# Transportation Planning Criteria for New Towns

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Effective transportation planning is needed in connection with the many new towns springing up in the fast growing areas of the United States. Sponsors of such new developments need this work to attract high-type tenants and developers, and to obtain approvals from various governmental agencies as to road plans, particularly the connections with adjacent road networks.

The transportation plan springs from both the land-use plan and economic base study. These criteria determine the volume and pattern of traffic, and the interchange between the new town and adjacent communities. There must be feedback between the preliminary findings of the transportation planners and the economic-base land-use planning team, whereby the latter's projections and recommendations may be modified to produce more acceptable transportation conditions. Examples are the proposed Universal City and Irvine Ranch developments in California, where impossible traffic densities were predicted on the basis of preliminary plans, requiring changes in proposed land-use densities and dispositions.

Steps in transportation planning may be summarized under the following headings: (a) formulation of trial road networks, based on preliminary land-use plan, (b) trip-generation estimation, (c) estimate of interchange between new town and outside communities and through traffic, (d) trip distribution (O and D), (e) trip assignment to alternate routes, evaluation and feedback as necessary, and (f) selection and staging of transportation plan.

•RAPID POPULATION GROWTH and overcrowding of urban areas have stimulated an increasing amount of new town planning and construction. These new towns are often set apart from existing urbanization and contain all the land uses normally associated with a city, including residential areas, a central business district, industrial areas, and schools. Two such cases will be described here in some detail—Mountain Park and Irvine Ranch, both in California. Another more frequently observed type of new city development is a complex of high-rise commercial and residential buildings introduced into an existing urban area via a redevelopment project, or perhaps on a vacant land site. Century City and Universal City, in Los Angeles, are typical of this type of development. Here movie studios have decided to turn their back lots into high-rise building complexes and transfer much of their outdoor movie making to less valuable land.

The need for thorough traffic estimation and synthesis of future travel patterns for new towns has been emphasized by the affected governmental jurisdictions. City, county and state agencies are increasing their insistence that the developer demonstrate that adequate planning has been undertaken to obviate future traffic access and

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circulation problems, among other things. The zoning mechanism is often employed to enforce compliance with the government's wishes in this regard. In addition, new town developers are aware of the fact that prospective tenants are becoming increasingly aware of possible future traffic problems. The traffic engineer's access plans and projections are becoming more useful as a promotional and selling aid for the developer.

## ECONOMIC-BASE STUDY

One of the most important criteria affecting plans for a new town is the economic-base study. This, together with other initial investigations, including those of controlling physical, legal and financial factors associated with the new town site, will determine in large part the character and extent of development possible. The economic study should establish such major determinants as marketability of land for various types of development, amount of employment that can be supported, and retail sales potential which give the land-use, traffic and architectural planners the necessary input for the plan of development.

### Self-Containment

The economic-base study should disclose the probable extent of self-containment of the proposed community. It is essential that the traffic planner have reliable estimates of the degree of self-sufficiency of the prospective new town, since the relative proportions of external and internal traffic will hinge on this matter. Specifically, he must know to what extent the local residents will work, shop and carry on other daily activities outside the new town's boundaries, and the extent to which outsiders will come into this area for such purposes.

If it is possible and practical for the traffic planner to consider the new town as one zone within a much larger zoned study area, extending perhaps as much as 10 to 20 mi in all directions from the town, and to synthesize a trip origin-destination (O-D) pattern for the entire area, the degree of self-sufficiency in the new town could be determined. In fact, this general process is implicit in the economic-base study, whether it is done mathematically or intuitively. It should be pointed out that such an approach requires soundly based estimates of employment, population, industrial activity, retail sales, etc. for the entire study area as well as for the new town.

## FEEDBACK

There must be coordination of planning effort and feedback of information between the economist, the land-user planner-architect, and the traffic planner. In a sense, there is a natural sequence of planning, from the initial economic-base studies to the land-use development plan to the traffic estimation phase. However, one member of the team cannot simply hand his output to the next member, to serve as input for the next stage of planning, and consider such a parameter to remain unchanged throughout the entire planning process. The output of the next planning stage is likely to indicate some problems and impacts which will require modification of the input (i.e., the output of the first stage). The traffic planner is likely to find, for example, that certain initial projections relative to densities or patterns of land use result in unusual traffic access or circulation problems. Average daily traffic loads projected to the future may indicate overloading of planned arterials or impractical peak hour volumes on freeway ramps and weaving sections. For example, a simple rearrangement of land uses may be indicated to spread peak hour traffic in one particular direction over two access points instead of being concentrated at one. Or a reduction in planned number of dwelling units or extent of office development may be indicated.

## TRAFFIC PLANNING PROCESS

Figure 1 summarizes the major elements of the traffic planning process for new towns. The estimation of traffic demand stems directly from the land-use plan, which in turn is dependent to a large degree on the economic potentials, physical capabilities, and financial, legal or other parameters governing the development. Frequently

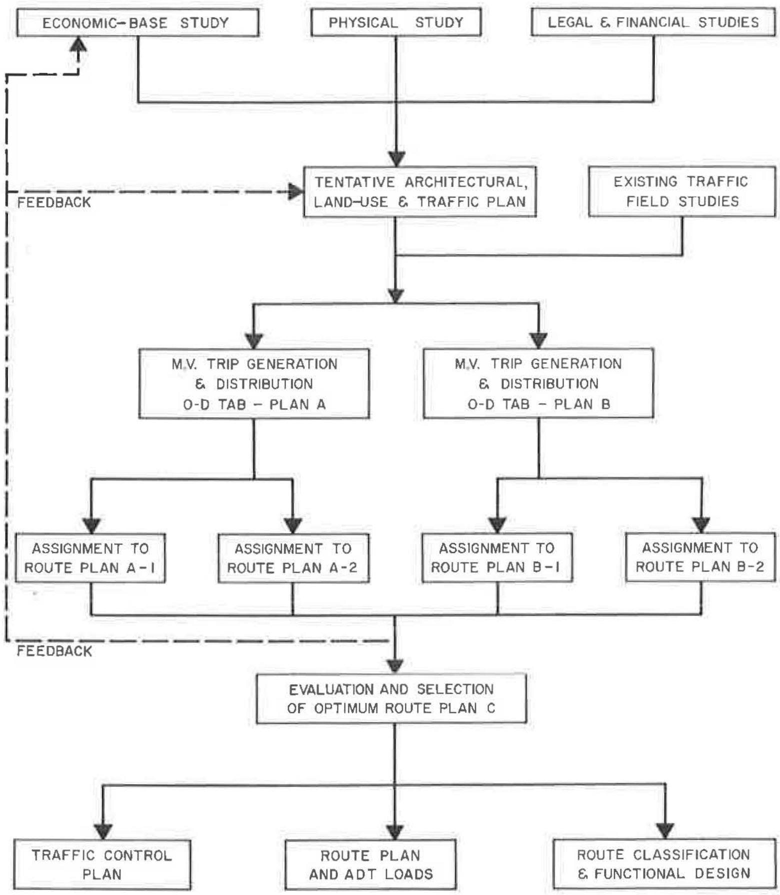

Figure 1. Flow of traffic-planning criteria for new towns.

two or more possible land-use plans are postulated for study, representing alternate concepts of density, pattern, or type of land use. In Figure 1, two plans have been assumed to exist, designated as A and B.

The trip-estimation techniques used in the studies cited in this paper involve three classes of data: (a) trip generation at home and purpose ends (of trips); (b) distribution of trips between zones and/or stations of origin and destination; and (c) assignment of trips to route networks. Criteria employed in this regard are discussed in the following paragraphs.

## Trip Generation

Daily trip production associated with a land-use plan can be estimated by applying anticipated trip-generation ratios to basic planning units. Trip ends generated by residential units are usually estimated on a per capita or per dwelling unit basis. Table 1 indicates per capita ratios employed in several studies conducted by Wilbur Smith and Associates. Home-based trips, approximating two per resident, relate to only those motor vehicle trips originated or terminated by the resident at his home. It does not include the trips he may make between other points, such as a trip from his work place to a store. The latter would be included in the nonhome-based category of resident trip production. Trips originating at other points and destined to the resident's home but not made by him (such as visits by friends or delivery trucks) are not included in the home-based generation figure shown here. Thus, the total trip ends at

TABLE 1

DAILY RESIDENTIAL MOTOR VEHICLE TRIP-GENERATION INDICES FOR NEW TOWN PLANNING, CALIFORNIA[a]

| Town | Trips per Resident | | % of Home-Based Trips for | | |
|---|---|---|---|---|---|
| | Home-based | Nonhome-based | Work | Shopping | Other |
| Mountain Park | 2.00 | 0.35 | 35 | 25 | 40 |
| Irvine Ranch | 2.05 | -[b] | 30 | 20 | 50 |
| Universal City | 1.90 | -[b] | 40 | 30[c] | 30 |
| San Ramon Village | 2.00 | 0.24 | 30 | 20 | 50 |

[a]Excluding nonresident trips made within town site.
[b]Not estimated.
[c]Including business trips.

residences will have a per capita ratio greater than the home-based ratio shown here and can be ascertained after the complete O-D tabulation has been synthesized by dividing the total residential trip ends by total residents. Some recent studies in the Los Angeles area have indicated current ratios of about 2.5 motor vehicle interzonal trips per capita in both single family and multi-family dwelling units, taking both home-based and nonhome-based residential trip ends into consideration (1). Including intrazonal trips, the overall ratio would exceed 2.5 by a small amount.

Three common categories of trip purposes utilized in traffic-estimation procedures are "work," "shopping" and "other." The home-based trip-generation totals in each traffic study zone are classified by these groups in the studies referred to in Table 1, and percentages estimated in each group are also given.

For the usual procedures employed in home-based trip-distribution procedures, it is necessary to make use of relative attractive forces at destination zones. Table 2 lists such trip-end generation indices applied in the Irvine Ranch planning study. Per-acre ratios are useful where land-use plans have not progressed to the point where planned building floor areas are available and, of course, must be used for parks or other areas where buildings are not the principal traffic generators.

Table 3 lists motor vehicle trip-generation and parking-space indices which may be used in business and commercial districts where planned building floor area data are available. These indices are based on studies by Wilbur Smith and Associates and the ranges reflect actual observed conditions in a number of buildings in different cities. (The figures represent the

TABLE 2

ESTIMATES OF DAILY MOTOR VEHICLE TRIP ENDS PER ACRE USED IN NEW TOWN PLANNING

| Lane Use | Land-Use Density Range | | |
|---|---|---|---|
| | Low | Medium | High |
| Industrial | 25 | 50 | 75 |
| Retail commercial | 200 | 400 | 600 |
| Other commercial | 100 | 250 | 400 |
| Schools and parks | 10 | 20 | 30 |
| Hotel and motel | 100 | 200 | 300 |
| Open space | 0.1 | 1 | 3 |
| Residential low density | 10 | 15 | 20 |
| Residential medium density | 25 | 35 | 45 |
| Residential high density | 100 | 125 | 150 |
| Airport | - | 10 | - |
| University | - | 20 | - |
| Health center | - | 10 | - |
| Cemetery | - | 0.5 | - |
| Bay front | - | 10 | - |

TABLE 3

COMMERCIAL AREA TRAFFIC- AND PARKING-GENERATION INDICES FOR NEW TOWN PLANNING[a]

| Building Type | Daily Motor Vehicle Trip Ends | Parking Spaces Required |
|---|---|---|
| Banks | 20-90 | 3-7 |
| Misc. private offices | 3-8 | 1-2 |
| State offices | 30-90 | N.A. |
| City and county offices | 10-30 | 2-5 |
| Post offices | 10-60 | 3-4 |
| Utility offices | 10-30 | 2-3 |
| Clothing stores | 20-40 | 2-3 |
| Dept. stores | 10-40 | 2-4 |
| Avg. | 30 | 3.6 |

[a]Per 1,000 sq ft building floor area.

extremes of the middle 50 percent range of building ratios.) Extent of public transit played very little part in the variations. The ranges are attributed to varying character of activity or popularity of services in the different concerns. Parking-space requirements summarized in Table 3, derived from the same source as the trip-generation indices, are useful in planning terminal facilities in business districts (2).

## Trip Distribution

The distribution of home-based trips between home ends and purpose ends is accomplished by a trip-distribution formula which is simply the total zonal trip production for the home zone multiplied by a travel time factor representing travel time between the two zones and by an attraction factor for the purpose zone; the resultant value is divided by the sum of all travel factor-attraction factor products for all interzonal trip interchanges associated with the home zone and all other zones. This mathematical form is the same as that now widely used in the gravity model applied to synthesizing O-D data.

Internal vs External. —The distribution of trips from home to work, etc., involves an important decision as to what proportion of trips will remain in the planning area and what proportion will be distributed to external points. The degree of self-containment will determine this split. Estimates of the extent to which residents will travel to points outside the area to shop, work, etc., are important considerations coming out of the economic-base study, as pointed out previously.

Table 4 gives some self-containment criteria utilized in connection with several new town planning projects by Wilbur Smith and Associates. In the case of Mountain Park, two possible conditions were investigated, as indicated by the two sets of figures. The makeup of a community, its size, and its relation, both geographic and economic, to other urban areas influence the percentages, as shown in this table. For instance, Irvine Ranch, being a very large development with large pools of employment, was considered to be relatively self-sufficient, and 63 percent of resident workers were estimated to work on the ranch. On the other hand, San Ramon Village, on the line dividing Alameda and Contra Costa Counties in northern California, about 10 mi east of Hayward, is relatively close to major employment concentrations to the west and north and is more of a bedroom community, generally speaking, than the Irvine Ranch. Only 40 percent of resident labor force are estimated to find employment within the village.

Table 4 indicates the degree of self-containment viewed from the purpose ends as well as the home ends of the trips. For example, of all Irvine Ranch jobs, 90 percent are expected to be held by local residents. Universal City, on the other hand, although expected to absorb over half the resident labor force, will have many more jobs than residents; hence, these resident workers will fill only 12 percent of the jobs on the site. Universal City will be more of a commercial complex than a typical community. Today it is principally devoted to the motion picture industry, but will come into the new town category if the apartment houses, office buildings, hotel, and retail shopping center are completed as planned.

Distribution Process. —The trip-distribution formula previously described makes use of trip attraction factors in each zone, as well as travel factors. In the planning

TABLE 4

SELF-CONTAINMENT CRITERIA ESTIMATES FOR NEW TOWNS

| Town | Planned Population | At Home Ends of Trips: % Res. Work Trips to Town Jobs | % Res. Shopping Trips to Town Stores | % Res. Other Trips to Town | Planned Employment | At Purpose Ends of Trips: % Res. Town Work Trips | % Res. Town Shopping Trips | % Res. Town Other Trips |
|---|---|---|---|---|---|---|---|---|
| Mountain Park (self-cont.) | 63,100 | 45 | 80 | 80 | 15,235 | 90 | 100 | 77 |
| Mountain Park (nonself-cont.) | 63,100 | 5 | 65 | 60 | 15,235 | 10 | 100 | 71 |
| Irvine Ranch | 285,000 | 63 | 81 | 82 | 125,000 | 90 | 73 | 76 |
| Universal City[a] | 12,000[b] | 54 | 33 | 50 | 12,300 | 12 | 30 | 11 |
| San Ramon Village | 40-50,000 | 40 | 90 | 80 | 9,500 | 39 | 67 | 80 |

[a]Development plans indicated not official, alternate plans under study.

[b]At assumed 2.5 resident per apartment unit.

work for the communities cited here (Table 4), estimated work trips were distributed from residential zones to employment zones, using the projected numbers of jobs and travel times from home to work as parameters. Nonhome-based trips were distributed between pairs of nonresidential zones, using trip ends (from the home-based distribution process) as a parameter. Shopping trips were distributed to destinations in relation to gross retail sales estimates or commercial building floor area, and travel time. Other trips were distributed on the basis of travel times and appropriate categories of trip-end generation in destination zones.

Typical trip-distribution travel time factors used in new town studies are depicted by the curves in Figure 2. There is little information available on calibrated trip-

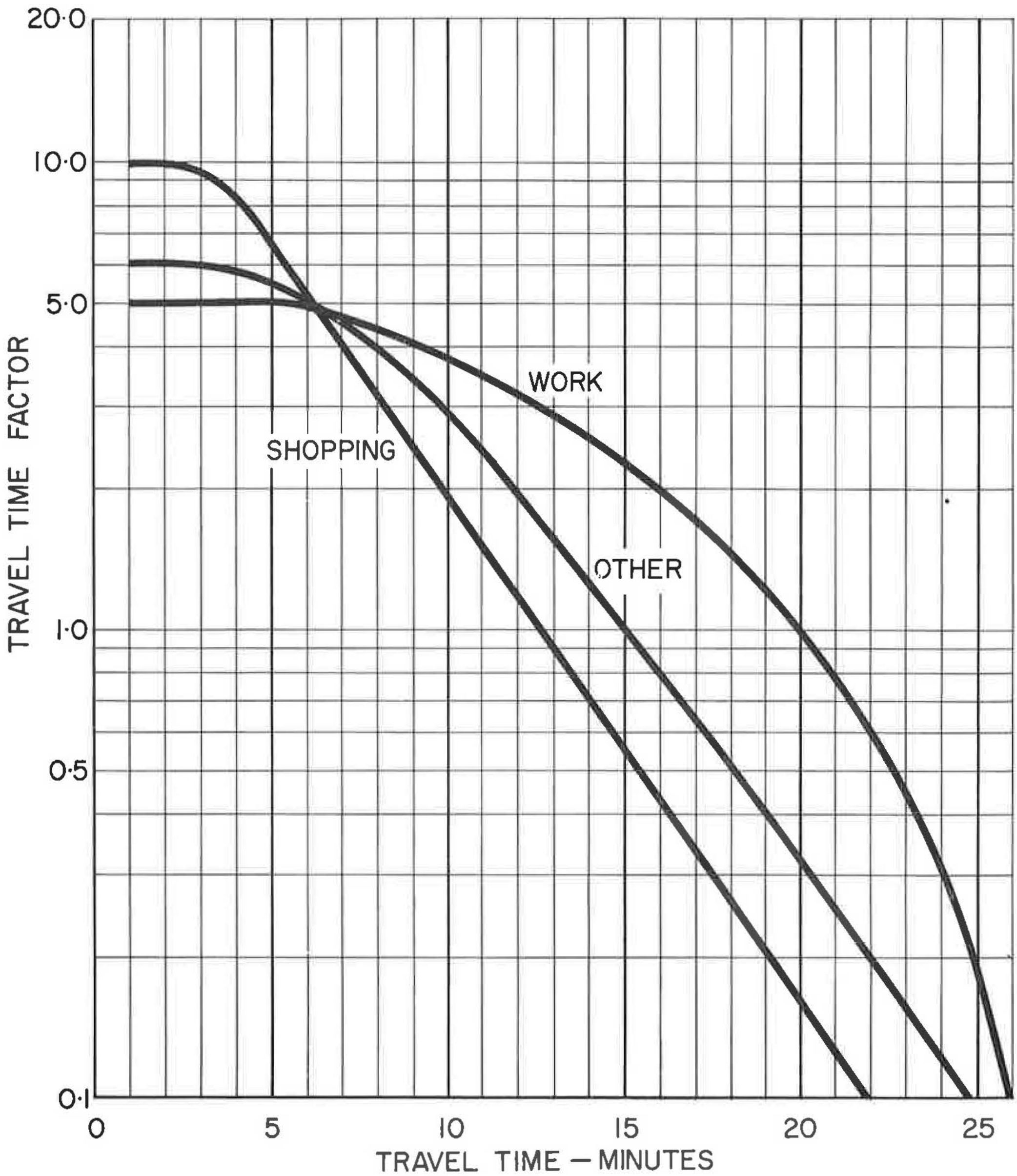


Figure 2. Typical travel time factors for home-based trips used in new town planning.

distribution curves for communities of 50,000 to 100,000, the general range of most new towns. The illustration is a generalization of data from various large and small communities. Much remains to be learned about these curves and how they vary in relation to trip purposes and environmental factors. However, the curves shown here are useful tools, reasonably accurate for the general planning work intended. Perhaps more important than the shapes of these curves are the other parameters of trip generation and distribution of attraction factors which determine quantity and direction of traffic flow. It is very likely that errors in these will influence assigned traffic volumes to a greater extent than variations in the shape of the travel factor curves.

## Traffic Assignment

Traffic diversion curves, such as those shown in Figure 3, are used to assign motor vehicle trips to route networks. The division is shown for interzonal trip volumes between a freeway (5) and alternate major street connecting a pair of zones. The dashed line shows the division between two alternate major streets (where no freeway route exists). The latter curve is intended to be used for splitting traffic between two arterials substantially the same in traffic service standards, not between a new arterial and alternate existing street offering poorer service which is a situation not often encountered in new town planning.

These curves recognize only the travel time differentials between alternate routes. The California Division of Highways has developed a more detailed method relating the relative split of trips between a freeway and the best alternate arterial.to both travel time and distance between the zones of origin and destination. The California formula is as follows:

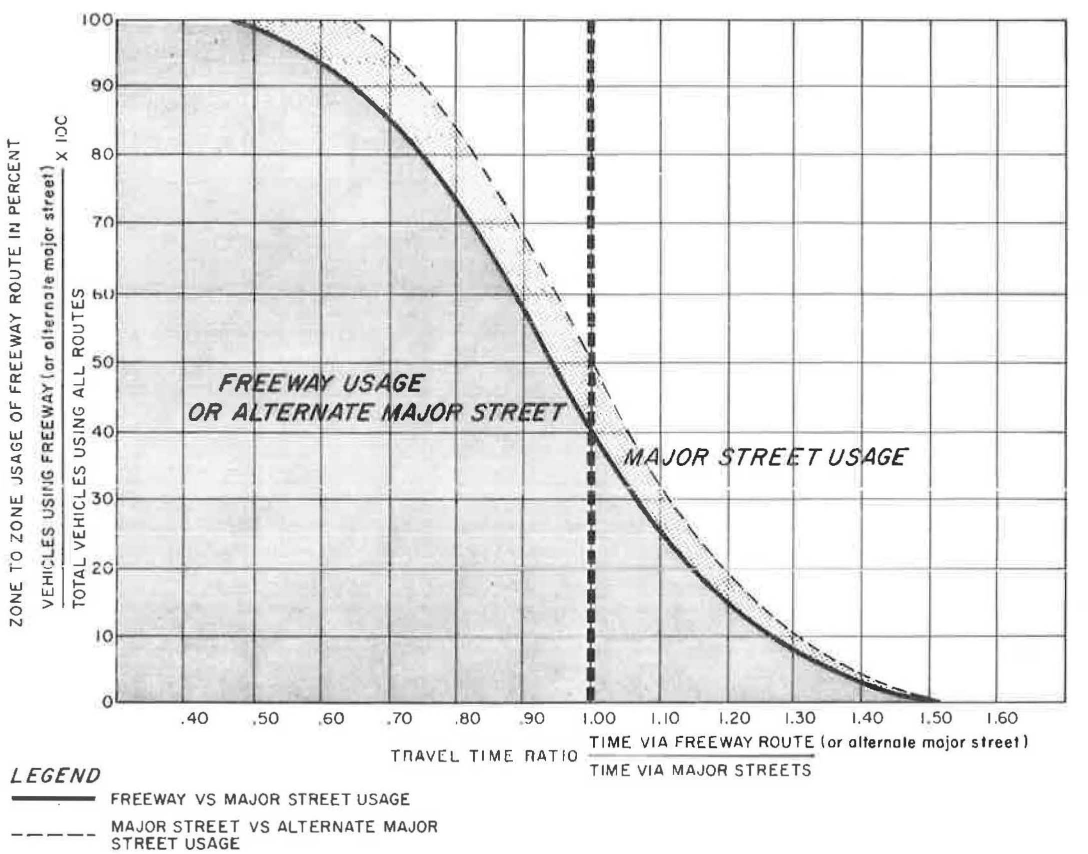


Figure 3. Traffic diversion curves.

$$p = 50 + \frac{50\,(d + 0.5t)}{\sqrt{(d - 0.5t)^2 + 4.5}} \qquad (1)$$

where

$0 \leq p \leq 100$,
$p$ = percentage of trips via freeway,
$d$ = distance saved via freeway (mi), and
$t$ = time saved via freeway (min).

A modification of this formula applies where p is less than 50 and the length of freeway travel on freeway route minus length of freeway travel on alternate route is under 2.0 mi.

There are also other recognized assignment methods, including the U.S. Bureau of Public Road's minimum path or "all-or-nothing" system which has been programmed for EDP methods and is widely used.

The differences in final answers that can result from choice of assignment method alone can be seen from a study Wilbur Smith and Associates is carrying on in Laguna Beach, Calif., at the present time. Table 5 indicates the comparative results of making

TABLE 5

COMPARISON OF FREEWAY ASSIGNMENTS BY CALIFORNIA VS BPR DIVERSION CURVE METHODS, LAGUNA BEACH

| Zones | Route | Time (min) | Distance (mi) | Diversion (%) | | Diff. on Freeway |
|---|---|---|---|---|---|---|
| | | | | Calif. | BPR | |
| 7- 1 | Freeway | 2.57 | 1.80 | 58 | 87 | +29 |
| | Alternate | 3.75 | 1.54 | 42 | 13 | |
| 11- 6 | Freeway | 9.39 | 5.48 | 40 | 57 | +17 |
| | Alternate | 10.39 | 4.56 | 60 | 43 | |
| 16- 8 | Freeway | 13.12 | 9.42 | 0 | 18 | +18 |
| | Alternate | 11.22 | 5.12 | 100 | 82 | |
| 4- 2 | Freeway | 2.25 | 1.07 | 52 | 70 | +18 |
| | Alternate | 2.75 | 1.00 | 48 | 30 | |
| 9- 5 | Freeway | 4.48 | 3.27 | 72 | 88 | +16 |
| | Alternate | 6.63 | 3.22 | 28 | 12 | |
| 9- 2 | Freeway | 6.19 | 4.04 | 70 | 85 | +15 |
| | Alternate | 8.73 | 3.82 | 30 | 15 | |
| 4- 3 | Freeway | 4.20 | 2.05 | 62 | 76 | +14 |
| | Alternate | 5.40 | 1.95 | 38 | 24 | |
| 9- 3 | Freeway | 7.31 | 4.50 | 60 | 73 | +13 |
| | Alternate | 9.13 | 4.13 | 40 | 27 | |
| 18-13 | Freeway | 18.69 | 9.69 | 53 | 63 | +10 |
| | Alternate | 21.31 | 8.57 | 47 | 37 | |
| 7- 6 | Freeway | 7.67 | 5.00 | 76 | 83 | + 7 |
| | Alternate | 10.65 | 4.67 | 24 | 17 | |
| 9- 7 | Freeway | 4.24 | 2.40 | 57 | 65 | + 8 |
| | Alternate | 5.00 | 2.36 | 43 | 35 | |
| 10- 5 | Freeway | 10.76 | 8.95 | 88 | 89 | + 1 |
| | Alternate | 16.52 | 8.78 | 12 | 11 | |
| 10- 9 | Freeway | 14.04 | 11.76 | 96 | 91 | - 5 |
| | Alternate | 22.39 | 11.80 | 4 | 9 | |
| 10- 4 | Freeway | 8.54 | 7.09 | 98 | 90 | - 8 |
| | Alternate | 13.49 | 7.43 | 2 | 10 | |
| 12-11 | Freeway | 7.43 | 3.44 | 99 | 84 | -15 |
| | Alternate | 10.44 | 4.11 | 1 | 16 | |

assignments by the two methods to a freeway routing under study: (a) using the differences in travel times and distances between trip origin and destination, and employing the California curves which take both into account; and (b) using only the ratio of travel times from the BPR traffic diversion curve. The zonal interchanges were selected at random, and the resulting data were arranged in order of magnitude of difference in freeway percentage assignment. It is evident that the largest differences occur where the trip distances are short, the ratios of travel times are substantial, and distances are in a contrary relationship. For example, trips between Zones 7 and 1 would be 1.2 min faster on the freeway, but 0.26 mi longer in travel distance. Looking at travel time ratios only, the diversion curve would assign 87 percent of trips to the freeway. But using the California curves which take the adverse travel distance into account as well, the freeway would receive only 58 percent of interzonal trips. This is an extreme case, and it is pertinent to note that the diversion curve sometimes assigns less trips to the freeway than the California method.

The purpose in pointing out these differences is not to claim weaknesses for traffic study methods, but rather to illustrate the degree of variability and unpredictability present in all traffic projections. The land-use data for future years is always subject to question and revision. The traffic models used to predict trip generation and distribution are subject to statistical errors of the order of ±20-25 percent. And the assignments to route networks are subject to similar errors.

The traffic planner is working with traffic flow predictions that may be subject to 25 percent error (perhaps as much as 50 to 100 percent for some low volume ratios), and he is only fooling himself if greater accuracies are implied. However, when considered in terms of the ultimate use of such data, the determination of capacity requirements, the situation is not as bad as it might first appear to engineers used to working with tolerances of a few percentage points. For traffic planning purposes, the analyst is primarily interested in ranges, such as 0-5,000 ADT; 5,000-10,000 ADT; or 10,000-15,000 ADT. Such predictions are entirely adequate for traffic planning purposes, although they may involve errors up to 100 percent (under 10,000 ADT, for instance). It may be expected that errors of assignment will diminish as larger volumes are involved (e.g., for values of 50,000 ADT and above) since compensating errors tend to bring corridor volumes into closer check with actual volumes; thus, errors due to assignment methods will decrease as larger numbers of zonal trip interchanges are added together.

The assignment of future traffic may be made to several alternate networks for purpose of assisting in selection of the best one. And effects of alternate land-use plans may be tested in terms of the resulting street network loads to be carried. For example, in Figure 1, two land-use plans, A and B, and two networks for each plan have been assumed, resulting in four networks.

The selection of the optimum plan will be based on many considerations, mostly subjective, but similar to those applying to traffic planning in general. New town planning permits a flexibility not possible, of course, in conventional work with existing cities. One of the chief factors in this respect is the ability to change the land-use input to obtain desired changes in traffic loading or other new town characteristics. Thus, the study of route assignments may indicate the desirability of altering the distribution and density of population, employment, or other aspects of the planned community. In Figure 1, the feedback indicates this process.

Once the optimum plan and assigned traffic loads are ascertained, the functional design details and traffic control system can be developed. Numbers of lanes, use of dividing strips, locations of median left-turn lanes, provision or prohibition of curb parking, traffic signal systems, and speed limits are the major elements referred to in this instance.

## MOUNTAIN PARK

The planned community of Mountain Park in the Santa Monica Mountains of Los Angeles, Calif., provides a good example of planning for a new town, with particular reference to the matter of self-containment and the impact of different assumptions concerning this factor. Due to the filling up of available flatland, builders in the Los

Angeles area are now turning increasing attention to the undeveloped mountainous areas which offer fine views and are reasonably close to primary regional employment centers. Ridge and ravine topography preclude the usual mass construction techniques. There has been much land scalping and stilt hillside construction.

A new technique of constructing homes on stilts on the hillsides was developed. The original residential developments took place in the bottoms of canyons and along

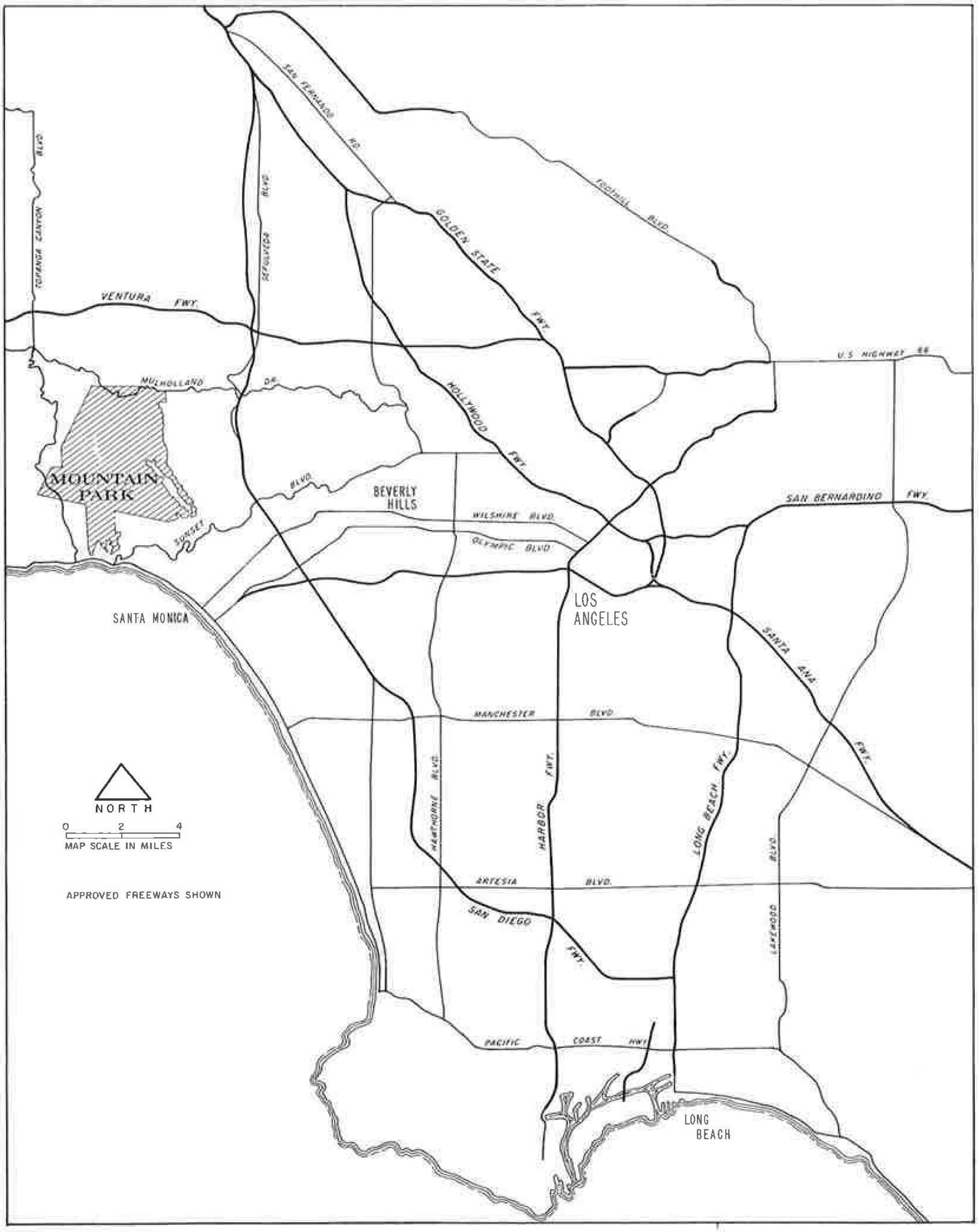


Figure 4. Map showing relation of Mountain Park to Los Angeles metropolitan area.

tops of ridges, leaving only the steep hillsides vacant, which are now being utilized by such unusual construction techniques. Extensive hillside cuts are being made in the Los Angeles area for buildings. Many homes on such hillside developments are priced in the $100,000 range.

Mountain Park is being planned to avoid carving up the landscape and to preserve the mountains and their scenic beauty. Greenbelts will be created to separate the clusters of buildings, concentrated in relatively self-contained mountain villages. Over 50 percent of the land will be committed permanently to open spaces in the form of parks, golf courses, recreational areas and greenbelts.

Figure 4 shows the location of this proposed community (3). It is presently an undeveloped area of 10,700 acres or 16 sq mi, with hillsides, canyons and rolling land ranging in elevation from 100 to over 2,100 ft above sea level. Primary highway access will be via Sunset Blvd. on the south, Mulholland Drive on the north, Topanga Canyon Blvd. on the west, and a planned new Reseda freeway bordering the development on the east.

The University of California is planning to develop a graduate-level scientific research center on a 350-acre site on highest portion of Mountain Park, looking northeasterly toward the San Fernando Valley. The center will create specialized employment opportunities. Incidentally, this is at the highest elevation of the planned community.

The planned single family clusters will consist of a concentration of residential buildings in certain portions of the land with adequate compensating open spaces in other areas so that development will meet acceptable overall density standards. Incidentally, this adds variety to new subdivisions, avoiding the repetitious monotony often seen in the typical gridiron layouts of urban land use.

Figure 5 shows the ten planning areas of Mountain Park and the extent of employment and population anticipated in each. Total population will approximate 63,000 people; employment will reach 15,235 jobs. Land-use and site plans have been developed which envision ten villages separated by large greenbelts. The villages are planned as "balanced communites," that is, containing a mixture of land uses including single family and multi-unit residences, neighborhood shopping areas, schools, parks, churches, and offices.

## Self-Sufficiency

One important factor in the plan is the design of each village as relatively self-sufficient to reduce the need for long commuting between home and work, relieve traffic loads on access routes, and help create a distinctive character for each of the ten villages. The extent to which this can be achieved will affect the number of lanes required for principal access highways leading into and out of Mountain Park. However, the actual degree of self-containment to be experienced at ultimate development is obviously open to question. This question was raised by the City of Los Angeles, and there was the feeling on the part of some persons that Mountain Park might in actuality become a bedroom community, and that approvals for access roads should be based on this possibility. Therefore, to evaluate the relative impact of the two extremes of self-containment vs nonself-containment, two sets of traffic estimates, one for each condition, were developed. In the first case, 90 percent of the jobs were assumed to be filled by local residents; the second case assumed a figure of 10 percent.

It was assumed that no outsiders would come into Mountain Park to shop. Local residents would do 80 percent of their shopping in town under the self-contained concept or 65 percent under the nonself-contained concept. For other trips, the percentages of resident trips to Mountain Park destinations were 80 and 60 percent, respectively, for the two concepts. Table 4 shows the various percentages estimated in this study.

Figures 6 and 7 show the resulting traffic desire line projections, in which the expected differences in travel patterns are apparent. The topography of Mountain Park limits the number of external origins and destinations to three major corridors. With the self-contained concept, there will be an estimated daily traffic volume to and from external points through the northern corridor of 22,000 vehicles. As a nonself-contained


Figure 5. Population and employment distribution at ultimate development.

community, this external trip volume will be 37,000. The two extremes for the eastern corridor were found to be 24,000 vs 40,000, and for the southern corridor, 17,000 vs 29,000. These are substantial differences, the bedroom community concept producing about 70 percent more external trips than for the self-contained community.

Figures 8 and 9 show the relative impact of the two concepts on one of the major access routes, Santa Ynez Canyon Road. The two assignments are 8,600 and 11,000 veh/day along the lower part of this route, and 15,700 vs 15,000 at the heaviest traveled point. The study concluded that a four-lane cross-section for this road would accommodate traffic demands in both self-contained or nonself-contained cases.

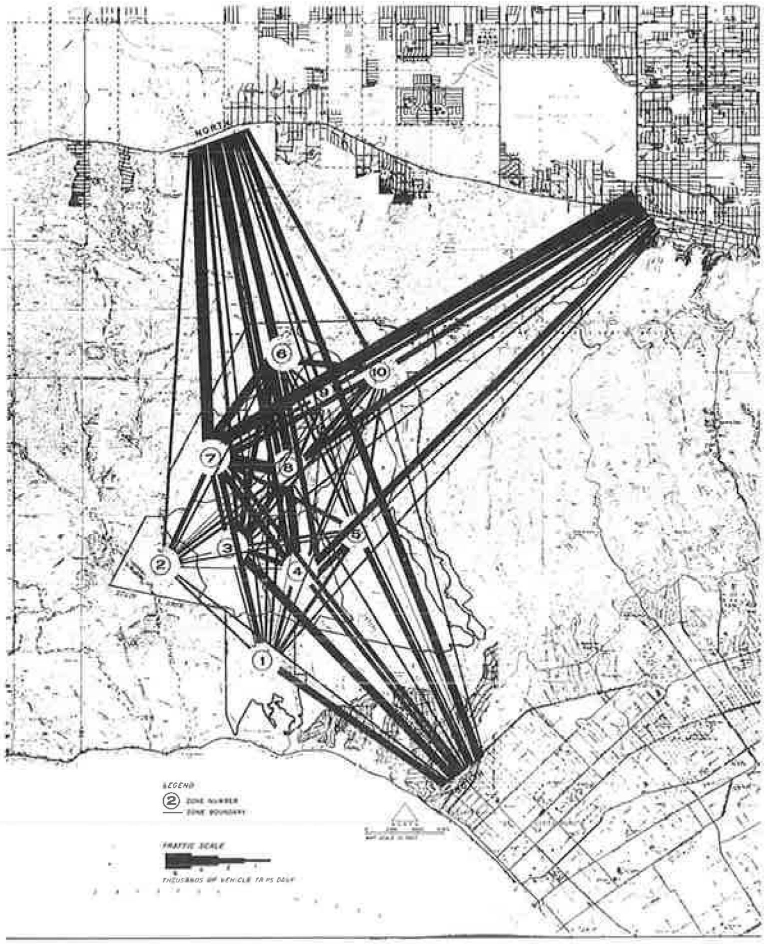

Figure 6. Traffic desire lines, 1980, self-contained community.

## Mulholland Drive

This important access route for Mountain Park was accorded special study for the approximate 8-mi section between Topanga Canyon Blvd. on the west and the San Diego Freeway on the east. A somewhat unusual phase of this investigation was the estimation of the future sight-seeing through traffic that will probably use this route after it is improved and completed.

The location of Mulholland Drive at the crest of the Santa Monica Mountains makes it attractive for motorists who want to get a birds-eye view of Los Angeles. Tourist, recreation and sight-seeing traffic is difficult to predict. In the absence of any recognized indices of trip generation of this class of traffic, it was decided to approach the matter on the basis of analogy.

The first basis of analogy was the observed difference in daily traffic loads between the seasonal peak during tourist season and the annual average volume on major Los Angeles routes known to carry substantial tourist and sight-seeing traffic. This difference averaged 5,700 for the twelve routes investigated (Table 6). The second approach was a consideration of the peak seasonal traffic generated by some of California's scenic tourist attractions (Table 7), which averaged 3,700 ADT. Based on these data, it was reasoned that about 5,000 ADT would be a suitable estimate of the seasonal sight-seeing traffic component of the total usage of Mulholland Drive (a high estimate to be on the safe side).

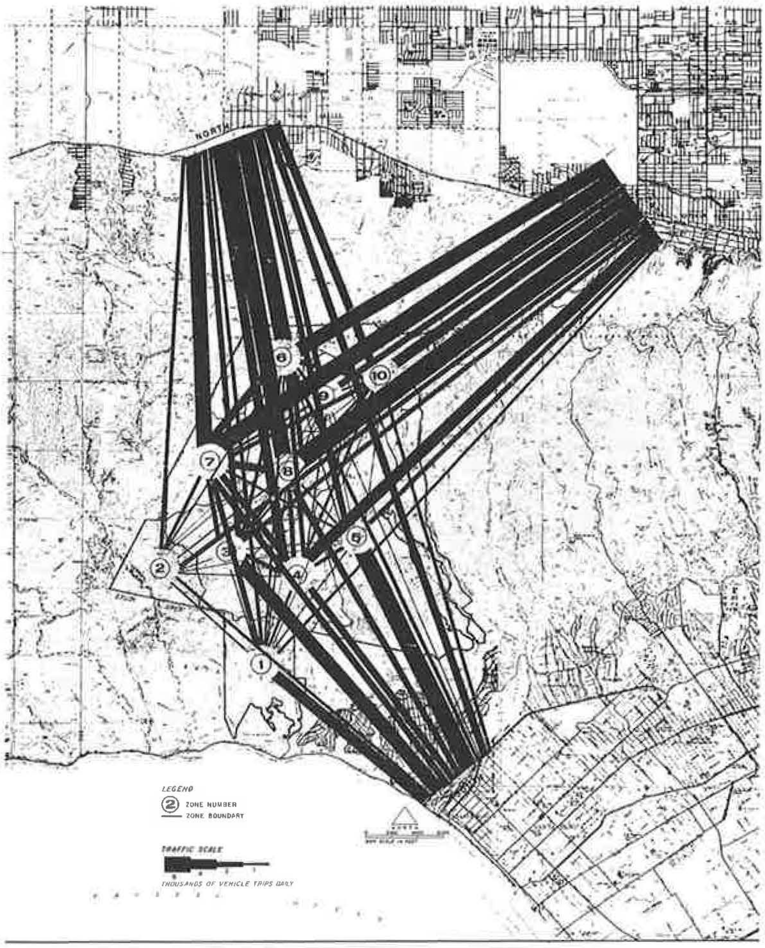


Figure 7. Traffic desire lines, 1980, nonself-contained community.

## IRVINE RANCH

Another example of new town planning is Irvine Ranch in southern California. The way in which feedback information was used in developing the plan for this community is discussed in the following paragraphs.

Figure 10 shows the location of this 93,000-acre planned community, one of the largest single land planning projects ever undertaken (4). It occupies 147 sq mi, or about seven times the area of Manhattan Island. The property has been held virtually intact and utilized almost exclusively for agriculture and ranching purposes since the time of the Spanish land grant to the original owners of the properties. The Irvine Ranch is located within Orange County, now close to a million in population and one of the fastest growing counties in the United States. Population of the county is predicted to reach 2.5 million persons by 1980.

The ultimate development of the ranch will include housing and employment for a population of 280,000 by 1980. The balanced complex of residential, industrial, commercial, agricultural, educational, and recreational facilities will include a new 1,000-acre University of California campus (now partially completed and in operation), complete with its own town center and residential community for students, faculty and university staff. The population on the ranch was approximately 25,000 in 1961, when the traffic planning studies cited here were begun, concentrated along the Pacific Coast

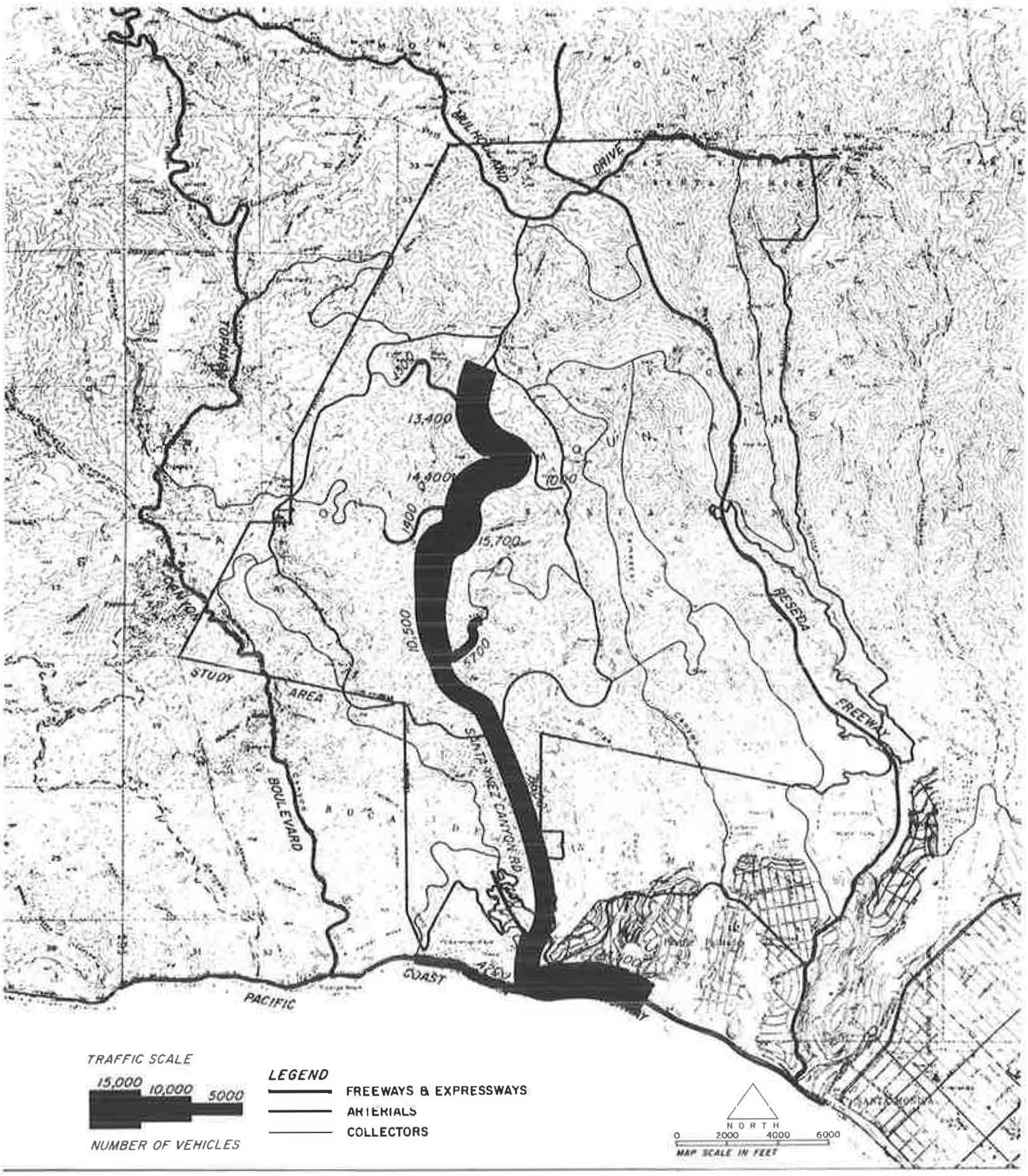


Figure 8. Average daily traffic volumes on Santa Ynez Canyon Road, Network A-ultimate development, self-contained community.

within the communities of Laguna Beach, Newport Beach and Costa Mesa. Several major industrial concerns are also located within the ranch.

Figure 11 shows the estimates of the total daily generation of vehicle trips, classified by purpose, and the extent of traffic interchange between Irvine Ranch and external areas. (The overall area shown is Orange County.) It was estimated that 63 percent (111,000) of resident-generated work trips will be associated with jobs within the ranch. Outside resident trips to and from the ranch for work purposes will number 20,000, making a total 131,000 motor vehicle trips per day associated with the predicted 125,000 jobs on the ranch.

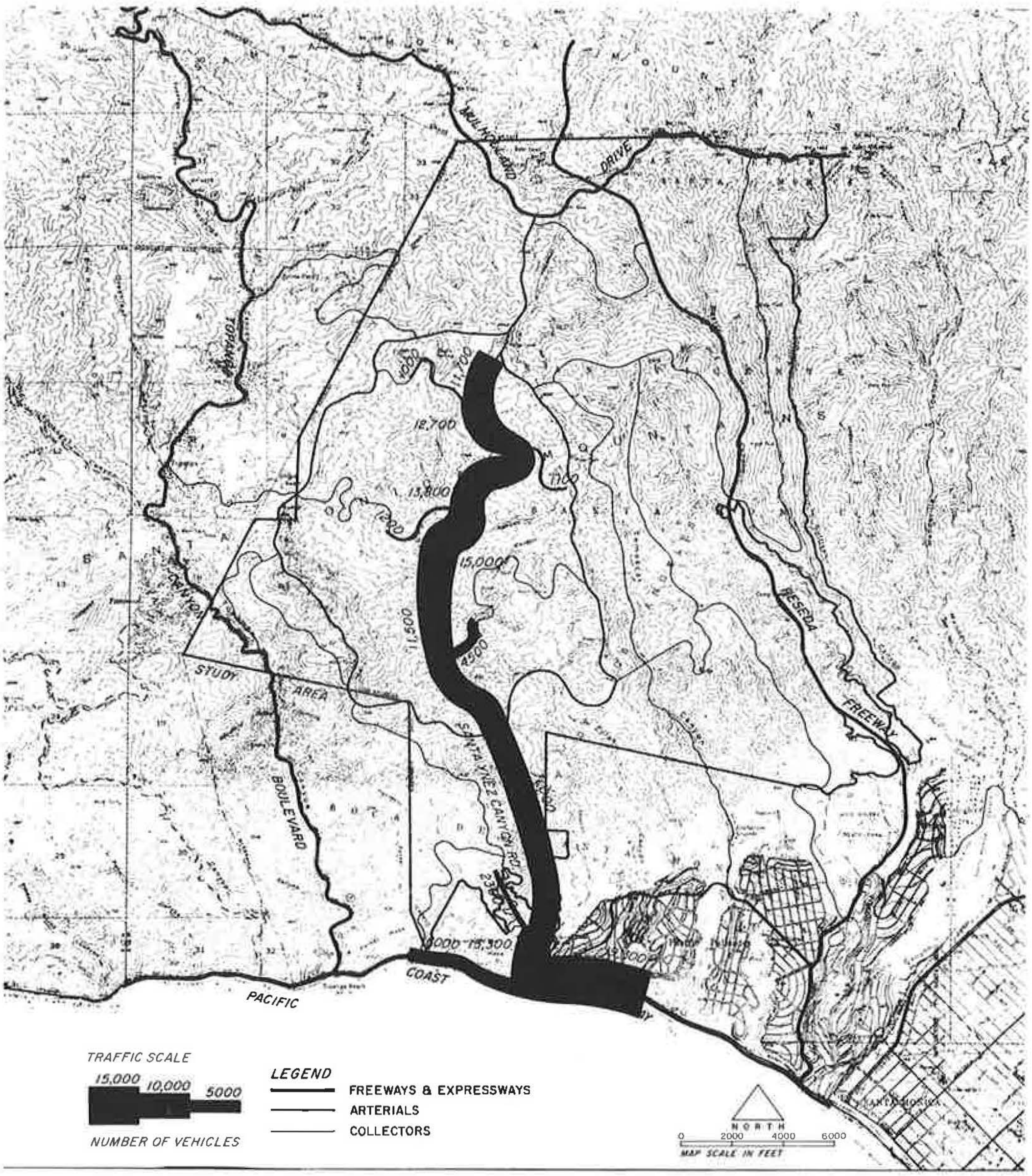


Figure 9. Average daily traffic volumes on Santa Ynez Canyon Road, Network A—ultimate development nonself-contained community.

The map shows major commercial centers and their retail sales volumes for the year between October 1959 and October 1960. These indices were used (with consideration given to future change), in conjunction with anticipated distribution of retail activities on the ranch, as a basis for distribution of the daily shopping trips of ranch residents. The residual numbers of shopping trips, starting with total shopper trip ends in Irvine Ranch retail centers and subtracting ranch resident trips, were allocated to residents outside the ranch. Other trips were allocated in similar fashion, the projected distributions of total vehicular trip ends being used as a guide in the trip-distribution model utilized in this instance.

TABLE 6

SEASONAL PEAK ADT VS ANNUAL ADT, LOS ANGELES ROUTES

| Route | ADT | | |
|---|---|---|---|
| | Seasonal Peak | Annual Avg. | Diff. |
| San Bernardino Freeway: | | | |
| West Covina | 69,000 | 61,000 | 8,000 |
| Pomona | 60,000 | 53,000 | 7,000 |
| County line | 57,000 | 51,000 | 6,000 |
| Ontario | 42,200 | 38,300 | 3,900 |
| Colton | 38,600 | 35,000 | 3,600 |
| Redlands | 26,700 | 24,000 | 2,700 |
| Coast Highway: | | | |
| Orange County line | 29,100 | 20,700 | 8,400 |
| Sunset Blvd. | 23,300 | 18,200 | 5,100 |
| Ventura County line | 6,900 | 5,400 | 1,500 |
| Santa Barbara County line | 24,000 | 17,000 | 7,000 |
| US 101, Ventura County line | 36,000 | 26,300 | 9,700 |
| US 99, Kern County line | 18,200 | 13,200 | 5,000 |

TABLE 7

SEASONAL PEAK TRAFFIC VOLUMES ON CALIFORNIA RECREATIONAL AREA ACCESS ROUTES

| Attraction | Seasonal Peak ADT |
|---|---|
| Yosemite Nat. Park | 7,100 |
| Sequoia Nat. Park | 4,400 |
| Big Bear Lake area | 6,200 |
| San Francisco: | |
| Santa Cruz Coast Highway | 3,000 |
| Stinson Beach Coast Highway | 1,000 |
| Carmel - Morro Bay - south of Big Sur | 2,400 |
| Skyline Blvd. - South Half-Moon Bay Road | 2,000 |

Figure 12 shows the synthesized 1980 trip desire data for interzonal movements. Heavy travel is projected between Zones 18, 23 and 30. Zone 18 will be mainly residential in character, with 50,000 population in 1980. Zone 23 contains the University of California at Irvine campus, with a projected population of 52,000 and employment of 20,000. Zone 30, besides residential and employment concentrations, will contain Newport Town Center, a regional shopping center. External trips are not shown.

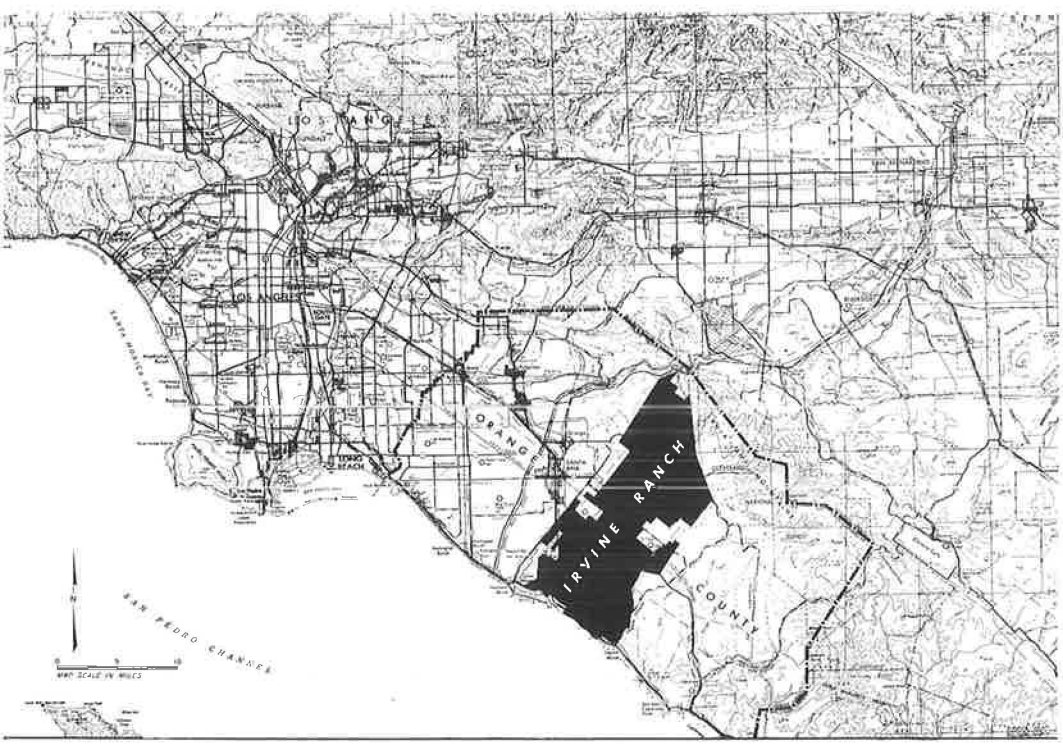


Figure 10. Map showing relationship of Irvine Ranch to Orange County and Los Angeles metropolitan area.

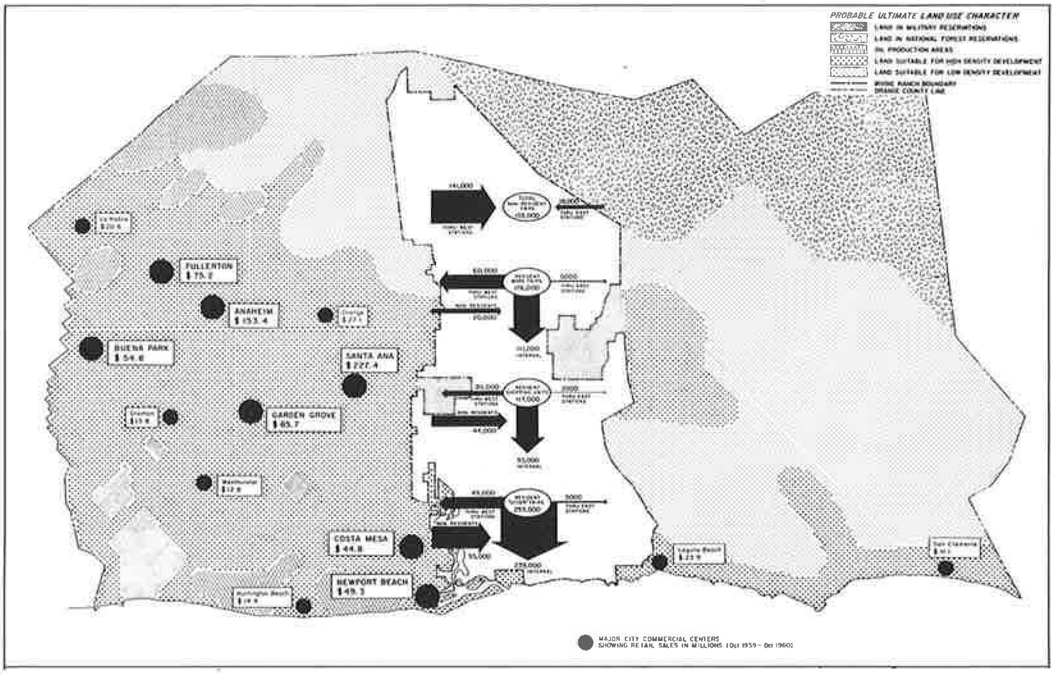


Figure 11. Distribution of 1980 trips by major trip purpose.

Figure 13 illustrates the assignment of 1980 travel desires to the recommended major route system. Through traffic, not associated with Irvine Ranch activities, is shown apart from traffic generated on the ranch. Through trips were projected separately from the others and were based on a study of traffic growth trends and projected population growth in southern California. Only one freeway, the Santa Ana Freeway, existed at the time of the study illustrated here. The major route plan includes six freeways (including the Pacific Coast Highway).

Table 8 gives the criteria used in this instance for recommending numbers of roadway lanes and other functional design requirements.

Newport Town Center

An example of feedback is provided in the case of Newport Town Center, a vast building complex planned for development at the intersection of the future Corona Del Mar Freeway and Pacific Coast Highway (also a future freeway) on the Irvine Ranch. The plan includes retail stores, hotels and motels, offices, a hospital and medical offices, residential units, automobile agencies, an auditorium, a theater, a library and a music center, and miscellaneous other service and recreational facilities. Initial plans called for 13 million sq ft of building floor area. Figure 14 summarizes the projected traffic loads assigned to access routes, aggregating 181,000 daily motor vehicle trips to and from the center.

Three of the most critical points would be the easterly at-grade intersection on Ridge Road (immediately west of Corona Del Mar Freeway), the most southerly intersection on Jamboree Road, and the Jamboree Road-Ridge Road intersection. All would have intersection approach volumes of 70,000 to 80,000 per day, and heavy turning movements. For example, at the most southerly Jamboree Road at-grade intersection immediately north of the Pacific Coast Highway (assumed to be a freeway in the future), the assignment shows a total daily turning movement of 37,000 into and out of the center to and from the south. (The diamond intersection diagrams show directional desires, not ramp assignments.) Analysis was made of possible at-grade operating conditions


Figure 12. 1980 traffic desires, interzonal motor vehicle trips.

during peak hours, in which some peak hour diversion to adjacent intersections was made, and provision of a third intersection on Jamboree was assumed, bringing the 37,000 turning movements down to 20,000. Any further addition of intersections would reduce spacing below that desirable for good traffic control. On the basis of this analysis, it was concluded that these intersections could provide capacity for about 65 percent of traffic demand generated by a 13 million-sq ft Newport Town Center.

Similarly, a study was made of peak hour operating conditions on the freeways. The 62,000 veh interchanging between the Pacific Coast Highway and the Corona Del Mar Freeway was considered to be above practical capacity for a reasonable design providing a high-type directional interchange, which would have a capacity for about 52,000 to 56,000 veh/day. A reduction to between 55 and 75 percent of the center's traffic generation (comprising only a portion of the 62,000 turning movements) would be necessary to bring the assignment down to the indicated capacity range.

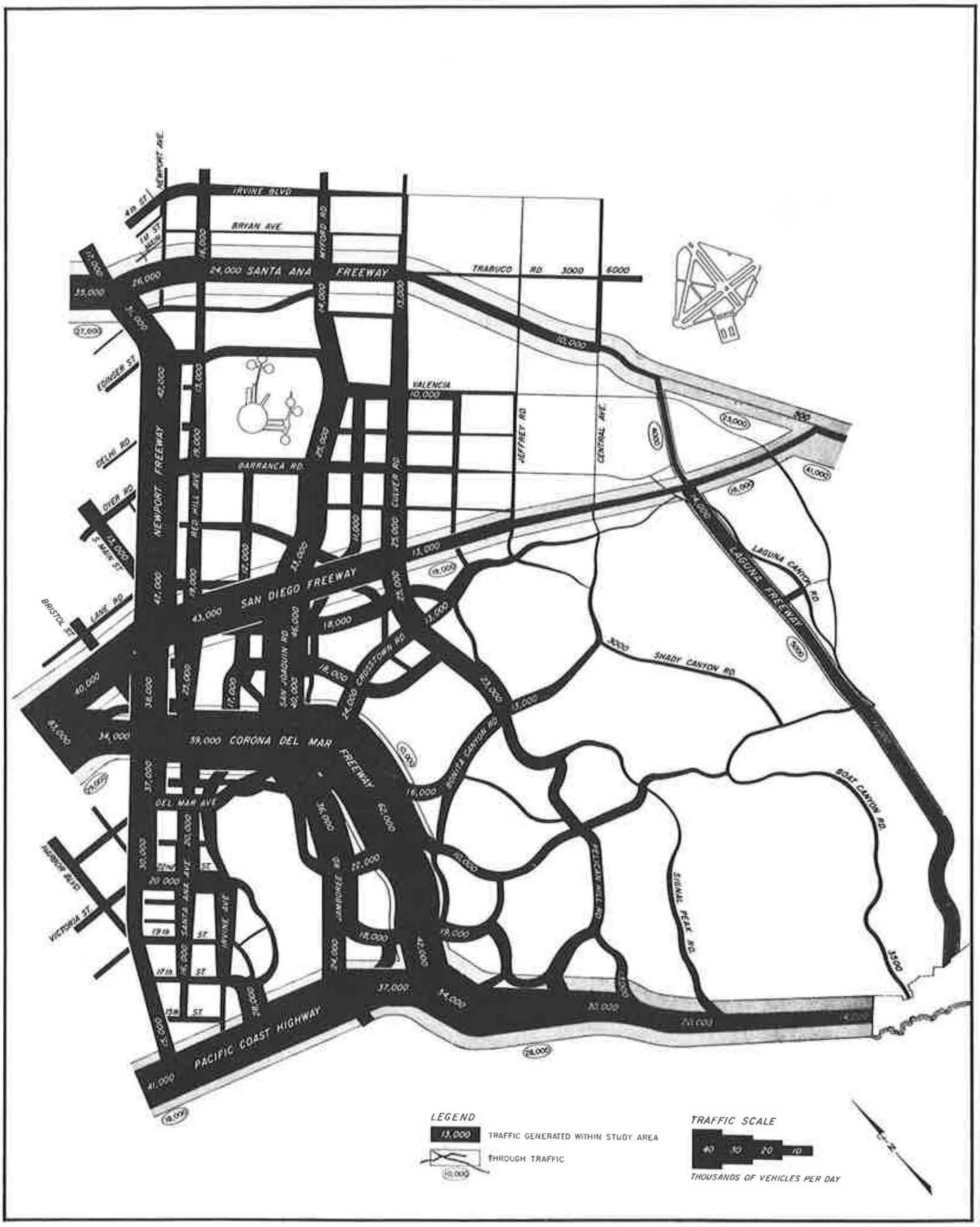


Figure 13. 1980 traffic flow.

Similarly, an analysis at the junction of Ridge Road and Corona Del Mar Freeway indicates the 40,000-veh daily traffic interchange from Ridge Road to and from the north would overload a diamond ramp interchange by 100 percent; a directional interchange by 10 to 25 percent. The most critical intersection, at Pacific Coast Highway and Jamboree Road, shows a 54,000 total desire between west and north. A reduction of the center traffic by 50 to 55 percent would be necessary to bring the peak hour

TABLE 8

TYPICAL ROADWAY CAPACITY CRITERIA FOR PLANNING NEW TOWNS[a]

| Type | 2-Dir. Vol. | |
|---|---|---|
| | Peak Hr | 24-Hr |
| 8-lane freeway | 8,000-10,000 | 80,000-100,000 |
| 6-lane freeway | 6,000- 7,500 | 60,000- 75,000 |
| 6-lane divided arterial (72-ft plus left-turn lanes, no parking) | 3,200- 3,700 | 32,000- 37,000 |
| 6-lane undivided arterial (72-ft, no parking) | 2,800- 3,300 | 28,000- 33,000 |
| 4-lane divided arterial (84-ft, including parking) | 2,000- 2,500 | 20,000- 25,000 |
| 4-lane undivided arterial (64-ft, including parking) | 1,700- 2,200 | 17,000- 22,000 |
| 4-lane divided major business street (84-ft, including parking) | 1,600- 2,000 | 16,000- 20,000 |
| 4-lane undivided major business street (64-ft, including parking) | 1,300- 1,700 | 13,000- 17,000 |
| 4-lane divided collector (84-ft, including parking) | 1,500- 1,800 | 15,000- 18,000 |
| 4-lane undivided collector (64-ft, including parking) | 1,200- 1,500 | 12,000- 15,000 |
| 2-lane arterial (44-ft, including parking) | 900- 1,300 | 9,000- 13,000 |
| 2-lane collector (44-ft, including parking) | 700- 900 | 7,000- 9,000 |
| 2-lane collector (40-ft, including parking) | 600- 800 | 6,000- 8,000 |
| 4-lane rural road | 1,100- 1,600 | 11,000- 16,000 |
| 2-lane rural road | 500- 700 | 5,000- 7,000 |

[a]Motor vehicle traffic capacities based on Highway Research Board Capacity Manual, with upward adjustments based on subsequent research. Freeway and expressway capacities based on A Policy on Arterial Highways in Urban Area, American Association of State Highway Officials. Calculations based on 60 percent signal go period, 10 percent trucks, 20 percent combined left- and right-hand turns, one direction volume two-thirds of other in peak hour, and 9 percent to 10 percent peak hour relation to 24-hr volume.

traffic loads down to the capacity of 32,000 to 35,000 vehicles estimated for the west-north directional desire.

It was concluded on the basis of this study that access roadway capacity limitations would permit a center development of only about 50 to 65 percent of the proposed 13 million-sq ft building floor area, in terms of traffic generation. The feedback of this information to the land-use planners on the Irvine Ranch planning team resulted in appropriate revision of Newport Town Center plans.

## IN RETROSPECT

The development of new towns offers an exciting prospect for planners, who are afforded the unique opportunity of complete planning without the hindrances and restrictions of established land uses. Team work is essential between the various specialists—the economist, the architect, the land planner, the traffic engineer, the civil engineer, the lawyer, the geologist, and the other disciplines involved in such planning. There must be the maximum of coordination and cooperation among these individuals if a balanced and successful plan is to emerge. In the specific area of traffic planning, no set group of criteria will be available for estimating future traffic loads in the new town. The planner must give careful consideration to the type of people who will live there, how they will be employed, the degree of self-containment to be expected, and other characteristics of the community and its environs before he can select the appropriate indices and parameters for traffic estimation purposes. The new "leisure towns" for example, may not conform at all to the trip-generation and attraction characteristics cited in this paper. And finally, the planner must be generous in supplying capacity for estimated needs, remembering the human frailty of not "thinking big" enough, and also the ever-present possibilities for future downgrading of standards in the name of economy.

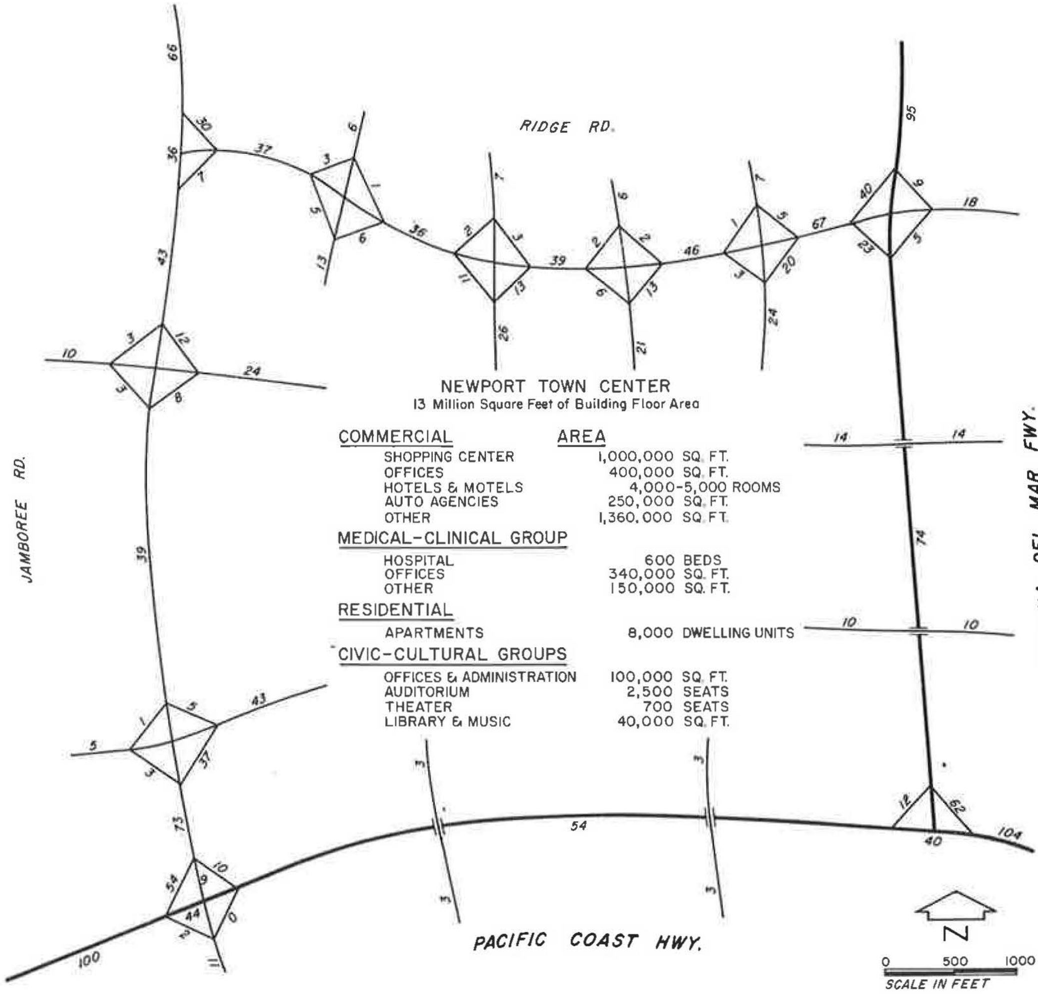


Figure 14. Average daily traffic, 1980, Newport Town Center (numbers indicate thousands of vehicles).

## REFERENCES

1. Residential Traffic Generation Data. Unpubl. rept., Los Angeles Dept. of Traffic, Oct. 1964.
2. Evans, Henry K. Parking Study Applications. Traffic Quarterly, Eno Foundation, Saugatuck, Conn., April 1963.
3. Wilbur Smith and Assoc. Traffic Planning Study—Mountain Park. Prep. for Lantain Park Corp., Nov. 1962.
4. Wilbur Smith and Assoc. The Irvine Ranch Traffic Planning Study. Prep. for Irvine Co., July 1961.
5. Guide for Forecasting Traffic on Interstate System, 1956. U.S. Bureau of Public Roads Circ. Memo.