KANSAS CITY

The survey data indicate the origin and destination of traffic into and throughout the metropolitan area in terms of zone to zone traffic and intra-zone movements. Modes of transportation at the time of the survey and under pre-war conditions were determined, as well as the purpose and length of time of the trip and the walking distance between transportation terminii and the origin or destination.

The expanded samples from the survey give information upon approximately 260,000 transit passenger trips in 24 hr. as compared with 198,000 internal automobile trips and 76,000 internal truck trips within the metropolitan area during the same period. External automobile trips were about 63,000 or 41 per cent of the total automobile movement. Figure 1 shows the percentage of external volumes up to 35 per cent of internal movements.

In order to present the data in the best possible form for further analysis and study it was necessary to segregate the various types of trips. Thus it was determined that the best results would be obtained from maps showing separately the volumes of external automobile movements, internal automobile movements,

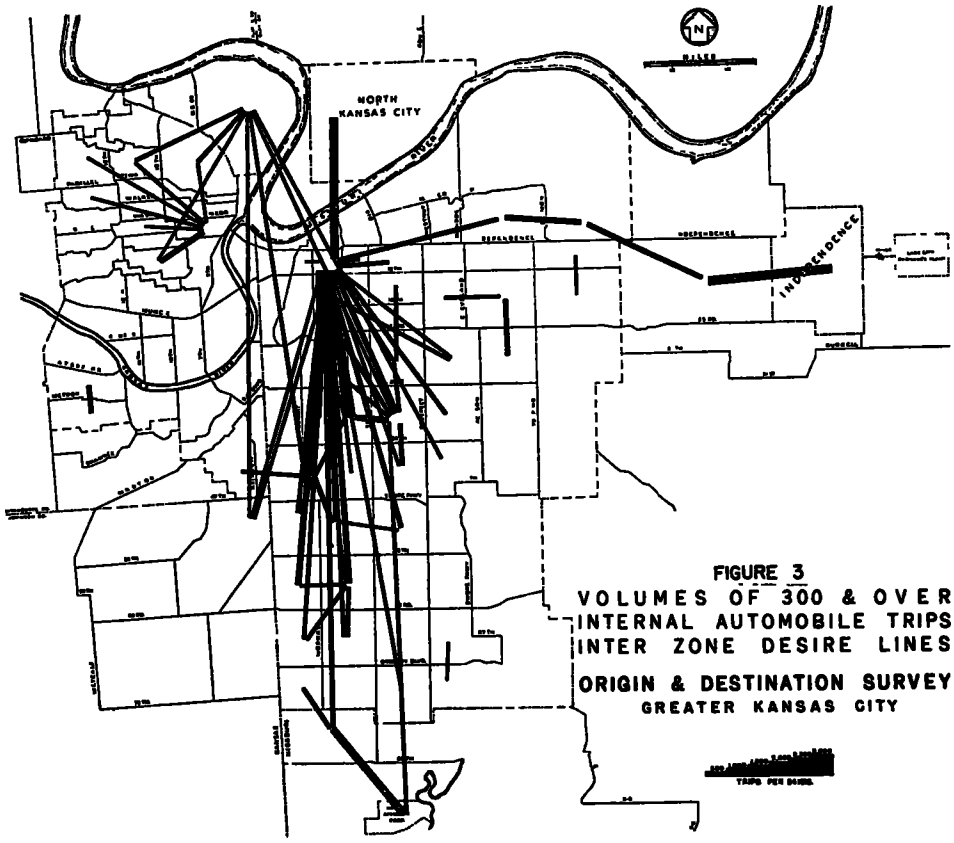



FIGURE 3
VOLUMES OF 300 & OVER
INTERNAL AUTOMOBILE TRIPS
INTER ZONE DESIRE LINES
ORIGIN & DESTINATION SURVEY
GREATER KANSAS CITY

trips with origin or destination in each zone. Major business and industrial zones tend to have larger proportions of external traffic than zones of residential character.

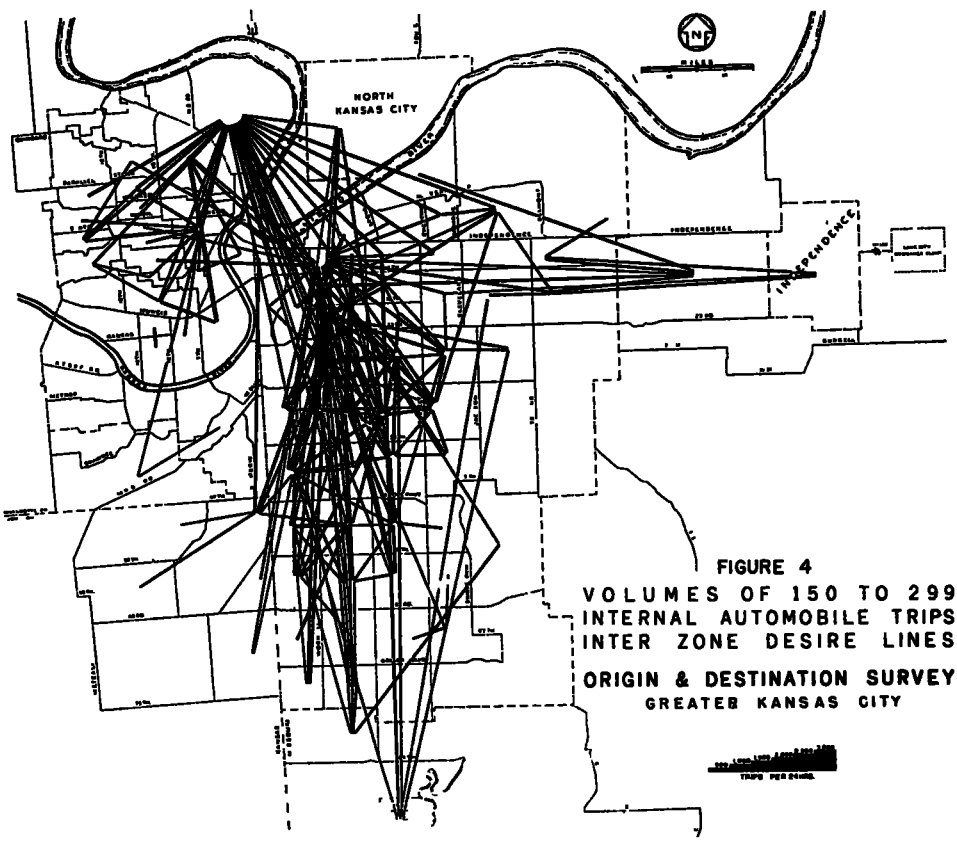
Intra-zone movements, beginning and ending within the same zone without entering other zones, averaged about 9 per cent of the total internal automobile trips. However, as shown on Figure 2, in the case of larger outlying zones, the intra-zone trips accounted for external truck movements, internal truck movements and transit passenger trips Figures 3, 4 and 5 together show the total internal automobile trip interzone desire lines, separated into three maps to facilitate analysis. The heavier movements on Figure 3 show dominant north-south and radial movements, and short isolated bands representing movements from industrial districts to and from nearby residential sections.

The intermediate movements on Figure 4 indicate some cross-town movements and additional north-south and radial movements. Lower interzone volumes on Figure 5 indicate a general dispersion of movements with no pronounced concentration. Figures 3, 4 and 5 include approximately 130,000 trips or almost two thirds of the total internal automobile trips. Interzone movements of lighter volumes than those indicated on these three figures amount to an additional one fourth from which no dominant pattern was apparent except the dispersion to all zones The remaining 8 to 9 per cent are intrazone trips which originated and terminated within the same zone

Figure 3 with heavier interzone volumes shows 37,000 trips on approximately 19 per cent of the total internal automobile trips, while Figures 4 and 5, combined with the unplotted portion of interzone movement amount to approximately 72 per cent of the internal automobile trips Therefore, while Figure 3 shows the dominant pattern of major interzone volumes, the four times larger percentage of the total volume in the dispersed interzone desire lines cannot be ignored in a determination of major desire lines

Figures 6 and 7 portray external automobile trips The heavier volumes on Figure 6 are destined for the central business districts of Kansas City, Missouri and Kansas City, Kansas or zones near the external stations The lighter volumes on Figure 7 tend to spread or disperse to all zones. The greater width of bands of external zone stations at the north and west as compared to the other external stations confirms the tentative location of interstate highways

In a similar manner, data were presented graphically for internal truck movements and



external truck trips, exhibiting generally the same patterns.

Combinations of the above data were made to facilitate analysis of major movements. Figures 8 and 9 show major directional desire lines separately for automobile and truck movements. These indicate heavy north-south and east-west traffic desire lines. In addition, these two figures direct attention to radial desire movements differing materially

The zone to zone travel desire patterns of transit passengers riding street cars, busses and trolley busses are shown on Figure 11, 12 and 13. The heavier volumes shown on Figure 11 terminate within short distances of the central business district. Most of the bands extend less than 4 mi. from the downtown area and only a few extend to or beyond the city limits. Some of the intermediate volumes on Figure 12 are trips to outlying sec-

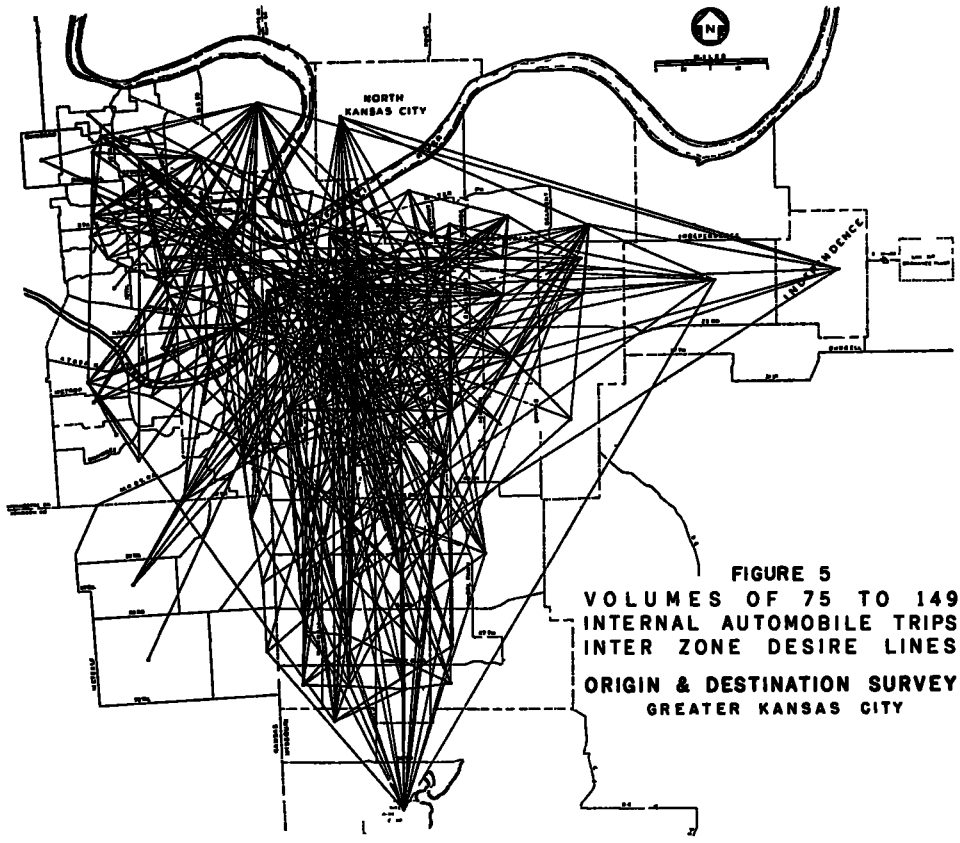



FIGURE 5
VOLUMES OF 75 TO 149
INTERNAL AUTOMOBILE TRIPS
INTER ZONE DESIRE LINES
ORIGIN & DESTINATION SURVEY
GREATER KANSAS CITY

from the actual traffic flow shown on Figure 10. This indicates that the majority of movements to the central business districts follow indirect routes in using the existing rectangular street pattern. Analysis of these three plates and similar data on transit passenger trips will prove the desirability of some additional radial routes and will indicate the general location of these to best serve the convenience of local transportation movements.

tions. Also, these indicate the desire for cross town movements in sections of the city nearest to the downtown area. The heavier volumes on Figure 11 generally consist of short haul passengers while the intermediate volumes on Figure 12 represent longer passenger trips.

The lighter volumes on Figure 13 show a general dispersion. These however, have the same general characteristics of radiating from areas of major employment and reflecting

cross town desire movements. Lighter volumes than those indicated on these three maps give a further dispersion with no dominant pattern.

The heavier volumes on Figure 11 comprise 31 per cent of the total transit passenger trips; Figure 12 shows 12 per cent of the transit passenger volumes and Figure 13, with lighter volumes, shows desire lines for about 19 per cent. Less than 2 per cent of the trips are

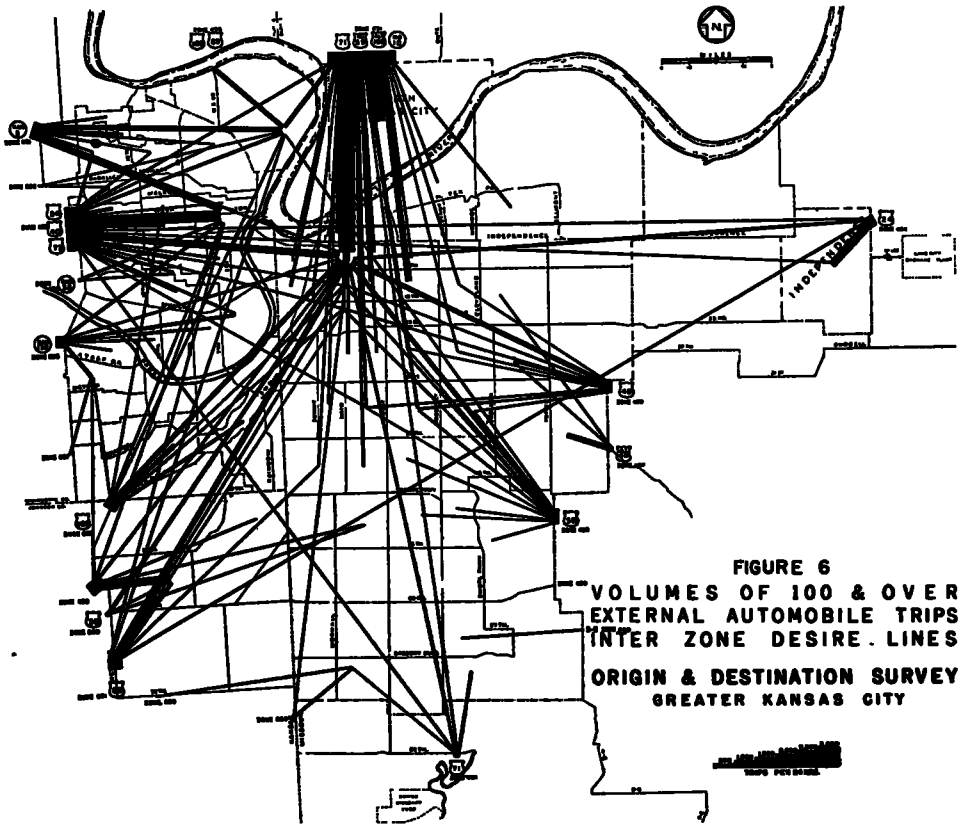


FIGURE 6
VOLUMES OF 100 & OVER
EXTERNAL AUTOMOBILE TRIPS
INTER ZONE DESIRE LINES
ORIGIN & DESTINATION SURVEY
GREATER KANSAS CITY

intrazone in character, beginning and ending within the same zone The remaining 36 per cent of the total transit passenger movements not shown on these three plates, amounts in each instance to a zone to zone movement of less than 150 transit passenger trips

The attached drawing from the City Plan Commission's Preliminary Report on Local Transportation, Figure 14, gives comparative data on actual transit vehicular volume obtained from the Kansas City Public Service Company's schedules for a normal week day. Study of this and the last three plates will indicate the extent of revision and modernization of transit routes necessary to serve the convenience of the Company's patrons. As in other types of local transportation facilities, there is practically no diagonal pattern apparent in the existing transit routes. Also there are much heavier vehicular volumes along Main Street than would appear to be required by a careful examination of the passenger trip desire bands shown on Figures 11, 12 and 13. Not only does this result in congestion but such rigid adherence to a previous pattern of development, now outmoded, mitigates against the provision of fast and direct service.

Unless drastic revisions are made to modernize transit service, the large majority of present transit passengers now living at some distance from the central business district will

be encouraged, in the post war period, to use private means of transportation The difficulties of providing sufficient street space and necessary terminal facilities for such movements appear to be too obvious to need further discussion here.

Thorough analysis of the origin and destination survey data and detailed tabulation of zone to zone movements will indicate the number of potential transit passengers, automobile and truck trips to and from each neighborhood This should be far more accurate than simply using the population distribution shown on Figure 15 and data on business and industrial employment shown on Figure 16, since the survey has established the points of origin and destination for these different types of traffic movements. Possible improvements in transit service must be considered as a factor which could reduce the necessity of additional highway facilities.

The survey has recorded the walk distance at each end of the trip for transit passengers. Analysis of these data may give a definite indication of the need for rerouting some outlying and feeder bus lines The main transit lines, located on primary thoroughfares, generally define neighborhood boundaries and thus should be carefully considered before any relocations are contemplated to furnish a slightly more favorable walk distance for passengers within a neighborhood

The survey data will allow determination of the desirability and practicability of additional cross-town thoroughfares and transit routes. Such suggested improvements may be justified or dimensioned on the basis of the volumes now existing for the various types of

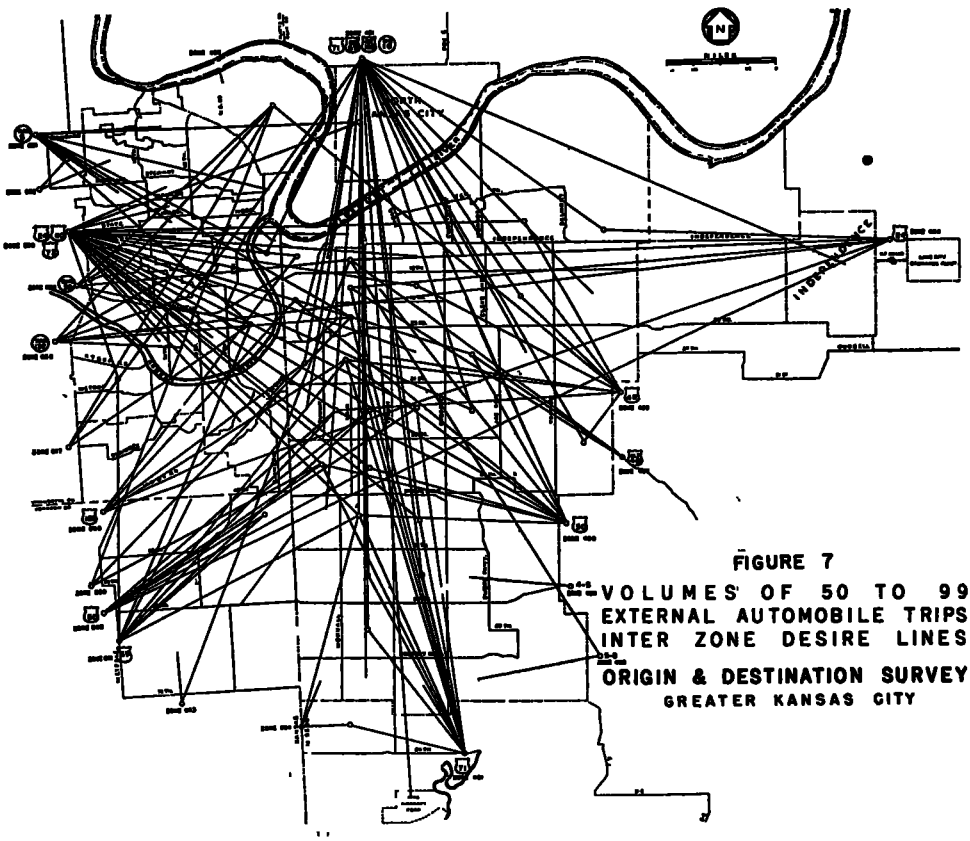


FIGURE 7
VOLUMES OF 50 TO 99
EXTERNAL AUTOMOBILE TRIPS
INTER ZONE DESIRE LINES
ORIGIN & DESTINATION SURVEY
GREATER KANSAS CITY

movements, potentials to be developed from the survey data and other forecasts.

Attention should be directed to the increased travel time spent by transit passengers in reaching outlying sections of the city compared with automobile travel times In the rush hour period, over 80 per cent of the population of the metropolitan area can drive from the central business district by private conveyance to residential areas within a 20-min. time interval Comparison with rush hour schedules of the Public Service Company indicates that the transit travel times are approximately twice those of automobile travel times. Improvement of service, types of equipment and the provision of more direct routes will reduce this differential in many instances.

Thus the major discrepancies of the existing transit pattern as related to the major transit passenger desire lines appear to be the lack of directness and the unbalancing of the existing system by rigid adherence to a fixed pattern of previous, and in some instances, obsolete travel habits. As a result, the present transit routes will not serve some transit passenger desire movements in the best possible manner. The same might be said of many existing major traffic arteries especially in view of future expected increases in vehicular traffic.

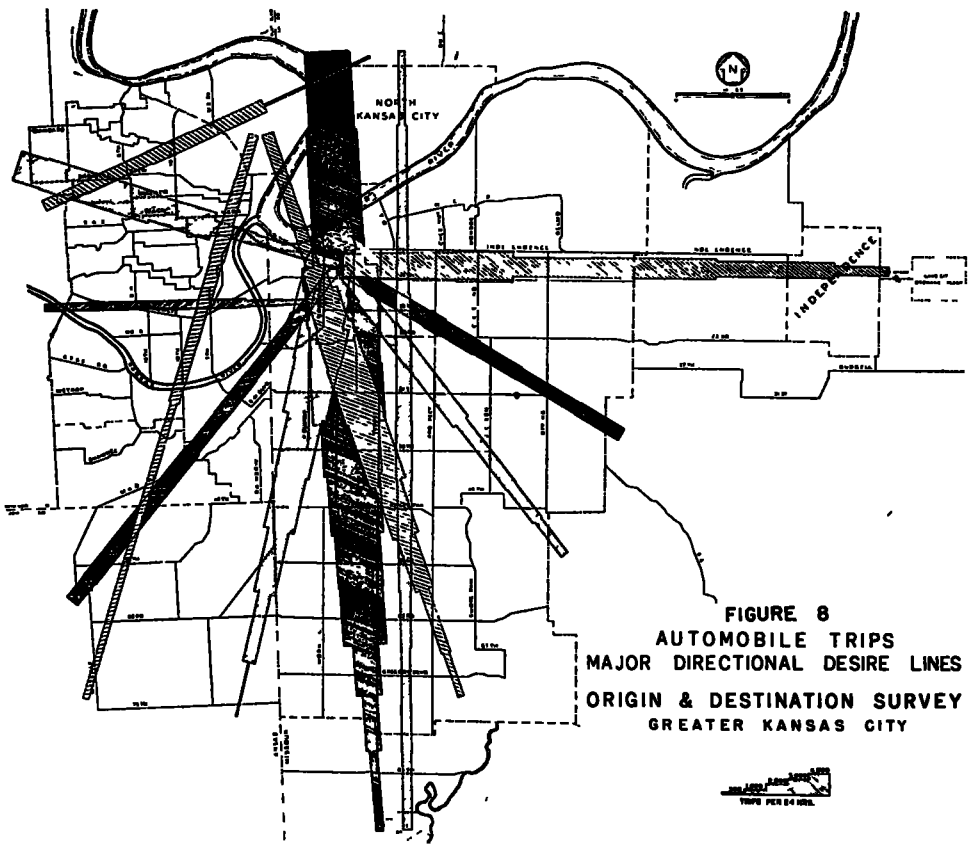



FIGURE 8
AUTOMOBILE TRIPS
MAJOR DIRECTIONAL DESIRE LINES
ORIGIN & DESTINATION SURVEY
GREATER KANSAS CITY

Figure 17 shows the destination volumes, zone by zone, for all automobile trips. The areas of the circles denote the number of trips for the purpose of going to work, to transact business, for medical and dental services, etc. A similar map could be prepared for the origin

or destination of transit passengers. This would illustrate the relative importance of service to various zones of the city and establish more definitely the source of concentrations, zone by zone.

Figures 18, 19 and 20 are indications of the types of data which may be obtained from the survey to indicate definitely the travel movements from residential areas to each area of major employment Lines radiating from these three major employment centers have been seen on some of the previous maps; these three figures indicate the zone residence location of the persons working in the hatched areas There are sizeable volumes of automobile trips destined for the central business district from zones in approximately the central third of the city. Improved transit service might reach additional potential transit passengers in this midtown section. Further detailed study of areas of major employment shown on Figure 16 and a comparison of automobile and transit passenger trip volumes from each zone could establish where rerouting or other changes in the local transportation system can better serve movements to and from each major industrial and shopping area.

Improvement of highway facilities in this central third of the city will undoubtedly need the provision of express highway routes and a detailed study of these maps will furnish much valuable information in this respect. From the zone to zone tabulations, increased by a factor accounting for the likely future increase in traffic, there can be developed, section by section, the anticipated traffic requirements of such routes.

The information obtained in the survey makes possible an analysis of the difference between war time conditions at the time of the

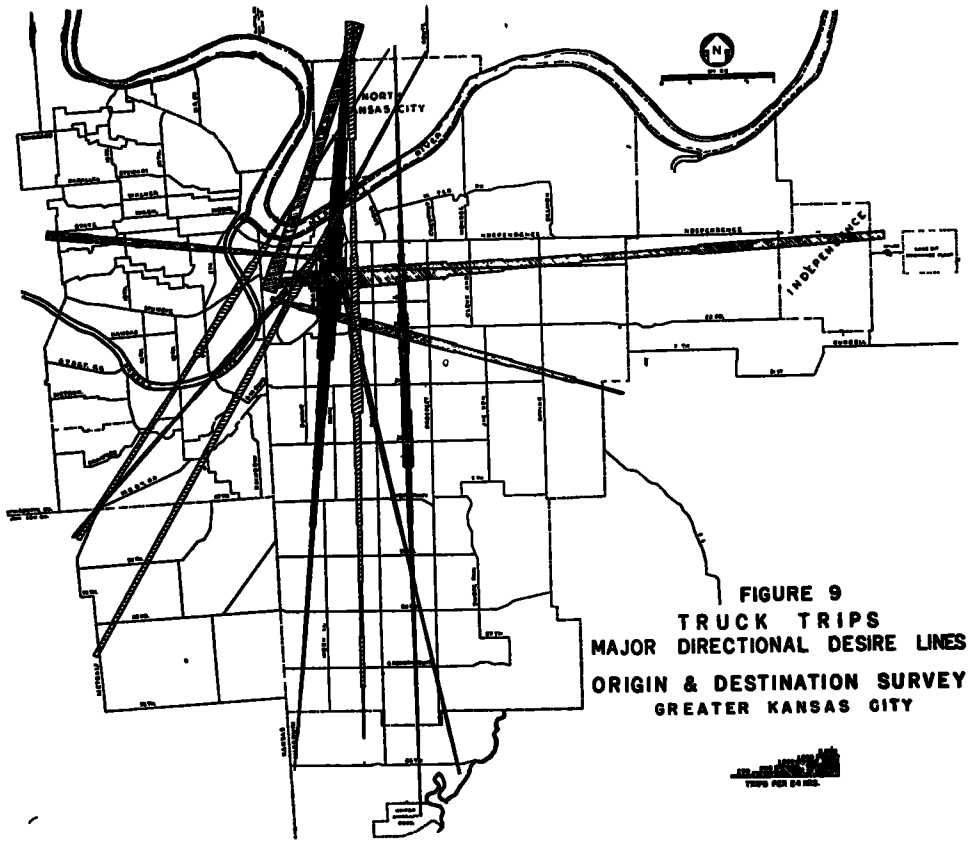



FIGURE 9
TRUCK TRIPS
MAJOR DIRECTIONAL DESIRE LINES
ORIGIN & DESTINATION SURVEY
GREATER KANSAS CITY

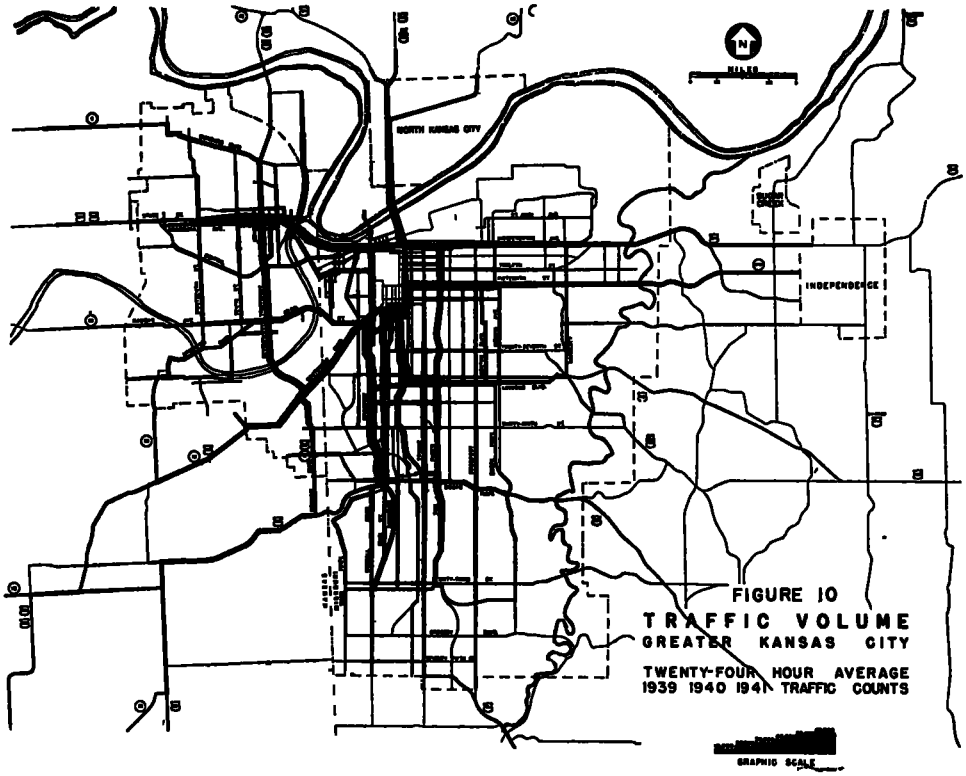


FIGURE 10
TRAFFIC VOLUME
GREATER KANSAS CITY
TWENTY-FOUR HOUR AVERAGE
1939 1940 1941 TRAFFIC COUNTS

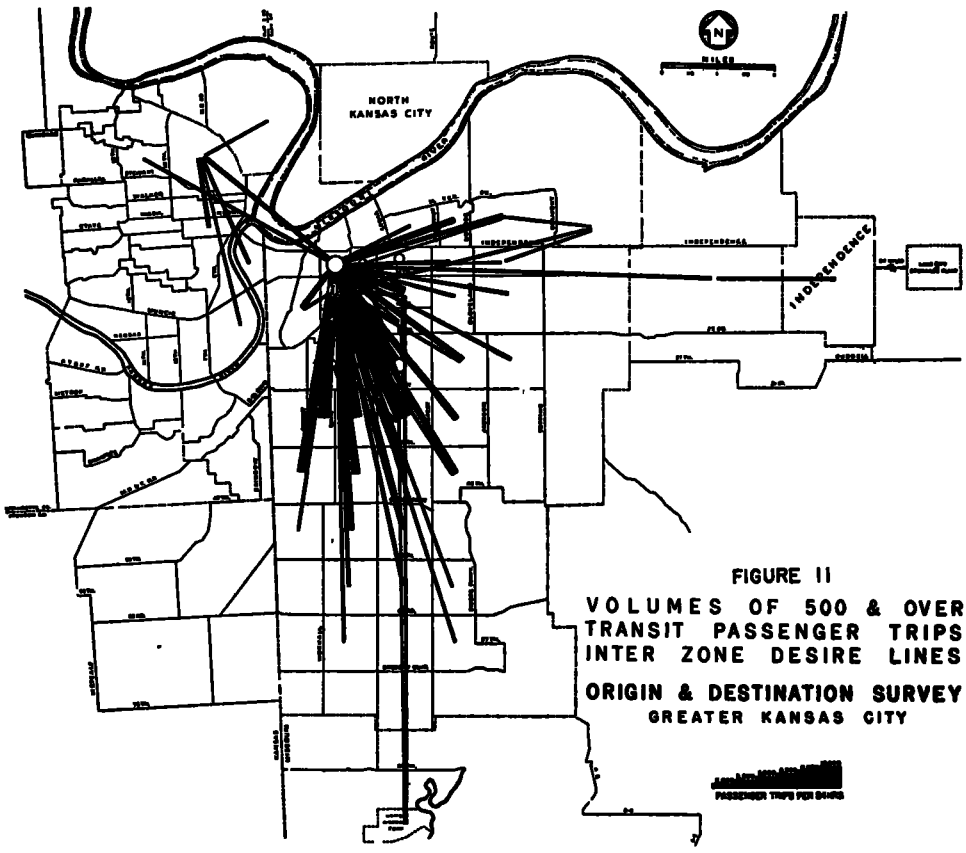



FIGURE 11
VOLUMES OF 500 & OVER
TRANSIT PASSENGER TRIPS
INTER ZONE DESIRE LINES
ORIGIN & DESTINATION SURVEY
GREATER KANSAS CITY

survey and pre-war travel habits. The following tabulation is based on 100,000 Missouri internal trips. These are all potential auto-

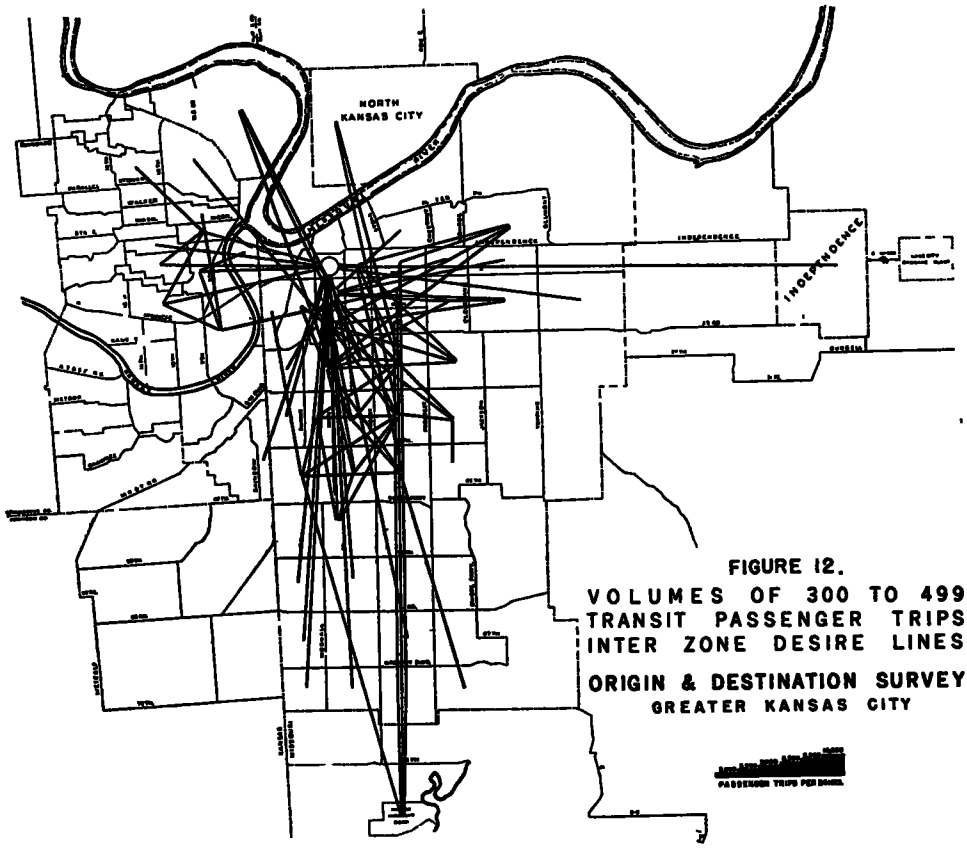



FIGURE 12.
VOLUMES OF 300 TO 499 TRANSIT PASSENGER TRIPS INTER ZONE DESIRE LINES
ORIGIN & DESTINATION SURVEY
GREATER KANSAS CITY

mobile drivers under pre-war or post-war conditions:

| Present Mode of Travel | Per cent |
|---|---|
| Auto Driver | 63.7 |
| Truck Driver | 2.0 |
| Auto Passenger | 13 0 |
| Truck Passenger | 0.1 |
| Street Car | 14 5 |
| Bus | 6.3 |
| Taxi | 0.4 |
| Total | 100 0 |

Thus approximately 21 per cent of the future potential passenger car trips represent persons who were transit passengers during the war. These may return, under post war conditions, to their pre-war mode of traveling. It will be necessary to determine how many of these war time passengers can be attracted to continue using transit service, if many important improvements are effected. It would appear that 13 per cent of potential passenger car drivers, who were automobile passengers, might be potential transit passengers if given improved and faster transit service.

The origin and destination survey data should be carefully studied also in relation to other physical, social, cultural and economic conditions which may affect transit and highway facilities and their integration with the entire urban pattern. Information must be provided which will indicate the many patterns that characterize the metropolitan area

and its people. Residential neighborhood development and preservation must be encouraged in an appropriate manner based on areas of similarity and the potential development of more protected neighborhoods These should be free from the intrusion of through traffic but adequately served by traffic and transit facilities on the edge of the neighborhood and with school, recreational and other community facilities provided centrally within the neighborhood. The proper balance between the provision of highway facilities and transit facilities properly correlated and coordinated for these people of like characteristics can be ascertained in a detailed application to each of the neighborhood units For these studies a detailed analysis of the intrazone as well as the interzone desire movements for each zone of the survey broken down further on neighborhood boundaries will assist in determination of desirable location of sub community centers, public buildings, etc.

The future land use plan with its indication of appropriate public, industrial, commercial and residential uses will serve as a guide in the long range programming of transit and highway improvements. For example, areas for redevelopment may indicate a possible change in the future requirements for both highway and transit facilities

The great importance of increasing the use of transit facilities has been demonstrated in preliminary studies now progressing to determine anticipated traffic volumes on proposed express highways The large passenger car volumes developed along sections of these proposed urban routes establish the fact that provision for mass transportation vehicles

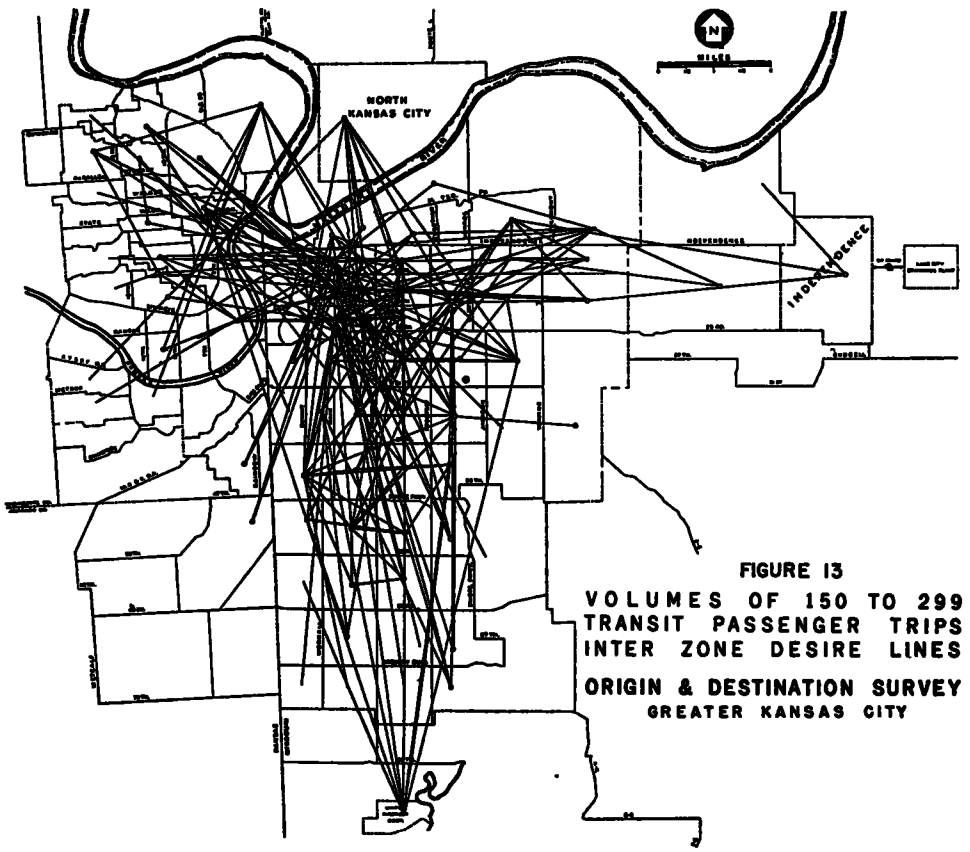



FIGURE 13
VOLUMES OF 150 TO 299
TRANSIT PASSENGER TRIPS
INTER ZONE DESIRE LINES
ORIGIN & DESTINATION SURVEY
GREATER KANSAS CITY

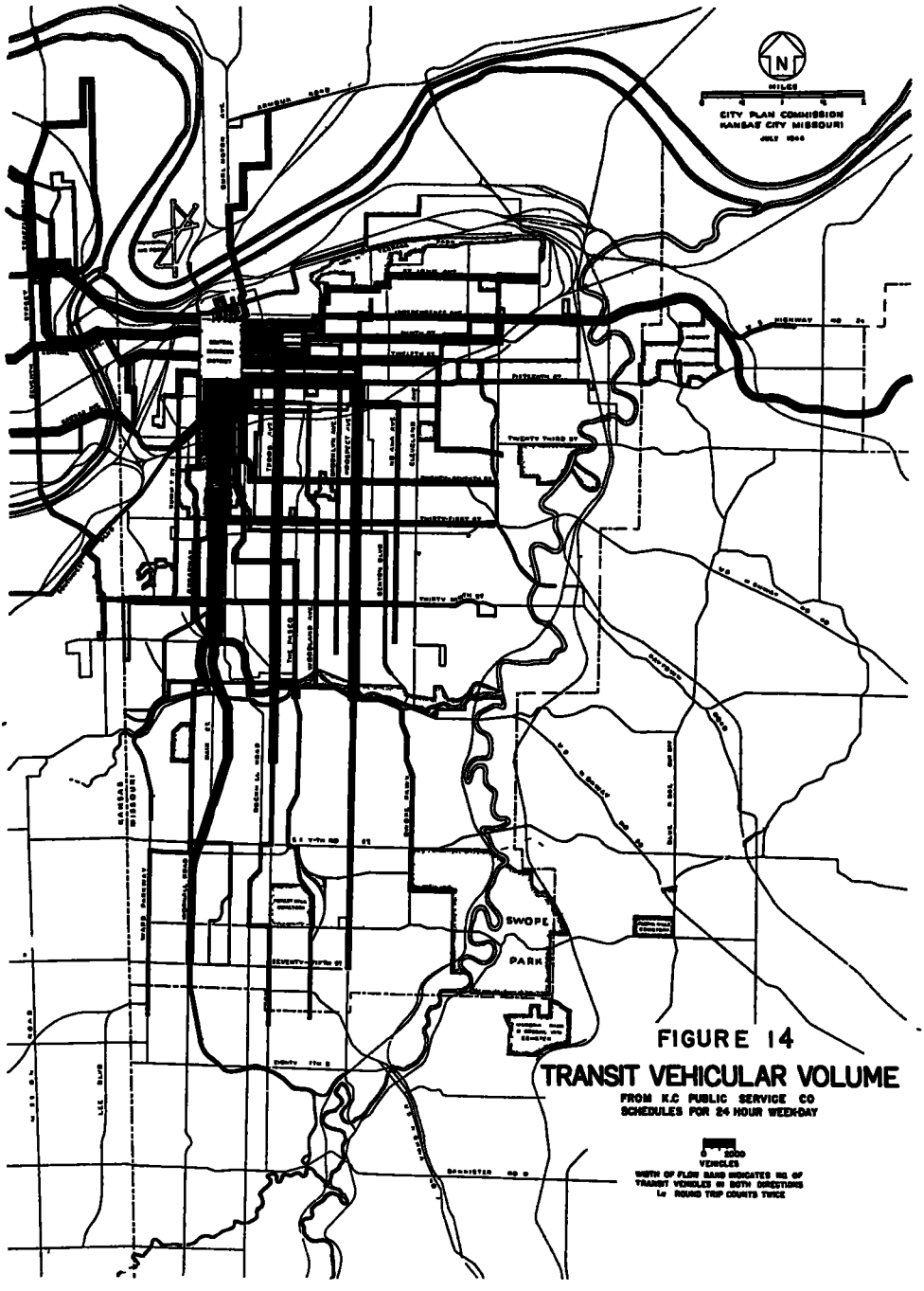



FIGURE 14

TRANSIT VEHICULAR VOLUME

FROM K.C. PUBLIC SERVICE CO
SCHEDULES FOR 24 HOUR WEEK-DAY

2000 VEHICLES

WIDTH OF FLOW BAND INDICATES NO. OF TRANSIT VEHICLES IN BOTH DIRECTIONS
i.e. ROUND TRIP COUNTS TWICE

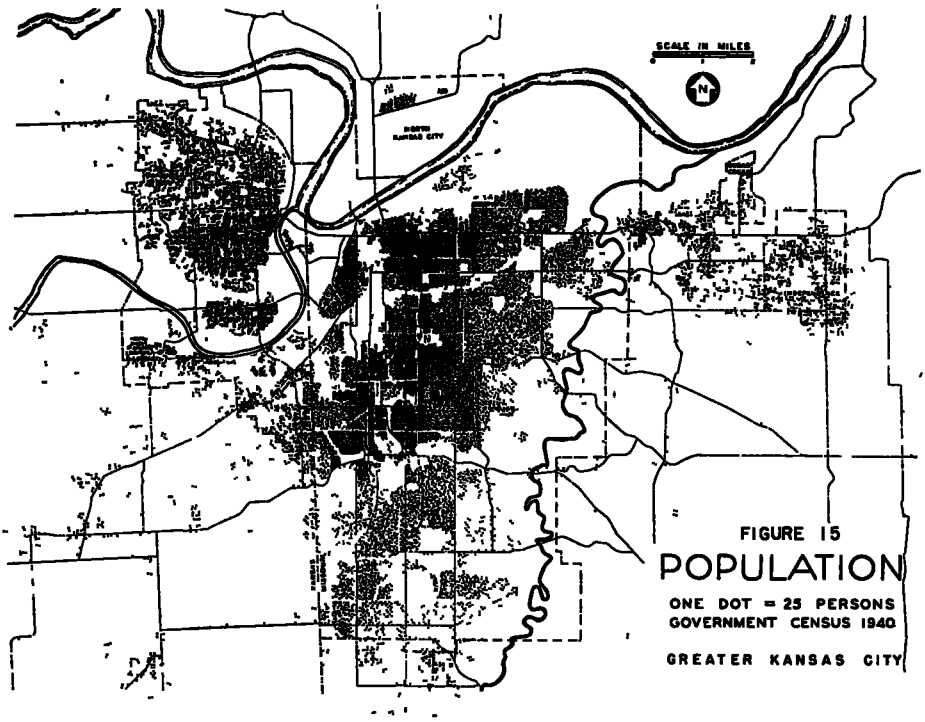



FIGURE 15

POPULATION

ONE DOT = 25 PERSONS
GOVERNMENT CENSUS 1940

GREATER KANSAS CITY

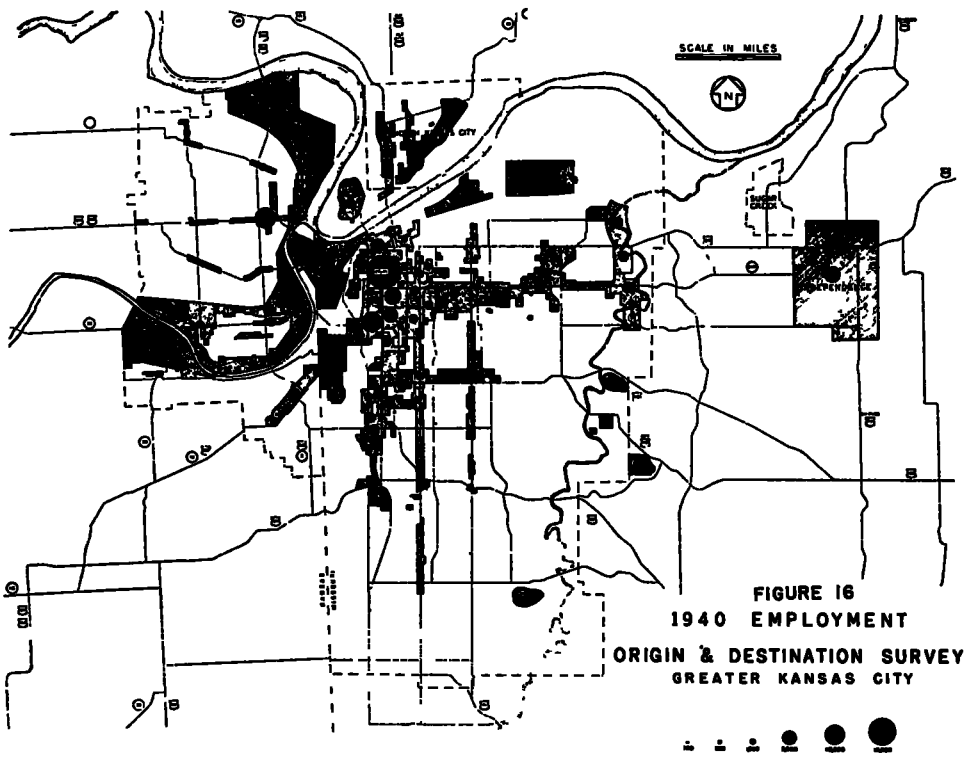



FIGURE 16

1940 EMPLOYMENT

ORIGIN & DESTINATION SURVEY

GREATER KANSAS CITY

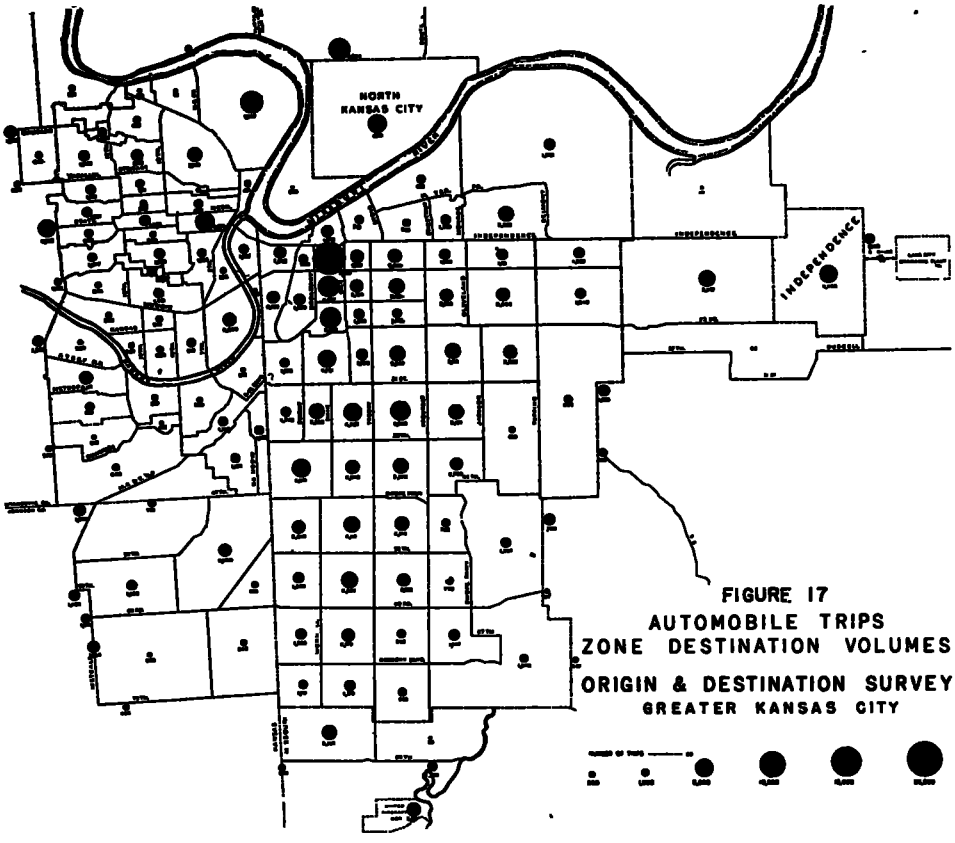
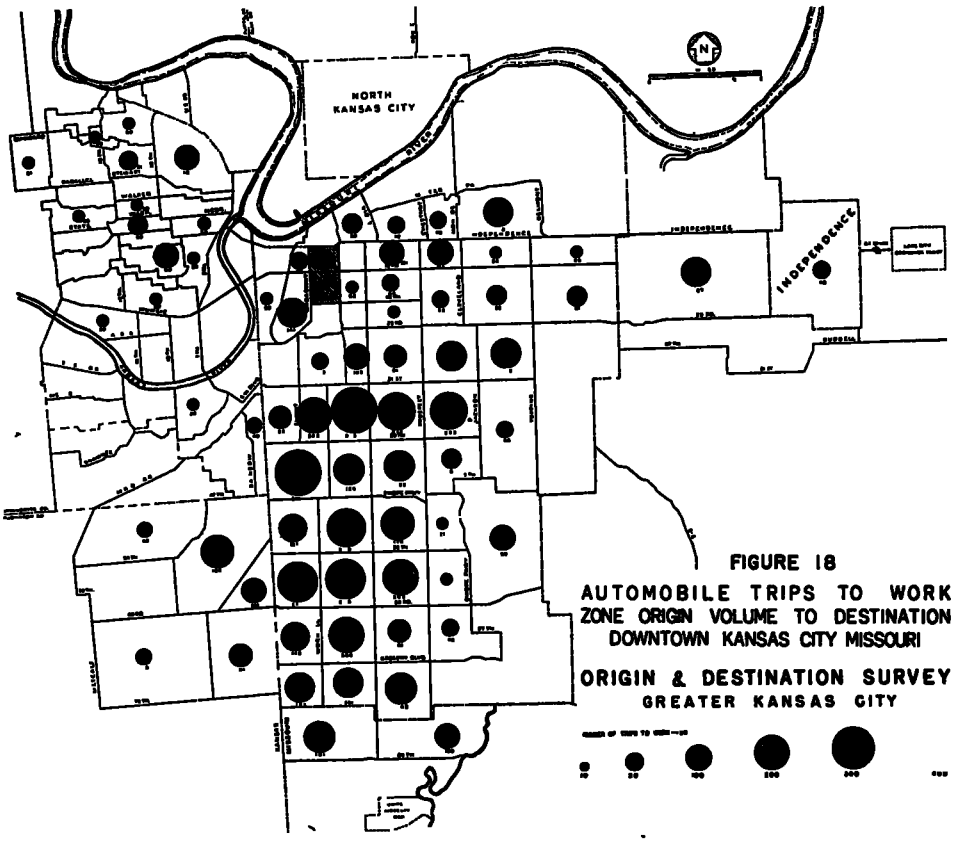



FIGURE 17
AUTOMOBILE TRIPS
ZONE DESTINATION VOLUMES
ORIGIN & DESTINATION SURVEY
GREATER KANSAS CITY


NORTH
KANSAS CITY
INDEPENDENCE
FIGURE 18
AUTOMOBILE TRIPS TO WORK
ZONE ORIGIN VOLUME TO DESTINATION
DOWNTOWN KANSAS CITY MISSOURI
ORIGIN & DESTINATION SURVEY
GREATER KANSAS CITY

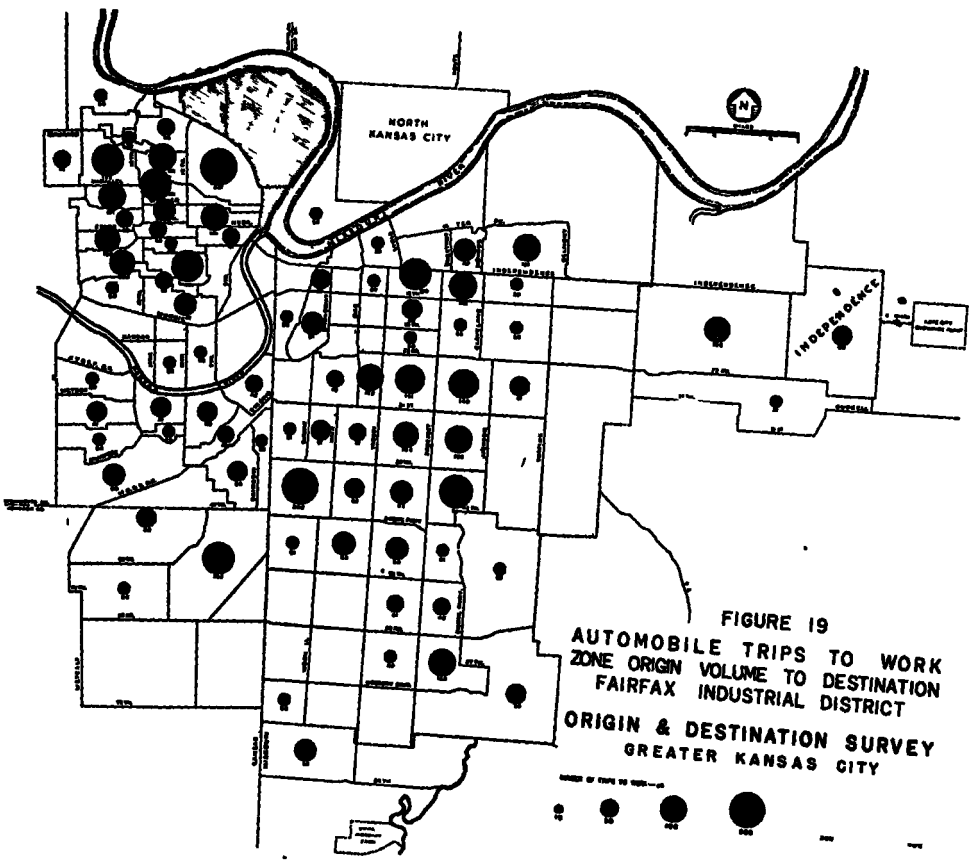



FIGURE 19
AUTOMOBILE TRIPS TO WORK
ZONE ORIGIN VOLUME TO DESTINATION
FAIRFAX INDUSTRIAL DISTRICT
ORIGIN & DESTINATION SURVEY
GREATER KANSAS CITY

should be incorporated in the design of express highways if vehicular volumes are to be reduced to the point where downtown parking facilities can adequately handle the load. Otherwise, tremendously increased expenditures will be necessary in providing these additional off-street terminal facilities, and the required street space for the additional traffic movements.

More detailed studies can be made from the survey data relating to parking characteristics and the extent to which transit and private automobile passengers will walk from the transportation terminations of their trips to their points of destination. Also, the survey data may be further applied in determining traffic and transit rerouting within the downtown area to assist in the solution of downtown traffic and parking problems.

Studies now progressing, based on origin and destination traffic data and the anticipated increase in future traffic requirements, indicate the necessity of considering additional urban express highways. The proposed interstate system of express highways will need further supplementing near the downtown areas and in midtown areas, to serve adequately urban traffic movements of the future.

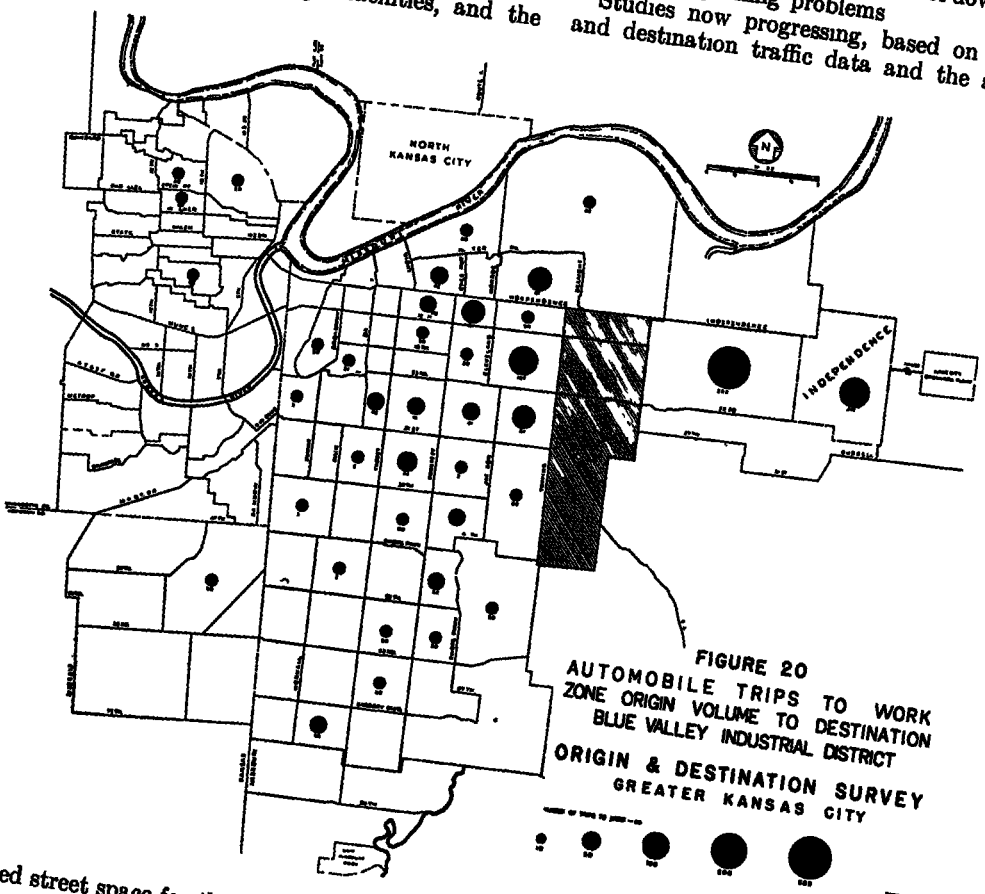



FIGURE 20
AUTOMOBILE TRIPS TO WORK
ZONE ORIGIN VOLUME TO DESTINATION
BLUE VALLEY INDUSTRIAL DISTRICT
ORIGIN & DESTINATION SURVEY
GREATER KANSAS CITY