A plan for future highways must be based on an estimate of the future needs. Any set of highway improvements are built after they are planned and used long after they are built. If it is necessary to borrow to build these improvements, all the more reason to expect that the needs of future users and taxpayers must be rationally anticipated. Difficult as it is to make forecasts, no planning can take place without a careful estimate of the future.

The more carefully detailed the estimate of future requirements, the sounder the plans will be. But detailing future traffic presents problems of increased error as details are increasingly fine. The following two chapters describe the construction of the forecast of traffic requirements expected in the Area by the target year, 1980.

**Why 1980?**

One may well ask, "Why choose 1980?"

The initial field data were collected in 1953. This report is issued two years later. Actual construction of new facilities must necessarily be spaced out over a substantial time period. Given some estimate of the time periods involved between conception and actual construction of new facilities, and realizing the increased inaccuracies which obtain from more distant forecasts, the compromise target year of 1980 was selected as a most reasonable point in the future. There is no magic in the selection of 1980. Another year could have been chosen. The selected point is twenty-five years in the future. To forecast beyond this period naturally would introduce greater errors. In twenty-five years, the present babies will be family heads and the size of the population can be more reliably estimated. A period of less than twenty-five years would perhaps be too short a time for planning public improvements whose usefulness will extend well beyond 1980. A reasonable time for bonds for such improvements is twenty-five years and, since new highways are designed after they are planned and built after they are designed, selecting a shorter time period than twenty-five years could well be short-sighted.

The growth which is estimated to occur by 1980 and the resultant increase in traffic demands may occur by 1975 or not until 1985. The inevitability of this amount of growth at some point in time near 1980 is of dominant importance. The fact that such growth will occur makes it simple, common sense to plan for it.

The growth estimates presented are subject to all the normal forecasting hazards. They should be reviewed by the agencies with continuing planning responsibility. If such agencies keep a finger on the growth pulse of the community the forecasts can be improved and sensibly modified. It is with this possibility in mind that the forecast logic and procedure are described in substantial detail.

**The Population Forecast—1980**

A total estimate of population is necessary before any detailed traffic forecast can be developed. The total population of the Area is the major determinant of the total amount of land to be used and of the total amount of travel which will be performed. Therefore, the first task in preparing a travel forecast involved agreement as to the size of the future resident population.

The cooperation of the Detroit Metropolitan Area Regional Planning Commission was immediately sought. This agency is charged with long term planning for metropolitan Detroit.
They are regularly concerned with making population forecasts for the region and they review these forecasts periodically. They had published a detailed population projection for 1970. It was agreed that they would review their 1970 projection and extend it to 1980.

Separate studies were also begun by the staff of the Study as an independent check. After both agencies had completed their studies, the results were compared and both agencies agreed on a 1980 population forecast for the Study Area of 4.4 million persons.

METHODS OF POPULATION FORECASTING AND RESULTS

There are two active components which will produce changes in the total population of a metropolitan area; natural change (births minus deaths) and migration. The relationship of births to deaths is a very significant factor for national population and the only factor for world population. In metropolitan areas, however, migration has been the most decisive factor in determining growth. To approach the problem of growth, then, two studies of population were made by Study personnel. The first was a natural increase study; the second one of future employment which is assumed to be a major determinant of net migration.

Natural Increase Forecast

If there were no in- or out-migration, population change would be simply a matter of the net difference between births and deaths. If these facts were known the 1980 population could be calculated.

A forecast of annual births was made using the cohort-survival method. This involves the calculation of the number of women of child bearing age in the Area (the cohort) at each year and the assumption of a birth rate. Since data for the Study Area were not available for prior years, the area for forecasting was the “Standard Metropolitan Area” (the three counties of Wayne, Oakland and Macomb).

The 1950 Census provided data on the number of women in the population by age group. By assuming both a birth rate and the proportion of boys to girls born, and by using life tables, it was possible to change the population by age and sex, year by year from 1950 to 1980 culminating in a complete age-sex population model for 1980.

This was done by using the death rates published by the U.S. Government2 and the Michigan Department of Health.3 A review of birth rates per 1,000 women aged 15-44 years disclosed wide variations for different periods of time. The low rates of the 1930 decade for Michigan was used as a “low” figure. This was 75 births per 1,000 women of child bearing age. The “high” rate of 105 births per 1,000 potential mothers was somewhat below the current rate in Michigan of just over 110. The average State birth ratio of 513 male per 1,000 live births was assumed. Then the 1950 population was moved forward year by year to 1980 using the three different birth rates. The results of this time consuming work are summarized in Table 1.

<table>
<thead>
<tr>
<th>Assumed Birth Rates</th>
<th>Calculated 1980 Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>High (105 birth rate)</td>
<td>4,263,900</td>
</tr>
<tr>
<td>Medium (90 birth rate)</td>
<td>3,872,600</td>
</tr>
<tr>
<td>Low (75 birth rate)</td>
<td>3,540,000</td>
</tr>
</tbody>
</table>

The 1950 census enumerated 3,016,197 persons resident in the Standard Metropolitan Area in 1950. It can be seen, therefore, that

3For persons aged 70 and over, Michigan Department of Health, Michigan Health Statistics, Lansing, 1951, Table 7A, p. 21 was used.
all three birth rates are sufficient to cause growth. These data are extremely helpful in working towards a final forecast but are obviously unreasonable because no account is taken of migration. It is of interest, however, that the present population, if current birth and death rates were continued, would increase by more than 1,250,000 persons in thirty years! Actually, the continued high birth rates between 1950 and 1953 make all of the above estimates somewhat conservative because these new children will be forming families before 1980.

**Labor Force Forecast**

This method of population forecasting is predicated on the theory that the population of a metropolitan area is largely a resultant of work opportunities. Simply stated, it means that people will live there if there are jobs and will move out if there are insufficient employment opportunities. The logic of the system goes even deeper than this. It is assumed that the most active ingredient in the economy of Metropolitan Detroit is manufacturing. This is assumed to be the main source of export goods. It is further reasoned that each manufacturing worker can support—indeed requires—other workers in non-manufacturing jobs. These other workers would be persons employed in retail stores, service industries, governmental work and the like. Therefore, if manufacturing employment could be predicted, this would give the total labor force, and the total labor force being a known part of the total population, this would yield the estimate of total population.4

To predict future manufacturing employment in the Standard Metropolitan Area, the total employment in manufacturing was developed for a series of years from data provided by the Michigan Employment Security Com-

**mission. It was reasoned that manufacturing employment in the Detroit Area would be sensitive to the national economy—especially the sector which would represent “hard goods” production. Several national series of data were correlated with the series on manufacturing employment in the Standard Metropolitan Area. The best relationship found was with U. S. employment in durable goods industries. Using the twelve years from 1940 to 1952, the correlation between these two series was very close. The correlation coefficient was .96 which would suggest that only about 8% of the annual variation in Detroit Area manufacturing employment could not be “explained” by factors affecting national employment in durable goods industries.5

Using a 1975 forecast published by the U. S. Bureau of the Census, national employment in durable goods industries of 12.4 million persons was derived. If this amount is entered in the predicting equation, it yields 980,000 employment in manufacturing in the Detroit Metropolitan Area. Assuming manufacturing employment as 46.5% of the labor force (an average figure for the past eight years), there would be an estimated 2,107,800 persons in the labor force of the Metropolitan Area in 1975.

If it is further assumed that 43.2% of the population will be in the labor force (again this is a current average percentage) then the 1975 population estimate for the Metropolitan Area is 4,880,000. By the conservative assumption of an annual population increment from 1975 to 1980 equal to the average annual increment from 1950 to 1975, the 1980 population would be expected to be 5,253,000 persons.

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4This method is fully discussed in Schmitt, Robert C. "Future Population of Metropolitan Flint." University of Michigan Social Science Research Project, Flint, Michigan, July 1947. It is greatly over-simplified in the limited discussion possible in this report.

5Annual national figures reported in U. S. Department of Labor Monthly Labor Review and summarized in the Statistical Abstract of the United States for various years.

6The regression equation developed was Y equals 12,691 plus .078 X where Y is manufacturing employment in the Detroit Standard Metropolitan Area and X is the annual average employment in durable goods industries in the United States.

This forecast and its logic are outlined to provide the reader with some basis for evaluation of the reasonableness of the population estimates used. It is clear that traffic needs will be a direct function of population size.

**Comparison with Independent Population Forecasts of Regional Planning Commission**

The Regional Planning Commission made a series of independent forecasts which projected the Area's population to 1980. They used employment forecasts, ratio forecasts for Michigan and the United States and forecasts of survival ratios and net migration. Their lowest figure was 4,800,000 and their highest 5,340,000. It was agreed by both agencies that the most reasonable single figure to use for the Standard Metropolitan Area in 1980 would be 5,150,000 persons.

It remained to define the population resident within the limits of the Study Area. In 1953 this had been slightly more than 90% of the population in the Standard Metropolitan Area. However, it was reasoned that by 1980 only 85% of the total would live within the boundaries described by the Study. The continued extension of suburban population would create greatly increased residential development just outside of the Study Area by 1980. Based on this reasoning the final estimate of 4,400,000 persons was agreed to by both agencies as the probable size of the 1980 Study Area population. This means that a 48% increase in population from 1953 to 1980 is expected within the Study Area.

In the accompanying Figure 1, the population of the City, the three-county Metropolitan Area and the State are shown by years since 1890. This chart shows both the amount and the rate of growth. The City, being nearly filled up, shows little increase after 1930. While all rates of growth slowed from 1930 to 1940, the growth rate has once again picked up. For the State growth continues at a steady pace. The Metropolitan Area of Detroit, after its great increase in the 1910-30 period, has tended to grow at a pace more nearly similar to that of the State as a whole. Of particular concern is the growth of the Study Area which, being limited in size and beginning to fill up by 1980, shows a tendency to fall behind the other growth curves.

**FIGURE 1. Population Growth—1890 to 1980**

In summary, separate population forecasts by a variety of methods showed substantial agreement although there were variations between high and low figures. The Regional Planning Commission and the Study staff agreed upon a single figure which represented an increase of 48% in the Area’s population within twenty-seven years. This population
estimate provides the point of departure for detailing future traffic requirements and is the determinant of the amount of future traffic.

**The Distribution Of Future Population and Land Uses**

In the preceding section it was shown how a forecast of total population for the Study Area was worked out. The factors determining the size of metropolitan populations are well studied and reasonably well known as compared to the factors which determine how that population will be spatially arranged within a metropolitan area. Yet it is just this spatial arrangement of people at home, at work, at school, at shopping and other activities which creates the local traffic situation. To anticipate the future traffic demands, it is essential that the increment of population together with the new and changed land activities, which such a population brings about, be accurately described. From a spatial description of people and land uses, it has been shown⁸ that traffic volumes can be reliably estimated and resultant travel desire patterns approximated.

In Chapter V of the first volume of this Report a detailed description was given as to the methods used in determining the trip generation per acre for each land use classification in each traffic zone of the Study Area. Likewise the inventory of all land uses in the Area as of 1953 was shown.⁹

The difficult problem, therefore, was one of determining the appropriate future group of land uses in each zone. Fortunately this problem was simplified because of the very high calibre, well staffed local planning agencies. The City Plan Commission of Detroit had prepared a detailed, official master plan for the City in 1951. They had also made a detailed, current land use inventory. They were therefore in an excellent position to furnish the development and redevelopment plans for Detroit and thereby provide measures of expected land use changes in the City.

The Detroit Metropolitan Area Regional Planning Commission likewise had prepared a future land use plan for the area outside of Detroit. The background studies of this agency and the wealth of data which they were able to furnish made the problems of anticipating future land use outside of Detroit a much simpler one. Both agencies put personnel to work on these special problems and were unstinting in their cooperation in making these detailed forecasts of future land use.

There were two difficult problems in determining the future land use of each traffic zone. First the future land use for Detroit was arranged in summary form by the Plan Commission within "neighborhood areas" and "industrial corridors". These areas bore little or no relationship to the traffic study zones. The translation of these future uses into traffic zones presented a difficult problem.

The second problem, largely outside of Detroit, was that future land use plans in the suburban areas were worked out for future capacities and it was necessary to devise some priority rating for land development in order to decide at what rates available land would be used and where the 1980 stopping point would be. A detailed description of the procedure used follows.

**FUTURE LAND USE IN THE CITY OF DETROIT**

Within the city of Detroit in 1953, 89% of the land was used and only 11% vacant. Therefore, major changes in land use and traffic generation were limited. The City population was expected to increase from the 1,853,000 persons counted in 1953 to 1,984,000 in 1980.¹⁰ The biggest changes expected were from development of the remaining vacant land and from redevelopment of some of the older

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⁸See Chapter V, Part I of this Report.
⁹For additional detail on these measures, please refer to the technical report, “Land Use and Traffic Generation in the Detroit Area”, mimeo, 1955.—58 pp.
¹⁰This forecast was made by the City Plan Commission and was based upon the future use of all land within the present limits of Detroit.
sections of the city.

The future land use for Detroit was grouped within traffic zones by land use classification using the 1953 land inventory and the planned future land use for each neighborhood. The translation of future uses from neighborhood to zone units was made by means of census tract and block measures. The future land uses according to the master plan for Detroit are shown in Table 2.

### TABLE 2

<table>
<thead>
<tr>
<th>Land Uses</th>
<th>Existing 1953 Land Use</th>
<th>Planned 1980 Land Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>acres 32,326</td>
<td>acres 39,304</td>
</tr>
<tr>
<td>Commercial</td>
<td>acres 2,331</td>
<td>acres 2,410</td>
</tr>
<tr>
<td>Industry and Utilities (including railroads)</td>
<td>acres 8,369</td>
<td>acres 11,324</td>
</tr>
<tr>
<td>Public Buildings</td>
<td>acres 3,486</td>
<td>acres 4,065</td>
</tr>
<tr>
<td>Public Open Space</td>
<td>acres 5,771</td>
<td>acres 7,041</td>
</tr>
<tr>
<td>Vacant</td>
<td>acres 11,801</td>
<td></td>
</tr>
<tr>
<td>Net Land Area Exclusive of Street and Alleys</td>
<td>acres 64,084</td>
<td>acres 64,084</td>
</tr>
</tbody>
</table>

Source: Detroit City Plan Commission, "City of Detroit—1950 and 1980 Estimated Total Land Uses", unpublished report, 1955, Table 1. 1980 land uses comprise large programs of both redevelopment and conservation and propose revisions in residential densities and in the amount of area devoted to neighborhood parks and schools.

### The Central Business District

Special attention was devoted to the forecast for the Central Business District. Detailed redevelopment plans of the City Plan Commission were used. The uses in 1953 were recorded by the Plan Commission in measures by floor area as well as land area. All future plans and densities were converted to measures of floor area by proposed future use categories. Thus each zone in the Central Business District had measures of present and future building floor area as a basis for forecasting trips.

### FUTURE LAND USE OUTSIDE OF DETROIT

As suggested, the problem for zones outside of Detroit was a matter of rating vacant land according to the priority of probable development. The future land use by traffic zones was worked out in detail with the Detroit Metropolitan Area Regional Planning Commission. The bulk of the future growth in both population and land use had to occur outside of the City of Detroit. Therefore, it was necessary to anticipate very great changes in land use and population in this area and correspondingly extensive future development of presently vacant land.

The cities of Highland Park and Hamtramck are both enclosed within the city limits of Detroit and are completely built up. Therefore, they would tend to remain constant in both land use and traffic generating characteristics. For the balance of the suburban area, however, a very careful procedure was followed. The industrial land which would be required was allocated first. This allocation was made on the basis of detailed forecasts prepared by Mr. Paul M. Reid of the Regional Planning Commission. This agency had prepared long term forecasts of the industrial employment for the Metropolitan Area and had allocated future employment to each community based upon detailed studies. In each community the forecasts included information on employee densities. Using this information, the number of acres of land and the additional employees expected in each community were known. Working closely with the Regional Plan personnel and the planned future industrial land, acreage and employment figures were worked out for each traffic zone. This land plus the additional lands reserved for industry were then extracted from the available supply of vacant land in each zone.

A survey of lands unsuitable for residential development had been made and these lands were extracted from the available land in the appropriate zones. This involved a further reduction of the available land for development.

All plans for public parks and for public land reservations in the area were obtained and the land so planned was withdrawn from available

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future use and designated as public open space. Again this was done zone by zone.

The next future land use allocated was for shopping centers. The Regional Planning Commission made special studies of this form of land use. All shopping centers currently under construction or planned were inventoried and plotted on maps of the Area. Considering future population and trade areas, the necessary enlargement of existing centers and sites for additional new centers were determined. In sum, twenty-six new centers were located and eight existing ones planned for enlargement. These accounted for 926 acres of commercial land or nearly 23% of the net increment of commercial land expected in the suburban area by 1980.

The next step was one of allocating the residential population based on the remaining available land in each zone and at the planned density standard for each zone. The difficult problem of deciding which lands would be developed and which would remain vacant by 1980 was undertaken by providing priority ratings to available land. Residential population was then allocated to each zone based on its available land and density. In this process added land for schools, stores and non-manufacturing industrial uses was allocated on a pro-rata basis with the residential uses. If a zone already had a shopping center or an unusual amount of commercial land, the additional land for commercial uses to be added with residential growth was proportionately reduced.

The results of this land allocation for the area outside of Detroit are presented in summary form in Table 3. This table shows that the increase of land used outside of Detroit was about the same order as the increase in population, i.e., 119%. Likewise the future land use distribution is shown to be very similar to that presently existing. All non-residential land uses increased somewhat more rapidly than did residential land. In some part this was due to the fact that subdivided, vacant land was frequently classified as residential in the 1953 inventory because of interspersed vacant lots and as these partly built up areas filled out, houses would have been added without increasing the amount of inventoried residential land. This correction was achieved by filling available plus existing residential land according to the planned density. The large growth in commercial land uses was due to the much more extensive use of land by new commercial developments—particularly the additional land required for off-street parking.

### Converting Future Land Use To Future Trip Volumes

For each zone in the Study Area the land uses by type were listed for 1953 and for 1980. Where no supplemental data were on hand to indicate a change in the intensity of the land use in any category in a zone, the trip-per-acre factors of 1953 were multiplied by the number of 1980 acres to predict the trip volumes for 1980 for each land use classification. When trip volumes for each land use type were calculated for a zone, these were summed to obtain the estimated 1980 trip volumes to that zone. In zones where residential density or worker density changed, or where a new commercial center had been sited, appropriate new factors for the 1980 land use were constructed using the additional information. Changes in floor area instead of changes in land area were used to compute the 1980 trips generated by central business district zones.

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Acres 1953</th>
<th>Acres 1980</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>60,602</td>
<td>136,292</td>
<td>125%</td>
</tr>
<tr>
<td>Commercial</td>
<td>2,520</td>
<td>6,647</td>
<td>164%</td>
</tr>
<tr>
<td>Industrial (including Utilities and Railroads)</td>
<td>11,430</td>
<td>26,352</td>
<td>131%</td>
</tr>
<tr>
<td>Public Open Space</td>
<td>6,055</td>
<td>19,410</td>
<td>221%</td>
</tr>
<tr>
<td>Public Buildings</td>
<td>5,567</td>
<td>13,075</td>
<td>135%</td>
</tr>
<tr>
<td>Unclassified uses</td>
<td>4,479</td>
<td>4,069</td>
<td>-9%</td>
</tr>
<tr>
<td>Streets and Alleys</td>
<td>39,045</td>
<td>80,596</td>
<td>103%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>130,298</strong></td>
<td><strong>286,441</strong></td>
<td><strong>120%</strong></td>
</tr>
</tbody>
</table>
By dealing with one zone at a time many other factors affecting the number of trips-per-acre were controlled. For example, where only the future acreage in industrial use could be predicted but where the number of workers per acre was unknown, the trip-per-acre figure for existing industrial land was used. It is only reasonable that the intensity of use of new industrial land will be similar to that of present uses. Land values tend to be similar and like kinds of industry are usually found together. Moreover the location of that zone in reference to other zones is automatically controlled for both points in time. Thus suburban zones will tend to have low density developments with many employees driving to work. This characteristic is "built in" to the 1953 data and has been preserved in making the 1980 forecast of trips. In brief, the already shown tendency for trips-per-acre to decline with distance from the central business area is taken care of automatically by dealing with one zone at a time.

When trip rates per acre for each land use in each zone were known, then it was a simple matter at each zone to multiply these rates times the acres (or, in the Central Business District, the floor area) to obtain the future trips terminating or originating there. By this very straightforward process, the 1980 origins and destinations were predicted for each zone.

**Reliability Of The Forecast Of Trips**

There is room for substantial error in the allocation of future land use within any one zone. This problem is not as severe as it might seem, however, because of two factors. First, the careful inventory of vacant land plus the careful measure of all land places certain limits on the total amount of development and the net increase in development possible in any zone. Secondly, the rate of trip generation per acre is similar for several kinds of use—for example, residential and industrial land tend to generate trips at comparable rates. These problems are further limited by the fact that there are some two years of great construction activity known since the field survey was completed and construction plans for large projects which will be built within the next few years are also known.

More information on the intensity of future land use is desirable to further improve the accuracy of such forecasts. A great portion of trips are generated by residential land and residential densities are an integral part of the land use forecast. Similar data are available for industrial land because of the data on workers were available for much of the new industrial land. For many of the larger shopping centers data were available giving the square feet of floor area. All of these are measures of intensity and were used to develop the forecast of future trips generated by zones. Thus, while additional information on future intensity of land use should further improve the trip forecast, the amount of improvement would not be so great as might be expected because much of the variation in intensity is accounted for by the measures used.

**PROBLEM OF TRENDS IN TRIP-MAKING**

One of the most difficult problems was that of determining the extent to which long term gains in income, and car ownership should underpin a forecast. An increasing trend in either or both of these factors would be expected to increase average rates of trip-making. Considerable thought was devoted to this problem. It was reasoned that one of the trends which had been current with increased incomes and car ownership had been suburban growth. It became apparent that if most of the future growth was in the suburban areas, people would be added in areas characterized by higher than average income and car ownership.

It would follow, then, that if all present rates were merely held constant at each zone and the added persons were given the characteristics of existing residents, the increment of population should tend to increase area wide per capita car ownership and trip-making. If a
family with no car, living in the older section of Detroit in a two-family dwelling received a higher income, it was reasoned that they would not buy a car, make more trips and yet live in the same place. It would be much more likely that a rise in family income would induce a change of residence and their old house would be occupied by another family with income and car ownership characteristic similar to those of the family which had moved.

Research had shown that car ownership, while positively correlated with income, was also affected by residential density and distance from the center of town. In brief, this finding shows that if people live in sparsely settled, outer suburbs, they make many trips and have high car ownership rates no matter what the family income rating is. Conversely, people living in dense, apartment areas near the center of town make fewer trips (as defined by O-D data) and have lower than average car ownership rates and this, again, is generally true regardless of income differences.

These facts led to the conclusion that the assumption of any long term trend toward increased trip making at all households would be a difficult position to support.

Evidence suggests that trips are made for distinct purposes. Certain members of the household go to work. Unless more travel is required for performance of work or people take on more jobs or they come home for lunch more often there is little likelihood that work trips at the average household will increase. Likewise, other trips are made to satisfy certain needs and therefore limited to meeting those needs. One may suppose that social-recreation trips are quite elastic, i.e., that most people want to make more trips of this nature but can't afford it. This will not be entirely true because only so much time can be devoted to trip making within any household's time budget apart from income considerations. Also there is no demonstrable trend toward increased social-recreation activities outside of homes. It has actually been suggested that television and larger families work to reduce these trips.

The degree to which the average householder may wish to increase his frequency or distance of travel is unknown. Lacking any evidence of such a trend, it was assumed that trip making per dwelling place would be at comparable rates in the same zone in the future as it was inventoried in 1953. A similar assumption was made concerning the number of trips generated per acre of land use in any zone where there was no supplementary information about intensity of future use.

TESTING THE RESULTS OF THE TRIP FORECAST

The trips per acre of land use were calculated for each zone based upon the allocation of future land use and the application of the trip-per-acre figure for each use in each zone as these data were developed from the 1953 travel inventory. This procedure plus the factored external trips yielded a total of 11,401,456 person trips for 1980 as compared with a total of 6,895,829 person trips in 1953. This was an increase of 65%.

In order to test the reasonableness of this total trip forecast, it was possible to reconstruct the trips which would have been reported by the 1980 population by estimating the results which would have been obtained from a 1980 home interview program. To estimate these results it was assumed that the trips which would be reported at households were at the same average rate as reported in 1953 for each zone. This involves merely multiplying the average characteristics of each occupied dwelling place in each zone in 1953 by the number of dwelling places in that zone in 1980. This process discloses that the internal persons trips reported in 1980 would have been 10,500,000. If the non-resident trips are extracted from the 11,401,456 trips predicted from land use, the

Rates were obtained by dividing the total person trips generated in each zone in 1953 by the gross acreage of the zone. Zones with similar rates were then grouped by isolines. See Table 16, Appendix, for person trips generated by each zone.

DETROIT METROPOLITAN AREA TRAFFIC STUDY
1955

LEGEND

Trips per gross acre

- 600 to 5,263
- 120 to 599
- 60 to 119
- 36 to 59
- 24 to 35
- 12 to 23
- 6 to 11
- 0 to 5

DETROIT TRAFFIC STUDY AREA

RATE OF DAILY TRIP ORIGINS OF PEOPLE — 1953

Map 1.
Rates were obtained by dividing the estimated total person trips generated in each zone in 1980 by the gross acreage of the zone. Zones with similar rates were then grouped by isolines. See Table 16, Appendix, for trips generated by each zone.

DETOUR METROPOLITAN AREA TRAFFIC STUDY
1955

DETOUR TRAFFIC STUDY AREA
ESTIMATED RATE OF DAILY TRIP ORIGINS OF PEOPLE — 1980

Map 2.
comparable figure would be 10,490,000, a difference of less than .1%. 13

Using the same process it was possible to show that if car ownership rates remained constant in each zone, the 48% increase in population would have yielded an increase in car ownership of some 61%.

These changes are effected by constant household trip rates at each zone and a redistribution of land uses. Since the logic in this system would also raise the average income of households in the Area, it is most reasonable that an appropriate economic trend correction is inherent in this process.

ILLUSTRATION OF RESULTS OF TRIP GENERATION FORECAST

The careful development of both land use and population forecasts were a means towards an end. This end, for purpose of this study, was a detailed measurement of the anticipated traffic requirements by 1980. Trips and travel are caused by the activities of people on the land. But in preparing a map to illustrate the results of the forecast, it was decided to present the end product or person trip generation per acre. Therefore, two maps were prepared to compare the 1953 traffic generation with that forecast for 1980.

Map 1 shows the number of trips per gross acre generated in 1953. This map is made by dividing the total person trip destinations (or origins) in each zone by the gross acreage of that zone. The resultant map illustrates the trip attraction or generation rates for all land in the Study Area. In order to summarize these data and to develop the broad patterns, isolines are drawn enclosing areas of like volumes of trip generation per acre. 14 Map 2 is drawn in a comparable manner from the traffic generation predicted for each zone in 1980.

A comparison of the two maps discloses the changes reflected by the basic redistribution of population and land use. At the same time this map is a measure of the intensity of land development since trips per acre are a reflection of this intensity. In 1953 large areas of green show trip generation rates of less than 6 trips per acre. These are generally areas containing less than an average of one dwelling place per acre and therefore having large amounts of vacant land. By 1980 little or no green areas remain. Since there is relatively little vacant land expected in the Study Area by then (roughly 87% of all the land was calculated to be in use by 1980), there are few instances where zones would have such low rates of trip generation.

There is virtually no change in the areas colored red which are the most intensively developed land areas. These areas contain much heavily developed commercial land and therefore are capable of generating unusually high trip volumes. If it were possible to work in great detail with the future forecast, undoubtedly other small nodes of red would appear. The fact that zones necessarily become larger with distance from the center of Detroit also works to eliminate this detail. High volume commercial generators are usually in zones of sufficient size so that averaging the trips by the acres spreads these concentrated trips throughout the zone.

The areas which are shaded in dark blue, i.e. generating over 60 trips per gross acre in 1980 generally correspond to areas which were at least light blue in 1953. In some cases, therefore, slight increases in land development could have changed their classification. The lighter blue area—trip generation rates of 36 to 59 trips per acre—shows only a moderate increase in coverage. Most of this area in within the city limits of Detroit. Indeed, the City of Detroit, being most intensively built up, has very little area which is not within the blue or red isolines.

The very great increase in trip generation comes in the outer suburban portion of the Area. The amount of land covered by the dark-
est yellow color—24 to 35 trips per gross acre—has enlarged in all directions. For residential land, this trip generation rate means that there would be an average of six or seven houses per gross acre. Six or seven houses per gross acre means that the average house has about a 5,000 square foot lot.

The portion of the Study Area generating from 12 to 23 trips per acre shows the greatest increase over 1953. Detail is lost in these outer areas because much area is classified according to the average characteristics of these large zones. On the other hand outer areas of great growth are most difficult to predict with precise geographic detail and large zones are necessary. It is obvious that the extent of the built up area is greatly enlarged. The star patterns of land development along the radial roads in 1953 has disappeared as the in-between areas are filled out by development. This is predicated on the continued use of private means of travel and improved road service. It is a decentralized pattern but is directly in the tradition of Detroit which has grown with the automobile. These extensive suburban developments will create new traffic patterns and will require a greater number of surface routes. This is the great inescapable truth of future growth in the Area.

These two maps, then, represent the changes in land development as measured by trip generation. They show tremendous coming traffic growth. And they suggest the need for imaginative and large plans.

Summary

No future traffic improvements can be planned without an estimate of the traffic requirements they must serve. Therefore, the most accurate possible forecast of future traffic had to be made. A future target point had to be established for predictions. The year 1980 was selected. This is twenty-five years in the future—a reasonable time span considering the useful life of highways.

To produce the traffic forecast, the 1980 population of the Study Area was estimated. With the guidance and help of the local planning agencies, this population forecast was converted to a detailed land use forecast. The industrial, commercial, public and other non-residential land uses were determined based on the predicted future growth. The added population together with the new, non-residential uses of land were distributed to zones based on the amount of land in each zone available for development. The result was an inventory of future land uses in each traffic zone which was consistent with the population forecast, the known present land uses and the planning goals set by the responsible agencies.

Using the information obtained in the 1953 traffic and land use inventory, future land uses were converted to future trip generation. The total trips generated by the land checked almost exactly with the total trips estimated on the basis of the residential location of the population.

The results of these procedures disclose that the Area's population would increase 48%, car ownership would increase 61% and number of person trips made by some means of vehicular transportation would increase 66%. These changes occur with no change in the trip making characteristics of any zone. They result from the fact that more people would live in suburban zones which are already characterized by highest car ownership rates and greatest number of trips per capita.

The suburban growth is clearly illustrated by maps showing the changes in the rate of trip production on the land of the Study Area. These facts set the magnitude of the future traffic loads and provide part of the basis for judging the quantity of traffic improvement which will be required. Before the complete picture of future traffic can be drawn, however, it is necessary to develop the travel patterns. This means linking the predicted origins and destinations by traffic interchange predictions. This is done in the next chapter.