HIGHWAY RESEARCH BOARD

Bulletin 311

Impact and Implications of Highway Improvement

National Academy of Sciences—
National Research Council

publication 856

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Presented at the
40th ANNUAL MEETING
January 9-13, 1961

National Academy of Sciences—
National Research Council
Washington, D. C.
1962

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Contents

Reflections on Concepts for Impact Research

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The economic effects or impacts of highway improvements have received an increasing share of research in the area of transportation and location in recent years. Although substantial progress has been made toward identification and measurement of changes which follow highway additions, much remains to be done in explaining how and why these changes occur and who or what groups are affected and how. It is believed that the explanation of highway impacts and their incidence can be aided by taking a look at certain essentially conceptual questions which should be dealt with in the planning stage of nearly every highway economic impact study. This paper discusses and offers tentative answers to the following four questions which the authors have found troublesome: (1) What fundamentally is meant by impact, and how and why should impacts be traced? (2) Is there a valid and theoretically defensible distinction between redistributive effects and benefits? (3) How should the area of impact for highway economic studies be defined? (4) What constitutes an appropriate time span for inclusion in the study of economic impacts?

The main purpose of this paper is to show that the kinds of impact studies made should depend on the answers to these questions and that the studies which are suggested by the view adopted here may well prove to be more fruitful than those of the past.

●ECONOMIC IMPACT of highway improvements consists of modifications or alternations of the structure of the economic system. Such modifications or alterations may take a number of forms and may be indirect as well as direct; they also vary as to timing and intensity. Some become immediately apparent and may be of either short- or long-run duration. Others become apparent only after a considerable length of time, but in the long run may be equally as significant for planning and policy decisions. Certainly, full assessment of the way in which highway improvements can or do modify the economic system depends on the explicit analysis of the characteristics of that system and its component parts.

There are inherent dangers in approaching highway economic impact research in a manner abstracted from the economic system unless careful attention is given to the general economic setting of the particular study.

For example, a recent handbook for highway impact research designed as a guide for systematic investigation includes the following statement:

> The important effect that location has on land use can hardly be overemphasized. Utilization of land depends in an important way on the location of the land with respect to markets or to the use which is made of surrounding land. The importance of location on land use with respect to markets is illustrated by the fact that land areas of like productive capacity located at different distances from market may be put to different uses. Since the cost of transportation—a key factor in determining land use—ordinarily increases with distance, land sites near a market usually have a comparative advantage over sites farther ways. (1)

This, of course, is a capsule explanation of a general principle in location theory applied to a developing economy.

Inasmuch as transportation improvements or refinements are being studied in the context of a developed economy, it is necessary to examine the foregoing statement carefully to avoid being misled. Inferentially the authors of the quotation draw on agriculture as an example of location with respect to markets, further, the statement is so worded that the supporting illustration appears to draw on spatial-transportation relationships in a developing economy with a transportation system inadequate for settlement and economic development. In such a period the quality of transportation is a critical factor in determining the value of land for productive use and the distribution of economic activities, because the greater the imperfection of a transportation system, the more important is the effect "that location has on land use." Within a setting of this type, transporation improvements lead to significant changes in comparative advantage and thus may effect substantial redistributions of economic activity. Even here, however, transportation improvements work to destroy the relative importance of situs. (Situs is defined as position or situation in the sense of position within a network or system in a spatial context.)

Today highway improvements are effected in a developed economy which has an extensive transportation system and where improvements continue to whittle away at spatial imperfections and further reduce the value of situs. But one should no longer expect gargantuan dislocations because of improvements providing access to land of greater productive capability. The economy is no longer primarily agricultural. Transportation improvements seldom open rich and untapped farm land for productive use. In addition and more important, as the economy swings further from concentration of productive effort in agriculture the greater is the separation of firms from land. The farm firm is identical with land, but this is not the case with most nonagricultural firms—particularly in manufacturing. But, even in agriculture, adjustments are encumbered by institutions and modified by market imperfections that appear to have little to do with spatial relationships. Nonspatial relationships, moreover, seem to be of even greater importance in nonagricultural industries. Perhaps more research emphasis should be placed on the essentially nonspatial implications of the changes or modifications of the economic system resulting from highway developments. These are likely to be just as important in terms of programing and finance as the rearrangement of activity in space. Of course, it is recognized that both spatial and nonspatial effects of highways are interrelated.

The effects of highway additions on the efficiency of the economic system are not ignored by highway impact studies inasmuch as they have important implications for finance and programing. Furthermore, the influence of better roads on the efficiency of the economy as a whole is fundamental to the determination of benefits and disbenefits If the effects on the efficiency and capacity of the economic system are accepted as important parts of economic impact of highways (as they are here), then the focus of some measurements of highway influence currently being made might profitably be altered, and additional variables be studied. This becomes clear when the way in which the highway system may contribute to economic efficiency is considered.

It is customary to speak of highway rebuilding and additions as "improvements." The word "improvements" is frequently interpreted in an engineering sense, but it also has economic meaning. From the point of view of the economic system, a highway addition would only be referred to as an "improvement" if it increased economic efficiency and/or capacity. The mechanisms through which efficiencies may result fall generally into three categories. (a) transportation efficiencies within a given distribution of economic activities, (b) efficiencies gained by changing the distribution of activities, or (c) a combination of (a) and (b).

Transportation Efficiencies with a Given Distribution of Economic Activity

Transportation efficiencies within a given distribution of economic activity involve operating economies caused by reduced transportation costs (including operating costs of vehicles, insurance of goods and vehicles, storage in transit, maintenance, etc.).

Such economies free resources for further productive use and can be regarded as raising either the effective resource base or real income even though frictional or technological unemployment of resources may result.

Efficiencies as a Result of Redistribution of Economic Activity

Efficiencies resulting from the rearrangement of economic activity may be much more involved than creation of efficiencies within a given distribution of activities. New and better roads may change the distribution of comparative advantage. The response may take the form of a shift in business location, change in market size or structure, or concentration or dispersion of economic function by location or by firm.

Analysis of the mechanism by which activity distribution is reorganized necessitates consideration of transportation and land as site within a theoretical framework. Basically land and transportation can be considered as subject to derived or secondary demands, because both are productive factors employed in the creation of time and place utilities. The time and place pressure of primary demands for possession of a product are reflected in the derived demands for transportation and land resources utilized in the production and distribution of that product.

However, this tie between the derived demands for land and transportation complicates analysis because results or effects of transportation improvements often appear to be causal. In talking of increases in the supply of land resulting from transportation improvements, Wendt recently stated: "In some sense, it can even be argued that increases in demand appear to bring about the increases in supply, rather than to follow." (2) It probably can be argued that increases in demand appear to bring about increases in supply in every sense.

Clarification of this point requires examination of some of the determinants of the physical supply of land. There is a limited number of sites which offers a particular "time-place" value to economic activity; the less stringent the "time-place" requirements are, the more sites there will be which more or less meet those requirements. Transportation is in a degree a substitute for "time-place" attributes of land because these attributes can be provided by movement, if it is economically feasible. Transportation improvements, to the extent that they facilitate movement and decrease its cost, work in general to reduce the urgency of the "time-place" situs requirement of land.

The type of transportation improvement effected by derived demands will modify land use by reducing unit transportation cost and/or increasing the ubiquity of transportation inputs of given quality. If the transportation improvement created as a response to derived demand increases economic capacity, it may increase the aggregate value of land. If it does not increase economic capacity, it does not increase aggregate land value. Rather, it only varies the form and distribution of land use and hence the distribution of land values. This does not suggest that aggregate land values cannot rise after transportation improvements are effected; they can. However, the rise is ascribable to the same pressures which led to the creation of the transportation improvement. In the absence of growth pressure, improved transportation can be expected to decrease aggregate land values.

The conclusion which follows logically from the relation of land and transportation as factors of production influenced by derived demands is that, because they are both complements and substitutes in production and distribution, a response to derived demand for better transportation necessarily involves a corollary response in land use. Obviously then, the isolation of the effects of a new or improved highway on the basis of quantified changes in only land use and value is tenuous.

Changes in economic form are of equal importance because efficiencies of an organizational nature are possible, and dislocations of an economic nature which raise questions in light of other overt policies are to be expected. To assess such changes one needs to know the form of the change, who is involved, and what modifications in economic organization and structure result. It is necessary to relate changes to characteristics of firm and activity organization and operation because economies effected may be due to altered scale of operation and firm integration.

Economies of scale and related economies may result from gaining control of specific land assets enhanced by changes in comparative advantage. But, for productive activities, advantages may be spread over a large area and not concentrated in a few sites. Economies of scale stemming from land assets enhanced by changes in comparative advantage are most likely to be found in activities for which there is a close tie between access to a new facility and access to a market or markets. These firms, in general, would be retail outlets whose market comes to them. Such firms must be readily accessible from a facility. The range of choice which is offered a retail market, of course, is extremely wide, and the relevant range is determined by such factors as knowledge of alternatives and the importance of relative convenience of alternatives. Highway service businesses are most sensitive to changes in market location resulting from highway relocations because convenience ranks very high for motorists and inflicts a self-imposed restriction on the range of alternatives. Equally important, knowledge of the availability of service alternatives is greatly affected by what motorists can see on or from the facility.

A substantial shift of traffic to a new facility from several existing roads or streets may concentrate traffic volume and enable a highway service business to acquire economies of scale which otherwise would not be possible. If, for example, the new facility is a bypass, expressway, or interstate highway, it may lead to separation of the market for highway services by separating traffic by length of trip, origin and destination of vehicles, and trip purpose. Efficiencies of the economic system as a whole may be gained to the extent that such service businesses are able to specialize in separate segments of the highway service business and thereby gain operating efficiencies. A great many more examples of a specific hypothetical nature could be listed such as the following: (a) chain restaurants can benefit from large-scale purchase of provisions, (b) multiple-unit operations can purchase standardized fixtures at lower unit cost, and (c) franchise chains may be able to secure capital easily and at favorable rates of interest. The point emphasized here is that possible economies of an organizational nature may be facilitated by spatial redistribution, and their identification requires more than the measurement of changes in landed assets because such efficiencies accrue to a firm.

In other cases retail firms may benefit from market shifts as a result of highway improvements which have nothing to do with access to a particular site. An example is the change in the structure or organization of markets due to secondary road improvement in rural areas. Here, road improvements can lead to concentration of retail activity in the larger rural centers; and, potentially, this could entail the replacement of locally owned and operated establishments by chain outlets—particularly grocery stores.

Plants which serve a geographically extensive market usually do not require a site on a particular traffic stream (aside from the advertising or public relations aspect of such locations). Access to markets and to sources of supply even in such cases are important, but specific site value is a function of general transportation efficiency rather than of access to a particular highway facility.

The larger the market served by a firm, the more latitude it has in choice of location; the more efficient and universal the transportation system, the less important is position within the system and the spatial market structure. (Market in the singular is, naturally, a little misleading. One speaks of a nationwide market, but even this has concentrations and differentiated characteristics. A firm serving a "large market" serves in truth a number of markets.) As the transportation system continues to be expanded and refined, the less important is "location"; and, as the economic system continues to industrialize, the greater will be the separation between the producing firm and land. (In this context it should be noted that as the economy continues to mature, a larger and larger portion of national income takes the form of services. Thus, services are important and will continue to grow in importance, and there are, as mentioned, distinct differences in location criteria between firms producing services and those producing goods.) This may lead to the dispersion of activities that are now concentrated because of transportation advantages or it may mean concentration of dispersed activities or both. Presumably such changes are motivated by the desire of

firms to achieve operating economies, but they are not necessarily synonymous with over-all economic efficiency. Such changes should be viewed as increasing the efficiency of firms, but also should be considered from the viewpoint of institutional arrangements. What effect do changes, if any, in institutional arrangements have on the mobility of productive factors, cyclical stability, price leadership, bargaining power, and other facets of the organization of activity which contribute to economic efficiency, capacity, and stability.

Hence, increased emphasis on the qualitative aspects of change is suggested. These are important and valid distinctions between firm and land, individual and group, and political units and economic area. Highway economic impact research could well focus more attention on the changing relationships among firm, industry, and economic region and among markets for products and services.

REDISTRIBUTIVE EFFECTS AND BENEFITS

The impact of improvements in and additions to highway facilities are not neutral in their effects on people, and it is only natural that one important aspect of highway impact studies has been the attempted isolations of gains and losses, benefits and disbenefits. Many of the highway bypass studies have had the expressed objective of providing factual data which could be used by highway officials in answering questions of what benefit or harm will be done to a bypsassed community; because, in attempting to remove through traffic from the business areas of small communities, state highway departments have run into opposition from merchants and other special interest groups objecting to the construction of bypass routes. A common question asked in these studies is whether or not the advantages of a bypass to the community as a whole outweigh possible losses to business.

Studies of this nature most often have been comparative "before construction" and "after construction" studies of land values and use, business receipts, and industrial development; and they have shown that numerous changes have followed highway improvements or additions. In general, however, they have been less successful in determining the nature and incidence of benefit or disbenefit than they have been in determining the magnitude of change in the variables studied. It is believed that this is the result of concentrating effort mainly on statistical methods of determining the magnitude of change with insufficient development of hypotheses for assessing the relation of change to benefit.

The successful relation of change to benefit depends first on the development of a clear concept of what is meant by benefit. Benefit can be defined in a number of ways depending on the point of view, as well as the point of reference in time and space. Disagreement on what is to be regarded as benefit and in what context, can lead to no small amount of confusion. One dimension of this confusion is illustrated in studies which focus on whether or not the advantages of a bypass to the community as a whole outweigh possible losses to local business. Implicitly a restricted definition of benefit seems to be adopted. It is restricted in at least three ways. (1) The criteria of judgment are largely short run (frequently 5 yr or less). (2) Data availability often restricts the area considered to unrealistic boundaries (at least in a market area sense). (3) Certain important factors whose assessment seems essential in the consideration of net benefits are missing. A limited concept of benefit is entirely reasonable provided the concept is clearly spelled out and logically follows from the research objectives. Otherwise, confusion, inconclusive research results, and frustration of sponsoring agencies are probable.

It might even be argued that bypass studies, as well as other studies of the impact of particular road sections, are not fundamentally concerned with benefit but are focused on the equally important subject of economic dislocation. Their primary aim is to collect and evaluate evidence about the nature of economic dislocation (reduced business receipts, historically) and to assess its severity. These studies are valid and useful in aiding adjustment to changes which have occurred or are likely to occur. They may also have important implications for programing and design, but they are subject to misinterpretation. In the extreme case, they have been viewed as a basis

for bypass justification. Can a bypass or any other particular road section financed by the public be justified on the basis of what it does or does not do to land values and business receipts in a bypassed ecommunity? (For that matter, are increased land values and/or business receipts necessarily valid indicators of benefit for the "community"?) The answer is no, unless such effects are weighed against the designed effects of the bypass and other corollary effects elsewhere. Changes in business receipts associated with the opening of a bypass can be either positive or negative as far as the community is concerned and yet not figure in aggregate social cost or benefit at all. The same can be said of land value and land-use changes. Justification of a bypass or any other improvement calls for full assessment of social benefit as opposed to social cost—in the sense developed by the Federal Inter-Agency River Basin Committee (3).

The difficulty of accurately assessing the primary, secondary and associated costs and benefits of a public improvement is well known. Nevertheless, progress toward application of cost-benefit relationships to highway economic impact research might be facilitated by distinguishing between net and relative benefits. The effects of highway improvements which increase the economic efficiency and/or the economic capacity of the system as a whole should be considered net benefits. Effects which are the redistribution of economic activity or economic values from one place to another are, until proved otherwise, only relative benefits. Because some balance of gain and loss is involved in relative gains, changes in form, redistribution of activity and of economic values, such variations may well be thought of as the redistributive effects of highway improvement. Of course, redistributive effects may result in increased efficiency or capacity. Nevertheless, the term benefit is best left to mean net benefits derived from these and other changes.

Pertinence of Net Benefits

Net benefits have major pertinence for programing and finance, and determination of net benefits seems essential to development of an equitable system for financing highway programs and for weighing the value of program alternatives. The mechanism by which net benefits come about as a result of a road improvement has already been discussed.

Research aimed at providing factual information for programing and finance is faced with the responsibility of determining the magnitude and particularly the incidence of benefits effected by changes in economic capacity and/or efficiency. In either case there may be efficiencies in the form of reduced operating costs for firms which directly bear costs of transportation (even though these costs can be and are passed on). If economic activity is redistributed, other efficiencies may be created by changing the patterns of control over assets. Such changes, for example, could lead to economies of scale or the reverse. But efficiencies or diseconomies of either type do not accrue at this time wholly to land but substantially to firms and thus will, in general, not be adequately reflected in land values—even though new sites used by affected firms may increase in value.

If cost reductions are passed on in the form of lower prices or increased wages, the gain in efficiency may benefit a large segment of the economy and lose its identity for purposes of specific taxation. To the extent that this happens, there appears to be every justification for using general fund money to finance highway improvements. This conclusion can be viewed as of general value at any political level. This view is mentioned by Garrison in a section of his recent book (4) when he states.

> It is traditional that, when benefits of activities are so widely spread as to defy collection by particular earmarked taxes, the benefits are recognized in general taxation. If the statement is true, the action called for is not behaving as if there are no benefits from the activity. The benefit may be recognized in general taxation.

It should, however, be recognized that many "nonuser" benefits are already subject to general taxation at various political levels.

As an example, Garrison (4, pp. 20-21) says: "A miniature example will serve to illustrate the phenomenon of transferred benefits. A road is improved from the city into a suburban area and costs of driving from residential sites in the suburban area to the city and back are markedly reduced These are vehicular benefits and results from demand for better transportation. In real cases, benefits are not generally captured by tolls on the facility set at rates which exactly capture the savings of each user; rather, the lower cost of vehicular transit is reflected in inflated property values in the area served by the highways." In Garrison's microcosm transferred benefits are already subject to general taxation, and any possible real estate depreciation elsewhere disguised or undisguised also is included in tax policy. The degree to which this is accurately measured will depend upon reliable appraisal for assessment. To be specific an owner selling an appreciated property is subject to a capital gains tax, which is a source of general fund revenue. Property owners will pay increased property taxes which are also sources of general fund revenue. Owners elsewhere will receive obvious tax breaks for depreciated property through capital losses or reduced assessments if the loss is identifiable; if secular growth disguises the loss, it also disguises the tax break.

If such gains in efficiency are not passed on in higher prices, there are fiscal implications. (1) In the case of user operating gains, it would be logical to tax the user efficiencies for highway construction. Note that this suggests a broader concept of user taxation based on user gain as well as incremental cost. (2) In the case of operating cost reductions due to economies of scale, which are not directly tied to a reduction in transportation costs but result from realignment of the market structure, it would appear that net nonuser benefits could be touched only through a special profits tax, which would be highly selective and very possibly discriminatory.

Redistributive Effects and Economic Dislocations

Reductions in the value of situs, as discussed before, imply spatial changes in the location of economic activity, dispersion of some activities and the simultaneous concentration of others may be expected. But spatial changes are not the only modifications in the structure of the economic system to be expected. Redistribution of economic activities, of values of assets in land, and of incomes means that firms, organizations, operations, and people will be variously affected by highway improvements. For example, redistribution of assets in land and income from land can imply concentration of economic power within an industry or activity group or, of course, the converse.

The spread of economic effects—the so-called impact area—would be determined by which persons or firms are involved in possible adjustments. The time span involved in adjusting to changed spatial economies (or indeed if there is any adjustment to spatial economies) will depend on the structure of the activities affected and characteristics of firms and institutions comprising the activity. As an example of the differential aspects of impact over time, a short-run period of loss in income which is a part of a long-run eventual growth in income in an area may mean that people or firms other than those which absorb the effects of the loss realize benefits from the long-run growth. The implications of such changes need to be explored.

These concepts suggest a possible new focus for the study of highway economic impacts. Studies of redistributive effects which have the objective of assessing net benefits fail for two reasons: (1) they may not be providing measures of net benefit, and (2) they may be leaving untapped a vast area of research which has nothing to do with benefits related to finance or justification. This is the area of economic dislocation, structural change, and system revision which, apart from the aspect of net benefits to the economy, may be relevant to policy at all levels of government.

Redistributive effects which involve such changes as income distribution, economic power, and bargaining power have direct pertinency because such corollary effects should be viewed in the light of other public policies and programs. The object, of course, is determination of the compatability of such side effects with expressed goals of other policies. In addition, such effects may indicate the need for personal or group action in the private sector of the economy in line with anticipated changes.

With questions about relative change in mind, several types of studies can be suggested. The following are but a few of the more likely possibilities.

1. Industrial development studies could consider not only employment statistics, but also effects of developments on the distribution of income, the relation of a new industry's wages to existing wage levels in the area and for similar employment elsewhere, the type of firm involved, degree of seasonality of the operation, sensitivity to cyclical fluctuations, employment of men or women, and the relationship of its employment to the local labor pool. If, for example, in an area of surplus labor and depressed economic conditions, a new manufacturing plant is located employing a small number of people, analysis does not end with a statement of its existence and a recounting of the number of jobs involved. Possibly such development could retard outward migration of people from the area by offering them the hope of greater future development which may not materialize. If, in truth, outward migration is basic to the solution of the area's economic problems, can isolated industrial development be considered a benefit? Such a hypothetical example is extreme, but it is designed to indicate one fundamental problematic approach

2. The scope of land value studies can be fruitfully broadened. Measurements of increases in land values are a small part of the changes inherent in a spatial redistribution of asset values. What firms or types of operations will control land the value of which has been enhanced as opposed to land the value of which is impaired? What differences in market concentration have been effected? Have markets been separated as a result of improvements in highway facilities? What do these changed market patterns mean in terms of local distribution of income? How have bargaining positions, firm integration, and concentration of economic power been affected? Has the redistribution of activity affected tax bases? Does the redistribution of activity require changes in-day-to-day government services? Does the change imply necessary revision of long-term programs, for example, capital improvements (not only quantity, but type and location)? Does such spatial change demand increased long-range planning activity and revision of supporting zoning and subdivision controls? The list is long, but certainly the end is nowhere in sight.

3. Business activity studies should continue to expand beyond concern with changes in gross receipts. Changes in gross receipts answer a few questions, but in addition raise further questions. What types of activity are involved? Do chain groceries, for example, supersede locally owned operations? Does such a change in retailing mean an increase in real income for consumers because of lower prices? Could a shift of purchases of consumer durables from rural service centers to regional centers do the same? Can such effects be traced to transportation improvements?

4. Some studies should also be made of the effects of distribution of activity and population among governmental units of varying size inasmuch as the effects on tax bases and cost of governmental services are important. From such studies one could evaluate the changing need for ad hoc units of government drawn on economic regional bases or on the predicted need for shifting costs among units of government.

5. Bypass dislocation studies could include a general as well as a case study approach. Communities could be classified according to whether a highway improvement changes the basic economic enterprise of the area, and the bases for such classification should be represented as the important study variables. For example, if a rural service center becomes a suburban satellite community, to what degree does survival of commerical interests and continuation of present ownership and operations depend on the local merchants' adaptability to change, their recognition of change, and their capital position? It may depend on new local residents identifying themselves with the community Such factors may well be a function of the rate of growth. Rapid growth may preclude or hinder the identification of new residents with the community. Also rapid growth may make it difficult for local merchants to adapt their merchandising practices to the new market, and thus they may lose it to branch operations of firms from the metropolitan center. Highway improvements, in an agricultural area, for example, may not change the basic economy, but some service communities may still decline Such effects may merely represent an acceleration of an existing trend toward

regional efficiency and the maintenance of only those service centers that have continued to adapt.

The analysis and prediction of impacts require prior classification of areas and hypotheses about them—not simple measurement and conclusions which merely recapitulate data. The few preceding examples illustrate some directions in which research efforts could well be pushed, and indicate that local studies should be viewed as extremely important because of their relevance to existing or potential local problems. Such studies can be used in aiding individuals and groups in their attempts to cope with change. Revision and re-examination of policy at all levels of government certainly should be directly involved with impact research. Results of programs and policies cannot be construed as amoral; and side effects cannot be dismissed as assumedly minor disruptions resulting from progress.

Attention can effectively be focused on "nondesigned" or side effects of the highway program to promote reasonable adjustment to changed conditions and economic dislocations by providing useful information for guiding decisions and reduction of adverse results.

DELINEATION OF IMPACT AREA

The meaningful delineation of an impact area for research purposes is an important conceptual concern. In addition, manageable delineation is a necessary development of methodology within a conceptual framework. Adopting the concepts of impact suggested in the preceding discussion necessitates re-examination of the manner in which these interrelated problems have been handled. Methodological systems typically have been constructed by using distance from a highway facility or from points of access to a facility and appear to have been largely designed to test functional relationships between business receipts or land values and distance or access distance from a highway.

Historically, many impact studies have been focused on land use and land values; and researchers have characteristically constructed systems by which the delineation of impact areas could be effected by using bands, zones, tiers, strata, etc. Although such studies sometimes show such a functional relationship between access and the study variables, attempts to integrate such relationships with market structure and organization are less common. Perhaps this is impossible under such conditions, for market relationships obviously are not based simply on distance or even access distance from a given facility. It is true that the economic impact of new or improved facilities does have special significant implications for patterns of form, but the use of essentially arbitrary systems of bands and zones appears to be an inadequate guide for evaluating the market implications of the observations.

To gain perspective on economic impacts, delineation of impact areas should be based more on hypothesized adjustments within a market and among markets. The spatial effects of highway improvements are conditioned by spatial extent of affected markets and their structural organization. In turn, such characteristics will vary from activity to activity and from economic region to economic region depending on the evolution of operational forms.

It should be apparent that research objectives are fundamental agents in conditioning the determination of "impact area." In a study of land values and land use, the purpose of the research will certainly modify the extent of the market included. For example, studies of residential land use and land values can be undertaken for a number of purposes, each suggesting a different view of "impact area." Some examples are studies of effects on the structure of a neighborhood, relative development within a segment of a community, over-all community development, a segment of the residential construction industry, firm relationships and organizations within the residential construction industry, the tax bases of political units, and the demand for government services of political units.

There does not appear to be any one delineation of an impact area which is best. Indeed, it may even be necessary to adopt different definitions in the same study. A definition used to isolate highway influence on adjustments in one market may be inad-

equate and erroneous for another. For instance, a bypass around a rural service center affects a great many markets all of which probably have different geographical boundaries. For study purposes, market boundaries must be determined and market organization described, because adjustments resulting from highway improvements take place within the boundaries, alter the boundaries, or both. Thus, the spatial extent of affected markets should as much be study variables as the more detailed aspects of the adjustments called forth. The markets affected must be at least hypothetically determined and should serve as the basis for delimiting impact areas.

It is recognized that the market area approach poses formidable methodological and data problems. Two studies are currently under way in Kentucky which it is hoped will contribute to the solution of some of these problems. One of these studies, an investigation of the impact of secondary road improvements, is essentially a market study. The secondary roads study is concerned with changes in retail markets, farm commodity markets, and wholesale distribution as the result of secondary road improvements in eastern Kentucky over a 10-yr period.

Focused as it is on markets, the secondary roads study in essence does not use impact or control areas at all. The impact area is in fact a major study variable, and there will in all probability be many impact areas as measured by market changes.

An example of the complexity of the types of market changes encountered, is the effect of upgrading the surface of rural secondary roads on the simplest type of elementary service center—the open-country general store. As would be expected, the noticeable result is a reduction in the number of such "centers." The second effect is a reduction in the number of functions which those that remain perform. The result of the first two effects is a concentration of convenience "functions" which were originally widely dispersed. The type of concentration effected varies, however, depending on the stage of development of the road network in the areas served by the original centers. Simplifying greatly, one could say that moving from dirt to graded gravel surfaces provokes a retrenchment involving the opening of a similar, but more centrally located, open-country center. Additional surface improvements lead to greater concentrations and further decreases in the functions of the remaining centers.

Such changes involve a great many corollary retail and wholesale market adjustments because the simple elementary centers, being general stores, originally handled many commodities; and concentration bringing or enhancing specialization affects the various commodity markets in different ways. Thus, a simple primary adjustment involves diverse secondary adjustments.

The principal sources of data are personal interviews with owners or operators of all retail or service businesses in the area studied and interviews with a stratified sample of farm operators. This it is hoped will allow a reconstruction of location patterns, tracing of changes in merchandizing, shifting of function, and determination of shopping patterns as influenced by roads.

The second study is a long-range examination of the impact of one of the first sections of Interstate 75 to be built in Kentucky. It was initiated before construction began and will not be completed until some time after the road is open to traffic. It is expected that the study will incorporate and build on methods and findings of the secondary roads project as they have a bearing on the impact area problem. The whole road structure of northern Kentucky, the general setting of this study, suggests that the new highway will profoundly influence traffic patterns at considerable distances, in some cases up to 50 mi or more, from the facility itself. Such a broad area cannot be dealt with in a strictly spatial way but observed shifts in certain important markets can be studied. It is anticipated that one of the most important will be a shift in the labor markets of Cincinnati, Ohio, and Lexington, Kentucky. As in the secondary roads study, market areas and the spatial extent of market areas will be study variables.

RELEVANT TIME PERIODS FOR INCLUSION IN IMPACT STUDIES

Another concept of vital importance theoretically and pragmatically to highway researchers is the determination of a relevant time period within which to assess the impacts of highway improvements. Just as it is important to discuss impact area in terms

of an economic activity, so it is necessary to discuss time in terms of economic activities and requisite adjustments, because the time period studied should be related to adjustment periods for the economic activities surveyed.

Adjustment periods obviously will depend on the nature of the adjustment called forth and also on prevailing economic conditions. But not so obviously they will additionally depend on the ability of firms to move or expand to other locations and motivation for such movement.

One could say that the mobility of firms depends on or measures freedom of movement as influenced by a number of factors such as the following: (a) size of individual firms or units, (b) the number of units comprising an activity, (c) fragmentation or integration within an activity, (d) differential growth of units, (e) capital positions of firms or units within an activity, (f) capital rationing, (g) sources of finance, and (h) complementary roles of firms and activities.

The relationship of firm mobility to adjustment periods can be illustrated by considering the case of highway service businesses. Highway service businesses could be expected to move relatively quickly in response to highway improvements. The reason, of course, is that access to a highway is, in essence, access to market, and there is need for rapid adjustment to changed market conditions. But this rapid response characterizes the group, not individual firms. There may be great motivation to expand or move to a new location, but which firms are involved depends on differentials in ability to move to a new location. Chain operations are able to move quickly and pre-empt prime locations adjacent to the interchanges of limited-access facilities. Such firms are highly mobile and, in some cases, completely internally financed. Others which operate by using franchises may have almost no difficult in securing local capital for area penetration and expansion. Most, of course, employ purchase options on possible sites and may obtain several before finally selecting a permanent location. In the process, the same firms pre-empt many sites enabling them to exercise partial control over development. This is very important, because no construction may be visible at all for some time after a highway facility is completed (as driving on many new limited-access highways confirms), and clues to eventual disposition of activities may be found in option purchases.

Highway service businesses of a nonchain nature located on a superseded facility may also have great motivation to move but may not be mobile. Such firms owning business shells and the land on which they stand are much less mobile than firms leasing business shells. A firm which has been established a long time is in a different position than is a firm of recent origin. Credit sources are more firmly established, and such a firm, if successful, is less liable to be restricted by credit rationing. If a firm has amortized its investment in land and building, it may be able to secure additional capital. It also could move more easily to a new location and absorb the waiting costs involved before sale of the superseded structure than could a recently established firm.

Such differences in mobility mean that time differentials are important, not only in studying relocations, but also in studying the incidence of business failure due to economic dislocations.

In other cases, interest will be focused on changes in consumer expenditure patterns, and such changes will depend on the goods involved and the freedom of people to change their shopping patterns. Dependence on local credit, difficulties in establishing credit elsewhere, and the size of cash reserves may influence how readily people adapt to changed shopping opportunities. In addition, there are a number of subjective and personal relationships involved between merchant and customer; these and the inertia of routinized transactions also influence reactions to changed shopping opportunities.

From the foregoing examples—simplified as they are—it can be seen that a standard or standards are needed against which to compare or measure economic changes over time. Such an adjustment "timetable" or "index" probably would not be as precise as could be wished, but it would enable the placement of observed changes into a meaningful context. By necessity one may have to study "old" facilities where adjustments over time could be catalogued and the influence of institutional restrictions assessed.

Substantial progress can be made toward developing useful adjustment timetables through cataloguing the sequence and timing of changes as reported in highway economic impact studies already completed. The recently reported study of the Northern Belt Line around Lexington, Kentucky, is a case in point (5). It carefully reports and documents the sequence of development of commercial and other land uses along that free access facility. It was noted there that the initial types of development significantly influenced later land uses, not only as to location but also as to type of activity and size of enterprise. It is also interesting that small establishments oriented to traffic developed first but were later followed by numerous developments apparently little related to highway service.

This and other similar studies provide information through which the sequence and timing of developments can be assessed and consistent patterns discovered. These patterns would serve the purpose of facilitating comparison of data from completed and current studies at various times after the completion of highway additions. Comparisons from which expectation models could be developed would supplement the more widely-used before-and-after studies with or without use of control areas.

The development of adjustment timetables might also make use of industry studies which give indication of adjustment periods based on firm and industry size commitments, capital requirement and position, labor requirements, and management's views of the future.

It seems unlikely that it will be possible to avoid limiting the time period in which studies are made. But to the extent adjustment timetables by type of activity, firm, and organization can be developed, perspective will be gained on what has taken place within a specified time period.

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Time-Series Maps for the Projection of Land-Use Patterns

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● TIME-SERIES mapping of quantified land-use data has been used for many years in historical geography to study the evolution of present patterns from the past. The procedure is extended here to embrace extrapolation from the past through the present into the future (3). The procedure includes four steps: (1) quantification and mapping of land-use data at time intervals over a number of years; (2) measurement of change in both the intensity and location of major uses; (3) search for regularities in both locational characteristics of major land uses and the rate, direction, and magnitude of change, and (4) extrapolation of both intensity and location of major land uses, on the basis of past regularities, into the near future.

This paper presents two examples of the procedure which has aided the projection

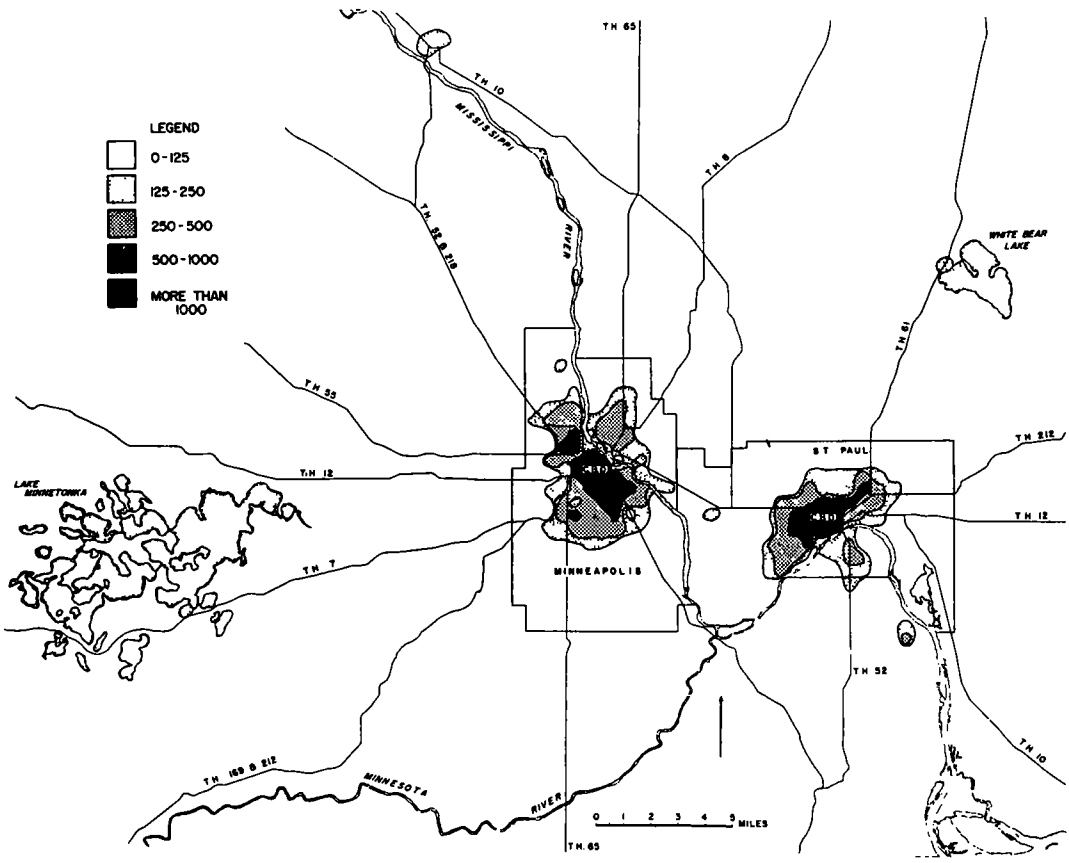


Figure 1. Number of dwelling units per quarter square mile, 1900.

of future land-use patterns for highway planning purposes in the Minneapolis-St. Paul metropolitan area. The studies discussed use time-series maps. The examples are intended to serve two purposes. First, they illustrate the procedures which have been used. Second, they provide the basis for a brief discussion of the applied and theoretical value and the limitations of studies of this type.

RESIDENTIAL EXPANSION

A time-series of maps was used in preparing a 1980 forecast of residential growth for the Twin Cities Area Transportation Study (TCATS), carried out by the Minnesota Department of Highways in cooperation with the U. S. Bureau of Public Roads. The dwelling unit forecast data were subsequently converted into trip-end data and used in traffic forecasting and assignment. It should be understood that as yet there exists no mechanical procedure which assures a dwelling unit forecast suitable for detailed traffic forecasting needs. The exercise of considerable subjective judgment is necessary. However, it is essential that the forecaster has the best possible understanding of the metropolitan area in which he is working. Further, he needs as much quantitative data as possible to implement his understanding of the nature of metropolitan growth and to back up whatever subjective judgments are necessary. The time-series map technique is useful in filling those needs.

The basic map series used in this analysis showed the number of dwelling units by quarter section for the years 1900, 1915, 1945, 1951, and 1958. Four of the maps are reproduced here (Figures 1-4). The study area consisted of about 3,600 quarter sections. Sources used for the historical series were insurance maps, U.S. Geological

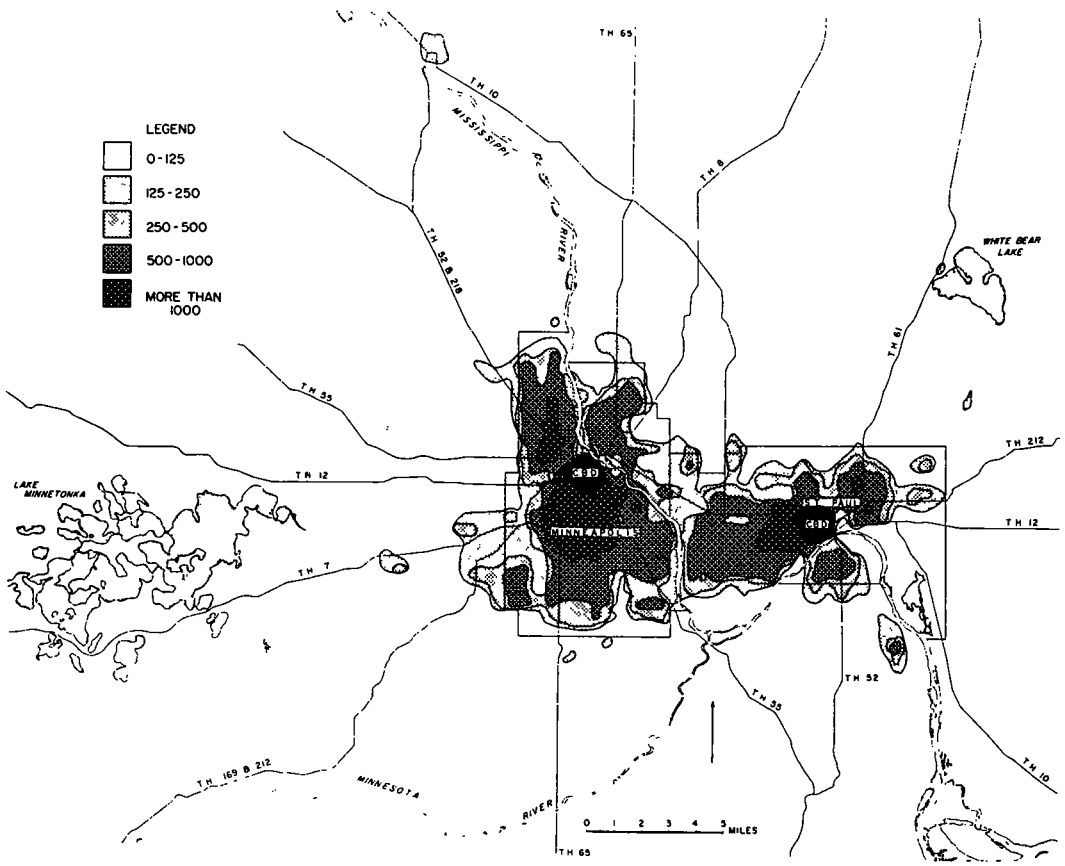


Figure 2. Number of dwelling units per quarter square mile, 1945.

Survey sheets, aerial photographs, census material, and land-use surveys. Isolines were drawn to outline the density classes of 0.50, 50-125, 125-250, 250-500, 500-1,000, and 1,000-2,000 dwelling units per quarter section. From these basic maps, a second series of maps showed the change in dwelling unit density per quarter section during each time interval (Fig. 5). A third very useful series showed the "percentage of saturation" for 1945, 1951, and 1958. This map showed the existing number of dwelling units expressed as a percent of the estimated maximum possible number of single-family units, or "saturation" density, by quarter sections. A fourth map group showed the changing positions of individual density isolines for each of the years in the series. These four series of maps provided a detailed, three-dimensional picture of the residential expansion and "filling-in" of the metropolitan area.

Much can be learned about the growth characteristics of an area simply by studying such a set of maps. Four investigations of particular value were carried out.

First, the study area was divided into 45-deg sectors radiating from both the Minneapolis and St. Paul CBD's. Dwelling units added in each sector were totaled for two expansion periods, 1945-51 and 1951-58. The results produced (a) a clear understanding of growth throughout the metropolitan area during the past 15 yr of rapid expansion, (b) measures of persistence of growth in given directions (c) measures of changes in direction of growth, and (d) comparative data needed to explain differences in expansion rates in various directions.

Second, rates of movement of the advancing urban frontier were investigated for the same sectors. To do this, it was assumed that the isoline of 125 dwelling units per quarter section defined the edge of the built-up area. The position of this isoline

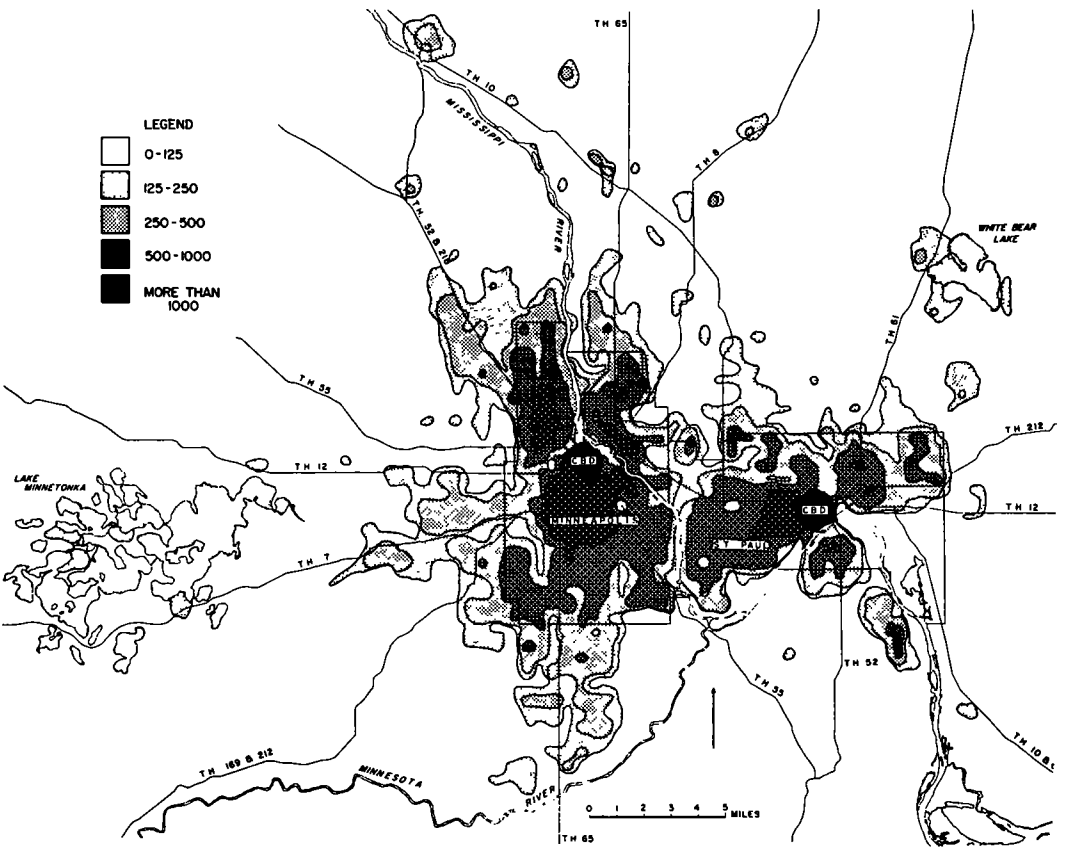


Figure 3. Number of dwelling units per quarter square mile, 1958.

was mapped from 1900 through 1958 (Fig. 6), with special attention to the years 1945 through 1958. This map, superimposed on the map of dwelling unit change, indicated the number of dwelling units added between the isolines during each time period. This procedure yielded data on several important characteristics of growth, including (a) absolute rates of movement of the advancing urban frontier, (b) fraction of the total area being added to each sector through growth contiguous to already built-up area, (c) relationships between movement rates and density of new areas (it was found that in both the 1945-51 and 1951-58 the areas where the urban frontier advanced fastest were also the areas which received the highest density of growth), and (d) a measure of the degree of scatter of new growth, by sector. The latter measure was obtained by comparing the number of dwelling units added at the edge of the built-up area with the number added throughout the entire sector. In the fastest-growing sector from 1951 to 1958, it was found that 60 percent of the growth was contiguous to the previously built-up area. In other sectors the figure ranged from 10 to 50 percent.

Third, an investigation of densities of development was carried out. It was well-known that much suburban growth is of low density, but no data were available on just what densities were common or on the locational pattern of different density groups. This study was based directly on the original series of maps of dwelling units. It indicated, for example, that the portion of all dwelling units in density classes under 500 per quarter section rose from 27 percent in 1945 to 34 percent in 1951 and rose again to 41 percent in 1958. Data of this type, and trends the data revealed, were of primary importance in forecasting not only for the total area but for given sectors. The trend toward lower density, for example, is responsible for the sprawling nature of the 1980 map.

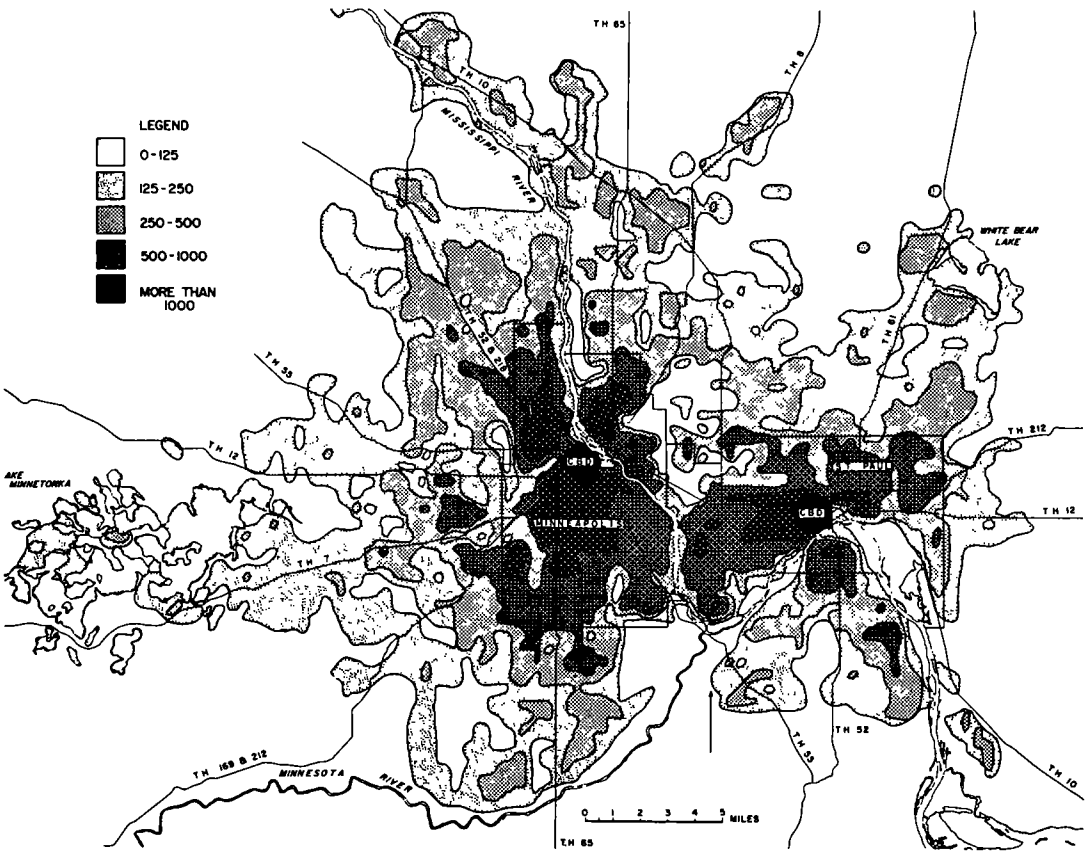


Figure 4. Number of dwelling units per quarter square mile, 1980.

The foregoing illustrations represent types of quantified data, from time-series maps, which were of value in forecasting procedures. Because one cannot blindly project past trends, it was considered necessary to attempt to find the reasons for differences in intensity and direction of growth. In the Twin Cities area one of the primary correlatives of rapid, intense growth in a given direction was the presence of a large amount of reasonably level, well-drained land suitable for mass development in middle and lower price ranges. Also, advancing development on such land had the highest suburban density and the highest rate of advance of the urban frontier. The time-series studies showed greater contiguity and less scattering of growth on the flat land and strong persistence of growth rate and direction in the flat land sectors over a 5- to 10-yr period.

Another correlative of rapid expansion in given areas is found in the accessibility characteristics of the areas. Accessibility may be defined in three principal ways:

1. Access to highways, which minimize travel time for relatively long trips within the metropolitan area.
2. Access to major functional areas of the city, especially major employment areas.
3. Time-distance from the Minneapolis CBD. (Although the Twin Cities area has double CBD's there is an observable tendency toward formation of a symmetrical urban complex around the Minneapolis core.)

A third factor found associated with suburban expansion into a given area is simply the location of previous growth. The persistence of primary growth patterns is obvious

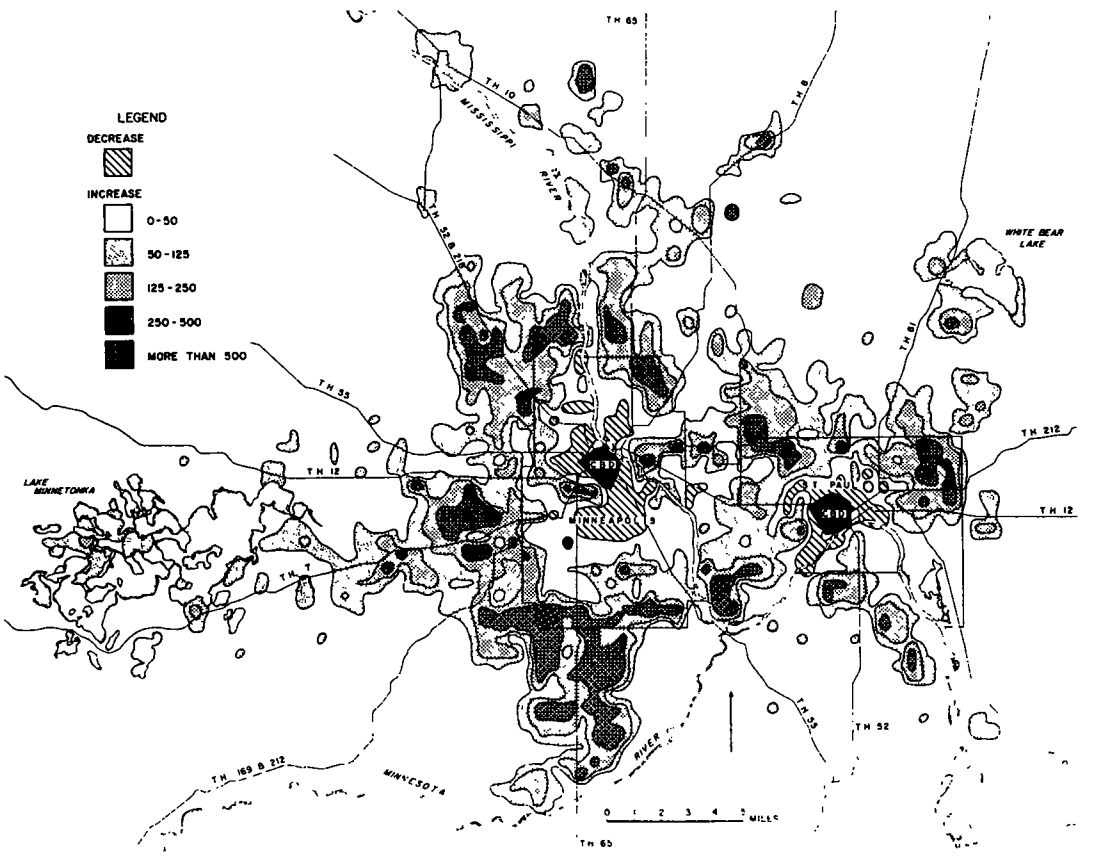


Figure 5. Dwelling unit change per quarter square mile, 1945-1958.

and striking. If one had to predict location of growth in the absence of much information, he would guess well to put the predicted growth at the present edge of the built-up area. It is recognized, of course, that this factor is not a determinant of growth characteristics, as are land-type and access.

The foregoing information, derived from time-series of maps, had direct value in forecasting. The information and the technique have also aided in the formation of hypotheses regarding urban growth. The hypotheses have played an important part in attempts to synthesize a satisfactory dwelling unit forecasting model, and that is probably their more important use in the long run.

COMMERCIAL-INDUSTRIAL GROWTH

The second illustration is a study of two major circumferential highways on the western edge of the Twin Cities (2). Both routes are shown in Figure 7. The two highways include existing Minnesota State Highway 100 and proposed Interstate Route 494. The existing highway was opened shortly before 1940. The proposed route will open about 1965. Both will serve as urban distributors and circumferentials. The problem was to project the probable pattern and intensity of major commercial-industrial land uses on the new Route 494.

The first step was to define two study strips each 1 mi in width centered on each highway. Next, the analogy of the two strips was established. Both will have been constructed to the highest standards used at the time of their opening; both are intersected by the same major radial highways and rail lines; both will have been located along the western frontier of urban expansion at the time of their opening (Fig. 8).

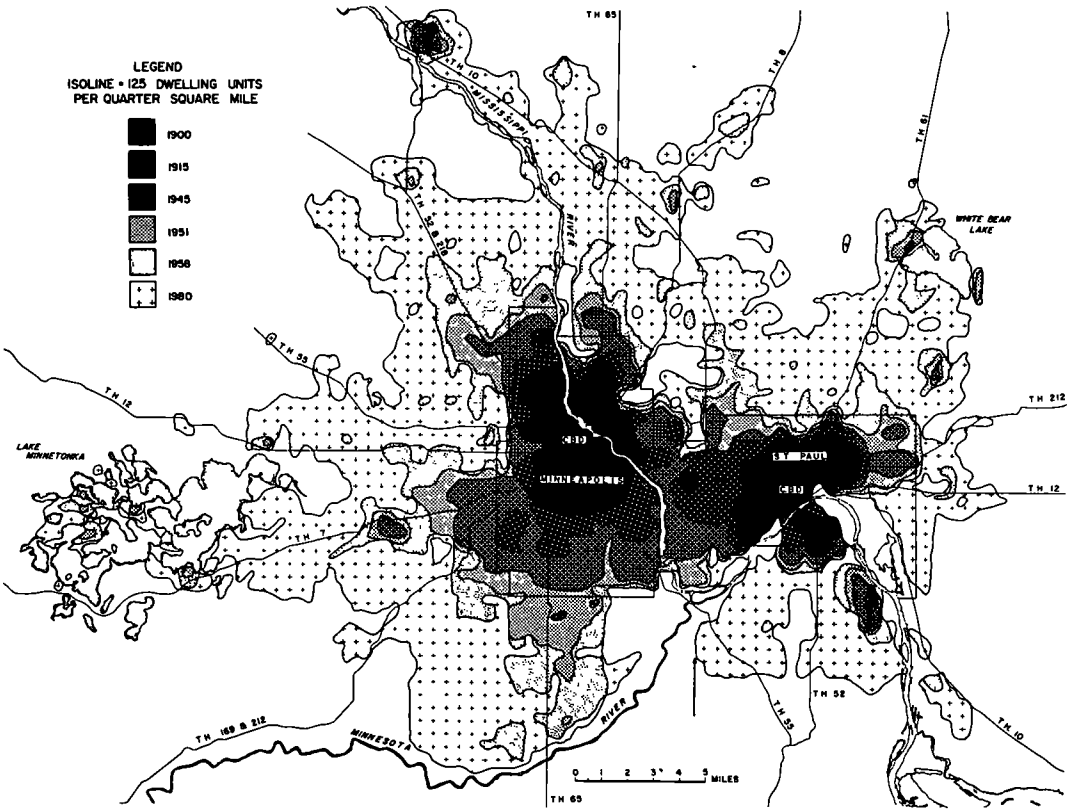


Figure 6. Urbanized area, 1900-1980.

Observers recorded and mapped the land area used by every non-residential establishment in the Highway 100 study strip for six different years from 1940 through 1959. The data were taken from aerial photographs and plat maps. The total of about 250 establishments were grouped into three categories. Two groups of retail and service establishments were recognized:

1. Shopping center uses, including grocery and drug stores, clothing stores, radio repair shops, for example.
2. Highway-oriented and urban-arterial uses, including auto sales, filling stations, drive-ins, lumber yards, and other similar uses (1).

Two other groups recognized were:

3. Warehousing.
4. Manufacturing uses, including associated office areas.

The establishments were then mapped for each year according to land-use category and land area. Figure 9 shows the patterns for the first and latest years of the series —1940 and 1959. Intermediate maps in the series show the details of evolution of the present-day pattern.

From the maps it was possible to determine the trends in site, locational character

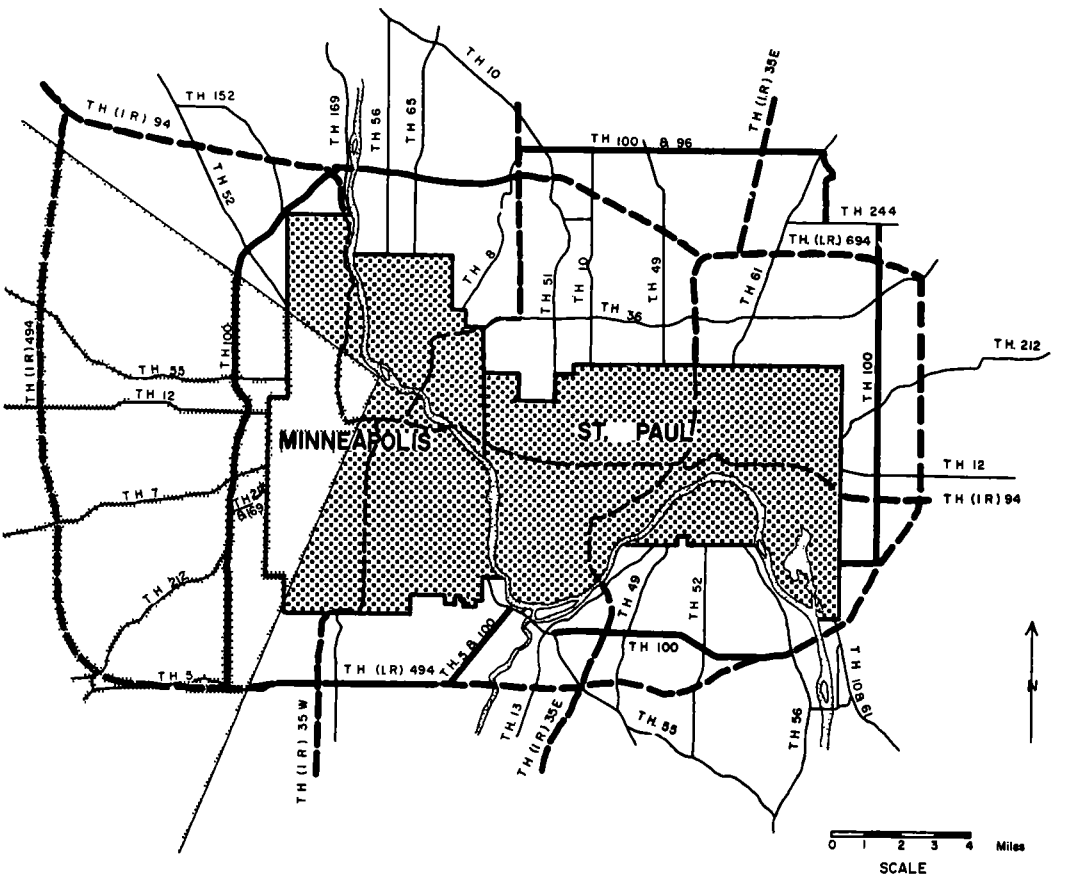


Figure 7. The present and projected Belt Line highways around the Minneapolis-St. Paul metropolitan area. Heavy solid lines mark the position of T.H. 100. Heavy dashed lines mark the Interstate Highway routes. The "western quadrant," to which this study refers, is indicated by fine stippling.

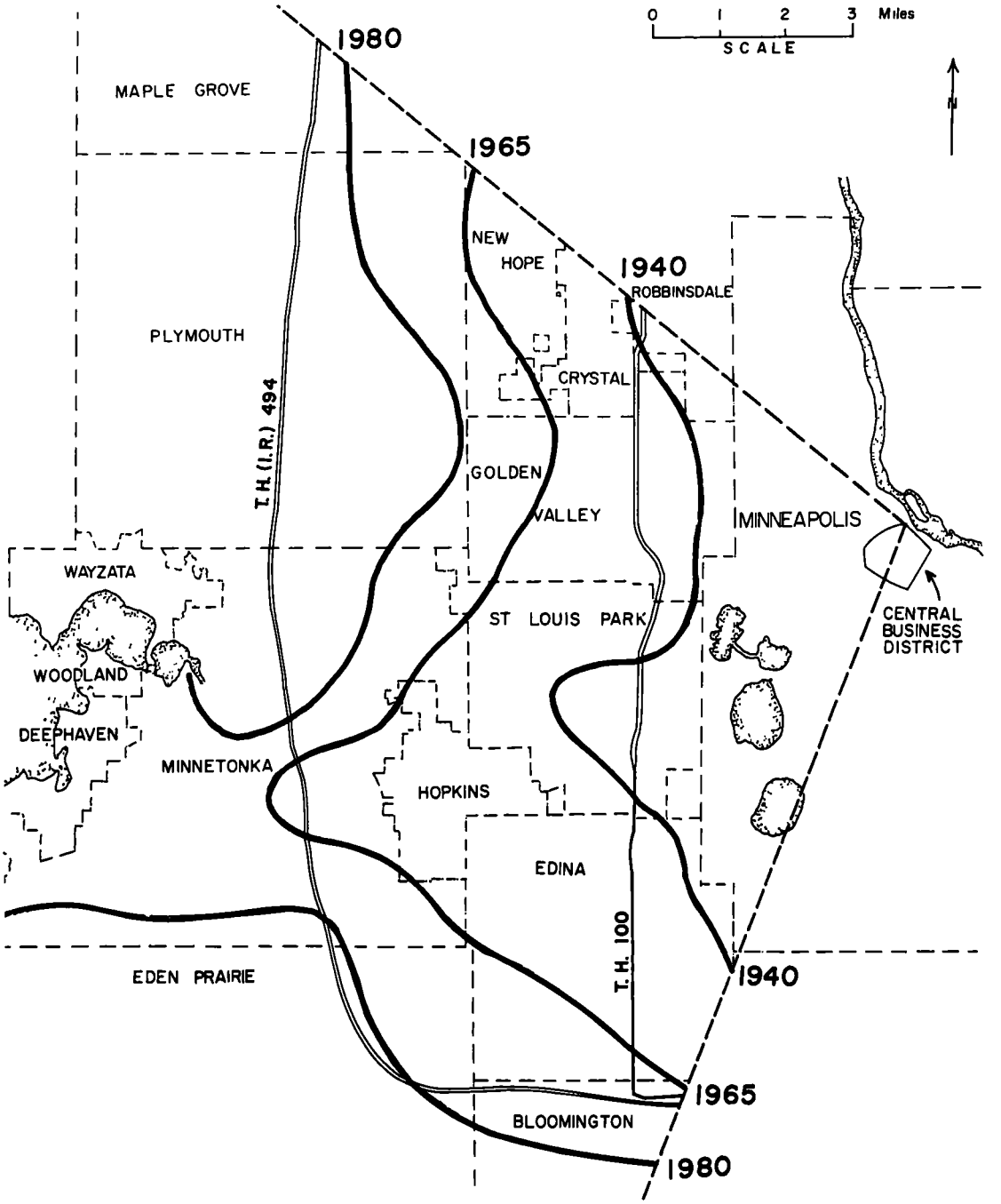
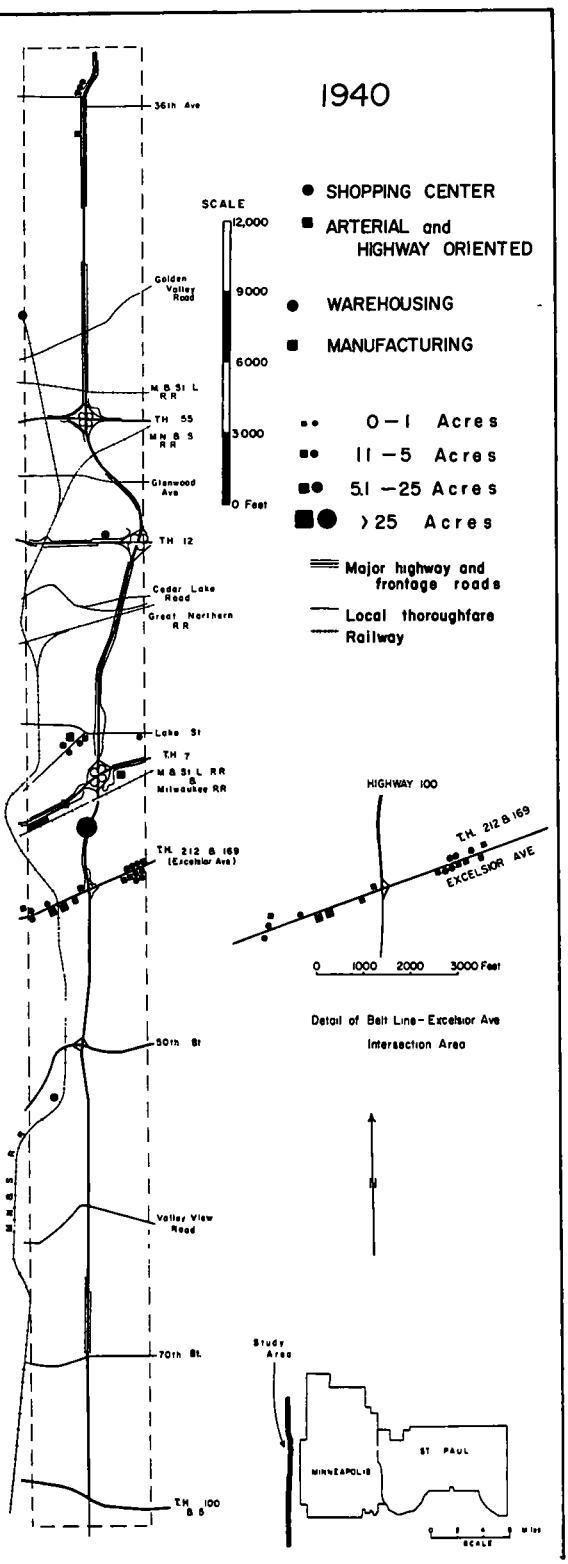


Figure 8. The similar positions of the old and new Belt Lines with reference to the advancing urban frontier. Heavy solid lines indicate generalized western boundaries of 500 or more dwelling units per square mile at successive times.



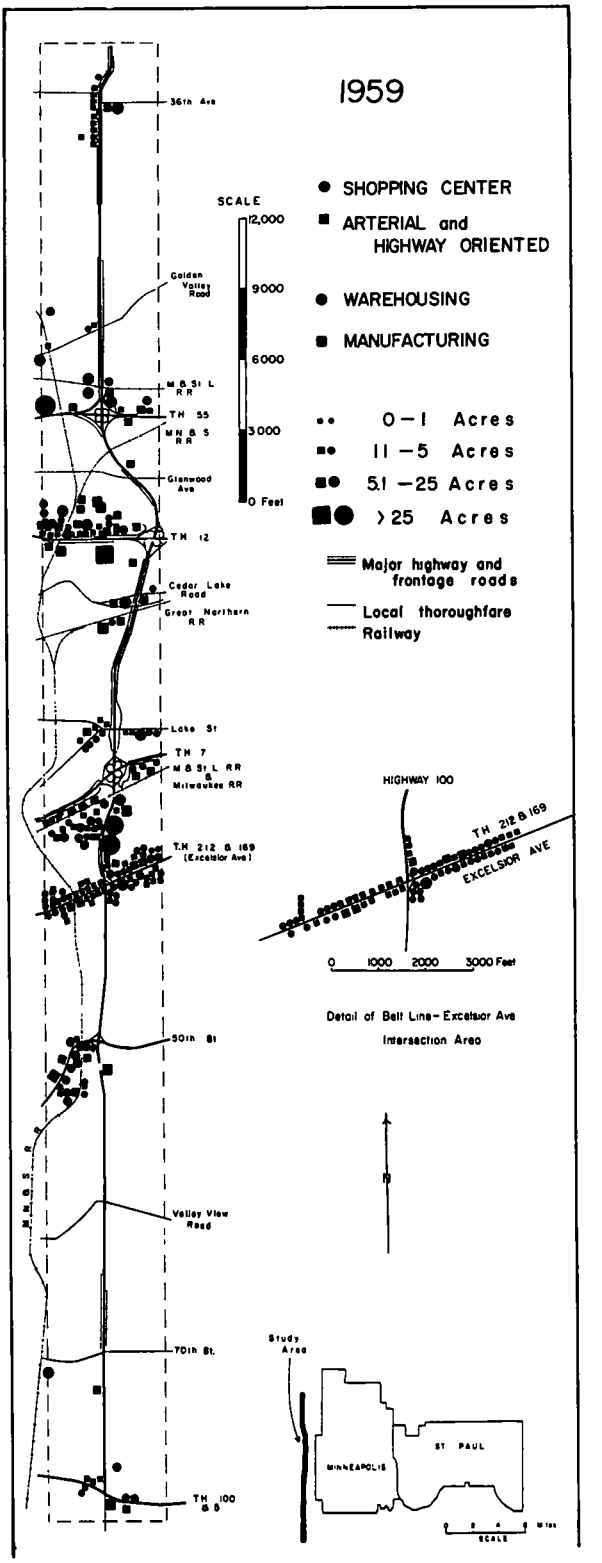


Figure 9. Development of commercial-industrial land uses, T. H. 100 study strip, 1940-59.

and land requirements for each type of use. Site requirements had remained practically constant. Commercial and industrial uses have adhered to level or gently-rolling, well-drained land. These site characteristics were quantified so that similar sites could be identified along Route 494.

Four important locational characteristics were identified, as follows:

1. The highway-oriented (including urban-arterial) retail and service uses along Highway 100 show a close relationship to volume of traffic; that is, the only use class which appeared to be traffic-related. Figure 10 show how it differs in its locational characteristics from the other major use classes.
2. Shopping center-type uses show a unique and quasi-constant association with the density of residential dwelling units. The degree of association is indicated by Figure 11.
3. Manufacturing and warehousing development were found to vary with distance by fastest highway from the Minneapolis CBD. The relationship between acreage in those uses and distance from the CBD in six major industrial concentrations is shown in Figure 12. The one area which appears anomalous on the graph is currently developing very rapidly. The time-series maps revealed that none of these relationships between particular uses and particular types of locations appeared full-blown at the

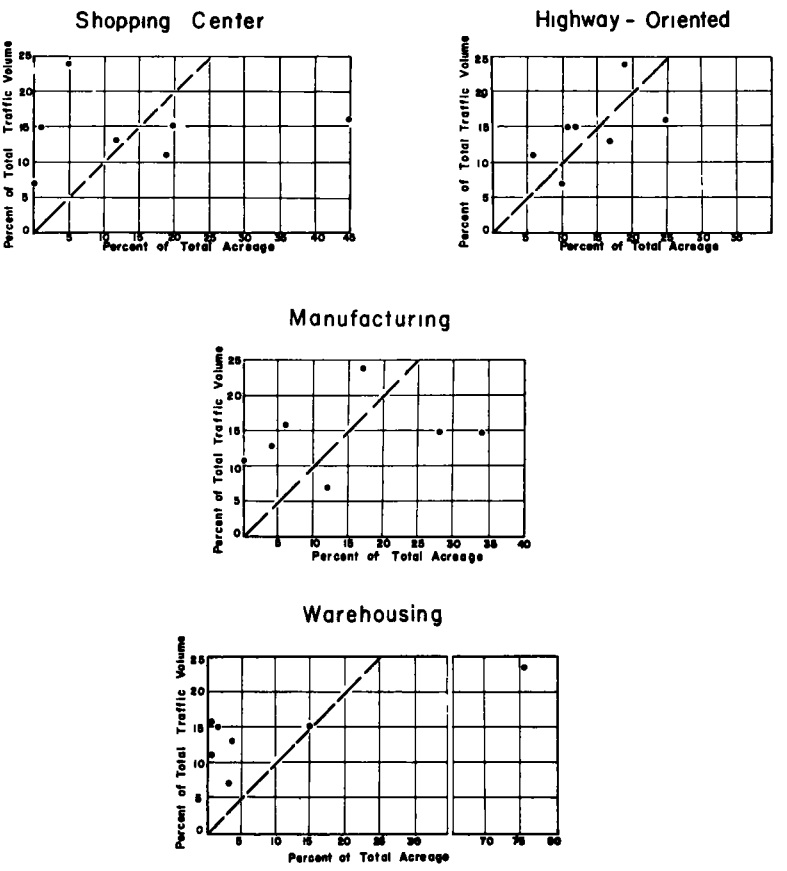
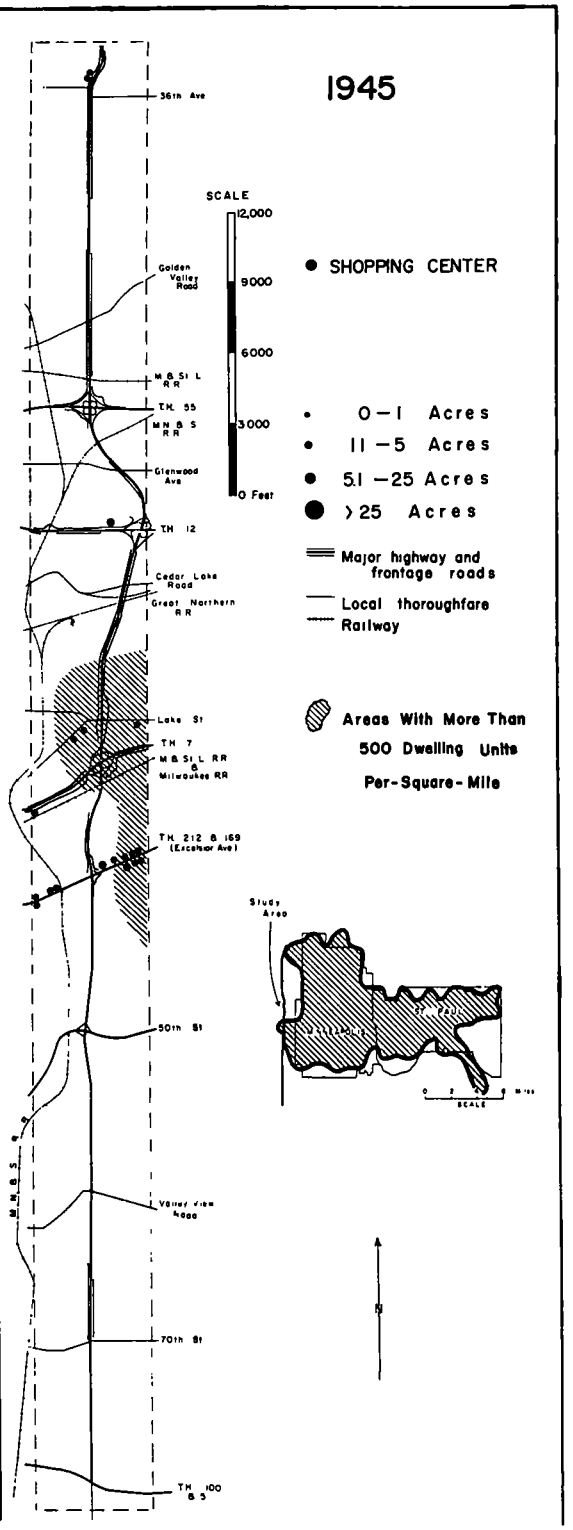


Figure 10. Commercial-industrial land uses related to traffic volume for 7 different segments comprising the T. H. 100 study strip. The dashed line on each graph has a slope of 1. Only the highway-oriented retail and service uses appear to show a close relationship to traffic volume.



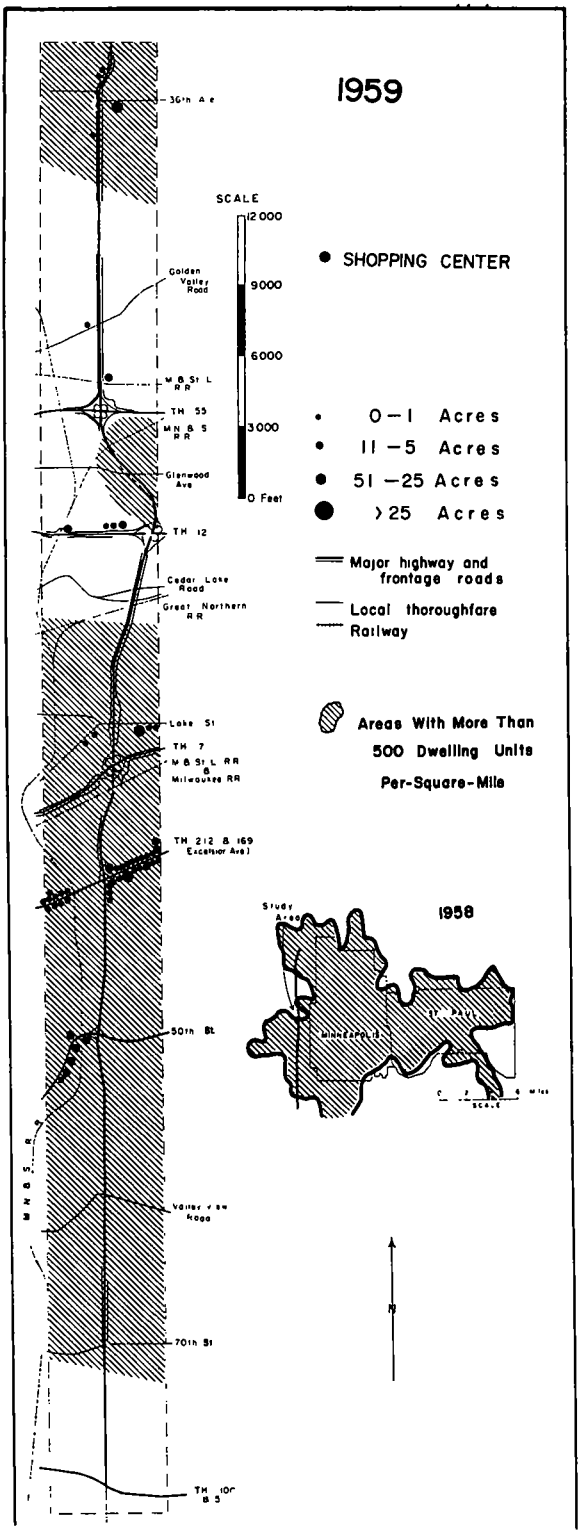


Figure 11. Shopping center-type retail and service uses along T. H. 100, 1945-1959. Shaded area indicates dwelling unit density greater than 125 per $\frac{1}{4}$ square mile.

beginning of the 20-yr period. Instead, they evolved over time into the orderly pattern which they have today.

4. It was observed that all of the major uses, regardless of whether they were oriented toward highway traffic, neighborhood residential growth, or the CBD, showed certain locational affinities within the study strip. Virtually all establishments lay within 2,500 ft of a major highway intersection; and virtually all warehousing and manufacturing establishments lay within 1,000 ft of both a major highway and a rail line.

Regularities and trends noted along Highway 100 permitted the projection of land uses along the analogous proposed Route 494. Ratios were computed to relate land requirements to traffic volume for the highway-oriented uses. These ratios made it possible to project acreage of highway-oriented uses on the basis of traffic projections for various segments of proposed Route 494. Ratios were also computed to relate shopping center types of land use to dwelling-unit density. Thus acreage of shopping center uses could be projected for various segments of Route 494 on the basis of projected residential growth (Fig. 4).

The projection of manufacturing and warehousing land requirements for Route 494 was somewhat more complex. Trends in land development for these two uses along Highway 100 were assumed to reflect a general demand for warehousing and industrial land along any major western circumferential highway in the metropolitan area. It was assumed that this general condition has been met historically by Highway 100 and will be met also in the near future by Route 494. Upper and lower ceiling were defined for growth of warehousing and manufacturing development in the Highway 100 study strip. A lower ceiling was determined by the remaining amount of level or gently-rolling, well-drained land within 1,000 ft of trackage and major highway frontage. An upper ceiling was determined by the additional remaining level, well-drained land within 2,500 ft of a major highway intersection. The available land below the first ceiling was assumed to be certain of development at the rate now prevailing in the Highway 100 study strip. It was assumed that the land between the lower and upper ceiling is marginal; it will be developed eventually but at a diminishing rate.

Figure 13 shows the resulting projection of demand for warehousing and manufacturing land in the Highway 100 study strip. The trend from 1940 through 1959 was projected

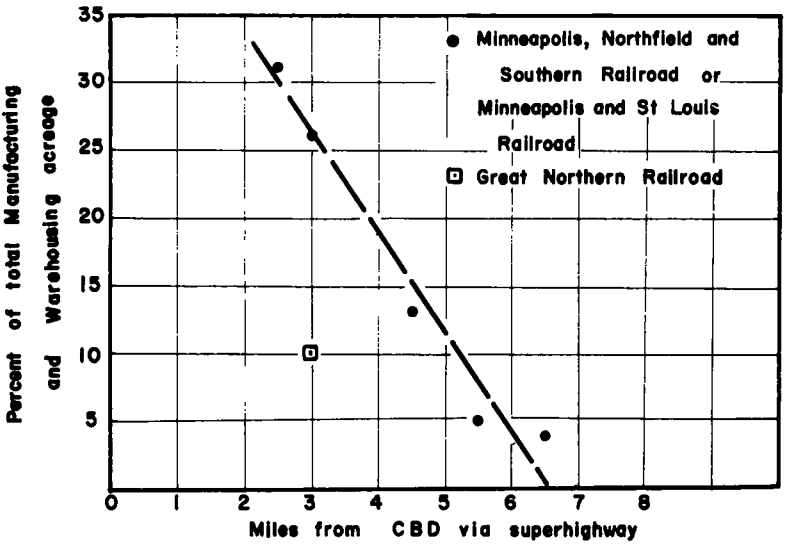


Figure 12. The relationship between industrial development and distance from the Minneapolis CBD for the six major highway-rail trackage locations in the T.H. 100 study strip, 1959.

in the form of a growth curve. It was assumed that, once the lower ceiling was reached, the development rate would decelerate at the same rate at which it accelerated in the early years after 1940. The recent, maximum rate of industrial development in the late 1950's was taken as the potential demand for industrial land along a western circumferential highway. There is a widening difference between projected development on Highway 100 and projected demand for land on a western circumferential. That difference was considered to be "surplus" demand transferable from Highway 100 to Route 494. It is apparent that the validity of this projection depends heavily on the assumption that the so-called "growth curve" plotted and projected for Highway 100 is representative of some general behavior of real estate development in cases of this nature. Much more study is needed in support of this assumption.

Through the use of procedures described, projections were made for the total acreage

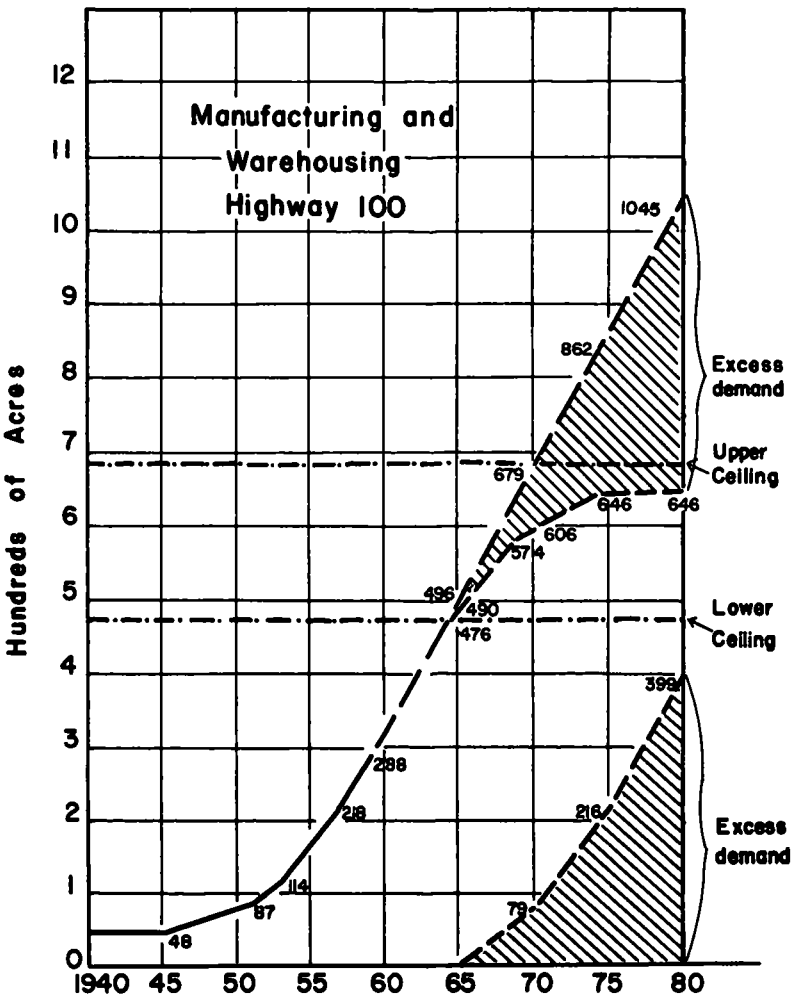


Figure 13. Manufacturing and warehousing highway 100 numbers on face of grid indicate acres. Solid curve represents rate of observed development 1940 to 1959; dashed curves represent projections. Upper dashed curve represents projected demand for industrial land in a western circumferential highway location. Shaded areas represent excess of demand over amount of land supplied from the Highway 100 strip. Dash-dot lines represent limits of supply of first-class and marginal land.

of land developed in each major commercial-industrial use along proposed Route 494 within 15 yr after the opening date. The probable geographical distribution of the acreage was also projected on the basis of locational characteristics observed in the development along Highway 100. The distribution was shown by means of a prognostic map.

CONCLUSIONS

The use of time-series maps for land-use projection is an adaptation of the method used in the biological study of the morphology of growth or in the meteorological analysis of a time-series of weather maps and the development of a prognostic chart. The maps provide a facsimile of observed changes in land uses associated with growth, decline, and changing relative location. The procedure simplified land use forecasting problems by (a) seeking the key to the near future in the recent past and (b) basing the forecast on empirical data from the same geographical and historical context for which the forecast is to be made. The procedure does not rely on a poorly-tested, general hypothesis of urban growth; yet it is producing the kind of material that is needed in large quantity to develop and test a general theory. In other words, continuing land-use inventories and accompanying cumulative time-series maps would serve both practical and theoretical purposes.

On the practical side, the studies described have three immediate uses. (1) They aid in planning land acquisition for highways; for they help to foresee where it is most important to buy right-of-way in anticipation of rising land costs and future traffic. (2) They are of value in highway programing; for they help to indicate where, when, and how much traffic generation and highway needs will grow in a given metropolitan area. (3) Finally, these studies are of use in comprehensive planning. They encourage the articulation of future plans with existing trends and principles. They increase the likelihood that any plan for the future will be a logical extension of an evolving pattern as well as a desirable theoretical design.

On the theoretical side, a program of continuing land-use inventory and time-series mapping would also make a contribution. It would provide the basic description of the urban land settlement process which is necessary to the development of a viable theory of urban growth.

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Transportation and the Spatial Distribution of Economic Activity

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● THE MATERIAL in this paper is drawn from a larger study that the authors are conducting. This larger study (being carried out under the auspices of the Transportation Center with financial assistance from Resources for the Future and the Ford Foundation) deals with certain long-run changes that are taking place in the distribution of economic activity in the United States. The long-run tendencies on which the authors have focused are those that have come to be described by the terms "suburbanization" and "regionalization". As applied to economic activity, the former term is usually interpreted to mean a movement out of the central city—particularly the core and the area adjoining it—to suburban areas within a given metropolis. On the other hand, the term regionalization usually refers to the diffusion of economic activity, especially manufacturing, among broad regions of the country. The main theme of the aforementioned larger study is that suburbanization and regionalization are closely related, competing tendencies. Both of them represent basic responses to changes that have been taking place in the mobility of factors of production; the techniques of production, transportation, and communication; the structure of transport rates, etc. The present paper deals with certain aspects of suburbanization.

As already indicated, this term is usually taken to mean a movement of population and economic activity out of the central city to the suburbs. This paper shows that, at least for Chicago, an approach based on this simple dichotomy does not permit a proper appreciation of the major changes that are taking place. Almost every previous study has employed this simple dichotomy because adequate data on the intra-metropolitan area distribution of economic activity were not generally available. As a result, it is not generally known what activities are declining in different zones of a metropolitan area, what activities are expanding, and at what rates these changes are taking place. However, it must be emphasized that the problems associated with metropolitan analysis have not been solely of a data variety. Research workers have not had a theoretical framework that could help them to understand the nature of the economic forces operating within metropolitan areas. Lack of such a framework has also led to the expenditure of great amounts of money and time on the collection of masses of data with only limited usefulness. As a result, much of the discussion concerning suburbanization and the changing functions of the central city is largely speculative in nature. With very little effort one can find "up-to-the-minute" reports, some claiming that "our central cities are coming back" and others claiming that central cities—particularly their compact central business districts—are relics of 19th century technology which will continue to decline, some of them in relative importance and others of them in absolute importance as well. Such contradictory claims can only be settled by a full-scale study of intra-metropolitan growth patterns for many activities. The present paper concentrates on the intra-metropolitan area distribution of manufacturing. This subject is clearly relevant, but the authors recognize that the picture presented is incomplete. (The changing distribution of service industries and the nature of their linkage with manufacturing firms are currently being studies by the authors.)

Changes in the geographic distribution of manufacturing plants within a metropolitan area reflect a composite of different types of investment decisions by many firms. Thus, some firms decide to go out of business, whereas other firms decide to expand their facilities for production and distribution. In the latter case, they must also

decide whether to expand at their existing site, to become a multi-plant establishment by setting up an additional facility at a new site within the metropolitan area, or to establish a new plant in a new location and abandon the old facility. Finally, new firms may decide to enter the area, and old firms may decide to leave. So far as the metropolitan area being studies is concerned, the latter decision amounts to a going out of business. The present study does not explain why firms decide to invest or disinvest. This decision is treated as a datum, major effort being devoted to explaining and documenting the locational aspects of these decisions.

By way of summary it may be said that the dispersal of manufacturing activity from the inner zones of the central city was clearly a dominant tendency in plant location during the past decade. Movement to the suburbs did indeed take place, but there was also a very marked tendency for growth to take place at the fringe of the city. To a considerable extent the tendency that most writers describe as suburbanization is actually a movement from the inner portions of the city to the periphery of the city. In other words, when firms decide to relocate from an existing site, they often select another site that is still within the political boundary of the city. There are a number of reasons for this decision. Some of the reasons have to do with certain frictions that act to moderate the distances firms move. They are explained later in the paper. The authors believe that the marked growth that has taken place at the fringe of the city is also related to transportation: firms prefer to remain within that zone of the city known as the commercial zone because there are transport cost advantages in doing so.

Earlier it was indicated that one type of investment decision involves relocation: a firm decides to shift its plant from one place within the metropolitan area to another. Data on plant relocations clearly reveal the over-all pattern of locational change that characterized Chicago's experience in the period 1950-1960.

The net influence of plant relocations within the Chicago metropolitan area has been to move economic activity from inner portions of the central city to the edge of the city and beyond. Thus, if the net gains and net losses of manufacturing plants due to relocations are computed, it is found that the greatest percentage gains took place in an area that is 10 to 15 mi from the core of the city. The greatest, and almost matching, losses occurred in a zone that is within 5 mi of the core. This pattern holds for the aggregate of all manufacturing activity and—with relatively small deviations—it also applies to all of the two-digit manufacturing industries. Thus, so far as the effects of relocation on the spatial distribution of manufacturing establishments are concerned, marked differences do not appear between industries.

To a certain extent this finding confirms the fears of those who talk about a flight of industry from the central city. However, this speculation must be interpreted with care. First, the major movement is not from the city to the suburbs, but from one part of the central city—the inner zones—to another part, namely, the fringe. Second, the pattern of expansions at old locations must be taken into account. Third, the pattern of new locations must be studied. Finally, the way in which the force of relocation actually works must be made clear

One way of formulating the "flight" hypothesis is to say that firms in the inner portions of the city operate under more unfavorable conditions that do firms in any other portion of the city. As a result, a higher proportion of them decide to relocate, and their decision takes them to the edge of the city or beyond. This version of the flight hypothesis can be formulated in a way that permits it to be tested. Thus, from actual data a figure k_1 is derived, which is the percentage of all firms that decided to carry out relocations in some given period of time. All firms in existence during this period are grouped according to their distance from CBD. The number of firms in each distance group is then multiplied by k_1. This multiplication provides an estimate of the number of firms in each distance group that would be expected to carry out relocations on the assumption that distance from the CBD has no effect. If distance actually does have a significant effect, the actual number of firms in the inner portions of the city that decide to relocate should be greater than the expected number, whereas the opposite would be true in the outer portions. In fact, distance from the CBD has no significant influence on the proportion of firms in each distance group that decide to

carry out relocations. It is true that absolutely more firms in the inner portions of the city relocate, but this is because there are more firms located there: distance from the core of the city has no significant influence on the proportion of firms in various distance groups that make investment decisions which involve relocation. (This result is based on a regression of the ratio of the number of plants that originated to the total number of plants by postal zone or the distance of the center of the postal zone from the CBD. The data were less than ideal because the total number of plants referred to 1960, whereas the number of origins referred to the 10-yr period. Use of postal zones also served to restrict the number of observations in the regression.) Firms all over the metropolitan area adjust to changed conditions by carrying out locational readjustments. On the other hand, once a decision to relocate is made, this decision most often involves a new site which is farther from the CBD than was the origin. There are interesting policy implications in this finding, but the discussion of these implications must wait until the review of the pattern of relocations has been completed and the locational patterns of the other types of investment decisions have been analyzed.

If the origin and destinations of all firms that relocated were plotted on a map, the over-all impression would be one of general disorder. However, this impression would be misleading because there are forces that appear to moderate and channel the locational readjustments that firms carry out. In general, and perhaps too simply, two sets of forces impinge on a firm that is considering a change in location. There are the motives for moving to a new location such as lower-priced land, better transportation, etc. On the other hand, there are considerations that tend to keep firms from moving too far from their old locations: an established labor supply, ties with other firms that provide material or service inputs; reluctance on the part of management to shift residence. These factors or linkages exert a friction on distance moved. Thus, we found that the mean and median distance moved by relocating plants were both abour five miles, and the distribution was very skewed toward the shorter distances. The modal distance moved was somewhat less than one mile.

Comparison between the destinations of relocating plants and the site selected by new firms provides further evidence concerning the hypothesis that there are frictions that act to moderate the distance moved by relocating plants. After all, a major difference between the two types of firms is that those which are new to the area have fewer or no established ties for local inputs of various kinds. It was found that relocating plants consistently had destinations that were closer to the CBD than did new plants, after corrections were made for size. This finding bears on a related issue, the separate influences of the CBD and the original site on distance moved. However, the relative strengths of these two types of frictions have not been determined.

The intensity of manufacturing activity in the outer rings of the city increased as a result of expansions at existing locations as well as by relocations. However, such expansions were much more evenly spread over the entire area than were the relocation destinations. The pattern does reveal a primary peak in a zone that is 11 to 13 mi from the core, but the dominant impression is one of a broad plateau. Once more it must be recalled that there are many more firms in the inner portions of the city than in the outer portions. Therefore, if the absolute number of expansions carried out at existing sites resembles a broad plateau, this must mean that a smaller proportion of firms in the inner portions of the city carry out expansions at their existing locations. In other words, whereas the percentage of firms that relocate does not bear any relation to distance from the CBD, the percentage of firms that carry out expansions at existing locations does exhibit such a relationship. Moreover, the relationship is negative; that is, the closer to the CBD, the smaller the proportion of firms that carry out expansions at existing sites.

Plants established in Chicago by firms that are new to the area tend to locate in two general areas. The greatest concentration of new firms is in a zone that extends 4 mi around the core area. A second, somewhat lesser, peak occurs in an area that is 11 to 16 mi away from the core. Once again, the separate industry experiences do not appear to differ significantly from that for the aggregate of all manufacturing. However, the size of new plants does make a difference. The locational tendencies of new small plants is systematically different from that for new large plants.

Findings on the latter issue tend to bear out the "seed-bed" hypothesis. This hypothesis states that the inner portion of the city tends to act as the spawning ground of new small enterprise. The logic of the hypothesis is best presented as a number of propositions.

1. New small firms lack the capital to construct their own facilities and must depend on lease space. Such space is most readily available in the inner portions of the city, particularly in that zone which has been called the grey area. Thus, it is the distribution of relocations (origins and destinations) that permits the core area to fulfill this function.
2. The farther a firm is from the CBD, the more is the likelihood that it will have to integrate vertically and provide itself with many auxiliary services. Small firms are more limited in their ability to carry out such vertical integration and are therefore likely to establish themselves where they can draw on the agglomerated service facilities.
3. It is alleged that small firms are more likely to obtain loans on reasonable terms in the core area because banking is more competitive there.
4. A small firm on the outskirts of the city is less likely to be able to draw on the large pool of unskilled, low-wage labor that is found in the inner portions of the city.

It has been found that the seed-bed hypothesis does have substance. Almost 25 percent of all small firms established themselves within 2 mi of the CBD in the period under consideration. The percentage of new large firms that selected this area was only 3.6. Fifty-four percent of new small plants located in a zone extending 4 mi around the CBD, whereas only 14 percent of large plants settled in this area. Lease of existing facilities rather than construction of new buildings did characterize the behavior of small firms. Whatever their distance from the CBD, the proportion of small plants that relied on leased facilities was always greater than the proportion of large plants that engaged in lease arrangements. Thus, within the 4-mi zone around the core of the city—that area so often referred to as the grey zone—85 percent of new small plants depended on lease facilities.

There are obvious implications in the foregoing discussion for urban renewal. The grey area is often regarded as that portion of the central city most in need of rehabilitation. It is also the area through which it is often recommended that inner circumferential routes be constructed. Such rehabilitation and road construction are prescribed as two of the cures for the ills of central cities. This analysis suggests that the attraction the central city has for new small firms will be reduced unless new facilities are constructed to replace present "run-down" buildings. Put bluntly, the area that appears to be so badly in need of cleaning-up is precisely the area that permits the central city to perform and benefit from the function of encouraging the growth of small enterprise. New buildings could also allow it to perform this function—possibly more effectively—but the issue of cost must be faced. Unless a subsidy is involved, such buildings would probably involve higher rents.

The amount of industrial construction that is taking place in the outer portions of the central city and in the adjoining suburbs raises questions concerning the future of the central city as a spawning ground for new enterprise. Over time, more facilities are likely to become available on a lease basis in peripheral and suburban area. This suggests that the locational pull the inner portion of the city now exerts on new small enterprise may be reduced in the future. Other locational elements such as the existence of a large pool of low-wage labor and the massed service industries will have to carry a larger part of weight if the central city is to attract as much new, small-scale industry in the future as it has in the past. Therefore, it becomes very important to determine what is happening to the distribution of banking, legal and other such business service industries within the metropolitan area. It is also important to determine whether the low-wage labor force is becoming more dispersed. These are issues which the authors are currently investigating.

Implications of Recreational Needs for Highway Improvements

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●THIS PAPER attempts to establish two major conclusions: (1) the demands of the public for outdoor recreation will create a demand for highway services that will be determinative, as against other demands, for many highways in the future; and (2) most highways are better suited to moving cattle to market than to moving people for recreation.

The use of every major kind of outdoor recreation area has increased regularly and steeply since the war, and often for a far longer period as well. National parks, national forests, Federal wildlife areas, Federal reservoir areas of all kinds, state park systems, and other types of public recreation areas for which reasonably accurate statistics are available show increases in total use approximating 10 percent from year to year—some a higher rate, others a little lower but still in excess of 5 percent. During the war, when travel means were restricted, travel to many areas declined to one-third or so of postwar peaks; but by 1946 the postwar levels had in most cases been regained. Since then, the annual increase has been remarkably steady. For the national park system, for which reasonably good data are available since 1910, the typical increase over this 50-yr period, except for the war, has been nearly 10 percent annually. These rates of increase show no signs of slackening; on the contrary, the rate of gain remains remarkably constant, year by year. And the more recent percentage gains are from a higher and higher base, of course.

BASIC FACTORS UNDERLYING OUTDOOR RECREATION DEMAND

The prolonged and rapid growth in ourdoor recreation stems from four basic factors: population changes, per capita income changes, increases in leisure, and improvement in the means of travel. Each may be examined briefly.

The total population of the United States has risen steadily from 4 million at the first Census in 1790 to 180 million in 1960. The spread across the nation, the tide of immigrants from Europe, the decline in death rates, and the fluctuations in birth rate have all been part of the fascinating demographic story, but cannot be explored here. The rate of increase declined irregularly from about 3 percent annually in the early decades to well under 1 percent in the decade of the 1930's; but has since risen to about 1.7 percent annually, where it seems to have stabilized for the present. The prospect is for substantial further increases in total population, the major differences of opinion turning only on the size of the increase. A total population of 300 or more million by the year 2000 is probable. The dominant, and largely unpredictable variable, is birth rate.

With the great increase in total population has come an equally impressive and significant redistribution of the population over the land. Whereas the United States was once a rural nation, now it is an urban one. About two-thirds of the total population now live in urban areas; the trend toward urbanization continues, and by 2000 82 percent or more of the population will be urban. This urbanization has many implications, economic and social, which cannot be pursued here; but urban people seem to want more outdoor recreation than do rural people, and surely must travel further for it.

A major long-term trend toward higher real incomes per capita is also evident, although over much of the past it has been obscured by price fluctuations and by economic cycles. Nevertheless, the increase has been real and great, as a reading of any contemporary account of life 100 or 50 yr ago will testify. The average rate of increase in real income per capita has been about 1.9 percent annually. Economists are fairly

well agreed that further increases will occur, a doubling of real income, from roughly $2,000 per capita now to roughly $4,000 in 2000, seems probable. As total income rises, that portion available for discretionary spending rises even more. It is highly probable that higher percentage of the larger income of the year 2000 will be spent on recreation than now, and that outdoor recreation will get its share.

Part of increased productivity has taken the form of increased leisure, or at least of reduced work week. One hundred years ago the average work week was 70 hr; today, it is less than 40. The work day has been shortened from 10 or 12 hr to 8 or less, the average work week has been shortened from 6 or 7 days to 5 or less, and paid vacations have become standard for a substantial portion of the total working population. Moreover, many people—both the older and the younger ones—that once would have been in the working force are not there today, but are retired or in school. Further reductions in average work week appear probable, although their timing is uncertain. A major factor, as far as outdoor recreation demand is concerned, is the form of the reduced work week—shorter days, shorter weeks, or longer vacations.

TABLE 1

FACTORS RELATED TO OUTDOOR RECREATION IN THE FUTURE

Item	Unit	1956		1980		2000	
		Amount	Index	Amount	Index	Amount	Index
Total population	Million	170	100	240	141	310	182
Personal income:							
Per capita	1955$	1,630[1]	100	2,525	155	3,660	224
Total	Bil. $	269[1]	100	605	225	1,135	422
Expenditures on all recreation[2]							
Percent of income	%	5.2	100	6.6	127	7.8	150
Total	Bil. $	14.0	100	39.9	285	88.5	632
Time.							
Average work week	Hours	40	100	32	80	28	70
Discretionary leisure per week[3]	Hours	30	100	38	127	45	150
Paid vacation, per worker[4]	Weeks	1.0	100	2.5	250	4.0	400
Total	Million Weeks	70	100	240	343	496	709
Travel:							
Per capita, total	Miles	5,000	100	7,000	140	9,000	180
Per capita, for recreation[5]	Miles	2,000	100	3,500	175	5,000	250
Total for recreation	Billion Miles	340	100	840	247	1,550	456
Recreation visits[6]							
User-oriented:							
Total[7]	Million	1,000	100	2,000	200	3,750	375
Per capita	Visits	5.8	100	8.3	143	12.1	209
Intermediate·							
Total	Million	312	100	1,200	384	5,000	1,604
Per capita	Visits	1.8	100	5.0	278	16.1	894
Resource-based:							
Total	Million	116	100	750	647	5,000	4,310
Per capita	Visits	0.7	100	3.1	443	16.1	2,300

[1] 1955

[2] Using Dewhurst definition of recreation.

[3] Assuming 8 hours for sleep and 6 hours for eating, miscellaneous personal activities, and travel to and from work in 1956. Similar assumptions in 1980 and 2000, but some reduction in travel time as work days per week are reduced.

[4] Dividing total paid vacations by total labor force.

[5] In 1957 approximately 40 percent of all trips were for vacation and pleasure (other than visiting relatives). Travel Survey, 1957, U.S. Bureau of the Census, September 1958.

[6] To public areas only.

[7] Incomplete estimate all years, chiefly an index of actual use.

One need not be reminded of the great improvements that have occurred in travel means over the past several decades. Good highways now criss-cross the land, although more and better ones are undoubtedly needed. The automobile has largely replaced the railroad as a means of human travel. Average per capita travel for all purposes today is more than ten times what it was before World War I. Not all of the increase has been for outdoor recreation, of course, but a substantial portion of the increase has been for this purpose. Further increases in total travel, and in travel primarily for recreation, seem probably in the years and decades ahead.

With each of these four basic factors trending upward in the past, it is difficult if not impossible to estimate the effect of each separately. Each will continue to trend upward in the future, as far as can now be seen. Their combined effect will be large and sustained; but it will vary according to the type of outdoor recreation area.

MAJOR KINDS OF OUTDOOR RECREATION AREAS

There are literally dozens of different kinds of outdoor recreation activities carried on in many different kinds of areas. However, it is possible to group the many kinds of areas into three broad classes, as follows:

1. User-oriented areas, whose dominant characteristic is their close availability to various user groups. Such areas are typically used after school or after work, or by mothers and small children during the day; and typical of such areas are city parks and playgrounds. The individual areas are small. Land characteristics of such areas are not too demanding, if the location factor is met.
2. Resource-based areas, notable for the superb character of their resources. National parks, some national forests, seashores, and similar natural areas fall in this category. Such areas are where you find them. Man can improve them, protect them, use them, but not make them. As a matter of fact, in this country, most such areas lie at a considerable distance from the homes of most people, thus requiring time and money to visit them. As a result, such areas are primarily vacation areas.
3. Intermediate areas, located closer to most users—preferably within one hour's travel time or less—and within this range on the best natural sites available. Such areas also require travel to reach them, but mostly are used on a one-day outing basis. Most state parks fall in this category.

The dominant, almost the exclusive, means of reaching the resource-based and intermediate-type areas is by private auto. Some travel is required to reach the user-oriented areas, but much of this is on foot or by bicycle, because such areas are mostly within ½ mi of most users. The length of the trip and the importance of the travel increase as the type of area shifts to the more distant ones. The effect of improvements in travel facilities will be particularly striking for the resource-based areas, many of which are several hundred miles distant from the homes of many users.

In the past and at present, time and cost of travel are surely deterrents to greater use of some outdoor recreation areas. As one result, some recreation areas are adequate in acreage and capacity to meet their effective demand. Improvements in transportation facilities will lower both time required for and monetary costs of travel. As a result, effective demand will rise for recreation areas along the improved travel routes or at their end. One consequence may be to render inadequate the recreation areas that previously were sufficient. Highway congestion could easily be replaced by park congestion.

The effect of increased per capita incomes will also be most striking for the more distant areas, which in any case cost more to visit than do nearby areas. As discretionary incomes rise, more and more will be spent to reach attractive but distant areas that could not be afforded previously. The effect of increased population will be felt for all types of outdoor recreation areas, perhaps more or less proportionately. The form of increased leisure will affect the different kinds of areas differently. Longer paid vacations will encourage visits to resource-based areas most, longer weekends will have their greatest effect on all-day outing or intermediate areas, and shorter work days will affect the use of user-oriented areas most.

Knowledge of the separate effects of these various forces and their interaction is too meager to enable forecasting of future recreation demand with much confidence. A mere extension of past trends, on a constant annual percentage rate, would lead to truly astronomical figures in another 50 yr. Some flattening of past growth trends, at some future date, seems inevitable; yet no such flattening has occurred to date. Considering trends in the basic factors, trends in past recreation use, and with some "judgment" modifications, the present author has estimated that outdoor recreation demand in the year 2000 would be 10 times what it was in 1956, for all types of areas; and that this would vary from a fourfold increase for the user-oriented areas, to a sixteenfold increase for the intermediate areas, to a fortyfold increase for the resource-based areas. Even if these estimates should prove too high—and there is just as good reason to expect them to be too low—a substantial increase in total demand is virtually certain.

TIME DISTRIBUTION OF OUTDOOR RECREATION

The use of outdoor recreation areas of all kinds is notoriously uneven, time-wise. Many if not most resource-based areas are used primarily or exclusively during the summer vacation season. Many mountain and seashore resorts are open only from late June to Labor Day, and are closed the rest of the year. Other areas get some visitors, but in much reduced volume, during the rest of the year. A few summer areas have developed winter skiing and other snow sports, sometimes attracting crowds as in the summer. Winter resort areas have had some success in attracting summer and other seasonal visitors. But, typically, the resource-based recreation area is developed, maintained, and staffed for the whole year to serve an active demand during less than one-fourth of the year; and even much of this time is used well below capacity in many instances.

By and large, the same situation exists for intermediate-type areas. State and metropolitan regional parks and Federal reservoir areas normally get twice or more the use on Sunday than they get on weekdays; sometimes Sunday use is more than one-fourth of the total weekly use. Sometimes Saturday use is heavy; sometimes no more so than weekday use. A long weekend, such as Memorial Day, July 4, or Labor Day may greatly increase the use of both resource-based and intermediate areas. This is particularly true for a resource-based area such as Yosemite National Park, which lies tolerably close to major metropolitan centers but too far to encourage most users to go for a normal weekend.

In intermediate and user-oriented areas, use varies greatly according to hours of the day. A local playground may be overrun between 3 and 6 in the afternoon, virtually or completely idle all the other hours in the day. A substantial proportion of the visitors to a metropolitan or state park will arrive during the same hours on Sunday afternoon, at that time crowding the area which was far from full earlier in the day.

The highly irregular use patterns, in a time-wise sense, of outdoor recreation areas create many problems. On the one hand, areas are acquired, developed, and managed to cope with peak demands, or else hopeless crowding arises at those periods; but the same facilities and investments lie idle for a major part of the time. Obviously, this extreme peaking in use results in much higher costs per unit of use than would be the case if total use were more evenly spread. On the other hand, it is true that extended periods of low use or idleness do permit the areas to recuperate from the effects of short periods of heavy use.

One consequence of these extremely uneven patterns of use of outdoor recreation areas is the peaking of demand on transportation systems. If one-fourth the weekly use of a park occurs on Sunday and if one-half the arrivals are between 3 and 6 o'clock, then a transportation system to serve them is under-used or unused much of the time. Likewise, highways into summer vacation areas may be largely idle during most of the year. Highway capacity must be determined in large part to meet peak traffic needs; and this in turn largely determines total cost of the highway. Use at other seasons and hours involves no added investment cost and little added maintenance cost; the whole overhead cost must be borne by the peak uses, with the marginal costs of off-peak use very low indeed.

It is impossible within a short paper to present such estimates as can be made, and in any case the available data are too scant to support refined calculations of the peak traffic demands for recreation purposes under different urban and other situations. However, the judgment may be hazarded that in several cities the weekend traffic peaks, primarily for recreation, do now or shortly will exceed the workday traffic peaks primarily going to and from work. Much highway planning in and around our larger cities must soon, if it does not already, take greater account of recreation than of business travel. Highway planning to predominantly vacation areas, such as mountains or seashore, is even more dominated by recreation.

HIGHWAYS AND PARKS

Highways bring people to parks; unfortunately, all too often they take land away from parks. To park and recreation specialists, in fact, the modern highway is the monster which devours their children. All too often parks and playgrounds lie astride the most logical routes, if only physical conditions are considered. And all too often highway planners regard an unbuilt-upon park or playground as though it were in fact unused, and hence logically available for highway use.

The fact is that parks and playgrounds produce large direct values. The fact that most of them are available free or for charges much less then their full value masks their full economic significance. Such measurements as have been made suggest that the larger suburban and closer state parks may well produce direct net incomes attributable to the land and other resources of $1,000 or more per acre annually. In-city parks and playgrounds, usually used more intensively, probably produce much greater values. But these direct values are only a small part of the economic worth of parks and playgrounds. One indispensable hallmark of a desirable residential area or urban community is its parks and playgrounds; without them, the value of all property declines or fails to reach its potential. It is hard to measure the amount of this effect, especially as it applies to a single dwelling or neighborhood. But it seems clear there is a high correlation between adequacy of parks and playgrounds on the one hand and the values of property in the community on the other. It is noteworthy that most slum clearance projects establish, or re-establish, at least some park and playground area, even on the high-priced land with which they are concerned.

Highway planners would do well to consider in the future the values of park and playground areas more seriously than they seem to have done in the past. Highway planners and engineers cannot afford to neglect or be indifferent to recreational values; to do so would alienate large segments of the professional and general publics. A little advance consultation and a little more willingness to listen to the viewpoints of park and recreation specialists and enthusiasts would go far toward reducing the almost universal resentment found today among such groups, directed toward highway specialists generally.

PHASES OF RECREATION EXPERIENCE

Thus far, this paper has been concerned almost entirely with the quantity or volume of outdoor recreation, and its relationship to highways. But, as every economist realizes, quantity is only one dimension of economic value; quality is the other, and equally important, dimension. Quality of recreation experience is harder to measure than quantity; the latter is at least approximated by entrance statistics. But what do recreationists get out of their park or playground visit or activity? What relationship, if any, does the kind of highway transportation have to the quality of the recreation experience?

Most discussion of recreation seems to assume implicitly that the whole recreation experience takes place on the physical site of the playground or park. This is definitely not true. Recreation experience, like any other human experience, is largely a subjective matter—part in the mind of the participant, part conditioned by the events around him. The whole recreation experience (for a day's outing in a state park, for instance) consists of five rather clearly distinguishable parts, as follows:

1. Anticipation—The individual or the family plans its outing, more or less formally and thoroughly. In talking about where to go, what to do, what to take, etc., the group may get many psychic satisfactions. In fact, in some instances the anticipation may far outrun the later reality. More trout are caught in imagination during the winter, while tieing dry flies, than are likely to be caught the next summer, for instance.

2. Travel to the recreation spot.—For the all-day and vacation recreation, one important aspect is travel. A recent California study indicates the average one-way distance for all-day outings is about 25 mi, and for vacation trips is 75 mi or more. For some national parks, the average visitor traveled 1,000 mi or more, one-way. Travel time, travel costs, and travel satisfactions or dissatisfactions are major parts of the whole recreation experience.

3. On site experiences.—These include the manifold activities which different members of the family indulge in at the park or playground. There is no need here to enumerate the long and diversified list of activities which may be pursued at various kinds of outdoor recreation areas. It should be noted, however, that typically outdoor recreation is a group undertaking, often a family one, and only rarely that of a single individual. When the group is made up of individuals of diverse ages and both sexes, the experiences must be satisfying to each member of the group, or at least tolerated by him or her, or else serious intra-group tensions may well result. On-site experiences are primarily the responsibility of the park and playground managers; unfortunately, they too have often assumed that this was the totality of the recreation experience.

4. Travel back home.—This is unlikely to duplicate the experience of travel to the area, even if the route is unchanged; the people are different, as a result of their experience at the site. In the case of an all-day outing, for instance, they are almost certainly more tired than when traveling to the site. Subjects of minor frustration when traveling to, may become matters of major irritation when traveling back.

5. Recollection.—Many a picnic or vacation has provided conversation material for months after the event. The rainstorm or the mosquitoes which were so annoying at the time may come to have major recollection value. Everyone can recall many outdoor recreation experiences, stretching over months and years in the past. Unless such recollections are pleasant, further outdoor recreation will be undertaken hesitantly. But for many people, recollection provides the richest and greatest rewards from outdoor recreation.

Highway specialists are obviously mostly concerned with the second and fourth parts of the total experience—the travel parts. Travel, per se, may range from highly enjoyable to neutral to an unpleasant necessity. As far as the author knows, there has been almost no direct evidence on how people regard travel—whether as a satisfaction or as a bore. Some users of outdoor recreation areas report they came primarily for the trip, including the kind of sightseeing which they can do from a car, so presumably this fraction of the population finds travel itself satisfying. In the author's youth, there was an evening or a Sunday drive whenever possible, for the sheer satisfaction of the automobile ride; but his younger children would laugh if a ride for pleasure were suggested. They will travel to get somewhere they want to go, but not ride merely for the sake of riding. There is almost surely a spectrum or a frequency distribution of attitudes toward travel as such; but the author cannot prove that the center of the spectrum or the mode of the frequency lies at a point of mild dissatisfaction but tolerance toward the travel parts of the total outdoor recreation experience.

TRAVEL SATISFACTIONS AND HIGHWAY PLANNING

The second main conclusion stated at the beginning of this paper is that modern highways are better suited to moving cattle to market than to moving people for recreation. The modern highway, especially the modern superhighway, is an elegant means of moving goods and people physically; the curves are smooth, the road surface is supersmooth, stoppages are at a minimum, and maximum distances can be traversed in minimum time. But they are also completely devoid of intellectual stimulation or emotional content. The astronauts who must some day travel for days on end through

space, with nothing to do and with only the most limited physical movements, would do well to train by long superhighway trips, where the conditions are remarkably similar. The view is monotonously bland; the driver can do nothing but drive, and the passengers can do little more. The radio offers weak escape. But the travel is often a major part, time-wise, of the whole recreation experience.

Any stretch of America has unique natural resources, unique history, significant present culture and economy. Why cannot some of this be brought to travelers? Some, of course, enjoy the nothingness of highway travel, but others would genuinely appreciate an opportunity for intellectual refreshment, if not solid meat.

The average urban dweller of today knows remarkably little about the rural landscape he sees. He may not know one farm crop from another; he will almost surely fail to distinguish a highly improved farm pasture from nondescript weeds and grass. He may not know one kind or breed of farm livestock from another. Land forms and features, such as moraines, escarpments, rivers, lakes, and the like, may have little meaning for him. He may be able to distinguish a steel mill from an oil refinery, but he is most unlikely to know why gas may be flared from either. Unless he is extraordinarily well informed, he will get no hint of educational or governmental characteristics of the districts and regions through which he passes.

But the author suggests that a significant proportion of all highway travelers would be interested in some of these matters, or in others that could be listed. Given the chance, many would be genuinely interested to learn something significant about the country they were passing through.

Highways are designed not merely to move goods and people at lowest cost, but also with an eye to their comfort and their satisfactions. Matters which are standard practice in highway design and construction today would have been considered unacceptably elegant and extravagant 25 yr ago; and standards of that day in turn were far beyond those of 25 yr earlier. Times change, and so do the ideas of what is good transportation. The author suggests that more thought be given to what the trip does to the user's mind.

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Discussion

FLOYD I. THIEL, Economist, Highway and Land Administration Division, Bureau of Public Roads—Pointing out the need for highways which lend themselves to recreational activities seems a worthwhile endeavor and one which has resulted in an interesting and thought-provoking paper. Along with all other groups whose activities are related in any way to recreation, highway planners are indebted to the author for what he as accomplished in his studies of recreation. His consideration of the supply and demand for recreation, his recognition of the increasing demand for recreational facilities and the implications this demand has for highways, including estimates of the magnitude of highway use for recreation, are obviously useful for highway planning. The comments which are listed below for the author's consideration involve opinion regarding highway travel effects and pertain only to a few of the nonquantitative implications of his paper.

One of the "two major conclusions (of this paper, that) most highways are better suited to moving cattle to market than to moving people for recreation" seems likely to be subject to considerable misunderstanding. It is entirely possible, for example, that the statement would cause a reader to wonder whether the author appreciates the need for highways which facilitate movement of both people and goods—highways able

to serve a variety of purposes. The wording of this "major conclusion" may very well tend to suggest that the author believes too much concern has been given to "moving cattle to market" (an impression which he surely did not intend to convey), or that he underrates the tremendous and increasing importance of this use of highways.

In establishing his conclusion regarding the movement of cattle and people via highways, the author complains that "the view is monotonously bland" and that modern highways are "completely devoid of intellectual stimulation or emotional content." The "monotonously bland view" referred to is apparently the countryside through which the highway passed. A highway adorned with billboard advertising or roadside stands would be far from "monotonously bland", but it is doubtful if the author desires this. It does seem somewhat ironic, however, that highways, which have often become unpleasant and unsafe because of excessive roadside commercialization, should now be found wanting by a recreationist for the apparent reason that they are not embellished with anything beyond the wonders of nature itself.

Stating that modern highways are "completely devoid of intellectual stimulation or emotional content" seems somewhat extreme. Well-designed bridges, tunnels, and other engineering features of modern highways are surely a source of both "intellectual stimulation and emotional content", to at least some travelers. The author should also remember that one of the primary purposes of modern highways is to permit the traveler to arrive safely with a minimum of emotional stress. It is of course along conventional highways, with their uneven stop and go movement, that high "emotional content" is encountered in highway traveling, though this is surely not what the author is pleading for.

The inference that too much may be expected from highway travel could be drawn from the author's presentation. After all, something is accomplished other than intertainment; namely, movement from one place to another. Perhaps a fair comparison would be between highway travel and other modes of travel. Some people no doubt find any form of travel boring, particularly air travel. And there are of course some activities (for example, talking, singing, story telling, radio playing) which can ordinarily be done better using highways than when traveling by air or rail.

In response to questions, the author presented the interesting suggestions that highway travel could be made more stimulating by (1) literature describing points of interest and by (2) limited radius broadcasting similar to recorded descriptions in modern museums and art galleries. Both of these are no doubt worthwhile. As he says, "Any stretch of America has unique natural resources, unique history, significant present culture and economy." However, the amount of literature available describing points of interest (from auto clubs, local, State, and Federal agencies, private associations and organizations, oil companies, etc.) is now almost overwhelming, as anyone knows who has taken the trouble to request this. It is of course possible that the type or quality of this literature could be improved.

Presenting travelogues on specified wave lengths would perhaps be a worthwhile addition to highway travel in certain areas, but putting such a scheme into operation would appear to be as much the responsibility of recreation and broadcasting people as it does a matter with which highway builders should be concerned. It seems entirely possible, however, that limited radius broadcasting may be useful for highway purposes in the future (for example, for providing motorists with up-to-date information about traffic and road conditions) and perhaps such a system could then also serve recreational needs.

These comments relate to the nonquantitative portion of this paper. There can surely be no disagreement with the author's main thesis: that serious consideration needs to be given to providing highways which can serve the present and future recreational needs. The attention the author's studies have focused on recreational needs and his forward-looking approach in showing the need for analyzing this facet of national life in terms of its implications for travel constitute a real service to highway planning and highway research.

THE NATIONAL ACADEMY OF SCIENCES—NATIONAL RESEARCH COUNCIL is a private, nonprofit organization of scientists, dedicated to the furtherance of science and to its use for the general welfare. The ACADEMY itself was established in 1863 under a congressional charter signed by President Lincoln. Empowered to provide for all activities appropriate to academies of science, it was also required by its charter to act as an adviser to the federal government in scientific matters. This provision accounts for the close ties that have always existed between the ACADEMY and the government, although the ACADEMY is not a governmental agency.

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The HIGHWAY RESEARCH BOARD was organized November 11, 1920, as an agency of the Division of Engineering and Industrial Research, one of the eight functional divisions of the NATIONAL RESEARCH COUNCIL. The BOARD is a cooperative organization of the highway technologists of America operating under the auspices of the ACADEMY–COUNCIL and with the support of the several highway departments, the Bureau of Public Roads, and many other organizations interested in the development of highway transportation. The purposes of the BOARD are to encourage research and to provide a national clearinghouse and correlation service for research activities and information on highway administration and technology.