METHODS TO DETERMINE THE RELATIONSHIP OF REAL PROPERTY VALUE CHANGES TO FIVE SELECTED URBAN GROWTH VARIABLES

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JAN HERMAN RAAD

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ABSTRACT

METHODS TO DETERMINE THE RELATIONSHIP OF REAL PROPERTY VALUE CHANGE TO FIVE SELECTED URBAN GROWTH VARIABLES

by Jan Herman Raad

This study was designed to develop and test an analytical study procedure which could indicate the relationship of five urban growth variables upon real property value change in Saginaw County, Michigan.

The five urban growth variables dealt with in this study were: 1) Soils, 2) Rivers, 3) Transportation, 4) Utilities, and 5) Zoning. Each individual growth variable in turn consisted of a number of sub-parts or sub-growth variables. For example, soils as a major urban growth variable consisted of seven individual soil areas and nine combinations of individual soil areas. Thus a total of sixteen sub-growth categories were defined to soils as a major urban growth variable.

Component parts of the remaining four major urban growth variables were defined and classified in a similar manner.

The next step of the investigation consisted of establishment of land value pattern for each quarter section located in Saginaw County for the years 1955 and 1968. This was accomplished through use of the 1955 and 1968 tax assessment rolls for each governmental unit in the County. The procedure established a 1955 and 1968 mean acre value for each quarter section in the county. In this manner the amount of change in real property value for each quarter section unit was determined between 1955 and 1968.

The statistical methods of analysis used were the analysis of variance technique, fixed effects model and the Tukey technique.

The statistical techniques required grouping of quarter sections into populations defined by the relative qualitative characteristics of each quarter section unit. Samples drawn from each respective population and grouped according to each major growth variable provided the basis for further statistical analysis.

First, the analysis of variance technique, fixed effects model was used. This technique determined if significant statistical differences exist between a number of sample groups. However, the technique could not determine where differences occurred, and which of these differences were significant. A second statistical technique known as the Tukey technique was used to indicate where significant differences occurred between sample groups within a major urban growth variable. The technique enabled the ranking of all sub-growth categories defined to a major growth variable from high to low in terms of relative real property value increase. All five urban growth variables were thus analyzed as separate sections. The results of the analysis was then depicted and illustrated as a comprehensive whole in Table and Map form.

The following conclusions could then be drawn from the overall investigation:

1. Significant increases in real property values between 1955 and 1968 have taken place. These increases could be attributed to the qualitative attributes of each sub-growth variable defined to a major urban growth variable.

2. A close correlation was found between the intensity of the land use pattern and the degree of real property value change. The more intensive the adjacent or existing land use pattern the higher the relative degree of real property value change.

3. The degree of real property value change seemed to be more closely correlated with the access and availability of man-made improvements than the natural constraints for development imposed by adverse physical features of the landscape.

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By

Jan Herman Raad

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TABLE OF CONTENTS

LIST OF TABLES

Table Page

LIST OF ILLUSTRATIONS

CHAPTER I

INTRODUCTION AND BACKGROUND

Introduction

The migration to metropolitan areas, natural growth within and movement from the central city to the suburbs have placed a ring of new development around existing urban centers. This new urban growth has taken place in response to many different factors and variables, some physical, others cultural and social. One common aspect to this new growth is the demand for land. As was pointed out by Barlow:[1]

> "Few relationships in life are more fundamental or more significant than that between man and land. Our natural resource environment or land as the economist knows it is necessary for human survival. It provides us with standing room, with living space, with food, and with the vast array of raw materials we use in the satisfaction of our many wants."

It is in the satisfaction of these wants that a land use pattern has evolved over time, and is continuing to evolve in order to accommodate the increasing needs of a growing population. The evolution of the land use pattern created by man through his efforts and ingenuity has been one of constant speculation and study.

Despite the torrent of literature and study approaches generated by the academic disciplines of geography, anthropology, economics and

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[1]Raleigh Barlowe, Land Resource Economics. (Englewood Cliffs, New Jersey, Prentice Hall, Inc., 1958), p. 1.

political science in attempting to explain the spatial structure of the land use pattern, minimal effort has been devoted to developing new workable analytical techniques which can readily be used and applied to field situations by the land use planner in his everyday working environment. For the most part, theoretical explanations on the spatial structure of the evolving land use patterns cannot be applied or tested in the working environment within which the land use planner finds himself. This can be attributed to the complexity of observable factors, and to the diversity and range of factors or land use determinants which govern urban growth and development. As Downs put it:[1]

> "Defining the most likely forms of urban growth requires an inherently subjective and arbitrary selection of a few combinations of key factors out of thousands of possibilities. Urban development and growth involves dozens of important variables, each of which could reasonably take on several different future values. Some of these variables are:
>
> 1. Location of new growth in relation to existing metropolitan areas.
> 2. Contiguity of new growth to smaller existing communities located beyond the continuously built-up portions of metropolitan areas (including outside such areas).
> 3. Type of planning control.
> 4. Level of quality standards required in new constructions.
> 5. Degree of public control over new urban development.
> 6. Degree of public subsidy for new urban development.

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[1]Anthony Downs, "Alternative Forms of Future Urban Growth in the United States," XXXI Journal of the American Institute of Planners, (January, 1970), 3.

7. Distribution of housing subsidies among various income groups.

8. Degree of social class integration.

9. Degree and nature of racial integration.

10. Mixture of transportation modes.

Just considering these ten variables, and several arbitrarily chosen values for each one, yields at least 93,322 logically possible combinations--each representing a potential form of future urban growth."

Additionally, the interrelationships which exist between a wide array of observed cultural, political, economic, and social forces are not easily discernible or separated from each other. As a consequence, many theoretical explanations in regard to the nature and basis of the evolving land use pattern tend to reduce themselves to nothing more than systematic statements or hypotheses on how any given area, actually functions and grows. These statements or hypotheses can never be proved correct and usually defy all efforts to prove them wrong.[1]

Thus, the land use planner must rely on, by necessity, a limited base of available information on the force and variables--human and physical--which tend to shape the land use pattern in his particular area of concern. Despite these inherent limitations of full and complete knowledge and the required resources to apply the selected aspects of developed theoretical approaches to practical field situations, the land use planner must develop and promote development proposals for a future land use pattern which are economically feasible and politically palatable to the public he serves. It is in his attempts to promote his plan

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[1]Britton Harris, "Plan or Projection?," Journal of the American Institute of Planners, XXVI, (November, 1960), 268.

proposals to guide the evolving land use pattern that the need for a workable analytical technique to gauge the consequences of his plan proposals become more and more evident.

The acceptance and eventural implementation of his plan proposals will, in the end, ultimately depend on not only a documentation of need, but also on tools of analysis used as a basis for the development of plan proposals designed to guide and shape the future land use pattern. Any land use planner, then, should have at his disposal a wide range of analytical techniques which can more fully document and substantiate the basis for plan proposals.

The Problem

As already indicated, the growth and development of any area takes place in response to many different forces and influences. These forces and influences tend to find their basis in a number of inter-related land use determinants. To the land use planner, many of these determinants and influences are evasive, extremely complex in nature, and even more difficult to manipulate in real life in order to shape and guide an emerging land use pattern which will be in the long range interest of the community which he serves. Despite many noble notions, such as the furtherance and well being of the public interest or the public welfare, many land use decisions are made on an everyday basis which funds their sole justification on a tangible economic basis, i.e. an increase in the local tax base, rather than the intangible non-economic aspects of the overall physical environment, such as aesthetics and social connotations.

The emphasis placed on economic considerations in land development activities can be considered a primary determinant for the evolving land use pattern in any given area in real life. In his classic study, Hoyt provided a systematic demonstration that land values influence land use, and conversely that the existing land use pattern influences land values. Hoyt also demonstrates that the pattern of land use, intensity of use and land values are strongly inter-correlated.[1] In essence, Hoyt's study tends to substantiate classic land economics theory in that the users or developers of land bid for sites in accordance with the sole economic development criteria of maximum profits and minimum costs.

Hoyt also provided a systematic empirical demonstration that land value patterns bear a close relationship to the land use pattern of an area. Additionally, his study also confirmed the fact that as the pattern of land value changes, the pattern of land uses also changes.

Duane Knox, in his study of Topeka, Kansas, tested the relationship of land to several assumed characteristics of land use.[2] Knox's study results substantiate the findings of Hoyt's study on the land values in Chicago. His study and Hoyt's early work indicate that the intensity of land uses will change as land values change. Both studies demonstrate that a clear interrelationship exists between the pattern of land use, land use intensity, and land values.

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[1]Homer Hoyt, One Hundred Years of Land Values In Chicago, (University of Chicago Press, 1933), p.449.

[2]Knox, Duane S., Distribution of Land Values in Topeka, Kansas, Lawrence Center for Research in Business, The University of Kansas, (May, 1962), p.34.

The functional implications of these relationships for the land use planner, as described by Knox and Hoyt, are readily discernable, as indicated by Chapin.[1]

> "The Structure of land values in the urban area has a very considerable influence on the way in which individuals seek to use land for various purposes in various locations and at various densities. The planner cannot proceed in land use planning studies without taking into account value-use relationships of urban land. The repeated approaches to planning commissions for the rezoning of corner lots for filling stations and continual requests of all kinds of re-zoning requests from one category to another to a higher category are manifestations of urban land market forces."

The reduction of costs and maximization of profits from any given site is thus dependent upon not only the normal operating market forces, but also can generally be related to the comparative advantage of one site or location over another site. Barlowe notes that:[2]

> "Comparative advantage is frequently thought of in terms of natural advantages, such as favorable soils and topography. With this approach, it is easy to assume a static situation in which some areas are for particular uses and in which their successful use for these purposes is more or less guaranteed. But the content of comparative advantage is far more dynamic than this. It is affected to a considerable extent by human judgement and by man-made decisions and policies. And in the final analysis it must be measured in terms of the economic ability of an area to complete with other areas in the production of given products. This means that it involves not only favorable climate, soils, and topography but also, favorable location and transportation costs and favorable institutional arrangements."

The land use planner in his plan proposals to accommodate future growth and development tends to touch on many different facets of the principle of comparative advantage. Plan proposals for an expanded transportation system, utility system, and zoning proposals all tend

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[1]Chapin, Stuart F. Jr., Urban Land Use Planning (Urbana: University of Illinois Press, 1965), p.330.

[2]Barlowe, pp. 246.

to increase or decrease the economic value in terms of economic development potential of any given number of sites.

If the land use planner's proposals gain an acceptance through formal adoption by the local planning commission and governing body, each specific proposal, when actually implemented, will either increase or decrease the comparative advantage of one site over another in terms of economic development potential.

Viewed primarily from an economic viewpoint, each major plan proposal, especially those requiring extensive public expenditures, coupled with the inherent advantages and limitations of the landscape would either decrease or increase the potential economic return. Thus, the pattern of land values of a given unit of land is affected by the proposed development activity.

Thus, the land use planner's concern in guiding the existing and molding the future use of land through various plan proposals in the public interest tends to exert, not only a definite influence on the economic development potential of a given area, but also will influence the pattern of land values. The effect of land use development proposals developed by the land use planner is somewhat ameliorated by the physiographic features of the landscape. Physical features such as flood plains, streams, and soil fertility also tend to play an important aspect in the pattern of land values and more indirectly in the use made of the area. A floodplain located within an urban area may represent the only large open land in the area, but yet remain undeveloped due to high economic costs involved in developing the floodplain to a higher use.

The various land use development proposals, along with the inherent physical contraints of the physical landscape would indirectly, through an increase or decrease in the real property value, determine the potential use and intensity of the site, and in this manner influence the potential land use pattern of a given area. The economic implications of plan proposals such as the site of required public expenditures required to implement portions of the adopted plan, tend to be the sole consideration for approval or disapproval by policy makers.

Despite the use of economic criteria by the public policy makers in their land use deliberations, the land use planner employed by these public policy makers as representatives of the overall community, is not concerned with increasing or decreasing the tax base or placing a primary concern on economic development activities.

Adams identifies and delineates five basic concerns of the land use planner.[1]

1. Guide the use of land to promote the advantageous development of the community.
2. Curb the misuse of land so that it will not injuriously affect the interests of the community.
3. Prevent the abuse of land.
4. Regulate the non-use or disuse of land.
5. Guide the reuse of land for more appropriate purposes.

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[1]Charles Adams, et al. Urban Land Problems and Policies, Housing and Town and County Planning Bulletin No. 7, (New York: United Nations, 1953), p. 34.

The basic concern reflected in these five pcints can be reduced to simply the ultimate goal of creating a future land use arrangement that is most efficient and least costly to the community. This emphasis tends to diminish the urban development process as an economic phenemenon. As Dyckman notes, "...the planner is professionally sensitized to values which are frequently non-economic."[1] In his attempts to create a land use arrangement that is most efficient to the larger community, the land use planner tends to diminish the importance of economic forces. These forces allocate space in both quantitative and locational aspects to various uses according to supply and demand relationships and at a least cost concept in an economic equilibrium system.

This orientation by the land use planner, in terms of economic implications of development proposals to guide future growth and development, cannot be termed as a lack of awareness. Indeed, the economic implications of any plan, either proposed or about to be implemented, are brought to his immediate attention by the public at large in any public hearing, and through his daily review of rezoning requests and proposed private development activities.

The problem of the land use planner regarding both the development of plan proposals and the review of private development requests is the lack of an analytical technique which can gauge in a systematic and analytical manner the economic implications of proposed development activities on the land use pattern. There seems to be no lack in the number of study techniques which can discern the effect of one major development consideration, i.e., a transportation network.

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[1]John W. Dyckman, "What Makes Planner's Plan?," Journal of the American Institute of Planners, XXVII, (May, 1961), p.165.

However, there seems to be a lack of a pragmatic technique which can distinguish and make a differentiation on the economic implications of the many different types of streets and highways which, as sub-parts, collectively constitute the overall transportation system.

Additionally, many of the theoretical explanations made in regard to the economic consequences of singular major plan proposals do not easily lend themselves to ready duplication in an everyday working situation. Often the theoretical situation is based on a set of circumstances or an ideal situation which is rarely, if ever, found in any given planning area. Moreover, the variation and differences which exist between planning areas in terms of any given set of influences and variables is rarely identical between two different areas.

The problem facing the land use planner who attempts to gauge the economic consequences of development proposals and the effect of existing physical features upon the land use pattern, is the lack of a technique or analytical method to objectively discern and distinguish between growth influences. As a consequence, many plan proposals are based on subjective criteria and generally have been based on a number of proven techniques, which have evolved over time. In general terms, the bulk of these techniques available and readily usable by the land use planner tend to be a curious patchwork of devices, the outgrowth of special purpose efforts which were developed and firmly established with much travail.[1]

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[1]Chapin, p.280.

Commonly, the techniques often used by planners in regulating the existing land use pattern and guiding the future land use pattern consist of extensive documentation which generally attempts to justify a specific recommended course of action. Techniques referred to in this context include the overworked zoning ordinance, the capital improvements program, the open space plan, a trafficways plan, and a land use plan; often these plans are then neatly packaged into one overall comprehensive development plan which depicts an ultimate proposed land use configuration based upon a stated set of development goals and objectives. While the various components of the overall land use development plan constitute a valid guide to the policy makers for future development, little or no attention is given to the economic consequences or implications of the various plan proposals. This can particularly be attributed to the generalized nature of plan proposals where minimal differentiation is made between the many sub-components which collectively constitute one major class of type of proposal. For instance, a public utilities system is composed of four or five different sub-systems: sewer, water, gas, electricity, and telephone. Each different sub-component of the overall utility system, due to differential characteristics and locational requirements, will also tend to differ in terms of its effect on the land value pattern and thus on the intensity of the land use pattern.

The same applies to proposals pertaining to the overall transportation network. An overall traffic system consists of a number of streets and highways; portions of these streets and highways tend to differ from each other in design standards and traffic volume capacity. The same is true for zoning ordinances which due to different restrictions between zoning districts will tend to differ from each other in terms of their individual influence on the land value pattern. If a land use planner, through a technique, could rank in order the sub-classifications of a major urban growth variable according to differential effects on land values and thus on the intensity of land use, he would have a more objective and less subjective basis for selected plan proposals. Additionally, he would strengthen his basis for discussion with dissenting groups.

There is as yet no technique, to the researcher's knowledge, which can distinguish between the different economic influences of sub-units in a major urban growth variable such as zoning, utilities, or trafficways, on the land value pattern. Lacking such a technique, the land use planner diminishes his rationale or basis for an objective and realistic justification for his plan proposals in a language familiar to private developers. In many instances land use planners have little use for new techniques which may possibly discredit the validity of commonly used working methods and techniques.

In their fight for professional recognition some land use planners have had to rely primarily upon an emotional reaction against gross inefficiency and the mistakes of past generations. However, this in no way dispels the need for new approaches and techniques in the planning process.

Dyckman reinforces this assertion with the following observation:

> "The lags that threaten to impede planners, come from two directions, one technical and the other 'cultural'. The lag of planners in accomodating to certain advances in analytic techniques, subject and method specifications and new instruments is highly visible,

> and to some extent from failure to keep abreast of the import of changing scientific views and fresh concepts is in the long run potentially more dangering to planning."[1]

The scope of this study is then two-fold. The first is to develop an analytical study method; a technique which can be applied to field situations. The second, the use of the study method to discern the effect of sub-classifications of five selected major growth variables upon land values over a thirteen year period.

Definition of Terms Used

Major Urban Growth Variable: Refers to one specific type of factor which exerts a guiding or shaping influence on the land use pattern. The nature of the influence is relatively broad, but has a clearly defined set of characteristics which are unique and not part of any other influence.

Sub-Growth Variable: Represents each individual part of a major urban growth variable, i.e., a public sewage disposal system would be considered a sub-variable to the overall utilities system which would be termed as a major urban growth variable.

Land Use Pattern: Refers to the distribution of human activity, features, and appurtenances upon the landed portion of the earth's surface.

Real Property Value: As used in this investigation, refers to the combined value of the site, and the human improvements made to the site.

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[1] Dyckman, pp. 243.

Also included are any other factors which influence and affect the value of the site or area. This includes locational features, fertility rates, and the other natural physical attributes which influence the value affixed to a site, parcel or area. In this study, the terms "real property value" as defined by state law and "market value" are interchangeable and considered the same.

Intensity of Land Use: Refers to the extent and degree a given site is used for primarily urban land uses.

General Plan of Investigation

This study is designed to develop and test an analytic technique which has the capability to assess the differential effects of various sub-units of a major urban growth variable upon the patterns of real property values. A second objective of the study is to apply the developed study technique to five selected urban growth influences in order to discern the influence of these five urban growth influences and the respective sub-variables of each major urban growth influence upon real property values over a thirteen year period.

Assumptions.

The design and execution of the study have been based on the following assumptions:

1. Saginaw County will ultimately be primarily developed for urban use. This urban development will take place in response primarily to current and future expectations of economic returns which may be gained from the land

and the highest potential use which may be made of the land. These future expectations will be expressed primarily through the market value or real property value of any given site or area.

2. Land as space, or as a site tends to increase in economic value due to the possible or expected conversion to a higher economic use of the land.
3. Land either developed or undeveloped for urban use requires either the presence or availability of a set of physical characteristics or human improvements which tend to deter or enhance the real property value of a given area.
4. Past effects of the five defined growth variables over a thirteen (13) year period will continue to exert the same relative degree of impact on real property values in the future if existing trends continue.
5. Real property values are indicative of the existing intensity of land use or the intensity of use in which any given site or parcel will be placed. The higher the real property value of any given parcel as reflected through the intensity of use made of the parcel, site, or area.

An argument can be made that a study of this nature is not necessary and that the consequences or effects of any selected number of growth variables upon real property values are readily discernible between two time periods through increases of tax assessment rolls, or through the relative increase of the more intensive land use categories made in a given area after certain characteristics of the site or area were altered or modified. However, comparative methods of this nature tend to be subjective and cannot distinguish the effect of various sub-types upon real property values within a major growth variable. In other words, an increase of assessed property tax evaluation, or an increase of more intensive land use categories in a given area which can be discerned by comparing one time period against another only establishes with certainty that growth or certain land use development activities has taken place. However, comparison of growth indicates between two periods of time cannot attribute the growth and development of a given area to any given cause or influence. The nature and basis of any growth and development determined in a comparative manner is usually couched on hunches and educated guesses and is usually attributed to one or two broad classification of growth influences, i.e., improved roads or the installation of public sewer.

This study seeks to develop and test a technique which will in a systematic manner discern the past economic influence of sub-categories of major urban growth variables upon real property values in an analytical manner.

Hypothesis Stated

The major hypothesis of this study is that changes in real property values are positively related to the presence of defined urban growth influences. Selected urban growth variables to be used in this study are five urban growth influences which in the planning profession are considered to be prime growth influences, the presence of which will exert an influence on real property values and thus directly influence the intensity of land use.

The major growth influences to be used in this study as independent vairables are: 1) Physical features, a) rivers and b) soils; 2) Population; 3) Utilities; 4) Zoning; and, 5) Transportation. The second hypothesis which is interwoven with the first hypothesis is that various sub-categories of each major growth variable tend to differ in terms of their individual effects on changes in real property values.

As no comparable research data or study technique could be located in the review of the literature, a major effort has been made in the development of a primary data base for the study. Through the use of statistical techniques a ranking as to the effect of major and sub-categories of growth influences upon real property values can be obtained.

CHAPTER II

REVIEW OF LITERATURE

In Chapter One, it was suggested that the land use planner does not have at his disposal an adequate analytical technique which can gauge the economic effects of selected plan proposals as related to changes in real property values. This is not to be confused with the approaches that have been made by many academic fields in their explanation as to the basis and origin of the special structure of the land use patterns. It must also be emphasized that no issue is taken with the applicability of the many study approaches and explanations developed by the various academic disciplines as they relate to the furtherance of man's knowledge about the use of land and its resources.

The primary point which the researcher wishes to make is that for the land use planner to be more objective, he needs additional analytical techniques to assist him in gauging the effect of growth variables on real property values in the past. In this manner he can obtain the knowledge to more objectively determine the economic effects on future proposed development activities.

Furthermore, as indicated in the foregoing chapter, the evolution of the land use pattern tends to be an unlimited dimension and the end product of an untold number of interrelated forces and variables. For this reason, the basis of the entire study must, by necessity, be formulated and limited to economic explanations of the land use pattern. Implicit is the rationale that economic forces interreact upon locally oriented forces of the land market to determine the use and function of the land.

The review of literature indicates a well documented and precise research dealing with the economic aspects of land use and land development. As a consequence, much reviewed literature as pertaining to the study is either indirectly applicalbe or implied. In addition, the volume of past research and documentation related to economic aspects of land use and land development is so diverse as to make a complete review of literature beyond the scope of this study. For this reason the literature reviewed for this study has been placed into three separate headings: 1) Historical-theoretical basis of growth influences as related to real property values; 2) Application of this historical economic development theory to real property values in urban areas; and, 3) Utilization of economic development considerations in land use planning.

Historical-Theoretical Basis of Development Influences on Land Values

Perhaps the earliest recognition of the relationship of land values to land use was made by Adam Smith in his *Wealth of Nations*, published in 1776.[1] In this work, Smith recognized that the economic rent, which may or could be derived from land depended and varied with the fertility of land. He indirectly implied that the value of agricultural land was directly related to the economic rent or income which could be derived from a given parcel of land.

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[1]Adam Smith, *Wealth of Nations*, (London, 1776: Modern Library Edition; New York, Random House Inc., 1937.), pp. 23.

David Ricardo, in the beginning of the eighteenth century, expanded on this theory by presenting a treatment of economic rent for agricultural land which yet today can be considered as the foundation of economic rent theory. In that theory, Ricardo stated that the most fertile acres are placed into use first and that land with less fertility is utilized only as the demand or price for agricultural produce increases.[1] Ricardo's theory states that economic rent on the most fertile land is based on the advantage this fertile land has in terms of production over the least productive land. Ricardo also recognized that land which is nearer to the market bears a lower transportation cost than land whose products must be transported a longer distance to market. This cost differential of transportation represents an economic advantage to the land which is accrued to the land owner. Ricardo's theory, in explaining economic land rent, is based primarily on the difference in land fertility rates but touches lightly upon the effect of location upon land rent.

The location or the transportation factor as related to land rent and thus indirectly to land values, was more fully developed in 1826 by J. S. Von Thunen.[2] Von Thunen based his theory primarily on the relationship of transportation costs to the use or allocation of land. Land closest to the market place will be more economically productive to its owner because of the diminished transportation costs required to move the produce to market. Land located farther from the market place will require higher transportation costs, which must be

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[1]David Ricardo, On the Principles of Political Economy and Taxation, as cited by William Alonso, Location and Land Use, (Cambridge: Harvard University Press, 1964), p.3.

[2]Ibid.

paid from the businesses rent or gain produced by the land. As such, the most distant land in cultivation yields no savings in transportation costs and if the transportation cost is high enough, the land yields no economic rent. In essence, Von Thunen states that the economic rent which can be derived from any location is equal to the value of its produce, less production costs and transportation expenses.

The economic approaches formulated by these three noted economists can be considered a primary basis for the conceptualization of the spatial structure in an agricultural society. Essentially, Mills, Ricardo, and Von Thunen view agricultural land development processes as economic phenomena

The dominant factor is the economic land market and the sorting process that the market plays in the allocation of space (land) to activities (use). Although implied, little was said directly about the relationship of land values to land use. However, clear reference was made to the effect of soil fertility, and transportation and location factors upon the economic rent which could be derived from a given parcel of land.

All three of these early economists had little to say about urban land and confined themselves primarily to two influences upon the economic rent of agricultural land.

Adam Smith indicates nothing about the valuation of urban land, remarking that urban land is unproductive and the landlord is a monopolist.

J. S. Mills viewed urban land as a monopoly problem where the value of a fixed and limited supply of houses and building ground in a "town of definite extent" will be offered.[1] One economist, Alfred **Marshall**

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[1]John Stuart Mills, Principles of Political Economy, (New York: Longmass, Green, 1934), p.444.

devoted one chapter to urban values in his book, "Principles of Economics" (Chapter 11).[1] In this chapter, Marshall concerned himself primarily with profit making land uses devoted to commerce and industry. According to Marshall, site value is the price which can be obtained for a parcel of cleared land when sold in the free competitive market. The land site will then be sold to the highest bidder and be placed into a use which will provide the buyer with maximum return. The price of the site and the use of the land are closely correlated and dependent upon each other. Marshall states, "If land is cheap, he will take much for it; if it is dear he will take less and build high."[2] In his conclusion, Marshall indicates that in urban area the potential uses of land make bids for various sites or locations based on respective locational advantages and the highest bidder obtains the site in each case.

Despite their preoccupation with the rent which could be derived from agricultural land, the economic theories developed by these individuals in the 1800's provided a foundation of the theoretical basis for the relationship of selected influences and variables upon land values.

Application of Economic Development Theory to Real Property Values

In his book, "Principles of City Land Values," published in 1903, R. M. Hurd developed a theory for urban land which closely resembles that of J. S. Von Thunen for agriculture.[3] In essence, Hurd's theory

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[1] Alfred Marshall, Principles of Economics, (7th ed; London; MacMillan, 1916), p. 448

[2] Ibid., p. 450

[3] Richard M. Hurd, Principles of City Land Values, (New York; The Record and Guide, 1903), pp. 11-12.

of urban land values states that the city growth and development, more remote land must be utilized to accommodate this growth. This in turn creates a price differential between land located close to the city and land more remote from the city. The basic price differential rests primarily on the location of urban land as indicated in his summary. Hurd states, "Since land value depends on economic rent, and rent on location, and location on convenience, and convenience on nearness, we may eliminate the intermediate steps and say that land value depends on nearness."[1]

Hurd's theory expands the economic equilibrium theory in which space or land is allocated in quantitative and locational aspects to various uses. The least cost aspect seemed to be attributed primarily to transportation costs required to move products to market. Traditionally, location was treated by the early economists as a constant.

Robert Haig, in 1926, introduced an innovation in the particular aspect of transportation cost by defining distance as a "friction of space".[2] The better the transportation the less the friction and therefore, transportation costs diminishes with the degree of friction involved in the movement of goods to market.

Based on his concept of "friction of space" Haig states that the

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[1] *Ibid*, p. 78.

[2] Robert M. Haig, "Toward an Understanding of the Metropolis," *Quarterly Journal of Economics*, (May, 1926), p. 421.

layout of an urban area tends to be determined by the collective efforts of property owners to minimize friction of space. Richard M. Ratcliff restates Haig's hypothesis; "...the perfect land market would produce a pattern of land uses in a community which would result in the minimum aggregated land value for the entire community. The most convenient arrangement results in the lowest aggregate transportation costs; in terms of saving transportation costs the advantage of more convenient sites are reduced."[1]

Haig attempted to interpret a greater degree of precision in his theory than R. M. Hurd. This attempt represented one more step in the evolution of economic literature in explaining selected facets of both the economic and locational aspects of land use. From an early preoccupation with explaining economic rent and land use of predominantly agricultural societies, the emphasis beginning with Haig, shifted more and more to urban areas. This can perhaps be attributed to the fact that during the 1920's, city planning as an established profession came into being. In conjunction with an increasing emphasis on city planning, published literature in the field of land economics started to place primary emphasis on urban land values. The principal tenants of urban land values were developed by Haig in 1926.

Utilization of Economic Development Considerations to Land Use Planning

Parallel to the establishment of the city planning profession, the academic discipline of human ecology, a branch of sociology, became established. Like land economics, this academic discipline also concerned itself with urban land values.

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[1]Richard M. Ratcliff, Urban Land Economics, (New York: McGraw Hill, 1949), p. 385.

In essence, the ecologists viewed land values as a result of a bidding process with the pattern of land uses in a city or urban area being established. As two noted ecologists, Park and Burgess have stated in their book, The City, land values are the chief determining influence in the separation of local areas and in the determination of the uses to which an area is put.[1]

In this classic study, Burgess, in attempting to explain the ecological processes of the city, depicted the city as a series of concentric zones. The center zone is the most densely developed with the most intensive land uses, while the other four zones represent a gradient in the intensity of land use in terms of human activities. Land values of each consecutive zone were generally related to the intensity of land use. It may be of interest to note that this represented another step in man's attempt to explain the spatial land use pattern in a logical systematic manner.

The next step in man's attempt to explain the spatial structure of the urban environment was developed by Harris and Ullman.[2] Both scholars expanded on the work previously done by Park and Burgess and by Homer Hoyt. In their theory, Harris and Ullman, using the conceptual framework of both Burgess and Hoyt attempted to seek the critical explanation of the observed irregularities which were not adequately covered in Burgess's consecutive zone theory. In their study, Harris and Ullman emphasized economic forces which influence the concentration of various land use

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[1] Ernest W. Burgess and R. E. Park, The Growth of the City, (Chicago: University of Chicago Press, 1925), p. 98.

[2] Chauncy D. Harris and Edward L. Ullman, "The Nature of Cities," The Annals of the American Academy of Political and Social Science, (November, 1945), p. 49.

activities. In essence, Harris and Ullman in their multi-nuclei theory identifies four influences that account for the emergence of separate nuclei in urban land use patterns. These four influences are: 1) Independence of land use activities between each other; 2) A clustering tendency of land uses which tend to enhance each other economically; 3) Land use activities which are inimical to each other, i.e. the utility system they required, etc.; and 4) high land costs which either attract or repel uses.

The multiple nuclei concept recognized directly and indirectly the selected growth influences which shape the land use pattern. However, in recognition of the aspects of land use change, the theory made a limited distinction between factors explaining the land use structure and the dynamics of land use change. As Chapin indicates:[1]

> "...some recognizing the concept probably find their explanation primarily in terms of national market forces; others in terms of overcoming friction of space made possible by the automobile, the development of electric power, and other technological advances, and still others in terms of community values and legislative controls such as zoning. Some may be sluggish, and some may be volatile in their response to forces of change. Some may affect surrounding patterns of land use one way and some may affect them in quite another way."

Chapin goes on to state that:

> "If land use patterns by whatever structure theory they are described are the aggregate result of the interplay of the forces of supply and demand acting on the sum total of all land parcels in an urban area, then some means, some intermediate set of operational generalities that recognize these forces, is needed to serve as a guide in making the transition from economic theory to land use planning principles."[2]

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[1]Chapin, pp.20.

[2]*Ibid*.

It is in the search for the operational generalities as referred to by Chapin that many techniques and studies have been developed to explain, predict and forecast the effect of many influences and variables upon land use. While it is outside the realm of this investigation to review the numerous published studies and articles, economic land use development models have a more direct implication and relevancy to the nature of this study.

Economic land use development models have been largely based on the various defined economic influences, i.e., location, transportation, soil fertility rates, etc., upon economic land rent and indirectly on the effect of these variables upon land or real property values. Subsequent economic development theories have expanded the variables and influences taken into consideration and applied the earlier developed concepts to an urban landscape as compared to the agricultural land use pattern which was the prime concern for Mills, Von Thunen, Ricardo, and others. With the advent of the city planning profession and the land ecologist's school of thought, considerable work has been done to further expand the restraints imposed by selected growth variables, and through manipulation of a number of other defined variables forecast or predict the consequences of a given variable upon the land use pattern. Perhaps the most noted work of this nature is the book, Transportation and Urban Land, by Lowdon Wingo, Jr.[1] In this book Wingo developed an economic model based on classic equilibrium economic theory, i.e., those who control space and those who

[1]Lowdon Wingo, Jr., Transportation and Urban Land, (Washington, D. C.: Resources for the Future Inc., 1961) pp. 14-38.

seek space will each behave to maximize their economic returns.

The maximization of economic returns has been based on a set of given variables, i.e., location of employment centers, transportation technology, number of urban households, values placed on location and the marginal value individuals have placed on residential space. These defined variables then form the basis for the economic model to determine the spatial distribution of population densities and economic rent and the spatial distribution, value, and extent of land required for residential use.[1]

The entire model attempts to achieve an equilibrium distribution by establishing a demand schedule which determines the point at which land prices and population densities are in balance.

Similarly, William Alonso[2] uses the market mechanism to distribute space users to urban land. However, instead of developing a demand function as developed in Wingo's theory, Alonso used bid price curves. Using a featureless plain, and beginning at the center of the city, land is placed on the market or as stated by Alonso, "put up for bid." Beginning at the center, and on the basis of the steepest price bid curve, the highest bidder takes the most central place, the next highest bidder or buyer takes the second most central place, etc. The price paid by the first space user is determined by the price at the marginal location, but for the second bidder what was a marginal location for the first user becomes a location for him with the bid

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[1] Ibid., pp. 50-69.

[2] William Alonso, Location and Land Use: Toward a General Theory of Land Rent, (Cambridge: The Harvard University Press and John Wiley and Sons Inc., 1964), p. 20.

being determined by the price paid at the marginal location for this site and so on.

Ira S. Lowry views urban spatial organization as an outcome to a process which allocates activities to sites.[1] According to Lowry, in our society this process is mainly one of transaction between owners of real estate and those who wish to rent or purchase space for many different pursuits and activities. Those transactions consist primarily of freely entered contracts neither party having a legal obligation to accept the other's offer. The interchangeability of those individuals who wish to buy and those who wish to sell commonly defines the market for real property.

In the real property market, sellers wish to secure and capitalize upon combinations of many different inputs of capital, labor and basic improvement. Buyers in turn will attempt to obtain real property which required a minimum of investment in terms of capital and labor and will, over time, produce a profit.

Negotiations between buyer and seller are conducted primarily by offer and counter offer. As a result the buyer demand price or real property value is usually a closely guarded secret, while the selling price is usually unstable unless the owner has accurate knowledge of the price or worth of his particular parcel.

The "demand price" or real property value tends to differ from site to site and from area to area. This difference in real property value is based upon an evaluation function which weighs and determines the

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[1]Ira S. Lowry, "Seven Models of Urban Development: A Structural Comparison," The Rand Corporation, (November, 1963), p. iiv.

relative merits and advantages of each site or area in view of obtaining a profit.[1] As such, the evaluation function represents a determination of the relative merits of the site or area under consideration. Some of these characteristics are fixed and an integral part of the site; others are not. Fixed attributes can be related primarily to natural and locational features, while the non-fixed or free attributes are related to an input or availability of man-made and institutional attributes. The nature of the characteristics used for the determination of locational attributes by Lowry is a primary determinant for the evaluation function used by buyers and sellers on the open market. As improvements are made to a site, establishments re-evaluate the sites and as a consequence the market may again be altered and changed. Lowry implicitely recognized the fact that the attributes and variables attached to each individual site are a primary factor in the value and utility of the site.

The basic evaluation concept of site values as formulated by Lowry has been incorporated to a certain extent into selected complex economic land use development models used in comprehensive land use planning studies. Primarily, these land use models have been based on various indices and forces which have been recognized as regulating development activities.

Many different models have been developed which tend to mathematically manipulate and rearrange the many different factors which influence the market evaluation function as discussed by Lowry. However, it is outside the realm of this investigation to evaluate the mathematical basis

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[1] Ibid., pp. viii.

of models similar to Wisconsin's. The first distributes households on the basis of employment; characteristics obtained in this fashion are applied to employment estimates at centers of basic employment to arrive at the residential distribution of this employment. The results of this first model is the formation of overlapping patterns of population densities generated from the employment centers. The second model is developed on travel indices for four types of retail uses and other land uses according to traffic types. By relating these indices to the new population generated, a distribution of various employment centers is obtained.

The Penn-Jersey Transportation Study Model depicts households seeking to fulfill their housing needs and desires in the market place with location decisions based on costs attached to obtaining housing as compared to budgets.

The model assumes that households will have full knowledge of the market and recognizes four factors: 1) A type of house; 2) An amenity level; 3) An accessibility combination; and, 4) Site size. Households with perfect knowledge of the market will attempt to maximize their rent paying ability and minimize their total rent within market constraints. The model as a basis for formulation requires a sampling survey of households to establish preference on housing type and amenity level and site soil. The information required to construct this and other models would require extensive field surveys and interviews.

An additional model for forecasting residential growth was developed by Thomas G. Donnelly.[1] In this model, a metropolitan area

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[1] Thomas G. Donnely, F. Stuart Chapin, Jr., and Shirely F. Weiss, A Probabilistic Model for Residential Growth, (Institute for Research in Social Science, University of North Carolina, May, 1964), p. 10.

with its particular configuration of uses, community facilities, transportation systems and pattern of vacant land is assigned a structure of existing land values. The computer then consults a plan and notes the locations of public improvements and employment centers expected to develop in a given growth period. Land values are often increased in accordance with the expected effects of new improvements on the existing pattern of land values. Having reassessed the land values pattern, a development-redevelopment pattern is set in motion. Areas of pre-established densities with a pre-determined alternative for development along with household units available for this growth period are distributed by a random process.

During the next development or growth period any changes in land value rates expected due to new policies and technological changes are introduced in the computer program. The plan is committed again to the computer, scheduled improvements noted and the land again re-evaluated in view of planning improvements. This process is continued to the end of the planning period at which time a pattern of probable residential development is depicted.

These foregoing brief discussions on four selected land development models have been based primarily on selected aspects of the economic development process which directly or indirectly tend to reflect on the relationship of land development and improvement towards land values.

In addition, those techniques to indicate a future land use pattern tend to have the following common characteristics:

1. Require extensive field surveys and data collection procedures to formulate required background data for the formulation of a land use development model.

2. Require extensive elements of time and staff capabilities and computer equipment which are often beyond the reach of a small planning office.

The resources and details required to develop models which can predict the consequence of selected development activities upon the probable intensity of land use and land values tend to preclude their application in a public planning office having limited resources. This further tends to emphasize a need for the development and application of an analytical technique which can serve as a decision making tool to a comprehensive land use planning program with limited resources.

Summary

The objectives of this study as compared to the reviewed literature or the study topic have areas of implied similarities and application. Primarily, the reviewed literature emphasized the effect of a given set of variables as a causal agent of land use change. The emphasis of the reviewed literature stresses prediction and attempts to foresee a probable land use pattern given stated growth influences and variables.

This study will be founded on the economic development concepts embodied in the reviewed literature and generally will attempt to indicate a probable land use intensity pattern, through the past effect of five growth influences upon real property value change of Saginaw County. To maintain the relative applicability of the study technique and method to actual field situations, the methods used in this study will be less sophisticated than the methods briefly described.

CHAPTER III

PROJECT DESIGN

The objective of this chapter will be to review and outline the study methodology used in this investigation. In order to provide a complete overview of the entire study, this chapter has been divided into three major parts. First, the study area as the base of the study will be defined and discussed. Secondly, the basis of the study methodology of the investigation will be defined. Thirdly, the study techniques used and applied throughout the study will be explained in outline form.

Study Area

Basis for Selection

Saginaw County, Michigan was selected as the study area for this investigation. The bases for selection of Saginaw County were as follows:

1. The researcher was employed as a full time professional planner by the Saginaw County Metropolitan Planning Commission from December, 1968 to March, 1970. During this period of employment the researcher was assigned the basic task of developing a base of pertinent information for the Comprehensive Land Use Transportation Planning Program.
2. Inasmuch as the County Planning Commission had been in operation for only two years, an adequate information base for the development of a Comprehensive Land Use

Development Plan was not available. This required basic land use data as an input into a Land Use Plan. The lack of available up-to-date information required extensive field studies and review of available public records for applicable planning information.

3. As an employee of Saginaw County, and as a resident of the County, the researcher with limited time and funds chose the study area to minimize costs associated with data collection while at the same time further expand upon, and more fully analyze the base of general information gathered in the preparation of generalized land value maps.

Location and Size

Saginaw County is located in east-central Michigan. The City of Saginaw, the major city in the county, is located approximately 70 miles north of Lansing and 95 miles northwest of the Detroit Metropolitan Area. Figure 1 shows the location of Saginaw County within the State of Michigan.

Topography

The existing topography of Saginaw County can be attributed to the Wisconsin Glacial Period, some 10,000 years ago.[1] When the Wisconsin Glacier entered the Great Lakes basin, it assumed the shape of lobes, each acting independently of the central mass. The thin Saginaw lobe melted faster than the Michigan or Huron lobes and its retreat was rapid, marked only by brief stops. Because the Saginaw lobe melted

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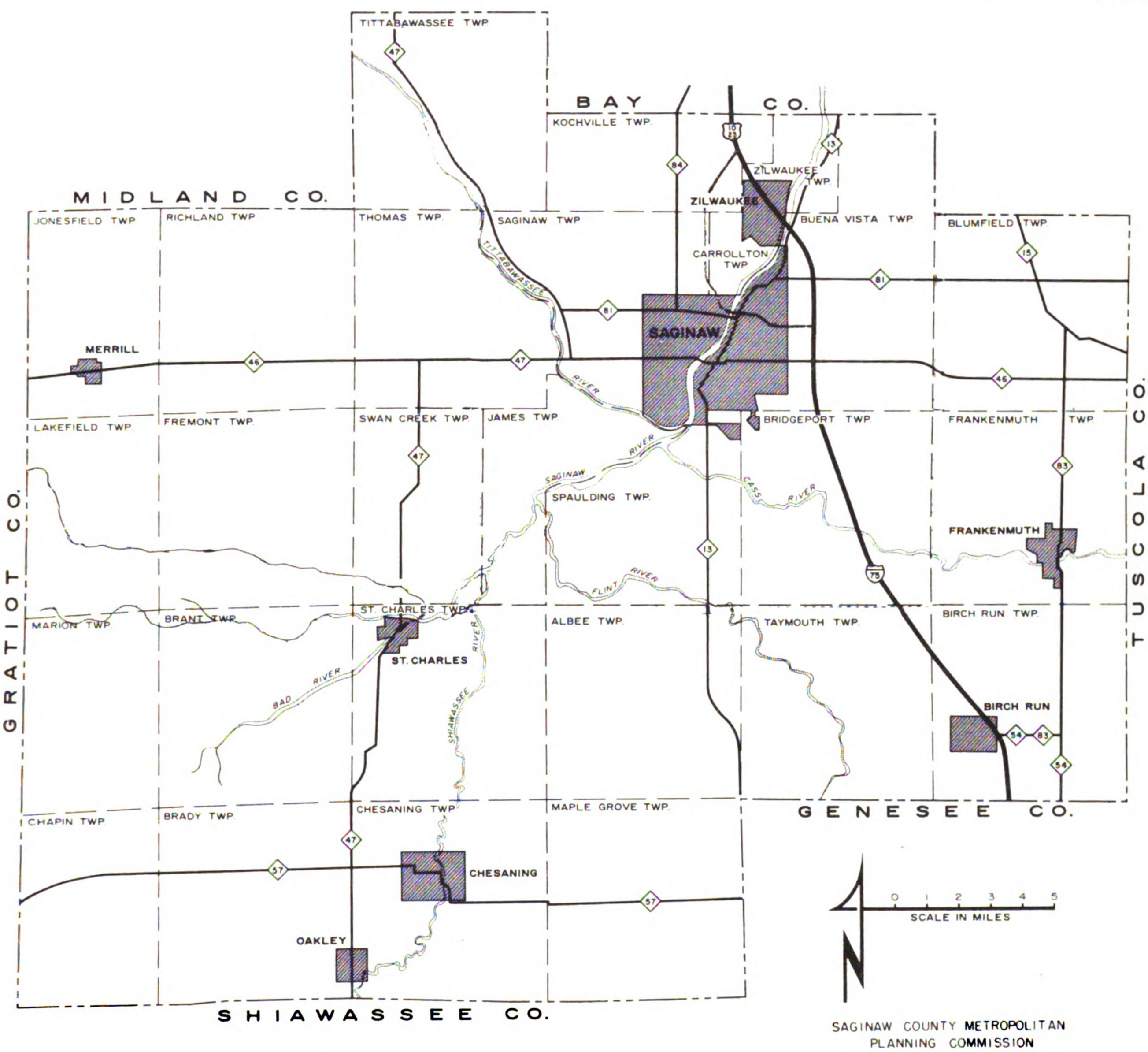
[1]Saginaw County Metropolitan Planning Commission, Physical Features Study, (Saginaw: Saginaw County Metropolitan Planning Commission, 1967), pp. 3-6.

Figure 1

SAGINAW COUNTY



faster than the other glacial lobes, the outlets for melted water were often blocked by ice dams. As a consequence, a large glacial lake was formed behind a major ice dam. When the ice obstructions eventually melted, a flat lake bottom, or lake plain, and a poorly developed drainage pattern remained. A clearly discernible physical remnant of this glacial period is the Shiawassee Wildlife Game Reserve Area which represents the center location of the glacial lake. In essence, the Saginaw River and its tributaries represent the basic drainage ways which were established when the glacial lake drained into Lake Huron.

Soils

The ancient, glacial lake-bed left an extremely large variety of soil conditions in the county. Broad expanses of level, fertile soils laced with an extensive, man-made drainage system predominate the Saginaw County land surface.[1] The areas directly adjacent to the metropolitan, or urban core of the county are predominantly fertile agricultural areas with an extensive, poorly-drained, and marshy area to the south, which represents the Shiawassee Wildlife Game Refuge Area.

Drainage

The glacial lake obliterated any natural lakes which may have been formed when the glacier retreated. However, Saginaw County is the point of convergence for six major river systems (Cass, Flint, Bad, Tittabawassee, Shiawassee, and Saginaw). These are of primary importance to the future development of the county.

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[1]United States Soil Conservation Service, A Soil Rating System for Saginaw County, A Report to the Saginaw County Metropolitan Planning Commission, (Saginaw: United State Soil Conservation Service, 1968), pp. 3-7.

This total watershed area, drained by the Saginaw River and its tributaries, covers an area seven times the size of Saginaw County.

The convergence of these watersheds into one general area, combined with the relatively flat topography and low stream gradient (less than one foot fall per mile for the Saginaw River), seriously complicates the drainage and flooding problems of the county.[1] This is especially true during periods of heavy run-off. Due to the undeveloped nature of the floodplain, excellent opportunities remain to guide the future land use within areas subject to flooding in the county. Figure 2 depicts the floodplain areas in the county.

County Land Use Pattern

Saginaw County with a total surface area of 529,375.7 acres has a total developed land area of 54,410.1 acres.[2] This total developed land area includes those land uses devoted directly to urban land uses, i.e., employment, education, public service, and transportation. Remaining land areas have been classified as undeveloped land use areas, which although not directly related to urban land use, are integrally related and part of the total county land use pattern.

The relative distribution of the developed and undeveloped land use categories in the county is depicted in the following table:

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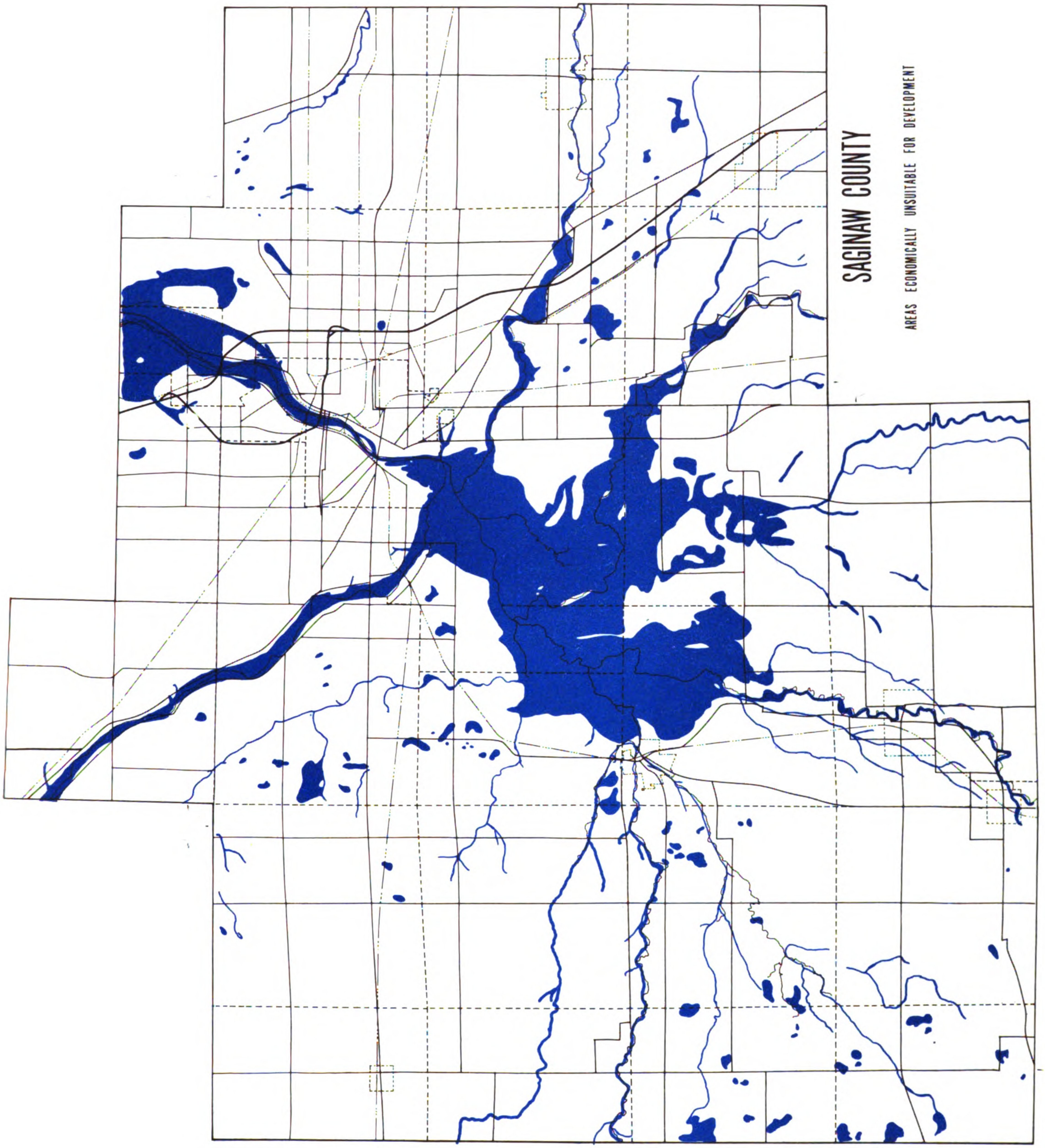
[1]Ibid,. p. 20-25.

[2]Saginaw County Metropolitan Planning Commission, Land Use Analysis, p. 40.

Figure 2



Map 2

TABLE 1

DEVELOPED AND UNDEVELOPED LAND USE CATEGORIES

IN SAGINAW COUNTY[1]

Developed Land Use	Acres	% of Developed Area	% of Total County Surface Area
Residential	22,775.8	41.86	4.31
Commercial	1,480.8	2.72	.28
Industrial	2,733.6	5.02	.52
Public & Quasi-Public	6,580.5	12.10	1.25
Transportation	20,839.4	38.30	3.93
Total	54,410.1	100.00	10.29

Undeveloped	Acres	% of Total County Surface Area
State & Federal Lands	21,298.4	4.02
Vacant	26,271.4	4.96
Agriculture	338,098.4	63.86
Wooded	82,736.5	15.64
Water & Rivers	6,580.9	1.24
Total	474,985.6	89.72 or 54,410.10 acres

The above table indicates that 474,985.6 acres, or 89.72 percent of the total county area is devoted to undeveloped uses, such as agriculture, Federal-State lands, and wooded or water areas. Of the

[1]Ibid., p. 41.

474,985.6 acres of open space uses, the agricultural land use type totals 63.86 percent of all open space land uses in the county.

Developed land area of county surface area totals 10.29 percent or 54,410.1 acres and of the 54,410.1 acres of developed land area, 41.86 percent was devoted to residential uses. The next most significant developed land use was transportation, which utilized 38.30 percent or 28,839.4 acres of total developed land area. Other major amounts of developed land area were in Public and Quasi-Public land use.

The location and intensity of the overall land use pattern in 1967 is depicted by Figure 3. The greatest intensity of land utilization is in the urbanized core, which consists of the City of Saginaw and the immediate surrounding ten (10) township area. As the distance outward from this urbanized core increases, there is a noticeable reduction of intensity of the use of land.

Figure 3 also shows that although present development is scattered, the intensive land use categories providing the county's employment base are largely concentrated within the urbanized core, its immediate fringe areas and in the incorporated areas. The distribution of population to the seven land use categories is depicted below:

TABLE 2

POPULATION DISTRIBUTION TO LAND USE CATEGORIES[1]

Land Use	Acres	Acres Per 1,000 Population
Residential	22,775.8	104.0
Commercial	1,480.8	6.7
Industrial	2,733.6	12.4

[1]Ibid,. p. 42.

TABLE 2 (Continued)

Land Use	Acres	Acres Per 1,000 Population
Public & Quasi-Public	4,212.5	19.2
Transportation	20,839.0	95.1
Open Space	136,887.2	625.0
Agriculture	338,098.4	1,543.8

*Based on the 1967 Population or 219,109 persons

Source: Saginaw County Metropolitan Planning Commission Land Use Dwelling Unit Inventory

Socio-Economic Characteristics of the Study Area

In 1960, Saginaw County had a total population of 190,752 persons. By 1967, the population had increased to 219,311 persons or an increase of 1.9 percent per year since 1960. This compared to a population increase of 2.4 percent between 1950 and 1960 and represented a decline in the rate of natural increase in the population.[1] This decline resulted from a sharp decline in the number of births between 1960 and 1967 (number of births per 1,000 population) from 27.5 in 1960 to 20.0 in January, 1967.

During the 1950's, immigration averaged only 200 persons per year compared with an average of 660 persons per year between 1960 and 1967. Table 3 depicts the relative rate of population change in the county through natural increase and through net in-migration.

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[1] Real Estate Research Corporation, Estimates and Projections of Economic and Demographic Characteristics, Saginaw County, Michigan, A Report to the Saginaw County Metropolitan Planning Commission, (Chicago: Real Estate Research Corporation, 1969), pp. iv-11 and iv-20.

Figure 3

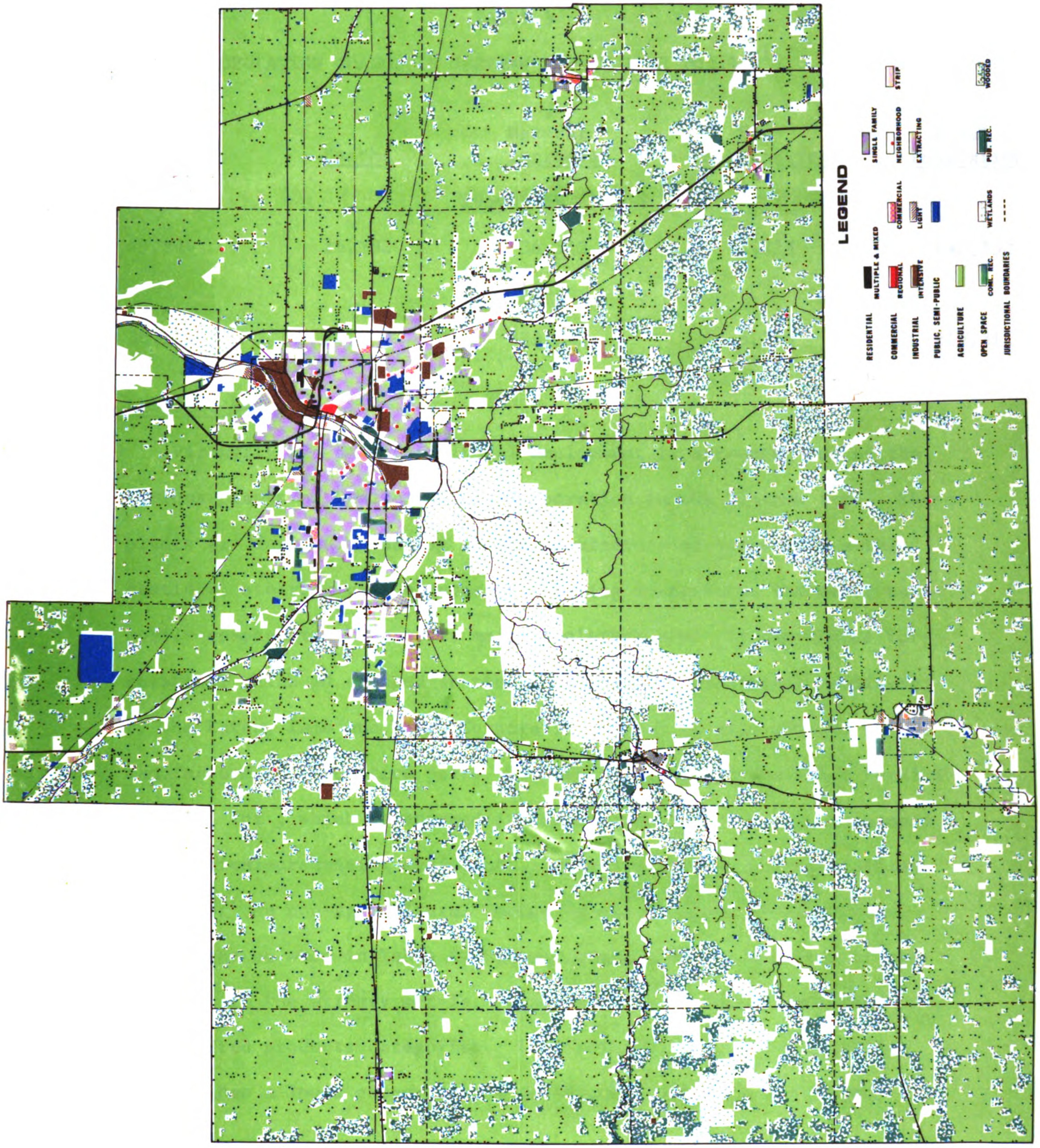
LEGEND
RESIDENTIAL
MULTIPLE & MIXED
SINGLE FAMILY
COMMERCIAL
REGIONAL
COMMERCIAL
NEIGHBORHOOD
STRIP
INDUSTRIAL
INTENSIVE
LIGHT
EXTRACTING
PUBLIC, SEMI-PUBLIC
AGRICULTURE
OPEN SPACE
COML. REC.
WETLANDS
PUB. REC.
WOODED
JURISDICTIONAL BOUNDARIES

TABLE 3

POPULATION CHANGE IN SAGINAW COUNTY 1950 TO 1967[1]

Live Births	Deaths	Natural Increase	Net In-Migration	Total Population
		1950-1959		
49,894	15,382	34,512	2,725	190,752
		1960-1967		
38.115	14,870	23,245	5,314	219,311

Economic Base

Virtually all non-agricultural employment is accounted for by the various plants of General Motors Corporation in the Saginaw area. These plants are engaged primarily in the manufacture of automotive metal castings, steering gear components, braking components, and other automobile components. The other major employers are: 1) the Wickes Corporation, which is engaged in the manufacture of electrical machinery; 2) the Eaton, Yale and Towns Corporation, which is also engaged in the manufacture of automotive parts and machinery; and 3) the Baker Perkins Company, Inc., which is engaged in the manufacture of bakery machinery and chemical-processing equipment. Table 4 indicates the specialized nature of the non-agricultural sector of the county's economic base.

As can be seen in Table 4, Saginaw has a higher proportion of employment in the primary metals, transportation equipment, and food and kindred products categories. In virtually all other cagegories, Saginaw has a lower proportion of employment than does either the

[1] Ibid., p. iii-29.

TABLE 4

1967 Employment Distribution by Sector for the United States, the State of Michigan, and Saginaw County [1]

	United States Distribution	Michigan Distribution	Saginaw County Distribution
Total non-agricultural employment	100.0%	100.0%	100.0%
Contract construction	4.9%	4.1%	5.2%
Manufacturing	29.4%	38.9%	45.6%
Machinery-nonelectrical	3.0%	6.1%	5.8%
Transportation equipment	2.9%	12.9%	15.8%
Motor vehicles & equipment	1.2%	12.4%	15.4%
Other Transportation	1.7%	.5%	.4%
Other Durables	6.4%	3.8%	2.7%
Non-Durable Goods	12.1%	7.5%	5.6%
Food & Kindred Products	2.7%	1.9%	3.5%
Printing & Publishing	1.6%	1.2%	.7%
Other Non-Durables	7.8%	4.4%	1.4%
Transportation & Public Utilities	6.5%	4.9%	6.6%
Wholesale & Retail Trade	20.6%	19.2%	18.9%
Fire	4.9%	3.6%	2.7%
Services & Mining	16.2%	13.4%	10.8%
Government	17.5%	15.9%	10.2%

[1]United States Department of Commerce, Bureau of Labor, Statistics-Employment and Earnings Statistics for States and Areas, 1939-1967, (Washington, D. C., U. S. Government Printing Office, 1968), p. 8.

State of Michigan or the United States. An exception is the non-electrical machinery category in which Saginaw County has a higher proportion of employment than the United States. However, even in this category Saginaw has a lower proportion than the State of Michigan.

Study Methodology

Conceptual Framework

The introductory chapter and review of the literature have placed a primary emphasis on the fact that the spatial structure of a land use pattern is strongly influenced by economic development considerations which in turn are reflected through a pattern of land values. As Chapin states, "The land use pattern can be viewed as a geographic pattern of values. These patterns usually bear a very approximate relationship to their market values and such relationships vary from one part of the city to another."[1]

The influence of many development activities instituted either by the private or public sector also affects this pattern of land values. The land use planner in his land use development proposals exerts in a direct and indirect manner a considerable influence on development decisions which in turn alter and change the land value pattern. Direct influences are exerted by the planner if his various plan proposals for public development activities are accepted and are implemented over time through the use of police powers and public expenditures for roads, utilities, etc.

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[1]Chapin, Urban Land Use Planning, pp. 8-10.

Many public and private decisions are made primarily on economic considerations which will affect the market evaluation process as referred to by Lowry in the review of the literature. This market evaluation process places a value on any given parcel of land. The determined value on any given site or parcel will differ according to the attributes or variables which affect the market evaluation process. These attributes or variables can be considered as prime ingredients in the scope of comparative advantage as outlined by Barlowe.[1] The five subject growth influences of population, zoning, transportation, utilities and physiographic features have a number of sub-types or sub-categories, each of which may affect comparative advantages of one site over another. This will affect the market evaluation function of each site influenced by the growth influences and their respective sub-categories. The degree of influence in turn will tend to be ultimately reflected in changes to the land values pattern. This change can be discerned. Knowledge on the past relative effect of each growth variable and the respective sub-categories on real property values can be used in the land use planning process as a decision-making tool for future development decisions.

Development of Study Technique

In order to discern changes in real property values over two periods of time, the first step in securing a data base for the study was the development of a real property value pattern for the entire study area. The basis for establishment of the real property value pattern for

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[1]Barlowe, Land Resource Economics, p. 244-248.

two distinct time periods has been based on state law, which defines real property and real property value, and delineates methods for determination and recording of same on public records on an annual basis.

Act 206 of 1893, Section 2, defines real property as follows:

> For the purpose of taxation, real property shall include all lands within the state, and all buildings and fixtures thereon, and appurtenances thereto, except such as are expressly exempted by law, and shall include all real property owned by the state.[1]

The determination of real property value for each parcel of land in Saginaw County and all other Michigan counties is based upon the Michigan State Constitution, Article IX, Section 3, which states in part:

> The legislature shall provide for the uniform general ad valorem taxation of real and tangible personal property not exempt by law. The proportion of true cash value at which such property, shall be uniformly assessed, shall not, after January 1, 1966 exceed 50 per cent.[2]

Act 409 of 1965 defines true cash value as follows:

> "The words 'cash value' whenever used in this act shall be held to mean the usual selling price at the place where the property to which the term is applied shall be at the time of assessment, being the price which could be obtained therefore at private sale and not forced or auction sale." [3]

The true cash value of real property as defined by Act 409 is based on an assessment made by a tax assessor or supervisor. Act 206 of 1893, Section 24, states in part that:

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[1]Michigan, Public and Local Acts, (1893), Act 206, Section 2.

[2]Michigan, State Constitution, Article IX, Section 3.

[3]Michigan, Public and Local Acts, (1965), Act 409.

> ...the supervisor or assessor shall make and complete an assessment roll, upon which he shall set down the name and address of every person liable to be taxed in his township or assessment district, with a full description of all the real property therein liable to be taxed.... Each description shall show as near as may be the number of acres contained in it, as determined by the supervisor.... The supervisor shall estimate, according to his best information and judgment, the true cash value of every parcel of real property and set the same down opposite such parcel.

Thus, the State Constitution and State Legislation require that the true cash value of real property be determined and recorded each year. The assessment of true cash value for each entity of real property as defined by law, along with the procedures used to record the assessments of true cash value, can then be considered a useable and valid source of information to determine the real property value pattern of the county.

All governmental units in Saginaw County, in compliance with state law, have assessed and recorded each recorded parcel of land under their jurisdiction. The recording procedure and format of description in generally established by law, although some variation in property descriptions and basic format is allowed. However, for Saginaw County, the tax assessment rolls for each local unit of government are prepared by the County Equalization Office, which in addition to the equalization function, also assists local township supervisors in assessing property. Each property description, as recorded in the tax assessment records, follows a consistent format for the entire county. An example of the basic format and the information contained in each property description is as follows:

KEY:

1. Parcel description, measurements, size.
2. Use of parcel
   AG - Agricultural
   R - Residential
   C - Commercial
3. Location of quarter section -
   1000 NW
   2000 NE
   3000 SE
   4000 SW
4. Location of parcel in county.
5. Owner's mailing address.

```
    11-5-5     A F BARRY ET AL
(3) 4001       5083 DIXIE HWY     (5)
    D-1        SAGINAW, MICH.

    COM.AT INTERSECTION OF E&W¼LINE
    WITH NE'LY LINE OF U.S.23 HWY.? RUN.
    TH.E.ON E&W¼LINE 504.3 FT.? TH.S.47° (1)
    TO NE'LY LINE OF U.S.23 HWY.277FT.

    TO SAID NE'LY LINE? TH.NW'LY ON SAID (1)
    NE'LY LINE 378.4FT. TO BEG.
    3.16 ACRES
(4) SEC. 5     T11N     R5E.     C   (2)


    10-4-10    MELVIN R. PRICE
    2001       2925 W. TOWNLINE RD. (5)
(3) D-3        SAGINAW, MICH.  R-1

    NS 1/4 - 160 ACRES   (1)
(2) SEC 10     TION R4E    AG


    12-4-16    CARLTON D EVANS
(3) 4427       4295 WEISS        (5)
    D-10       SAGINAW, MICH.

    E. 100 FT. OD W.1214 FT. OF N.436 FT.
    OF NW¼ OF SE¼ ALSO KNOWN AS LOT 25-  (1)
    MUELLER'S SUB-DIV.-UNRECORDED. 1 ACR
(4) SEC. 16 T12N R4E   R (2)
```

For each parcel of land thus described the assessed valuation of both the real and personal property is indicated. In addition, the county equalized evaluation and the state equalized evaluation of each described parcel is indicated by the assessing office in separate columns of the tax assessment book.

Area Unit of Analysis

The pattern of real property values as described on a parcel-by-parcel basis for the entire county can be compared to a giant puzzle superimposed upon the square area of the county. This pattern of property descriptions and real property values is made up of some 85,340 individual parcels. These parcels range in size from 900 acres to 2,000 square feet in area. Thus, the problem which confronted the researcher was determination of a constant unit of analysis which would have a constant size area and which could utilize the basic format and content of each parcel description as recorded in tax assessment records for each local governmental unit. By virtue of this limitation, the area unit of analysis had to be based on one common denominator which constituted a constant in each individual property description. This one common constant factor which is incorporated in each assessed parcel of land is the property description based upon the township and range survey method. This survey system was established through the provisions of the Northwest Territorial Ordinance of 1789. The ordinance provided for town roads every mile which set the pattern of accessibility to four 160 acre farms per square mile of land. Each property is thus described by town, range, section, and quarter section.

Inasmuch as the quarter section represented the smallest constant area unit contained in each individual parcel description, it was used throughout the study as the area unit of analysis. The quarter section unit is coded to each square mile by the numbers 1000, 2000, 3000, and 4000. The thousand figure designation indicates the location of the quarter section in a square mile. 1000 indicates the Northwest quarter, 2000 the Northeast quarter, 3000 the Southwest quarter, and 4000 the Southeast quarter. The number of individual parcels described to any given quarter section is also made part of the quarter section designation. For instance, the number 4002 would not only indicate the Southwest quarter, but also indicate that two (2) parcels of land were described to that quarter section. As such, the designation by code of individual parcels to a quarter section and the designation of a quarter section to a square mile enabled the aggregation of all parcels described to a quarter section as the next step in the development of comparative real property value patterns for the county.

Establishment of Real Property Value Pattern

The establishment of a uniform real property value pattern for Saginaw County was accomplished through the following procedure:

1. All sections and quarter sections for each governmental unit in Saginaw County were clearly identified in each individual property tax description. In addition, the size of each parcel was also clearly indicated and made part of each quarter section as the established area unit of analysis.

2. For each quarter section, the individual parcels inscribed to that quarter section were aggregated to total not more than 160 acres. In many instances, especially in the urban areas, the total acreage or size of the aggregated parcels did not total 160 acres. This can

be attributed to the acreage devoted to public roads and properties and not assessed for property taxes.

In the same step, the state equalized value was also aggregated for each quarter section. After the total assessed acreage for each quarter section was aggregated and the total state equalized value for this aggregated acreage was determined, the total state equalized value was multiplied by two and divided by the total quarter section. The remitting value figure then represents the average or mean per acre real property value; an example of the above procedure is depicted in Table 5.

The entire procedure used to arrive at a mean real property value per acre for each quarter section in the county can be stated as follows:

$$PV \text{ equals } \frac{\Sigma Vn}{\Sigma Ln}(2x) \quad \text{where}$$

PV: The average per acre real property value for a quarter section.

ΣLn: The sum of the number of acres inscribed to a particular quarter section. Σ stands for summation, L is the number of acres per parcel, and n is the number of parcels per quarter section.

ΣVn: The sum of real property values for all land parcels within a given quarter section. Σ stands for summation, V is the value for each parcel, and n is the total number of parcels.

2x: The equalization factor for each governmental unit for any given year, multiplied by two to obtain the market value for a given quarter section.

This procedure was completed for all 3,832 quarter sections described in the tax assessment rolls of all 37 governmental units for 1955 and 1968. An intervening time period of thirteen years was chosen to more clearly emphasize and distinguish between the changes of average per acre real property values on a quarter section by quarter section basis.

TABLE 5

Governmental Unit: JAMES TOWNSHIP
Calendar Year 1955

(Sample Format Used to Depict Quarter Section Values)

Range	Twp.	Section	Quarter	Total Assessed Acres	Total Assessed Value	(3.67) R.P. Value Quarter X2	(4+6) Av Acre R.P. Value
R3E	T11W	1	NE	150	$69,650	$255,616	$1,704
R3E	T11W	1	NW	143	$10,400	$ 38,168	$2,669
R3E	T11W	1	SW	148	$12,500	$ 45,875	$3,099
R3E	T11W	1	SE	158	$22,318	$ 81,907	$5,184

* An urbanizing township within the Saginaw Metropolitan Area. 1955 equalization factor is 3.67, 1968 factor is 5.62.

Another reason for the selection of the thirteen year time period was based on the fact that Saginaw County experienced a relatively rapid rate of urbanization between 1955 and 1969. The year 1968 was used as the final year because the assessment rolls from each governmental unit in the county for the year 1969 were not yet available. By using 1955 as the base year, the effect of this rate of urbanization on changes in real property values would be simplified. Additionally, an assumption was made that the relatively long time lapse between the two years would emphasize any relationship that may have existed between real property values and any growth influences exerted upon a quarter section unit.

The average per acre real property value for each quarter section was then placed in the following format for all governmental units:

TABLE 6

Governmental Unit: JAMES TOWNSHIP

Range & Twp		Section	Quarter	1955 Average Per Acre Value	1968 Average Per Acre Value	Difference 1955-1968
R3E	T11W	1	NE	$550	$1,704	+ $1,154
R3E	T11W	1	NW	$700	$2,660	+ $1,969
R3E	T11W	1	SW	$692	$3,099	+ $2,407
R3E	T11W	1	SE	$792	$5,184	+ $4,392

The formulation of an average per acre real property value for two time periods for each quarter section in Saginaw County then completed the establishment of the data base for the investigation.

To summarize, the use of the quarter section as the area unit of analysis can be visualized as a one-quarter square mile grid pattern laid over the entire surface of the county. The determination of average real property values for each piece of that grid for two time periods indicates that some change has taken place in this average real property value in the intervening time period. Figure 7 further illustrates the above for one square mile area.

FIGURE 7

1955 Value

700	550
692	792

1967 Value

2660	1704
3099	5181

Difference In Dollars 1955 - 1967

1969	1154
2407	4392

Method of Statistical Analysis

This grid pattern uniformly established over the entire county is subject to many influences and variables. Each individual cell or quarter section of the grid pattern tends to differ from all other cells of the grid pattern by virtue of location, soil conditions, type and extent of the transportation and utility network superimposed upon it, population density and any other given variables which exert their influence on each cell.

These influences, limited to the physiographic features of rivers and soils, transportation network, utilities systems, population increase and the zoning pattern, represent qualitative characteristics for each major growth variable which tend to differ according to the sub-components which collectively constitute the major influence. The overt influence of the major growth variable and the differential influences exerted by the sub-components constitute a fixed qualitative independent variable. The average per acre real property value for each cell or quarter section is the dependent variable. Throughout this investigation, then, the null hypotheses to be tested are:

1. There are no significant differences in changes of the average per acre real property value which can be attributed to each of the differential qualitative characteristics or their respective sub-components.
2. The average per acre real property values for the years 1955 and 1968 are equal.
3. Interreaction effects exist between the five major growth variables and their sub-components, and the average per acre real property value for the years 1955 and 1968.

These three hypotheses will be tested through the analysis of variance method two-way, fixed effects model. If each of the different growth influences and their sub-components exert a different degree of influence upon the mean acre property values, these differences can be statistically discerned.

In the same way, an analysis may be made of the influences of passage of time and inflation upon property values, and a test for interaction between the two independent variables may be made. The theoretical assumptions, formulas, and procedures for conducting a two-way analysis of variance, fixed effects model, is described in

William L. Hays' book, Statistics.[1]

The rationale for and the application of the analysis of variance two-way, fixed effects model to the developed data base has been divided into five steps, which are described as follows:

Step One - Sampling Techniques

Rationale: A sample of the entire population of each quarter section which was traversed, influenced, or affected by one defined growth variable was randomly chosen so that the results derived from the sample could be generalized to all quarter sections which were traversed, influenced, or affected by a given growth variable.

Procedure: All the possible combinations of the sub-categories of one major growth variable were determined, and listed under the sub-categories to which they belonged, i.e., all cells or quarter sections which were affected or influenced by one given sub-category of a major individual growth influence were grouped together. Quarter sections which were split by two or more sub-categories of a major growth variable were listed under the appropriate combination.

A number of quarter sections were randomly drawn from one combination of sub-categories classified on one major growth variable.

The number of samples drawn from each sub-category of a major growth variable was 30. The rationale for a sample size of 30 is that, if a sample has 30 or more subjects, the distribution of effects due to treatment can be assumed to be normal.[2] Thus, we may assume that our sample is normal.

All the various sub-categories classified on one major growth variable had an equal number of samples (n=30). This insures that the error is constant for all groups.

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[1]William L. Hays, Statistics, (New York: Holt, Rinehart, and Winston, 1963), pp. 310-360.

[2]Ibid., pp. 238-240.

Steps four and five together satisfy the assumptions required by Hays for application of the analysis of variance technique.

All possible groupings and combinations of a set of sub-categories of a major growth variable were listed. From the total number of quarter sections in each of these groups, a sample of thirty quarter sections was selected at random.

All other groupings or combinations of the sub-categories listed for one major growth variable which did not have thirty representative quarter sections were grouped under "others" and a sample of thirty quarter sections was randomly selected for this grouping.

In this manner, a number of sample populations were created. These sample populations, once determined, were placed in the following format for all five major growth variables.

Title-Sample Population	1955 Value	1968 Value	1955 & 1968 Value
	500	1,800	2,300
	300	2,000	2,300

<u>Step Two</u> - Tabulation

The 1955 and 1968 real property values of sample quarter sections for each sample category constituted the primary base for futher analysis. The following steps were then taken to place the raw data into a form more convenient for the analysis of variance computations:

1. For each sample population, property values for each year (1955 and 1968) for the entire sample were summed. Total sample values for all other sample categories were summed in the same manner. This resulted in a total value for the entire quarter section. [sample (n is 30)

for each of the sample categories.] The values for 1955 and 1968 for each sample category were then summed. Values for 1955 and 1968 were also summed to provide a combined 1955 and 1968 total. The 1955 and 1968 values were added together for all categories and for the entire sample.

2. The same procedure was repeated, except that each category value was first squared, then all squared values for a category were summed, and all category sums were totaled. Table 7 represents an example of this computation.
3. Steps one and two prepared the data for substitutions into the analysis of variance formulas which are reproduced in Table 8.

Step Three - Description of Technique

The two-way, fixed effects analysis of variance test was used, as described in Table 9. A more complete analysis of the meaning of these formulas will be found in the list of symbols which follows:

Σ - means to sum the following terms

j - column scores

k - row scores

i - cell scores

y - one individual score

n - number of subjects in each cell

N - total number of subjects

R - number of rows

C - number of columns

df - degrees of freedom

Ss - Subjects

SS - sums of squares

MS - mean square

EMS - expected mean square

There are five basic formula terms involved in the two-way analysis of variance. These may be designated A, B, C, D, and E. The process used to solve these formulas is illustrated in Table 8.

Step Four - Summation of Sums of Squares and Mean Squares

Once the terms A through E have been solved, these may be substituted in the following simplified formulas to find the Sums of Squares.

Sums of Squares for Columns: D - A

Sums of Squares for Rows: E - A

Sums of Squares for Interaction: C - D - E + A

Sums of Squares for Error: B - C

TABLE 8

Computation of Sample Data into Sample Populations

TERM A: $$\frac{\left(\sum_{j}\sum_{k}\sum_{i} y_{ijk}\right)^2}{N}$$

1. Add together all individual property values (y) within each cell ($\sum_{i}$), then across the columns ($\sum_{j}$), and then across the rows ($\sum_{k}$). In other words, add together all individual property values in the total sample.

2. Square the number arrived at in step one.

3. Divide this squared number by N - the number of subjects in the entire group.

TERM B: $(\sum_j \sum_k \sum_i y_{ijk})^2$

1. Square each individual test score $(y_{ijk})^2$ for the entire population.

2. Sum all of the square scores.

TERM C: $\dfrac{(\sum_j \sum_k (\sum_i y_{ijk})^2}{n}$

1. Sum all of the values within each cell ($\sum_i y_{ijk}$), and square this number. Repeat this process for every cell.

2. Add the squared value of all cells.

3. Divide the above number by the number of subjects per cell (n).

TERM D: $\dfrac{\sum_j (\sum_k \sum_i y_{ijk})^2}{Rn}$

1. Add all scores in each column together ($\sum_k$).

2. Square the sum of each column.

3. Add the squared totals of all columns together; sum over j.

4. Divide the above number by Rn, the number of rows times the number of subjects per cell.

TERM E: $\dfrac{\sum_k (\sum_j \sum_i y_{ijk})^2}{Cn}$

1. Add all individual scores across a row.

   $(\sum_{j})$.

2. Repeat the above procedure for all rows.

3. Square the sum of each row.

4. Add the squares of all rows together $(\sum_{k})$.

5. Divide the above number by Cn, the number of columns times the number of subjects per cell.

<u>Step Four Continued</u> - Once all four sums of squares have been computed, it is necessary to find the appropriate degrees of freedom for each variable, for interaction, and for error. The following formulas give one the necessary information:

df for;	is;	
Columns	C - 1	One less than the number of columns
df for;	is;	
Rows	R - 1	One less than the number of rows.
Interaction	(C-1) (R-1)	The df for columns times the df for rows.
Error	RC(n-1)	The number of rows times the number of columns times one less than the number of subjects per cell.

To find the mean square for any variable, divide the sums of squares by the corresponding degrees of freedom. The following table gives the formulas for this process:

$$\text{Columns MS} = \frac{SS_c}{df_c} \qquad \text{Rows MS} = \frac{SS_r}{df_r} \qquad \text{Interaction MS} = \frac{SS_i}{df_i} \qquad \text{Error MS} = \frac{SS_e}{df_e}$$

All sums of squares, degrees of freedom, and mean squares should be placed in an analysis of variance table (example - Table 9) at this point.

Step Five - Computation of F Ratios

Before computing F Ratios, it is necessary to complete the portion of the analysis table headed "Expected Mean Squares". This column is the rationale for computing F ratios. It describes the components which make up the individual mean square. In the fixed effects model, both the mean square for columns and the mean square for rows are composed of treatment effects plus an error factor.

The interaction mean square is composed of interaction effect plus error. The error mean square stands for error alone. Thus, to determine what the effect of treatment is, we separate the treatment effects from the column mean square by dividing it by the mean square error, which measures error alone. The same process is used to isolate the treatment effect of rows, and interaction. The formulas may be stated as follows:

$$\text{Column effect equals } \frac{\text{Mean Square Columns}}{\text{Mean Square Error}}$$

$$\text{Row effect equals } \frac{\text{Mean Square Rows}}{\text{Mean Square Error}}$$

$$\text{Interaction effect equals } \frac{\text{Mean Square Interaction}}{\text{Mean Square Error}}$$

The ratio resulting from any of these divisions is known as an F ratio, and has numerator, denominator degrees of freedom. The computed ratio may next be compared with a mathematical F ratio at the 1 percent, 2.5 percent, or 5 percent level of significance. If the computed ratio exceeds the mathematical ratio, the experimental effect is statistically significant.

Once the entire analysis of variance procedure has been completed for this particular study, the results are noted on an analysis of variance table, a sample of which may be found on the following page.

Step Six - Further Statistical Analysis

The analysis of variance tests can determine whether or not there are statistical differences between a number of sample groups of any one of the five defined growth variables but it does not point out where these differences occur, and which of them are significant. To do this latter job, it is necessary to use a post-hoc test. The most convenient test for this purpose as related to this particular study, is the Tukey Technique. This method compares two individual groups, and hypothesizes that there is no statistical difference between them. Each part of a defined growth variable may, therefore, be tested against every other part within one defined growth variable to find which areas are most valuable, least valuable, etc. The Tukey Technique enables one to compute a confidence interval, which charts the possible area in which the difference between two property's land values will fall a large percent of the time. In other words, if one

TABLE 9

Two-Way Fixed Effects Model
Analysis of Variance Test

SOURCE OF VARIATION	SUMS OF SQUARES	DF	MEAN SQUARES	F RATIO	EXPECTED MEAN SQUARES
COLUMNS	$\frac{\Sigma j(\Sigma k \Sigma c Yijk)^2}{Rn}$ $\frac{(\Sigma j \Sigma k \Sigma i Yijk)^2}{N}$	C-1	$\frac{SS_c}{df_c}$	$\frac{MS_c}{MS_e}$	Column effects plus error
ROWS	$\frac{(\Sigma k \Sigma j \Sigma i yijk)^2}{Cn}$ $\frac{(\Sigma j \Sigma k \Sigma i yijk)^2}{N}$	R-1	$\frac{SS_r}{df_r}$	$\frac{MS_r}{MS_e}$	Row effects plus error
INTERACTION	$\frac{\Sigma j \Sigma k(\Sigma i yijk)^2}{n} - \frac{\Sigma(\Sigma k \Sigma i yijk)^2}{Rn}$ $\frac{\Sigma k(\Sigma j \Sigma i yijk)^2}{Cn} + \frac{(\Sigma j \Sigma k \Sigma i yijk)^2}{N}$	(C-1)(R-1)	$\frac{SS_i}{df_i}$	$\frac{MS_i}{MS_e}$	Interaction effects plus error
ERROR	$\Sigma j \Sigma k(\Sigma i yijk)^2 - \frac{\Sigma j \Sigma k(\Sigma i jijk)^2}{m}$	RC(n-1)	$\frac{SS_e}{df_e}$		Error alone

measures the value of soil type one and soil type two for one hundred times, the difference between the two values will fall within the derived limits 99 times out of 100 (at a .99 level). If zero is included within this confidence interval, this means that the difference between the two properties may be zero, and the two are not significantly different. However, it the confidence interval does not include zero, this indicates that the difference in the value of the two types of land may be statistically significant. To arrive at this confidence interval, it is necessary to calculate a Tukey factor, which is then added to, and subtracted from, the mathematical difference between two property values. The computation of this factor is illustrated in Table 10 on the following page.

These outlined study techniques and statistical analysis procedures constitute the study methods which are constantly and identically applied to each of the five growth variables. Chapter V indicates both the manner of application and statistical findings obtained from the application of the study techniques to the five subject matter areas.

TABLE 10

Computation of the Tukey Factor[1]

1. Basic Formula:

$$\hat{L} - T\sqrt{MS} \quad (\tfrac{1}{2}'c')_j \leq L \leq \hat{L} + T\sqrt{MS} \quad (\tfrac{1}{2}'c')_j$$

$\hat{L}$ is the difference between two sample soil groups.

T equals $\frac{1}{\sqrt{n}} q \quad 1-\alpha;\ r,\ N-r$

$1-\alpha$ equals the confidence level, in this study .99 (1 - .01)

r equals the number of different subjects to be tested against each other, 16.

N is the total number of subjects, in this case 480 (each quarter section's 1955 and 1968 values are summed for this test).

q is a tabled value found by looking at the table with $1-\alpha$ significance, with r, N-r degrees of freedom.

T for this study equals $\frac{1}{5.48}$ (5.49) or 1

c stands for the integer which preceeds each of the values being subtracted, in this case each area has an integer of one so ½ 'c' would equal ½(2) or 1.

2. Substitution of numerical data:

$$\hat{L} - T\sqrt{MS} \quad (\tfrac{1}{2}'c') \leq L \leq \hat{L}\ T\sqrt{MS} \quad (\tfrac{1}{2}'c')$$

(Area 1 - Area 2) - $1\sqrt{MS}$ (1) - L - (1) MS (1) (Area 1 - Area 2)

3. The confidence interval for the true value of (Area 1 - Area 2) is the difference between these two, plus or minus $\sqrt{MS}$. $\sqrt{MS}$ is the same for this test as for the analysis of variance. The tables used for the Tukey Technique can be found in the cited text of this study.

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[1] William C. Guenther, Analysis of Variance, (Englewood Cliffs; New Jersey, Prentice Hall., 1964), pp. 110-170.

CHAPTER IV

RESULTS OF THE INVESTIGATION

This chapter discusses the application of the study procedure and study methodology as outlined in Chapter III to the five defined urban growth variables. Due to the basic nature of the study design, the two statistical analysis methods had to be applied separately to each individual growth variable. The study technique and results of each growth variable will also be treated and discussed separately. In developing this chapter, the study methodology and procedure will be placed in five individual sections according to type of growth variable. In each section the five attributes and significance of each growth variable as related to real property values will be discussed separately. Secondly, the rationale used for the selection of each sample population will be stated. Thirdly, the statistical results for each growth variable will also be stated separately within the section.

In Chapter V an attempt will be made to present and analyze the separate findings of the five growth variables as a whole.

Physiographic Features

The effect of physiographic features on land values and land uses has been a prime area of concern of many professions concerned with and dealing with the use of land for any infinite number of purposes. As indicated in Chapter I, physiographic features as a broad category of urban growth variables include many different aspects. The topography, drainage pattern, soil characteristics, climate, and ground water supply represent but a selected number of individual parts of a much larger subject matter area. Each individual part(s) of this larger subject matter area, in turn, can be divided up into another set of characteristics. In this section of this chapter, two individual parts of the overall physiographic environment will be considered separately. Both will be treated as separate sections in this investigation. These are: 1) Soils as the base upon which all human activities must take place; and, 2) Rivers which as drainage courses and natural obstacles tend to exert a shaping influence on growth and development.

Soils

The soil pattern of Saginaw County tends to differ from area to area in texture, permeability, stratification, percolation, and slope. Due to these different characteristics inherent in the soils pattern, differential influences in turn would seem to be manifested in the real property value pattern. The soil characteristics of any given area not only represent the base upon which all human activities must take place, but also determines the degree of productivity and use which can be made of the land. Soils in this sense cover land as a continuum. The suitability of this continuum at any one place results from the combining influence of climate, and the living matter existing upon apparent rich material as conditioned by relief over a period of time. This includes the effect of the cultural environment and man's use of the soil, inasmuch as those influences differ from each other in terms of specific use capability. These differences in use capability, to sustain any given land use, may be reflected in the use made of any given parcel of land and in this manner determine the economic productivity of the area.

Should any parcel of land have soil characteristics which offer little economic return, or which cannot be used for any other economic activity, the real property value of this parcel of land (on a per acre basis) will be lower than a parcel with soil characteristics more suitable for agricultural production, or for higher economic land uses. Poorly drained sandy soils, due to their lower expected economic return, have a lower real property value than well drained clay loam soil. In the same context, land with unfavorable soil characteristics for both the existing use and for future development will, over time, not experience a similar degree of increase in real property value. Land parcels with favorable soil characteristics for future development will experience a higher proportionate increase in real property value over a period of time than areas with unfavorable soil characteristics. As such, it would seem that change in real property values may be attributed naturally to the soil characteristics of any given area.

<u>Delineation of Soil Areas Into Sample Population</u>

In order to determine the relationship of soil area characteristics to real property values, the different soil area within Saginaw County were defined and delineated on the basis of the 1933 Bureau of Soil and Chemistry soils map for Saginaw County. Each soil area has one or more dominant soil type. The ten soil areas, as determined, considered the following use-capability groups in the 1933 rating system (refer to Figure 4):

"Urban Development. Urban development includes one or two storied dwellings with basements, parks, playgrounds, shopping centers with one or two storied buildings, schools, churches and the necessary roads, streets and parking lots. The majority of the development is dwellings, roads, parks, and playgrounds.

It is assumed that all urban development is planned to provide for surface water runoff, both from the development and from adjoining areas. There will be a minimum of erosion or flooding during construction and none after completion. Water leaving the development will not cause damage to lower lying areas.

A. Urban development with sewers and sewage disposal systems (Rating column headed "Sewers"). In this category, the limiting factors are properties that cause uneven settling, cracking of walls, and flooding of basements. The limitations may be from permeability, volume change, stability of ability of the soil to support loads. The limitations may be from the normal water table and probability of soil saturation in wet periods. Well drained soils are assumed to have slight limitations, moderately well drained and somewhat poorly drained soils have moderate limitations and poorly drained soils have severe limitations. The limitations may be from slope of the soil. Slopes of less than 12 percent are severe. Slopes near 12 percent may have severe limitations if shape of the land is such that sewers cannot be designed without numerous pumps.

B. Urban development without sewers and disposal systems, but have individual septic tank disposal systems (Rating Column headed "Septic"). This category has all the limitations of: a) Urban development plus the factors that limit the efficient working of septic tank systems. The added limitations are the soil properties that affect the movement of effluence in the soil. Texture, stratification and percolation rate of the soil must be considered. The slope of the soil is assumed to have slight limitations up to 6 percent moderate from 6 to 12 percent, and severe over 12 percent. Water in or on the drain field can cause many limitations. Soils that have normal water tables at or near the surface or are periodically flooded have severe limitations. Soils with fluctuating water tables that are near the surface for short periods of time are assumed to have moderate limitations if the shape of the land is such that surface water never stands on them. Soils with seepage spots would have severe limitations if the seepage enters the drain field and moderate limitations if cut off and diverted away from the drain field. Well drained fields are rated as having slight limitations.

Agriculture. Agriculture is the growing of farm crops and livestock. Specialized practices as sod farms, orchards, and nurseries for landscaping or forestry use are included, (Rating Column headed "Ag"). The limitations are the nutrients available in the soil, the ability of the soil to hold and release added nutrients. The ability of the soil to hold water flooding, slope, and the erodibility of the soil. Soils have been rated for agriculture in the land capability system of the soil conservation service. Capability Class I and II are assumed to have slight limitations, Class III and IV have moderate limitations, Class V and higher have severe limitations.

Forestry. The Forestry Category is the growing and harvesting of forest products (Rating Column headed "For"). Limitations are fertility and water holding capacity of the soils, water table, or any other soil property that restricts root growth, periodic flooding, and the direction of slope. Steepness of slope is not considered a limiting factor up to 18 percent and then only as it limits ability to harvest the products. Usually, steep slopes are narrow and have little effect on Management and Harvest.

Recreation. Recreation includes all phases of recreation and includes the necessary constructed facilities and buildings, constructed facilities, such as ball diamonds, golf courses, intensive camp sites and the necessary buildings to facilitate these intensive uses would have the same use rating as urban development. It is assumed that within an area reserved for recreation, there would need to be sites with limitations suitable for these uses. (Rating Column "Rec"). In this system, the soils are rated on the limitations for the less intensive uses as picnic areas, play areas, paths and trails, hunting, fishing, bird watching, and primitive camp areas. Limitations are compactability of the soil, ability to grow sod that will stand foot traffic, high water table, and flooding during the season of use. Water tables at or near the surface and occasional short period flooding are assumed to have moderate limitations. Water tables that fluctuate but seldom are at or near the surface during the use season and well drained areas are assumed to have slight limitations. Frequent flooding and water tables at or above the surface during the use season are assumed to have severe limitations.

Limitations. Slight limitations: Limitations that have little effect on a specific use can be easily corrected by standard methods, (Rating Column headed "1"). Moderate limitations: Limitations that can be economically and feasibly corrected. They may cause some alteration in design for a specific use. They can economically or feasibly be corrected for the specific use category. Use is very questionable, except for wild fowl hunting, which may be best under a severe limitation from wetness (Rating Column headed "3"). In rating soils, the most severe limitation for a use determined the rating.

TABLE 11

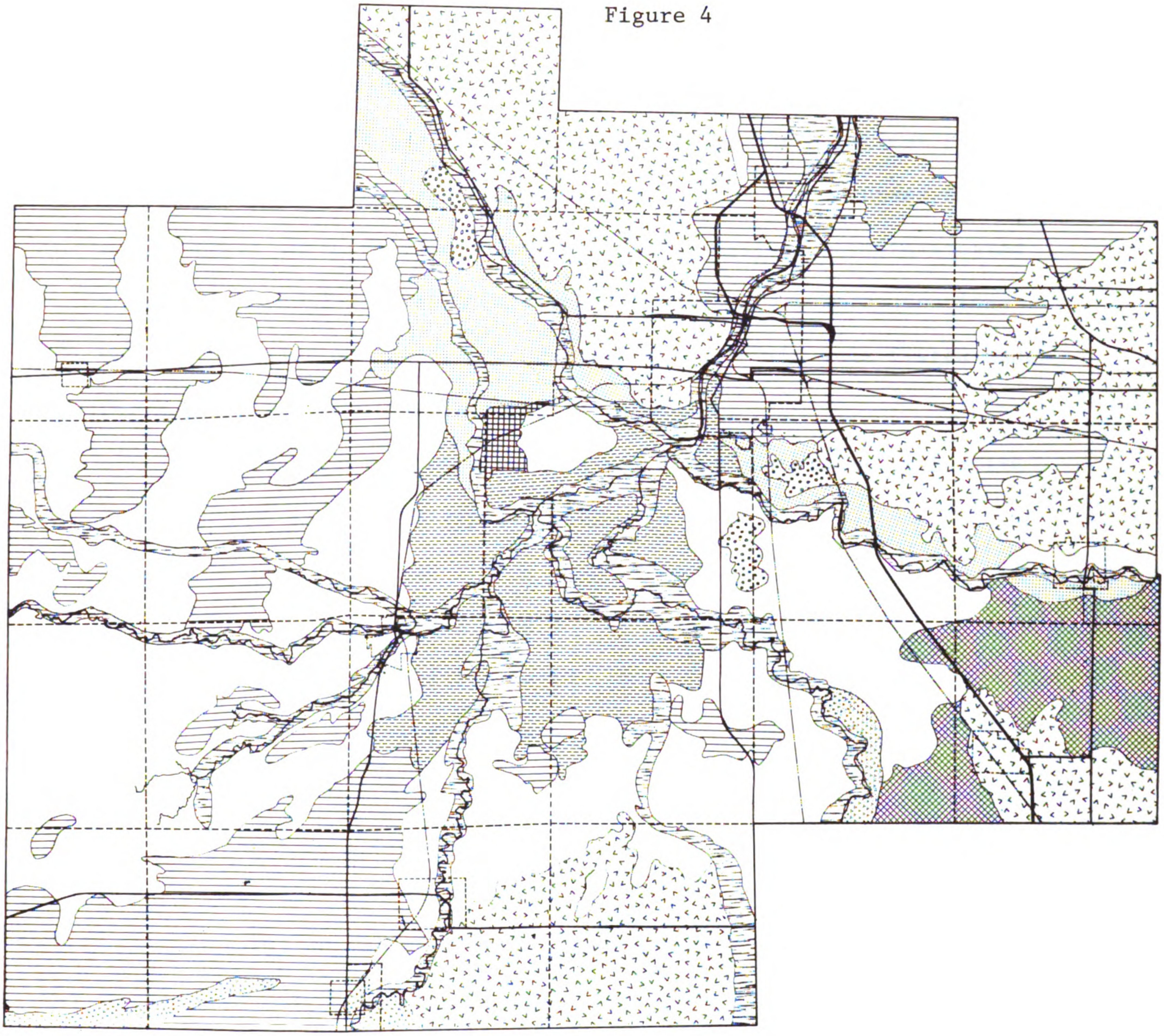
Use Rating Scale For Soil Area Map

		Use-Rating				
Area	Dominant Soils	Sewer	Septic	Ag.	For.	Rec.
1	Newton - Dominant	3	3	2	3	3
1	Arenac - Major Inclusion	2	2	2	2	2
2	Brookston & Wisner	3	3	1	3	3
3	Kawkawlin, Conover, Macomb	2	2	1	3	2
4	Toledo & Clyde	3	3	2	3	3
5	Tuscola - Very Fine Sandy Loam	1	2	2	1	1
6	Tuscola - Silt Loam	1	2	1	1	1
7	Colwood	3	3	2	3	3
8	Ottawa	2	2	2	2	2
9	Oshtemo	1	1	2	2	1
10	Genesee - Dominant	3	3	1	2	1
10	Griffin - Major Inclusion	3	3	2	3	3

Sampling

The grid superimposed over the total county service area in square quarter section units did not uniformly fit the soil area pattern; as

Figure 4



SAGINAW COUNTY SOIL AREAS

AREA 1:

A complex mixture of dark colored wet sands and light colored somewhat poorly drained sands. Long narrow ridges of well drained sands are scattered thru the area. Inclusions are small areas of poorly drained loams and loams with a shallow covering of sand. Area has slight limitations for agricultural use but severe limitations for land uses associated with urban development.

AREA 2:

The dominate soils are poorly drained loams and clay loams. Included are small areas of somewhat poorly drained loams and loams covered with sand. Area has slight limitations for agricultural use but severe use limitations for urban development.

AREA 3:

The dominate soils are the somewhat poorly drained loams and clay loams. Included are areas of poorly drained loams and clay loams also included are areas with shallow covering of sand. Area has slight limitations for agricultural uses; and moderate limitations for urban development.

AREA 4:

This area is the poorly drained clays and heavy clay loams. Included are numerous areas with a shallow covering of sand. Moderate limitations for agricultural use with severe limitations for urban land uses.

AREA 5:

Most of this area is Tuscola very fine sandy loam. It is a moderately well-drained soil composed of silts and very fine sands. Included are areas of poorly drained silts and silts over loams. Slight to moderate use limitations for both urban and agricultural land uses.

AREA 6:

Most of this area is Tuscola silt loam. The area is nearly the same as Area 5, but has a silt loam surface and generally more silts and less fine sands in the profile. It is less subject to wind erosion than Area 5. Slight limitations for both urban and agricultural land uses.

AREA 7:

An area of poorly drained stratified silts and fine sands. Included are small areas of somewhat poorly drained silts. Severe limitations for urban land uses. Moderate limitations for agricultural land uses.

AREA 8:

An area of loamy sand with a substratum of clay loam at depths of $3\frac{1}{2}$ to $5\frac{1}{2}$ feet. Moderate use limitations for both agricultural and urban land uses.

AREA 9:

An area of well-drained gravel soils. Included are somewhat poorly drained gravel soils. Slight limitations for urban land uses. Moderate limitations for agricultural land uses.

AREA 10:

River flood plains. The soils are material deposited by the floods. The major soils are well-drained, but included are areas of poorly drained soils. Slight limitations for agricultural land uses. Severe limitations for urban land uses.

NOTE: When more detailed information for a use category on different parcels of land are needed, the soils on that parcel as indicated on the 1938 soils map of the County should be used. The use ratings for the soil areas is the use rating for each soil found in the County. Many changes have occured in the soil classification system since 1938. When interpretations are made for the 1938 soils under the present interpretation system, there is a possibility of errors because of difference in classification since 1938. It must also be noted that the use limitation for each soil areascan be reduced through man made improvements to increase natural drainage, or bearing capacity of the soils through excavation and pilings.

a consequence, some quarter sections contained portions of two or three different soil areas. Thus, to determine the different populations of soil areas, all quarter sections were listed under the soil type to which they belonged, i.e., all quarter sections located in one individual soil area were grouped together; quarter sections which were split by two or more different soil areas were listed under the appropriate combination of soils category.

Soil groupings with more than thirty quarter sections from which to select a sample of thirty include:

Area 1	Areas 1 plus 2	Areas 4 plus 10
Area 2	Areas 2 plus 3	Areas 3 plus 5
Area 3	Areas 1 plus 10	
Area 4	Areas 1 plus 4	
Area 5	Areas 2 plus 10	
Area 6	Areas 1 plus 3	
Area 10	Areas 6 plus 10	

From the total number of quarter sections in each of these soil groupings, a sample of thirty quarter sections was selected at random. All other soil area combinations which did not have thirty (30) representative quarter sections were grouped together under "Others", and a sample of thirty (30) quarter sections was selected at random. Thus, a total of sixteen soil groups was created.

By using the statistical technique as outlined in Chapter III, property values for 1955 and 1968 for the entire sample for each individual soil area were summed up. The total sample values for all other soil areas were summed up in the same manner. This resulted in a total value for the entire quarter section sample (n is 30) for each of the sixteen soil areas. Table 12 depicts the summed up values for 1955 and 1968 for each individual soil area. The 1955 and 1968 values were added together for all sixteen soil areas and for the entire sample (N = 960). The same procedure was repeated, except that all individual values were squared and then summed. Table 13 shows the results of this computation. These two steps then completed the data for substitution into the analysis of variance formats discussed and depicted in Chapter III.

TABLE 12

Summed 1955 and 1967 Real Property Values
For Each Soil Area

Soil Area Number	Samples Number	1955 Value	1967 Value	1955 & 1967 Value
1	1-A to 1-DD	3,054	9,670	12,724
2	2-A to 2-DD	13,469	68,814	82,283
3	3-A to 3-DD	5,626	26,969	32,595
4	4-A to 4-DD	2,754	11,778	14,532
5	5-A to 5-DD	4,023	12,989	17,012
6	6-A to 6-DD	10,167	83,782	93,949
10	10-A to 10-DD	7,763	31,969	39,732
1-2	8-A to 8-DD	4,521	19,200	23,721
1-10	9-A to 9-DD	27,831	68,986	96,817
1-4	10-A to 10-DD	6,445	25,341	31,786
2-10	11-A to 11-DD	110,226	208,556	318,782
1-3	12-A to 12-DD	25,325	46,579	71,904
6-10	13-A to 13-DD	64,530	171,645	236,175
2-3	14-A to 14-DD	7,180	24,781	31,961
4-1	15-A to 15-DD	2,456	8,334	10,790
Others	16-A to 16-DD	16,549	34,137	50,686
TOTALS		311,919	853,530	1,165,449

TABLE 13

Squared 1955 and 1968 Real Property Values
For Each Soil Sub-Growth Variable

Soil Area Number	Sample Number	1955 Value (n^2)	1968 Value (n^2)	1955 & 1968 Value (x^2)
1	1-A to 1-DD	760,286	6,578,846	7,339,132
2	2-A to 2-DD	54,053,885	1,079,701,129	1,133,755,014
3	3-A to 3-DD	1,211,436	64,566,725	65,778,161
4	4-A to 4-DD	368,046	6,157,292	6,525,338
5	5-A to 5-DD	687,565	6,716,054	7,403,619
6	6-A to 6-DD	15,100,713	1,113,025,483	1,128,126,196
10	7-A to 7-DD	18,697,835	209,606,436	228,304,271
1-2	8-A to 8-DD	1,144,533	51,303,870	52,448,403
1-10	9-A to 9-DD	590,377,615	3,113,487,344	3,703,864,959
1-4	10-A to 10-DD	2,754,423	26,954,465	29,708,888
2-10	11-A to 11-DD	10,893,685,605	36,449,086,922	47,342,772,527
1-3	12-A to 12-DD	454,374,610	1,135,777,631	1,590,152,241
6-10	13-A to 13-DD	1,220,781,334	3,669,345,777	4,890,127,111
2-3	14-A to 14-DD	1,795,832	22,566,556	24,362,388
4-10	15-A to 15-DD	525,149	5,464,038	5,989,187
Others	16-A to 16-DD	43,088,959	158,782,320	210,871,279
TOTALS		13,299,407,826	47,119,120,959	60,418,528,714

Table 14 depicts the F ratios which were computed using the analysis of variance techniques, fixed effects model. The result of the entire analysis of variance procedures was completed and noted separately.

TABLE 14

Analysis of Variance:

Computed F Ratios - Soils

Source of Variation	Sums of Squares	DF	Mean Square	F Ratio	Expected Mean Squares
COLUMNS	307,231,745.13	1	307,231,745.130	5.04	Column effects plus error
ROWS	1,851,077,064.43	15	123,405,137.630	2.03	Row effects plus error
INTERACTION	294,144,536.13	15	19,609,635.742	.32	Interaction effects plus error
ERROR	56,551,209,356.23	.928	60,938,803.18	--	Error alone

Results

1. The F ratio of the Mean Square for columns at the .01 level indicates that a significant increase of real property value between 1955 and 1968 has taken place. This disproves our null hypothesis that real property values for 1955 and 1968 were equal.
2. The F ratio at the .01 level indicates that the Mean Square for rows is statistically significant. This disproves our first null hypothesis that no significant differences in real property value due to soil area characteristics exist.
3. The F ratio for the Mean Square interreaction at either the .01 or .05 level indicates changes in real property value were either due to passage of

time or soil area characteristics, i.e., there was no interaction effect. Real property values increased proportionally, although not equally during the intervening thirteen (13) year period.

By using the Tukey Technique, as described in Chapter II, all soil areas were compared and ranked with each other. The results of the Tukey Technique were computed at the .01 level and ranked according to the increase of real property value between 1955 and 1968. Table 15 depicts the results of the Tukey Technique.

TABLE 15

Real Property Value Increases of Soil Areas and Soil Area Groupings by Rank Value 1955 - 1968

1st Area 2-10.

2nd Area 6-10.

3rd Area 6, and Area 1-10.

4th Area 2.

5th Area 1-3.

6th Others.

7th Area 10, and Area 3.

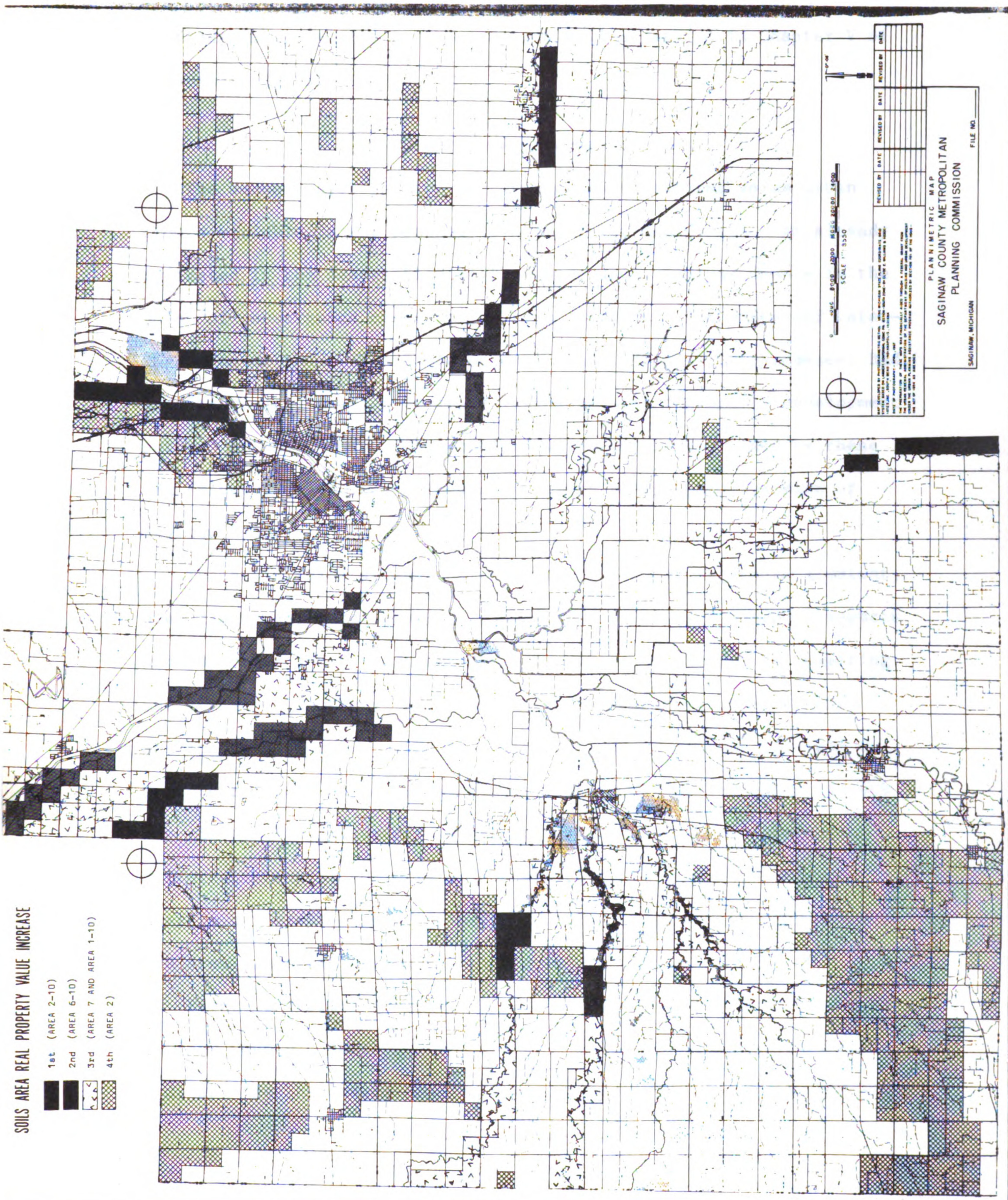
8th Area 3, Area 2-3, Area 1-4, (Area 3 fits in two groupings).

9th Area 1-2, and Area 5.

10th Area 5, Area 4, Area 1, and Area 4-10. (Area 5 fits in two groups.)

Figure 5 depicts the four soil groupings on a quarter section basis which experienced the highest increase of real property value over the thirteen year period. A more detailed elaboration on the significance

Figure 5


SOILS AREA REAL PROPERTY VALUE INCREASE
1st (AREA 2-10)
2nd (AREA 6-10)
3rd (AREA 7 AND AREA 1-10)
4th (AREA 2)
PLANNIMETRIC MAP
SAGINAW COUNTY METROPOLITAN
PLANNING COMMISSION
SAGINAW, MICHIGAN
FILE NO.

of findings as related to this section will be stated in Chapter V of this investigation.

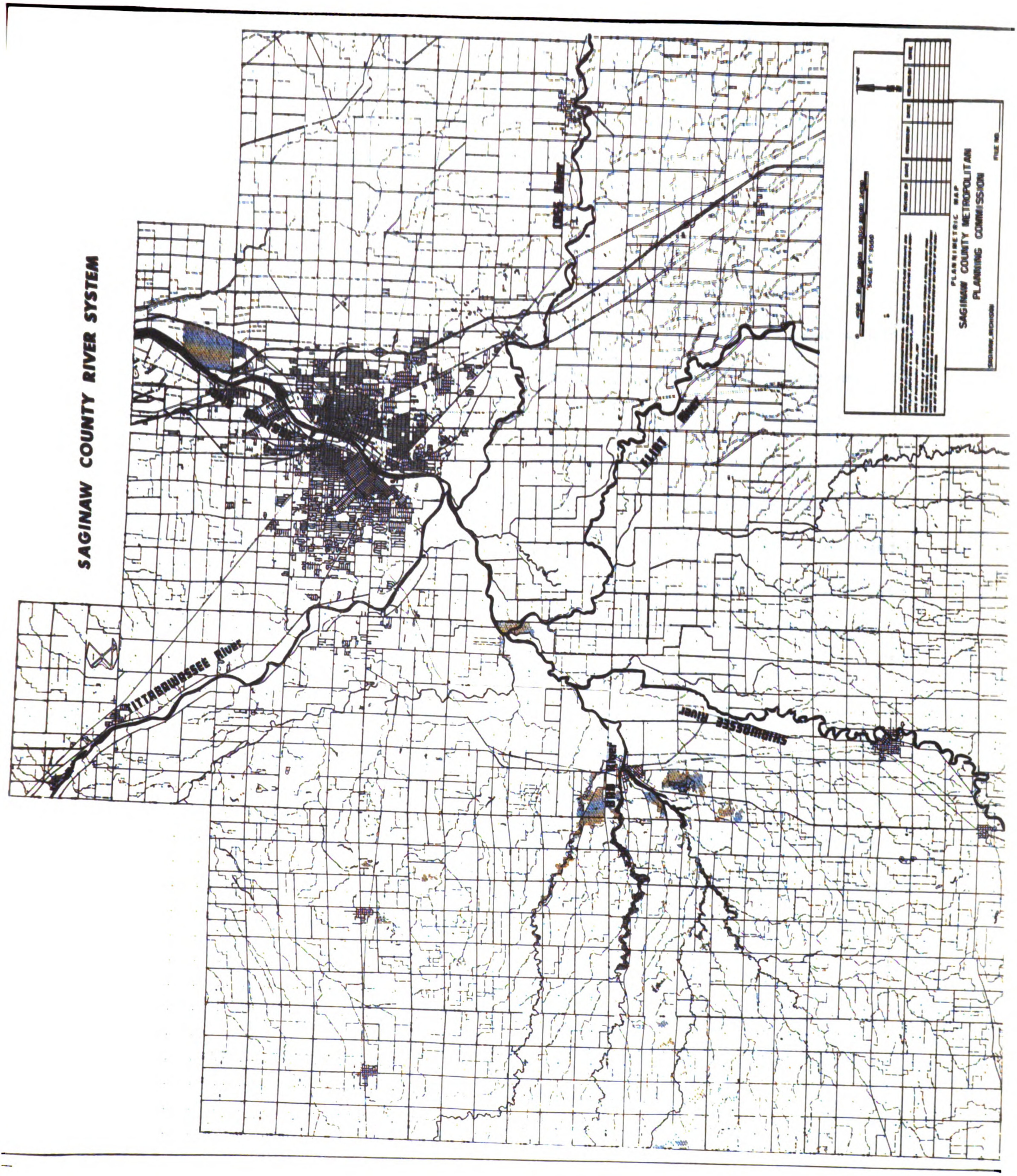
Rivers and Streams

The second major portion of physiographic features as an urban growth variable is the drainage system of Saginaw County. As already indicated in the description of the study area, Saginaw County is the point of convergence of six major river systems. The shape and watershed area of these rivers and streams (Cass, Flint, Tittabawassee, Bad, and Shiawassee) exert a dominant influence upon the entire development pattern of the county. The combined watershed area drained by these six tributaries to the Saginaw area covers seven times the size of Saginaw County.

These six major streams differ from each other in stream gradient, area traversed, water quality, dimensional aspects, locational aspects and any other number of considerations which may be used in comparing one stream to another. As with soil characteristics, the various attributes of the five streams cannot be clearly defined but tend to be interrelated in such a manner as to make each stream unique in its own right. The uniqueness of characteristics further increases the differentiation of one stream from another. This in turn tends to exert a different degree of influence over the real property values of the area traversed by any one individual stream.

Figure 6 depicts the location of six major streams which traverse Saginaw County. These are the Saginaw, Tittabawassee, Cass, Flint, Bad, and the Shiawassee Rivers. Due to the fact that the Saginaw River

Figure 6


SAGINAW COUNTY RIVER SYSTEM
TITTABAWASSEE River
SHIAWASSEE River
FLINT River
PLANIMETRIC MAP
SAGINAW COUNTY METROPOLITAN
PLANNING COMMISSION

represents only a relatively minor and limited part of the overall river system in terms of length and area affected, the required sample size of N 30 could not be obtained. Briefly, the characteristics of the other five major rivers which merge to form the Saginaw River and for which an adequate sample size could be obtained are as follows:

Cass River

This is a secondary stream or tributary to the Saginaw River and generally traverses the county in an east-west direction. Stream width averages from twenty to fifty feet. Historically, the river was used as a water transportation route for lumber cut in the eastern part of the county. Despite its rating as a recreational stream, it is extremely polluted by municipal and industrial sewage generated from the City of Frankenmuth, and Bridgeport Township. The pollution factor and the natural debris from dead elm trees detracts and deters from the recreational potential of the stream. Essentially, the river represents a fixed natural obstacle for development activities which have spilled southward from the City of Saginaw and the urbanizing townships of Buena Vista and Bridgeport. The open wooded floodplain areas adjacent to the river constitute the only major open areas with recreational development potential. This has created extensive pressures for urban development activities, especially for residential development activities to locate adjacent to the stream.

Flint River

The stream originates in Lapeer County, traverses the Flint Metropolitan Area and merges with the Shiawassee River in Saginaw County.

The stream traverses Saginaw County in a general north-south direction. Stream width averages a constant 20-40 feet. Over one-half (½) of the Flint River, as it traverses Saginaw County, is located within the Shiawassee Game Refuge Area. The remaining portion traverses an agricultural and open space area. However, the use made of the Flint River in Genesee County by the entire Flint Metropolitan Area has extensively deteriorated both the water flow volumes and the water quality level of the stream. The general deteriorated state of the stream, relative location, and area traversed can be considered as primary factors which tend to negate its development potential.

Shiawassee River

Generally, the Shiawassee River traverses Saginaw County in a southwesterly direction. Stream width averages 15-20 feet near the Village of St. Charles and widens to 50-75 feet where it joins the Saginaw River. The stream tends to be less polluted than either the Tittabawassee, the Flint, or the Cass Rivers. This can be attributed to the fact that the river traverses a predominantly agricultural region and the entire Shiawassee Wildlife Game Refuge Area. Only two minor urban settlements utilize the river for the disposal of treated sewage. No extensive industrial activities are located directly adjacent to the stream. Despite the somewhat higher water quality of the stream, the recreational development potential and potential for urban development activities tend to be restricted by the lack of public access, the extensive floodplain and flooding problems of the river. Another factor related to the lack of development pressures exerted on land adjacent to the Shiawassee River can be attributed to the large areas in proximity to urban areas dedicated to the Shiawassee Wildlife Game Refuge Area.

Tittabawassee River

This stream traverses Saginaw County for a length of approximately 25 miles. Average stream width ranges from 50-75 feet. During the lumbering era, this stream represented the main route for the transport of timber from the northern timber lands of the Saginaw watershed area. Currently, the Tittabawassee River is utilized almost in its entirety by the Dow Chemical Company in Midland for the disposal of treated industrial waste and as a coolant for industrial manufacturing processes. In addition, the City of Midland in Midland County along with the urbanizing townships of Tittabawassee, Thomas, and Saginaw, located in Saginaw County, utilize the river for sewage effluents. Due to the extensive utilization of the river as a disposal medium for public sewage and industrial wastes, the river has been designated by the Michigan Water Resources Commission as a Commercial Stream.

Another factor related to the intensive use of the stream can be attributed to the direction of urban growth and development. Over the past two decades, extensive urban development activities have taken place in a northwest direction relatively close to the Tittabawassee River. This can be attributed again to the spillover of growth and development from the older urbanized core area, the presence of a well developed road system and developable open land. As with the Cass River, the Tittabawassee River despite its polluted condition has open space and aesthetic qualities which seem to attract high grade residential development activity.

Bad River

This river represents a major branch of the Shiawassee River. Generally, this stream drains the southwest portion of Saginaw County and runs in a semi east-west direction. Stream width varies from 12 to 25 feet. Due to the predominantly agricultural and open space nature of the area traversed by the Bad River, this stream has not been contaminated to the same extent and degree as have the other four streams. Due to the relatively low level of pollution and the absence of extensive floodplains this area is of prime potential for recreational development activities. However, the relative location of the stream in relation to urban and urbanizing areas in the county in terms of travel distance has thus far been a prime factor in the lack of development pressures.

Sampling Procedures

All quarter sections which were traversed in any way by one individual stream were grouped together as a population. A random sample of N 30 was drawn from the total population of quarter sections for each of the five streams. To ascertain if rivers exerted any change over real property values, a sample of thirty was drawn at random for the total population of quarter sections not traversed or directly affected by a river.

Rivers with a sample of thirty quarter sections included the Cass, Flint, Shiawassee, Tittabawassee, and the Bad Rivers. In addition, a sample of thirty was drawn from areas not traversed or affected by rivers. This sample was designated as "no rivers". Using the identical techniques outlined in Chapter III and further discussed in the previous section, a base for further statistical analysis was completed. Tables 16 and 17 depict the sample values summed and squared for each river.

TABLE 16

Summed 1955 and 1968 Real Property Values for Entire Sample of Quarter Sections Traversed by Rivers

River	Sample	1955	1968	1955 + 1968
Cass	N-30 A	39,910	105,531	145,441
Flint	W-30 B	6,778	15,851	22,629
Shiawassee	W-30 C	2,692	10,093	12,785
Tittabawassee	W-30 D	13,088	91,803	104,891
Bad	W-30 E	3,443	108,498	111,941
No River	W-30 I	6,699	18,362	25,061
TOTALS		72,610	350,138	422,748

TABLE 17

Squared 1955 and 1968 Real Property Values for Entire Sample of Quarter Sections Traversed by Rivers

River	Sample	1955	1968	1955 + 1968
Cass	N-30 A	624,980,832	2,260,657,587	2,885,638,419
Flint	W-30 B	14,448,237	28,723,885	43,172,122
Shiawassee	W-30 C	460,732	7,597,581	8,058,313
Tittabawassee	W-30 D	24,326,208	727,398,375	751,724,583
Bad	W-30 E	1,113,799	3,616,366,820	3,617,480,619
No River	W-30 I	6,896,472	27,265,041	34,161,513
TOTALS		672,226,280	6,668,009,289	7,340,240,569

Using Tables 16 and 17 and following the outlined statistical procedure, any statistical significance of relationship of rivers toward changes in real property values could then be discerned.

TABLE 18

Analysis of Variance
Computed F Ratios - Rivers

Source of Variation	Sum of Squares	DF	Mean Square	F Score	1% F Ratio
Columns	213,949,418.84	1	213,949,418.84	11.9890	6.63
Rows	270,059,947.43	5	54,011,898.49	3.0266	3.02
Interaction	149,581,241.00	5	29,916,248.20	1.6764	3.02
Error	6,210,216,985.33	348	17,845,451.12		

Results

1. The F ratio of the Mean Square for Columns at the .01 level indicates that a significant increase of real property value between 1955 and 1968 has taken place. This disproves the null hypothesis that real property values for 1955 and 1968 were equal.
2. The F ratio at the .01 level indicates that the Mean Square for rows is statistically significant. This disproves our first null hypothesis that no significant differences in real property values were due to the characteristics of quarter sections traversed by rivers.
3. The F ratio for the Mean Square interreaction at either the .01 or .05 level indicates changes in real property value were either due to passage of time or to the characteristics

of quarter sections traversed by rivers; there were no interaction effects. Real property values increased proportionally, although not equally during the intervening thirteen-year period.

Application of the Tukey technique to the statistical findings derived from the analysis of variance techniques indicates a ranking of increases in real property values over the thirteen-year period. All differences are significant because all values are more than $3,675.22 apart (except for the Bad River and no rivers sample category).

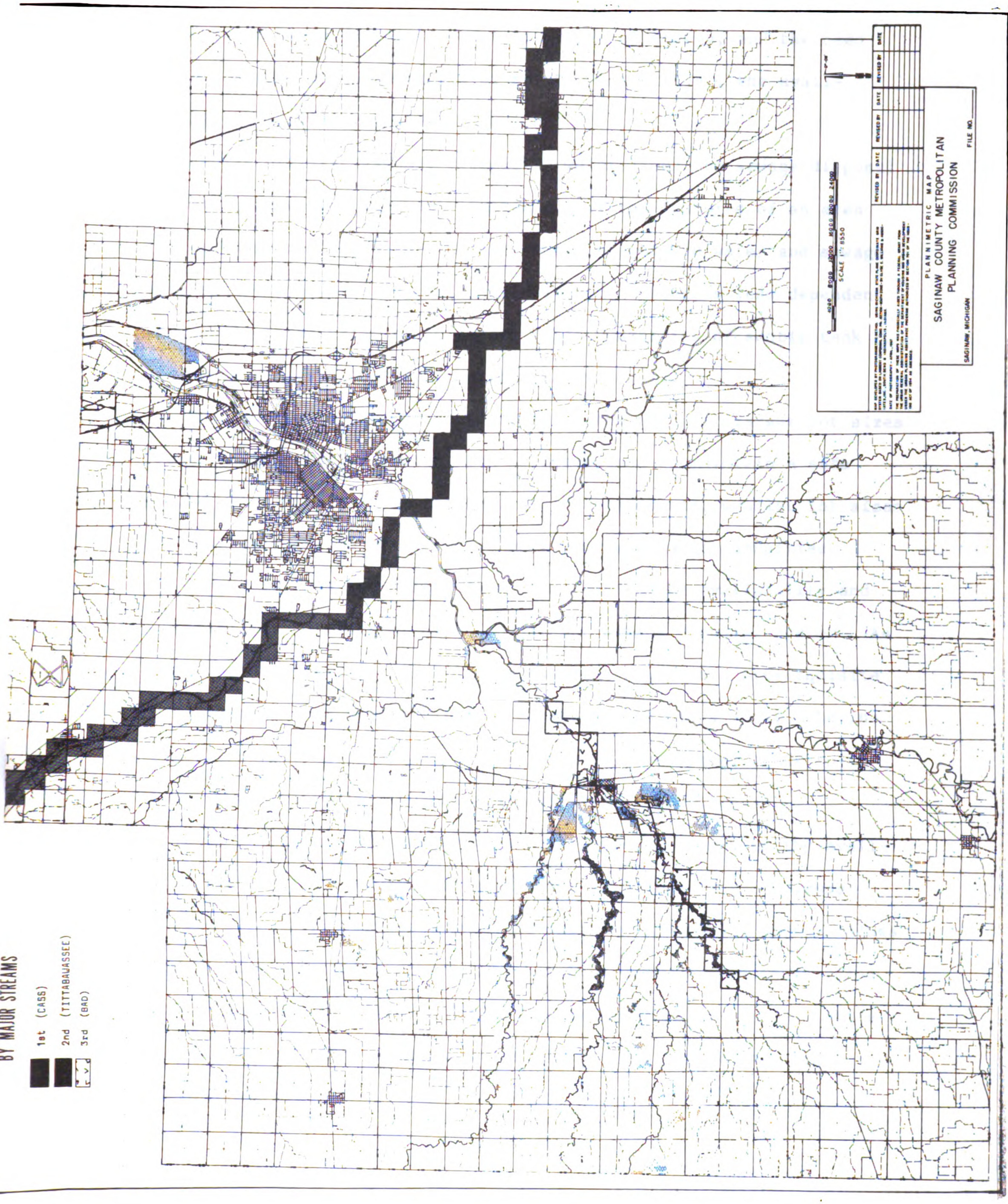
1. Cass River
2. Tittabawassee River
3. Bad River - No Rivers
4. Shiawassee River

The above ranking indicates that land traversed by the Cass and Tittabawassee Rivers experienced a higher increase in real property values than land not traversed or affected by a river. This, however, was not the case with the Bad and Shiawassee Rivers. Area traversed by these two streams did not increase significantly in real property values when compared to areas not traversed or affected by a river. Figure 7 depicts graphically the above ranking.

Utilities

Urban growth and development in any given area tends to be largely influenced by the availability and accessibility of a system of utility services. The availability of a system of utility services enables a more intensive and extensive use of the land by eliminating the con-

Figure 7


BY MAJOR STREAMS
1st (CASS)
2nd (TITTABAWASSEE)
3rd (BAD)
PLANNIMETRIC MAP
SAGINAW COUNTY METROPOLITAN
PLANNING COMMISSION
SAGINAW, MICHIGAN
FILE NO.

straints of waste disposal, constant supply of energy, and the need for a constant adequate supply of potable water; i.e., the availability of a utility system.

Public utility systems, especially water lines and sewage disposal systems, reduce the inherent limitations of the features of an area for development. With an external supply of potable water and sewage disposal methods, the intensity of development becomes less dependent upon soil characteristics to absorb large quantities of septic tank effluents and as a source of potable water supply.

When available for residential areas, the need for larger lot sizes formerly required for septic tank effluents and to maintain a safe ground water supply is diminished. As a consequence, smaller lot sizes are usually required which result in higher population densities.

Commercial and industrial land uses require the availability and accessibility to external water supply and sewage disposal system. As such, the availability of utilities can be considered a pre-requisite for commercial and industrial development. Thus, as a whole, the intangible desirability of an area for further development tends to increase proportionally with the availability of utilities.

Both the intangible and tangible attributes provided by the availability of utility services to a site not only tend to remove undesirable site characteristics but also increase the real property values through higher expected returns which can be derived from those areas served by public utilities. These real property values tend to be reflected not only in the market value of the site but in the larger surrounding area.

Unlike physiographic features, the component characteristics of the overall utility system can be more clearly defined. This is due to the functional design and capability of each component of the overall utility system. Water lines serve as a method for the transportation of potable water. Gas lines provide for the transportation of fuel. Sewer lines have been designed exclusively to serve the transportation mode for the removal of wastes. The functional utility of electricity and telephone tends to be defined similarly and need not be elaborated upon.

Delineation of Sample Population for Utility System Components

In Saginaw County, the availability of one individual utility system often dictates the presence of another utility service. All areas served in the county by public services are also served by a public water supply and gas service provided by private utility companies. While public water and natural gas may be available separately in various parts of the county, sewer lines are always found in combination with a public water and a gas supply system. Additionally, while electricity and telephone service as separate utility systems are uniformly available throughout the county, the three major utility systems of gas, water and sewage disposal are limited to certain portions of the county.

For this reason, the sampling will limit itself to the quarter sections traversed or affected by these utility systems, either singularly or in combination with each other. Further, to distinguish between areas served and not served by these three utility systems and to establish a relative basis for comparison, a sample population of quarter sections not affected or traversed by these three utility systems was also determined. The categories of columns for which a sample population of quarter sections was established is as follows:

1. Water and Gas in combination.
2. Water, Sewer, and Gas in combination.
3. Water only.
4. Gas only.
5. Not affected by either water, sewer, or gas utility service.

<u>Sampling Procedures</u>

The grid of quarter section units superimposed over the surface of Saginaw County, each individual quarter section having a mean real property value for 1955 and 1968, again will form the basis for the determination of the sample population. All quarter sections which were traversed or touched in any way by one of the above defined utilities categories were grouped separately as a population. After the population of quarter sections was determined, a sample of N 30 was drawn at random from each population.

Tables 19 and 20 indicate the summed and squared mean property values for each utility column for 1955 and 1968.

TABLE 19

Summed 1955 and 1968 Real Property Values
For Quarter Section Samples Serviced by Utilities

	Sample	1955	1968	1955 & 1968
Water	30-A	7,010	23,998	31,008
Gas	30-B	6,165	81,146	87,311
Water & Gas	30-C	11,784	56,808	68,592
Water, Sewer & Gas	30-D	32,763	222,006	254,769
No Utilities	30-E	4,591	12,859	18,450
TOTALS		62,313	396,817	460,130

TABLE 20

Squared 1955 and 1968 Real Property Values
For Quarter Section Sample Serviced by Utilities

	Sample	1955	1968	1955 & 1968
Water	30-A	1,854,024	22,452,006	24,306,030
Gas	30-B	1,659,479	1,470,811,264	1,472,470,743
Water and Gas	30-C	17,363,756	177,329,604	194,693,360
Water, Sewer & Gas	30-D	558,279,745	6,558,911,154	7,117,190,899
No Utilities	30-E	943,227	7,839,209	8,782,436
TOTALS		580,100,231	8,237,343,237	8,817,443,468

The data contained in Tables 19 and 20 were analyzed again using the outlined statistical procedures. The statistical significance of changes in real property values of each category or column could then be discerned and is depicted in Table 21.

TABLE 21

Analysis of Variance
Computed F Ratios - Utilities

Source of Variation	Sum of Squares	DF	Mean Square	F Ratio	Expected Mean Square
COLUMNS	375,209,780.057	1	375,209,780.057	16.0538	Column effect plus error
ROWS	603,221,528.831	4	150,805,382.209	6.4523	Row effect plus error
INTERACTION	355,402,085.933	4	88,850,521.461	3.8015	Interaction effect plus error
ERROR	6,777,878,016.933	290	23,271,993.162	---	Error alone

Results

1. The F ratio of the Mean Square for columns at the .01 level indicates that a significant increase of real property value between 1955 and 1968 has taken place. This disproves the null hypothesis that real property values affected by utilities systems for the period 1955 and 1968 were equal.
2. The F ratio at the .01 level indicates that the Mean Square for rows is statistically significant. This disproves the first null hypothesis that no significant difference in real property value was due to the characteristics of the quarter section sample traversed or affected by the three utilities systems.
3. The F ratio for the Mean Square interreaction at either the .01 or .05 level indicates changes in real property value were either due to passage of time or to the characteristics of quarter sections traversed by the utility system; no interaction effect. Real property values increased proportionally, although not equally during the intervening thirteen year period.

The application of the Tukey technique to the statistical findings depicted on Table 21 indicates the following ranking of increases of real property values by utility category.

1st - Water, Sewer and Gas combination

2nd - Gas only

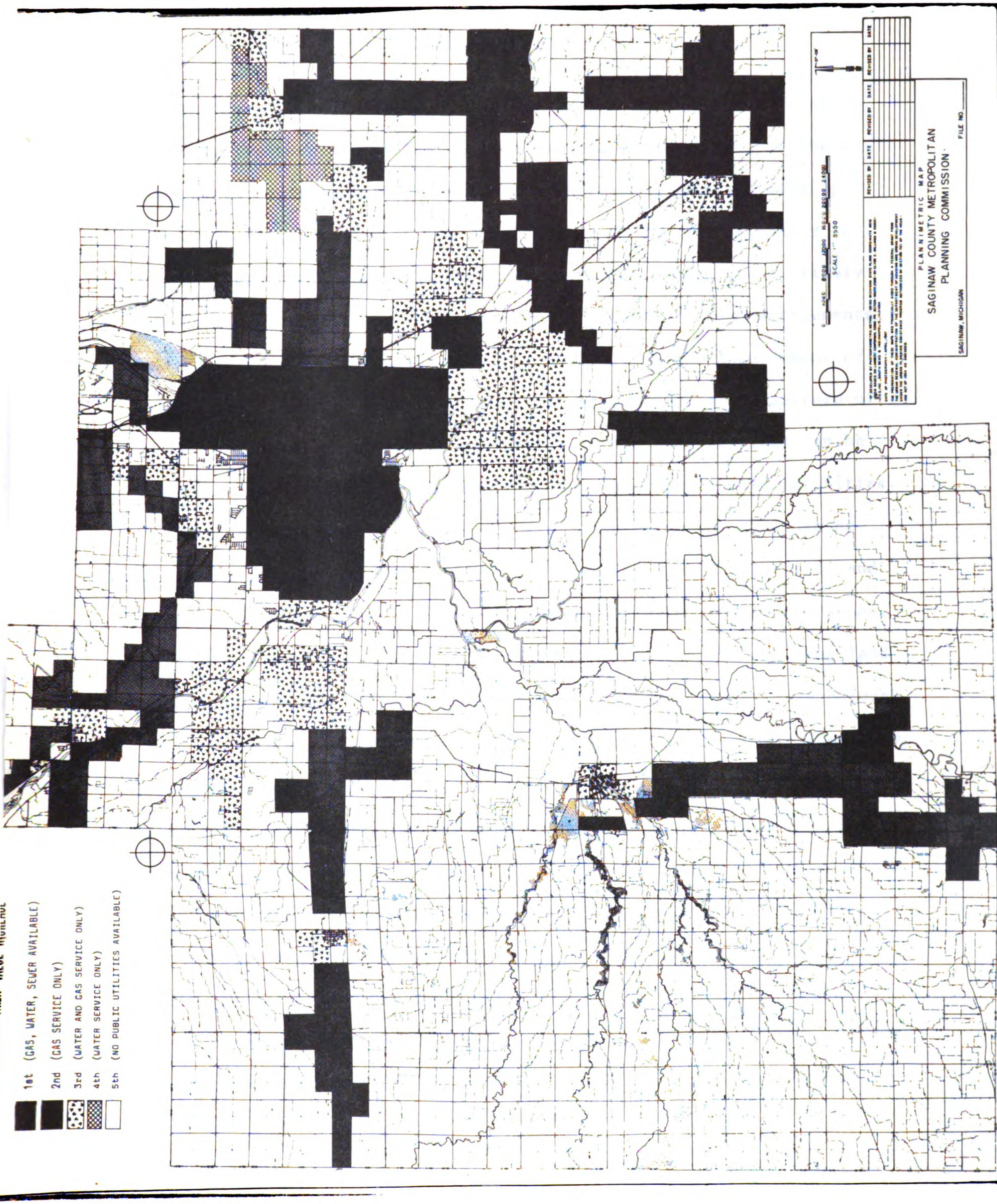
3rd - Water and Gas in combination

4th - Water only

5th - No Utilities

Figure 8 depicts the location of real property value increases by rank.

Figure 8


1st (GAS, WATER, SEWER AVAILABLE)
2nd (GAS SERVICE ONLY)
3rd (WATER AND GAS SERVICE ONLY)
4th (WATER SERVICE ONLY)
5th (NO PUBLIC UTILITIES AVAILABLE)
PLANNIMETRIC MAP
SAGINAW COUNTY METROPOLITAN
PLANNING COMMISSION
SAGINAW, MICHIGAN
FILE NO.

Transportation

The overall environment of Saginaw County can be viewed as an accumulative total of different land use components. Each of these components is influenced not only by historical growth and development patterns, but also by the availability of and accessibility to a system of trafficways. Transportation routes constitute a primary determining influence on the location and nature of urban settlements, and constitute a prerequisite for the utilization and development of the natural resource base of a given locality. Within the pattern of growth and development the accessibility to and from any area can be considered as a constant pre-condition for land development activities.

This relationship of travel and travel costs to the land use development pattern has been a major topic of concern by economists and land use planners alike. In the review of the literature, Von Thunen, Haig, and Wingo, among others, related and explained the existing land use pattern to the availability or the lack of a transportation network in terms of time and travel costs to move goods and services. Land use development models as used by the more elaborate and complex land use planning programs clearly define and emphasize the relationship of the transportation network to service the surrounding land use pattern. In these land use development models, land use components in themselves are viewed as traffic generators. Traffic generated by the adjacent and surrounding land use pattern will differ in terms of generated traffic volumes from one land use category to another. Through a determination of traffic volumes generated by a given land use component, a transportation system can then be designed which has the capacity to handle traffic volumes subjected to it by the various defined traffic generators. The intensity of land use patterns as traffic generators thus tend to be closely correlated with the functional design capability of the transportation network servicing a given locality. Additionally, by either increasing or decreasing the accessibility of a given area, the existing trafficways system exerts an influence on the intensity of land uses traversed.

The intensity of land uses in turn would ultimately be reflected in the pattern of real property values of any given area traversed by these various component parts of the overall transportation network.

Delineation of Sample Populations for Various Components of the Transportation Network

The travel pattern within and between various land use components thus takes place over a system of streets and highways. This system of streets and highways tends to differ in basic design capacity to service and move traffic volumes generated by the adjacent land use pattern.

A four-lane highway with limited access will have a higher traffic volume carrying capacity than a four-lane highway with no limitations on access. In this context the extent and degree of influence a transportation network can exert upon the adjacent land use pattern can be considered directly proportionate to the design and the differentiation of design capacity between parts of an overall transportation system. This differentiation can be attributed to the design standards incorporated in various parts of the highway network. The design classification assigned to parts of the overall highway system tends to differ in terms of trip lengths, access control, median width, and surface.

In Saginaw County the existing transportation network has been classified by the Michigan Department of State Highways according to a functional design classification system. The five basic highway classifications for Saginaw County include: Statewide arterials, regional arterials, metro area arterials, principal collectors and secondary collectors.

Table 22 depicts the design criteria applied to each functional highway classification. Figure 9 depicts the classification system as applied and determined for the existing transportation network in Saginaw County. This classification of the existing transportation network was determined by the State Highways Department in collaboration with the Saginaw County Road Commission.

Sampling Procedure

All quarter sections which were traversed in any way by any portion of the transportation network designated and classified according to the design standards depicted on Table 22 were grouped together as a population. Thus, a population of quarter sections was obtained for each of the following designated functional highway classifications:

1. Statewide Arterial
2. Regional Arterial
3. Local Arterial
4. Principal Collector
5. Secondary Collector
6. Areas not traversed or affected by streets and highways not classified according to the design standards depicted in Table 22.

Figure 9

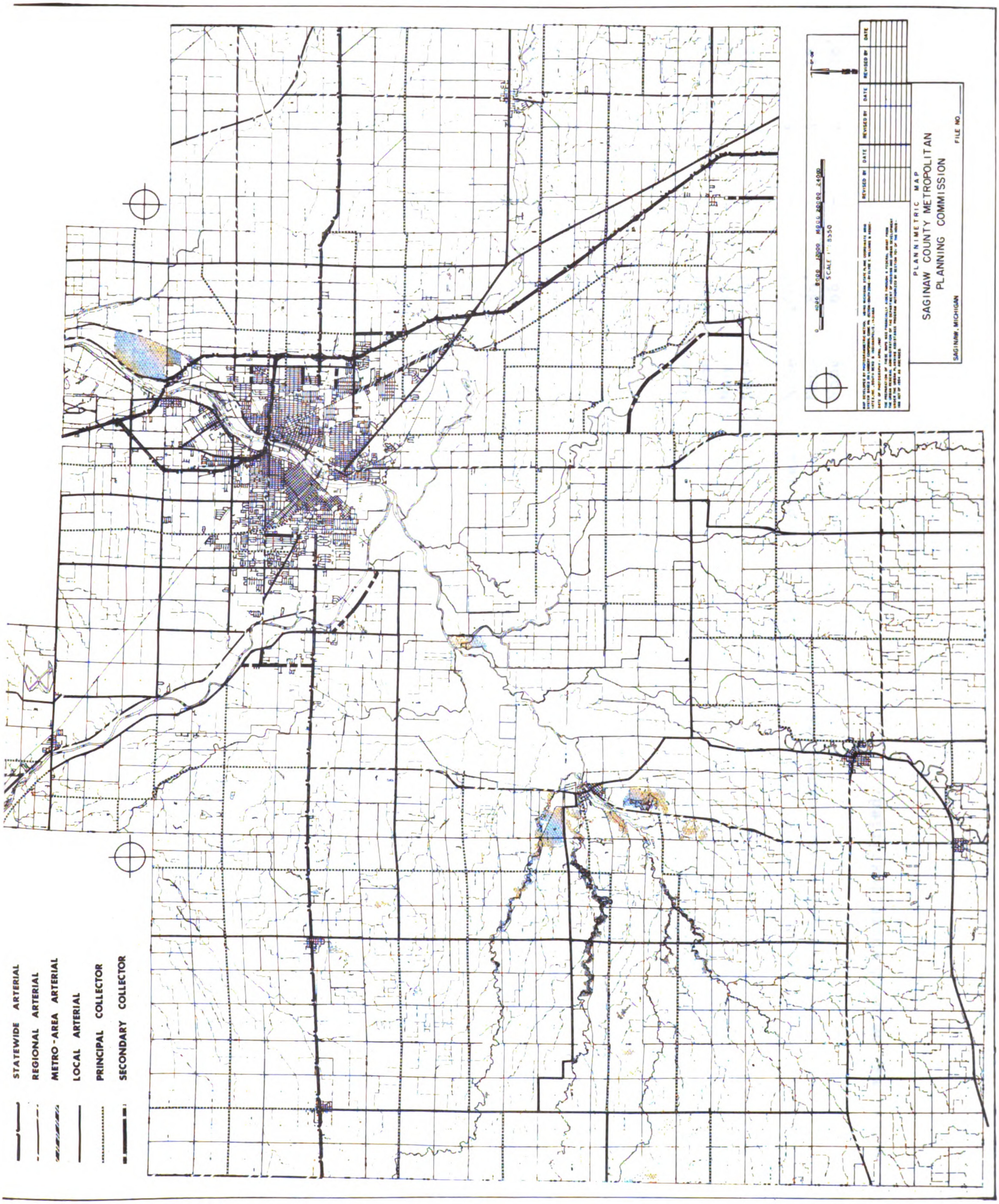

STATEWIDE ARTERIAL
REGIONAL ARTERIAL
METRO-AREA ARTERIAL
LOCAL ARTERIAL
PRINCIPAL COLLECTOR
SECONDARY COLLECTOR
PLANNIMETRIC MAP
SAGINAW COUNTY METROPOLITAN
PLANNING COMMISSION
SAGINAW, MICHIGAN
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TABLE 22

FUNCTIONAL CLASSIFICATION OF HIGHWAYS

FUNCTIONAL ASSIFICATION	PRIMARY SERVICE FUNCTION	SPEEDS (mph)	TRIP LENGTH (miles)	Access Control	Right of Way	Median Width	Lanes	Surface Width	Type
TERIAL SYSTEM									
atewide Arterial	Through traffic	45-70	4 - 20	Full	350'	26'	8	2 @ 48'	Paved
				Full	320'	26'	6	2 @ 36'	Paved
				Full	320'	50'	4	2 @ 24'	Paved
				None	150'	-	4	48'	-
gional Arterials	Through traffic, limited land service	35-45	1 - 15	None 5/	200'	60'	8	2 @ 48'	-
				None 5/	200'	60'	6	2 @ 36'	-
				None 5/	200'	84'	4	2 @ 24'	-
				None	150'	-	4	48'	-
cal Arterials	Lesser arterial service at local level, more emphasis on land access	30-45	10 or less	None	120'	-	7	84'	-
				None	120'	-	5	60'	-
				None	86'	-	4	48'	-
				None	66'	-	2	28'	-
LLECTOR SYSTEM									
incipal Collectors	Connect local systems with arterials	25-40	2 or less	None	120'	-	7	84'	-
				None	120'	-	5	60'	-
				None	86'	-	4	48'	-
				None	66'	-	2	28'	-
condary Collector	Connect local systems with arterials and other connectors	25-35	1 or less	None	100'	-	5	60'	-
				None	86'	-	4	48'	-
				None	66'	-	2	28'	-

Partial Access may be used where justified.

The next step included the random selection of a sample of n-30 from each of the above quarter section populations. Tables 23 and 24 reflect the summed and squared real property values for 1955 and 1968 for each sample population for each component part of the functional design classification as applied to the highway and street network within Saginaw County.

TABLE 23

Summed 1955 and 1968 Real Property Values for Transportation Quarter Section Samples

		Sums		
		1955	1968	1955-1968
Statewide Arterial	30A	18,624	108,191	126,815
Regional Arterial	30B	12,483	117,162	129,645
Local Arterial	30C	7,334	60,993	68,327
Principal Collector	30D	5,125	29,763	34,888
Secondary Collector	30E	157,300	447,975	605,275
Areas Not Served	30F	4,743	16,753	32,496
		205,609	780,837	986,446

TABLE 24

Squared 1955 and 1968 Real Property Values for Transportation Quarter Section Samples

		Squared		
		1955	1968	1955-1968
Statewide Arterial	30A	35,142,954	1,038,803,339	1,068,946,293
Regional Arterial	30B	23,540,954	4,542,531,588	4,566,072,542
Local Arterial	30C	3,348,812	9,590,652,610	9,594,001,422
Principal Collector	30D	1,661,461	7,908,888,970	7,910,550,431
Secondary Collector	30E	11,502,840,552	45,015,993,586	56,518,834,138
Areas Not Served	30F	958,819	14,952,327	15,911,146
		11,567,493,552	68,106,822,420	79,674,315,972

TABLE 25

Analysis of Variance Table
Computed F Ratios - Transportation

Source of Variation	Sum of Squares	DF	Mean Square	F Ratio	Expected Mea Square
Columns	919,131,255,511	1	919,131,255.511	4.4968	Column effec plus error
Rows	3,777,087,020,899	5	755,417,404,038	3.6958	Row effect plus error
Inter-action	1,145,759,987,489	5	229,151,997,498	1.1211	Interaction effect plus error
Error	71,129,349,622,933	348	204,394,682,825	--	Error alone

Results

From Table 25 the following results in regard to the statistical significance of the transportation influence on real property values between 1955 and 1968 can be interpreted as follows:

1. The F ratio of the Mean Square for the columns at the .01 level indicates that a significant increase of real property values between 1955 and 1968 has taken place. This disproves the null hypothesis that real property values for 1955 and 1968 were equal.
2. The F ratio at the .01 level indicates that the Mean Square for rows is statistically significant. This disproves our first null hypothesis that no significant difference in real property value due to the characteristics of quarter sections traversed by various parts of the trafficways system exists.
3. The F. ratio for the Mean Square interreaction at either the .01 or .05 level indicates that changes in real property

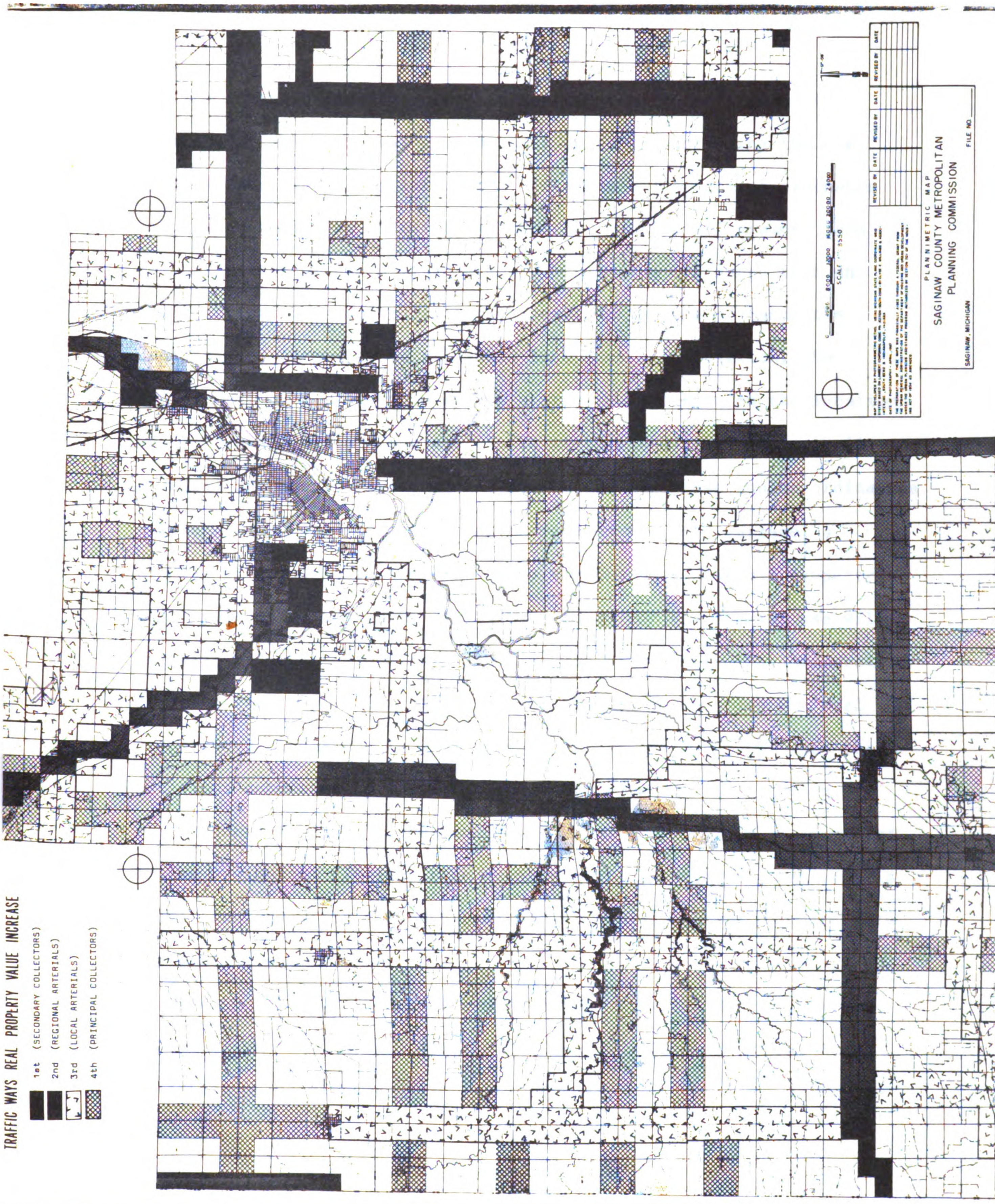
values were either due to passage of time or to the characteristics of quarter sections traversed or affected by portions of the trafficways system. All real property values increased proportionally although not equally during the intervening thirteen-year period.

By using the Tukey technique with respect to the statistical findings depicted on Table 26, the following ranking of real property value increase could be determined. The ranking is from highest to lowest increase in real property values of quarter sections traversed by the functional design classification assigned to the street or highway servicing the area.

1st or highest real property value increase - Secondary Collectors
2nd highest real property value increase - Regional and State Arterials
3rd highest real property value increase - Local Arterials
4th highest real property value increase - Principal Collectors
5th or least amount of real property value increase - Areas not served by roads classified according to the functional design classification.

Figure 10 depicts and illustrates graphically the results of the Tukey technique.

Figure 10


TRAFFIC WAYS REAL PROPERTY VALUE INCREASE
1st (SECONDARY COLLECTORS)
2nd (REGIONAL ARTERIALS)
3rd (LOCAL ARTERIALS)
4th (PRINCIPAL COLLECTORS)
PLANNIMETRIC MAP
SAGINAW COUNTY METROPOLITAN
PLANNING COMMISSION
SAGINAW, MICHIGAN
FILE NO.
SCALE
REVISED BY
DATE

Zoning

The zoning ordinance currently constitutes the most effective device available to local governmental units in controling the use of land "for the public interest". In essence, the zoning ordinance and its accompanying district map tend to restrict and promote land use activities within a given area. Through the ordinance text and the district map, zoning ordinances regulate the use of land, the density, and intensity of allowable land uses. In addition, the zoning ordinance as a whole exerts a primary influence on the location and relocation of land use activities as they relate to the overall physical and social environment. Due to the fact that zoning ordinances regulate the use which can or may be made on the land surface, a clearly discernible influence is also exerted upon the real property value pattern of any given area. Land zoned for residential use will normally be lower priced than land parcels zoned for either commercial or industrial uses. The effect of the zoning pattern upon the real property value pattern is also constantly manifested by the fact that petitions submitted to the local governing body for the rezoning of land request a higher allowable use than formerly allowed or permitted in the ordinance. It is a rare occurrence that a rezoning petition is submitted requesting that a parcel of land be zoned from commercial to residential designation.

Due to the fact that each local zoning ordinance and map clearly define allowable land use categories from one area to another, this variation of permitted land uses between areas will also be reflected in the variation of real property value pattern. In this context local zoning ordinances can be considered as a prime growth variable which not only influence the composition of the overall land use pattern but also exert considerable influence on the real property value pattern in any given area.

Delineation of Sample Populations for Zoning Categories

In Saginaw County, 24 of the total 37 governmental units have adopted zoning ordinances and have defined various areas for specific land use categories. Due to the many different levels of local governmental units which have adopted zoning ordinances, considerable differences exist between the individual ordinances currently in force in the county. These differences can be related primarily to the definition of terms, number of land use districts, and allowable land uses permitted within a defined zoned land use district. The resulting disparity between local zoning ordinances adopted in Saginaw County requires that only common attributes inherent in each zoning ordinance be used as a basis for the determination of sample quarter section populations. Common attributes which were relatively consistent for all 24 zoning ordinances were the designation of four major land use districts. These districts can be broadly defined as Commercial, Industrial, Residential, and Agricultural. The land use activities allowed in each broadly designated land use category were relatively constant but not identical for all 24 zoning ordinances. The major differentiation occurred in the lot sizes required by the broadly defined residential land use category. To further distinguish between the major differentiating attributes of the residential land use category, seven sub-residential categories were created. In this study, they were designated as R1, R2, R3, R4, R5, R6, and R7. The attributes of these seven sub-residential categories are as follows:

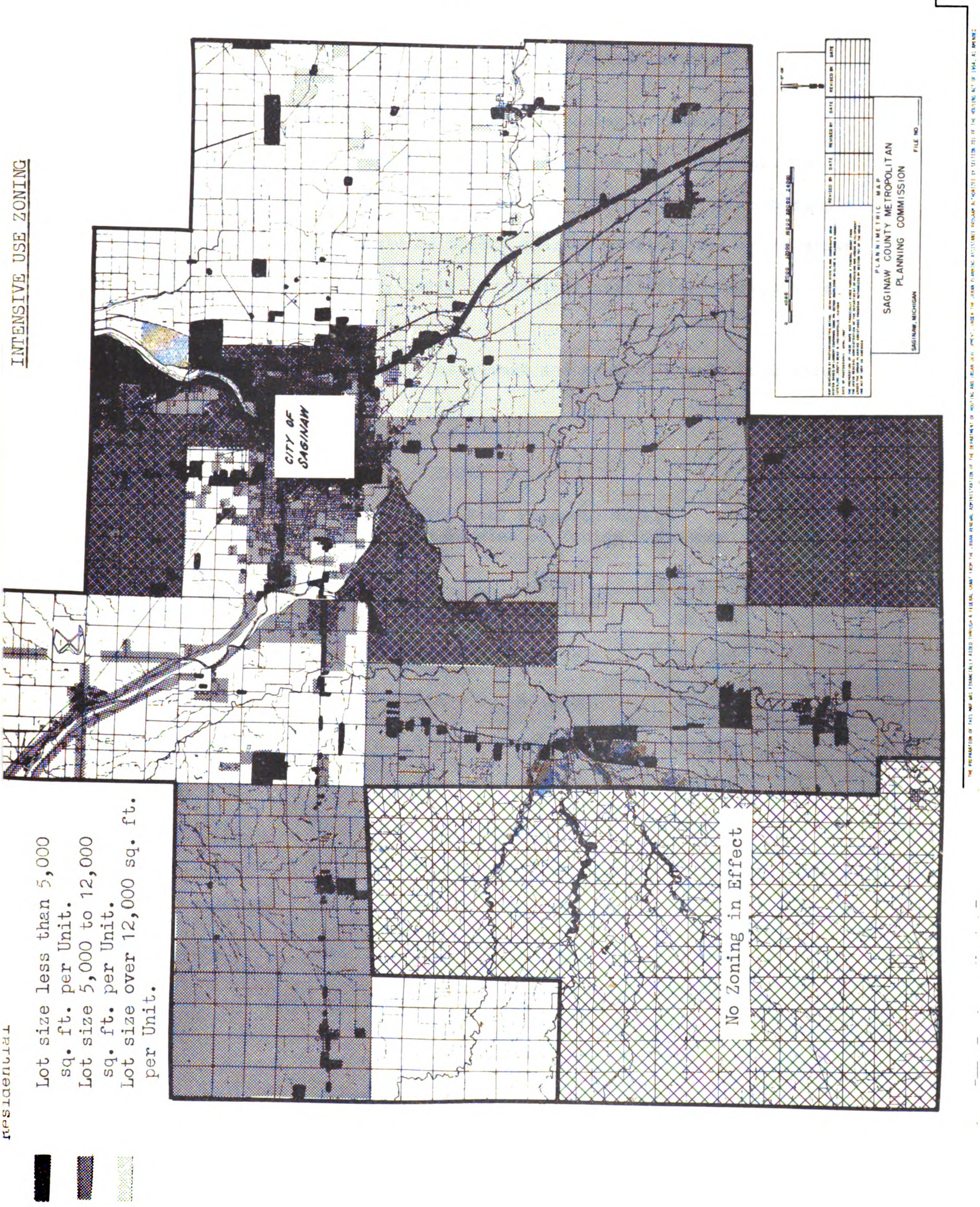
R1	No minimum lot size required
R2	Lot under 5,000 square feet allowed
R3	Minimum lot area 5,000 to 12,00 square feet per dwelling unit
R4	Lot area of 12,001 feet to 20,000 square feet per dwelling unit required.
R5	Lot area of 20,001 square feet to 40,000 square feet per dwelling unit required.
R6	Lot area over 40,000 square feet and over required for each dwelling unit.
R7	Designated as an agricultural district with residential land uses allowed. No specifications made as to minimum lot size made.

Sampling Procedure

The overall county land use pattern as zoned by the 24 local units of government tends to be uncoordinated and lacks a continuity of zoning districts. Figure 11 depicts the extremely scattered and dispersed nature of the zoned land use pattern. Due to this lack of continuity and coordination, many quarter sections contained two or more zoning designations. This especially is the case with commercial, industrial and residential land use categories. In order to take into account the various possible combinations of zoned land use designations within a quarter section unit, the following zoning categories or columns were designated as populations from which sample quarter section populations could be randomly drawn:

1. Residential (R1 to R7) singularly
2. Commercial-Residential in combination

Figure 11


INTENSIVE USE ZONING
CITY OF SAGINAW
Residential
Lot size less than 5,000 sq. ft. per Unit.
Lot size 5,000 to 12,000 sq. ft. per Unit.
Lot size over 12,000 sq. ft. per Unit.
No Zoning in Effect
PLANNIMETRIC MAP
SAGINAW COUNTY METROPOLITAN PLANNING COMMISSION
SAGINAW, MICHIGAN
FILE NO.

3. Industrial-Commercial in combination

4. Commercial-Industrial and Residential zoning designation in combination

5. No zoning (not affected by a zoning ordinance)

The total county population of quarter sections was then separated according to the five zoning categories or columns. From each sample population a random sample of thirty quarter sections was again drawn to constitute the primary basis for further statistical analysis as outlined in Chapter III.

Tables 26 and 27 depict the summed and squared sample populations for each zoning column or category.

TABLE 26

Summed 1955 - 1968 Real Property Values for Quarter Section Samples by Zoning Ordinance

	Sample	1955	1968	1955 - 1968
Residential R1	30A	6,638	31,978	38,616
Residential R2-3	30B	7,082	30,777	37,859
Residential R4	30C	7,246	41,006	48,252
Agric - Res R6	30D	7,526	26,057	33,583
Agric - Res R7	30E	5,323	21,073	26,396
Commer Res	30F	49,228	255,189	304,417
Indus., Comm.	30G	139,809	412,169	551,978
Comm. Ind. Res.	30H	53,414	913,836	967,250
No Zoning	30I	2,953	5,919	8,872
		279,219	1,738,004	2,017,223

TABLE 27

Squared 1955 - 1968 Real Property Values
for Quarter Section Samples by Zoning Category

Residential R1	30A	8,933,848	66,176,969	75,110,817
Residential R2-3	30B	14,608,684	284,161,279	298,769,963
Residential R4	30C	3,309,698	120,833,192	124,142,890
Agric - Res R-6	30D	3,369,620	41,077,311	44,446,931
Agric - Res R7	30E	1,105,840	16,867,336	17,973,176
Commer Res	30F	990,820,666	29,162,328,607	30,153,149,273
Indus. Comm.	30G	11,830,317,494	65,273,987,699	77,104,305,193
Comm. Ind. Res.	30H	636,101,294	290,292,538,728	290,928,640,022
No Zoning	30I	425,981	1,738,253	2,164,234
		13,488,993,125	385,259,709,374	398,748,702,497

The summed and squared real property values for each sample population as with the preceding sections provided the required base of information for further statistical analysis. Tabel 28 depicts the statistical findings derived from the application of the analysis of variance method (one-way) to the data depicted on Tables 26 and 27.

TABLE 28

Analysis of Variance
Computed F. Ratios - Zoning

Source of Variation	Sum of Squares	DF	Mean Square	F Ratio	Expected Mean Square
Columns	3,940,836,437.86	1	3,940,836,437.86	5.278	Columns effect plus error
Rows	18,632,432,477.26	8	2,329,054,059,675	3.119	Row effect plus error
Inter-action	6,556,988,283	8	819,623,535	1.098	Interaction effect + error
Error	389,748,710,551	539	746,645,039.3	--	Error alone

Results

1. The F. ratio of the Mean Square for columns at the .01 level indicates that a significant increase of real property value between 1955 and 1968 has taken place. This disproves our null hypothesis that real property values for 1955 and 1968 were equal.
2. The F ratio at the .01 level indicates that the Mean Square for rows is statistically significant. This disproves our null hypothesis that no significant differences in real property value due to zoning designations exists.
3. The F. ratio for the Mean Square interreaction at either the .01 or .05 level indicates changes in real property value were either due to passage of time or to the characteristics of the county zoning pattern.
4. All property values increased proportionally although not equally during the intervening thirteen-year period.

The statistical findings were then applied to the Tukey formula to determine the relative ranking of the nine zoning designations within the overall zoning pattern. The results of the Tukey method indicated the following results in the relative ranking of real property value increase for each zoning category:

1st highest real property value increase - Quarter sections zoned as Commercial, Industrial and Residential in combination.

2nd highest real property value increase - Quarter sections zoned to Commercial and Industrial land use in combination with each other.

3rd highest real property value increase - Quarter sections zoned to Commercial and Residential land uses in combination.

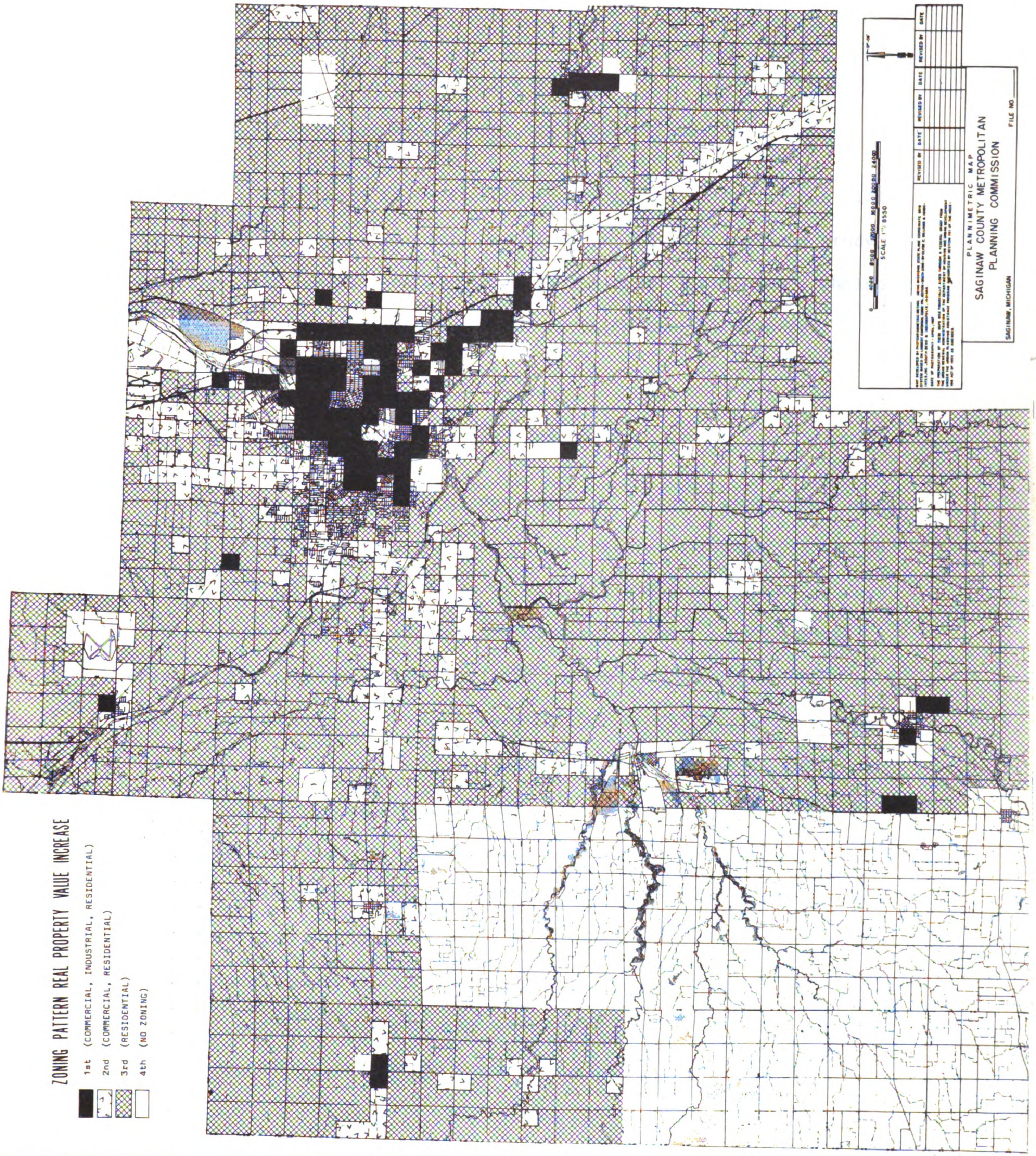
4th highest real property value increase - Quarter sections zoned to residential use. Within this ranking a difference of real property value increase between the seven residential zoning types can be discerned. Thus, with the overall residential zoning classification the real property value increase is as follows:

a. Residential R4
b. Residential R1
c. Residential R.3
d. Residential R6
e. Residential R5 and 7 (not significantly different from the No Zoning designation)

5th highest real property value increase - Quarter sections not zoned

Figure 11 depicts graphically the above value ranking.

Figure 12


ZONING PATTERN REAL PROPERTY VALUE INCREASE
1st (COMMERCIAL, INDUSTRIAL, RESIDENTIAL)
2nd (COMMERCIAL, RESIDENTIAL)
3rd (RESIDENTIAL)
4th (NO ZONING)
0 4000 8000 12000 16000 20000 24000
SCALE 1"= 8550
REVISED BY
DATE
PLANNIMETRIC MAP
SAGINAW COUNTY METROPOLITAN
PLANNING COMMISSION
SAGINAW, MICHIGAN
FILE NO.

CHAPTER V

LIMITATIONS, SUMMARY, AND CONCLUSIONS

This chapter will be devoted to the presentation of (1) the limitations of the study procedure and findings; (2) a summary of study findings; (3) conclusions suggested by the investigation as a whole; and (4) potential application of the investigation to land-use planning decisions.

Study Limitations

As with any research study dealing with selected aspects of urban growth dynamics, certain portions of the entire investigation can be questioned. These questions as to validity and accuracy can be related primarily to the attempt to indicate positive relationships between one singular growth variable and an increase or decrease in real property values. This in turn can be related to the fact that a considerable degree of interreaction exists between and within the twenty defined sub-growth variables. In addition, various degrees of interrelationships exist between any given number of sub-growth variables. Furthermore, many tangible and intangible growth factors and influences not mentioned or dealt with in this study may exert an undetermined degree of influence of real property value change. Growth factors related to social, economic, political and cultural considerations constitute the entire institutional framework of policy and decision making which governs nearly every aspect of our lives. Yet it is virtually impossible to separate these considerations from the urban growth variables as agents which influence real property value change. The two conjunctive statistical techniques used in this study could only detect the influence of one singularly defined variable upon value change. The techniques used could not separate or distinguish between the many forces which interreact with any given growth variable as agents of real property value change. However, this limitation is experienced by most research studies which attempt to analyze any given aspect of change in a dynamic evolving urban society. Another question which arises is the possibility that the findings of the entire investigation might have been different if subjected to different analytical techniques. No precise answers can be given or surmised for these inherent study limitations. The researcher feels that the findings of the investigation reflect the existing generalized urban growth pattern which appears to be manifested at this time and place. Further research and perhaps more advanced and sophisticated analytical techniques and equipment may substantiate or disprove the findings of this study.

The validity and utility of this study cannot or should not be proved or disproved by this single investigation. Further refinement or possibly the introduction of new methods or considerations to the overall study methodology and procedure may further increase the functional utility and applicability of the study as a tool; a starting point for yet further different approaches to develop methods and techniques which would constitute a somewhat more unified, coherent and objective catalogue of planning tools.

Only through a willingness to experiment and try new untested techniques for analysis and plan formulation can the planning profession as a whole hope to interject more objectivity and less subjectivity in the overall planning process. It is the hope of the researcher that this study may prove to be a small step in this ultimate direction.

Summary

In this section the findings of this investigation will be presented in summary form. For purposes of format the summary has been structured to the relative rank of real property value increase for each of the twenty sub-growth variables as a whole. Table 29 indicates the relative increase of real property value by relative rank of real property change. Each rank indicates which sub-growth variable experienced a higher degree of value change compared to other sub-growth variables. Figure 12 depicts graphically the relative ranking of value change by area. All quarter sections irrespective of sample designation were ranked from highest to lowest relative increase. Each rank value was then coded and plotted. Each of the four rank values depicted on Table 29 and Map 12 will be treated and discussed separately.

Highest Increase of Real Property Values 1955-1968

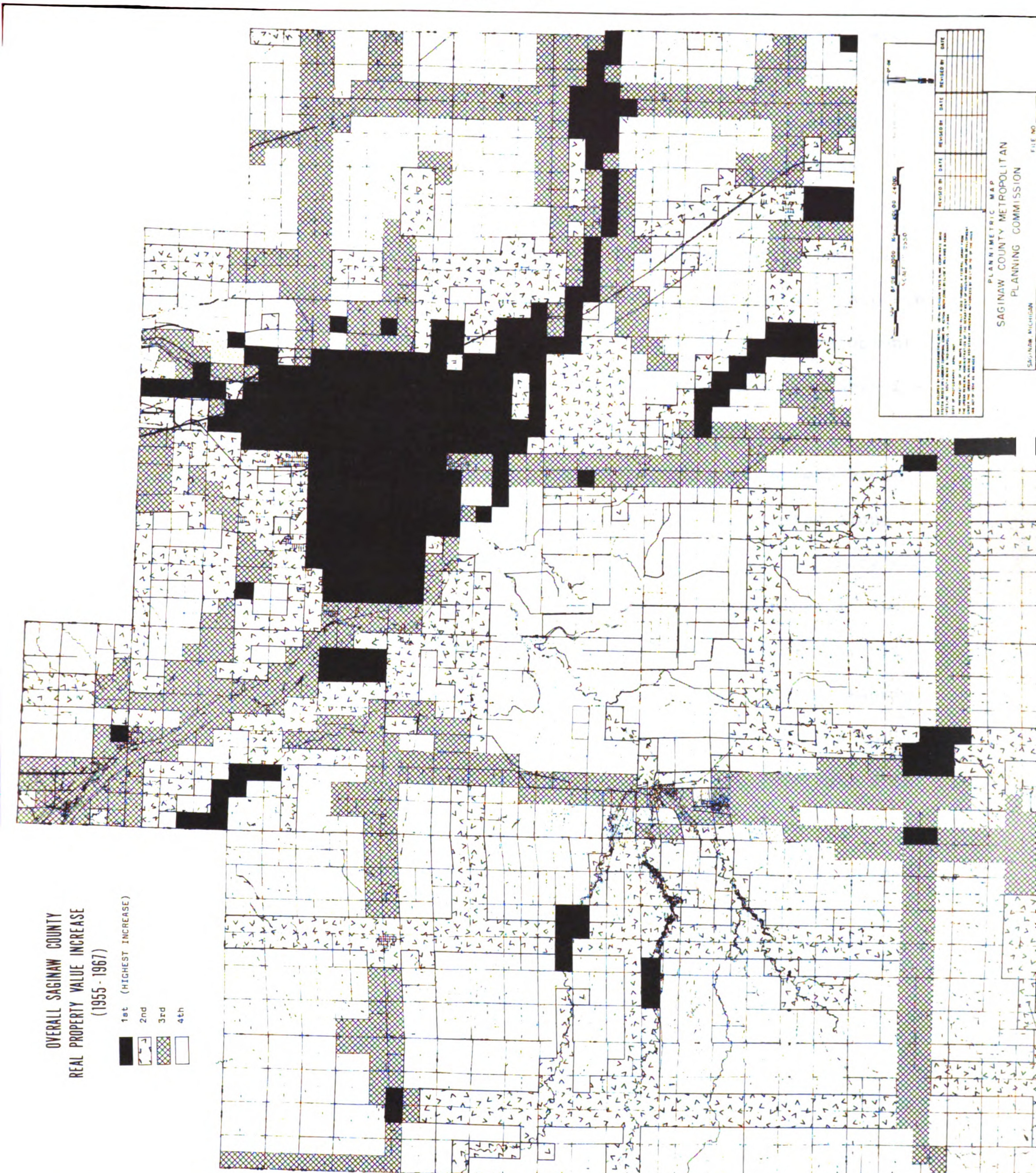
The highest or the first rank of real property value increase was

TABLE 29

Summary Ranking of Real Property Value Increase
1955-1968

Rank Value Increase	Soils	Rivers	Utilities	Transportation	Zoning
1	Area 2-10	Cass	Water-Sewer Gas in Combination	Secondary Collectors	Commercial Residential Industrial in Combination
2	Area 6-10	Tittabawassee	Gas service only	Regional and State Arterials	Industrial Commercial in Combination
3	Area 7 and 1-10	Bad River No Rivers	Water, Gas service in Combination	Local Arterials	Commerical Residential in Combination
4	Area 2	Shiawassee	Not serviced by utilities	Principal Collectors	Residential Agricultural in Combination

Figure 13


OVERALL SAGINAW COUNTY
REAL PROPERTY VALUE INCREASE
(1955-1967)
1st (HIGHEST INCREASE)
2nd
3rd
4th
PLANNIMETRIC MAP
SAGINAW COUNTY METROPOLITAN
PLANNING COMMISSION
SAGINAW MICHIGAN

experienced by quarter sections traversed or influenced by: Soil Areas 2-10 in combination, the Cass River, serviced by a combination of water, sewer and gas utilities, serviced by secondary collectors and zoned to a combination of commercial, residential and industrial land uses. These five sub-growth variables experienced the highest increase in real property values between 1955 and 1968. It may be noteworthy that all quarter sections included in this ranking are geographically located in areas of the county which have experienced intensive urban development activities. The qualitative attributes of each sub-growth variable included in this rank value will be considered separately.

1. Soils - Soil area 2-10 is the highest ranked sub-growth variable within all soil groupings and is located and concentrated along major rivers in Saginaw County. Soil area 10 represents the county's floodplain, while soil area 2 can be considered as a grouping of clay loams with moderate limitations for urban development activities. It may be noteworthy to indicate that the second and third highest ranking of real property value increases for the soils category includes soil area 2 combined with soil area 10. This would indicate that soil area 10 as floodplain soil exerts a more discernible influence on real property values than any other soil area or combination of soil areas. Due to periodic flooding and surface drainage problems the soil area characteristics of floodplain areas and soil areas in combination with floodplain areas cannot be considered as economically productive or suitable for intensive agricultural use. Therefore, it can be assumed that the increase of real property values can be attributed more to factors not inherently related to soil area 10, or soil areas which

are in combination with soil area 10. Based on recent development trends in Saginaw County, a considerable spill-over of population from the urban core area has taken place in the surrounding areas. Given the location of the urban core area within Saginaw, County, the floodplain areas as soil area 10, is represented by the Tittabawassee and Cass Rivers. These two major floodplains represent a natural barrier to the expanding population. Additionally, the floodplains and the areas immediately adjacent to floodplains have certain unique qualities which cannot be found in other soil area combinations. The attraction of water, unique scenic and open space attributes related to floodplains have attracted extensive urban development activities of primarily residential nature. Irrespective of the inherent danger of urban development activities on floodplain areas the relative increase of real property values of soil area 2-10 and other soil areas in combination with soil area 10 reflect the actual urban development activities which have taken place on the county's floodplains during the past thirteen-year period.

2. Rivers - As indicated on Table 29, areas traversed or influenced by the Cass River also experienced the highest relative increase in real property values during the thirteen-year period. This can be specifically attributed to the fact that soil areas adjacent to the Cass River have been classified as floodplain area and thus consist of soil area 10. Other factors which may exert an influence on the high increase of real property values of areas traversed by the Cass River is the relatively undeveloped nature of areas located in proximity to the Cass River. Only within the past three to five

years have urban development pressures been exerted on areas adjacent to the river. These same urban development pressures were exerted on the Tittabawassee River some eight to twelve years ago. Thus in essence the real property values or areas adjacent to the Cass River have been "catching up" although belatedly to the real property values of areas located along the Tittabawassee River.

3. Utilities - Quarter sections serviced by a combination of the three major utilities also experienced the highest relative increase in real property values. Primarily quarter sections serviced by these three major utility systems (water, sewer and gas) also have experienced extensive urban development activities. Due to the basic nature of these urban development activities, the installation of water lines, sewers and gas lines was accomplished in response to a critical need for adequate waste disposal, the need for adequate supply of potable water, and heating fuel. These utility services were provided to selected areas within Saginaw County in response to rapidly increasing population densities and the development of concentrated intensive land uses. In no instance were these three utility components installed prior to the development of any given area for urban land uses.

4. Transportation - Areas serviced and traversed by secondary collectors also experienced the highest increase of real property values over the thirteen-year period. As compared to areas serviced by streets or highways with a different functional classification, the high increase of real property values experienced by secondary collectors can generally be related to the character and nature of the surrounding land use pattern. In Saginaw County, secondary collectors

traverse high density residential areas. Secondary collectors serve as connecting links with arterials and other major connectors. As such, secondary collectors traverse densely populated areas and areas devoted exclusively to urban land uses or primarily of a residential nature. The entire quarter section sample would, therefore, include areas almost exclusively devoted to intensive urban land use categories. This would not be the case of the quarter section areas traversed or serviced by an arterial system. While an arterial system serves concentrations of higher economic activity such as commercial and industrial land uses, the concentration of these higher economic land use activities would be relatively spotty and isolated. Additionally, a considerable number of quarter sections would be traversed which would not be devoted entirely to urban type land uses. Thus, the high increase of real property values in areas serviced by secondary collectors can be related to the constancy of high land values for the entire quarter section sample population.

5. Zoning - Quarter sections zoned to residential, commercial, and industrial land uses experienced the highest increase in real property values. The high increase in real property values for this sub-growth variable is related to the intensity of the land use pattern zoned to a combination of these three zoning classifications. In general, the high intensity zoned land use designation in Saginaw County confirms the existing land use pattern, and substantiates the effect of available water, sewer, and gas service upon real property value increases. All quarter sections in Saginaw County which were zoned in a combination of commercial, industrial and residential land

uses have been serviced by the three utility systems. Thus in this instance a close correlation exists between intensively zoned land use categories and the availability of the three major utility systems.

Second Highest Increase of Real Property Values 1955-1968

The second ranked level of real property value increase as depicted in Table 30 indicates that quarter sections traversed by the following five sub-growth variables experienced the second highest increase of real property values over the thirteen year period. These second ranked sub-growth variables are: 1) Soil area 6-10; 2) Areas traversed by the Tittabawassee River; 3) Areas serviced by gas service only; 4) Areas zoned to a combination of industrial and commercial land uses; and 5) Areas traversed by highways classified as regional and state arterials. The attributes of each of these individual sub-growth variables differ somewhat from those of the aforementioned sub-growth variables.

1. Soils - Soil Area 6-10 differs from Soil Area 2-10 primarily in terms of suitability for development and the geographic location and distribution of soil area 6 in relation to the urban and urbanizing areas. As with the highest ranked soils category, Soil Area 6-10 still represents quarter sections which have a surface area composed of a combination of two different soil areas. Soil Area 6 does not differ significantly from Soil Area 2, other than in it's relative distribution in relation to the urban areas within the county. It may also be noteworthy to indicate that as with the highest ranked soils category, the second highest ranked soils category represents a combination of floodplain soils.

2. Rivers - A second highest increase of real property values was experienced by areas adjacent to or traversed by the Tittabawassee River. Again a striking similarity exists between areas traversed by the Tittabawassee River and areas traversed by the Cass River. As already stated, areas located adjacent to the Tittabawassee River experienced an intensive rate of urban growth prior to 1955, while urban growth in areas located adjacent or in proximity to the Cass River have been of a more recent nature. Due to the diminished availability of suitable open developable areas near the Tittabawassee River, speculative land development pressures and development activities have been somewhat less intensive than in areas adjacent to the Cass River. Another factor which exerts an influence on the relative rate of real property value increase is the relative location of the Tittabawassee River to the "grain" of the emerging urban development pattern. Due to its northwesterly direction, the Tittabawassee River represents less of a natural obstacle to population spillover than the Cass River. In general, urban development activities in the western part of the county have taken a northwesterly course. As such the direction of the urban growth pattern follows the general direction of the Tittabawassee. In contrast, the Cass River generally extends in an east-west direction and cuts directly across the path or grain of the urban development pattern emerging from the eastern part of the older urbanized area. This direction of urban growth has taken place in response to the I-75 expressway and to the construction of major General Motors manufacturing plants in Buena Vista Township and Bridgeport Township. The Cass River thus is directly located in the path of the emerging pattern of urban growth. This is

more conducive for a higher rate of real property value increase than the semi-developed floodplain areas adjacent to the Tittabawassee River.

3. Utilities - Quarter sections serviced by gas utility lines experienced a somewhat lesser degree of increase in real property values than quarter sections serviced by a combination of water, sewer and gas utilities. Primarily the main attributing factor for the second highest increase in real property values of areas serviced by gas can be related to the fact that gas service is installed by private concerns in response to a clearly defined market area. As with the highest ranked utility category, the need and demand for gas service existed prior to the installation of gas lines. Before gas service is provided to any area, extensive market surveys are conducted to determine its economic feasibility. In this particular instance, the urban development pattern must be sufficient to warrant installation of this utility. It would seem reasonable to assert that the provision of gas service would increase the real property value of any given area. The degree of actual influence in this regard would require further study.

4. Transportation - In the overall transportation category, quarter sections traversed by regional and state arterials experienced the second highest ranking in real property values between 1955 and 1967. As with the foregoing ranked transportation sub-growth variable, the differences in characteristics in this sub-growth variable are easily discernible. In comparison to secondary collectors, regional and state arterials serve major centers of activity in the county, whereas secondary collectors service more limited portions of the urban areas. State and Regional arterials carry a majority of total urban area

travel desires as well as the bulk of trips desiring to by-pass the central urban core area. Another attribute of regional and state arterials is their continuity between regions. Secondary collectors tend to be restricted or limited to a smaller area.

5. Zoning - The next sub-growth variable which experienced a second highest increase in real property value were quarter sections zoned to a combination of commercial and industrial land uses. The primary factors for this are the basic nature and quality of quarter sections zoned to a combination of industrial and commercial land uses. Generally, land uses thus zoned are located in proximity to state and regional arterials and represent the older industrial and commercial areas within Saginaw County. Other factors related to the second highest increase in real property values are the traffic volumes and the enlarged market area served by state and regional arterials. Both land use activities require a greater degree of accessibility than residential areas. The relationship of commercial and industrial land uses to state and regional arterials is easily discernible by development trends along major arterials leading into major urbanized areas in the State of Michigan. Another contributing factor for the increase of real property values in this sub-growth category is the desire of local governmental units to increase the tax base. Due to the lack of other suitable sites for commercial and industrial land use activities, each local governmental unit has designated areas directly adjacent to the state and regional arterial system for commercial or industrial land uses.

Based upon a survey conducted by the Saginaw County Metropolitan Planning Commission, 73 percent of all land areas adjacent to state or regional arterials have been zoned for either commercial or industrial land uses. The remaining 27 percent represents a mixture of residential land uses and a wide assortment of existing commercial land uses.

Third Highest Increase of Real Property Values 1955-1968

The third highest increase of real property values for the next five sub-growth variables were: 1) Soil Area 1-10; 2) Areas traversed by the Bad River, or not affected by any river or stream; 3) Areas serviced by water and gas utility lines; 4) Areas traversed by local collectors; and 5) Areas zoned to a combination of commercial and residential land uses. This entire ranking of real property value increase, as with the foregoing two value rankings, is related to the relative character of areas which have been affected by these five sub-growth variables. As a whole, the entire area, which is depicted on Figure 12, is generally characterized by a mixture of rural and urban land uses. The semi-rural nature of the entire area can be attributed to the peripheral growth influence exerted from urban development activities which have taken place immediately adjacent to the older urbanized areas. Over the thirteen-year period this area has experienced a transition from an entirely rural to a semi-rural or urban character. More specifically, the attributes of each sub-growth variable in this value ranking, when compared to the second highest rank in real property value increase, substantiate the basic land use characteristics of the area.

1. Soils - Soil Area 7 along with Soil Area 1-10 represent two basic soil areas which have experienced an equal increase of real property values over the thirteen-year period. While the characteristics of the two soil groupings differ in terms of suitability for agricultural or urban land uses (see Figure 4), they are located and distributed very similarly in relation to the urban and urbanizing areas. Again, the increase of real property values in these two soil areas is more strongly related to the geographical and locational aspects than to the actual soil characteristics.

2. Rivers - Quarter section areas traversed by the Bad River or by no rivers at all also experienced a third highest increase in real property values. This indicates that the Bad River exerts little influence on the rate of real property value increase. This can be attributed to the basic location and character of the river. The entire stream traverses an entirely rural area with no urban concentrations of any kind. Additionally, the stream does not have the basic characteristics desirable for intensive land use development activities. The relatively rural areas traversed, along with the distance from any concentrations of urban activity, account for the equal increase of real property values in areas not traversed by a stream. It can thus be assumed that the real property value increase in this particular sub-growth category can be more related to the inflation of land values than to any attribute manifested by the Bad River.

3. Utilities - Quarter sections serviced by water and gas also experienced a third highest increase in real property values over

the thirteen-year period. This increase can be more equitably related to characteristics of areas serviced than to the actual influence of this sub-growth variable itself. Areas serviced by a combination of water and gas utilities tend to be geographically located between the urban core and the smaller urban concentrations represented by the City of Frankenmuth, and the Villages of St. Charles, Chesaning, Merrill, Shields, Freeland and Hemlock. Rural areas located between these smaller urban areas and the Saginaw Metropolitan Area are thus also serviced. Thus, in this instance, the availability of these two utility services cannot be attributed to either market demand or intensity of urban land uses. The criteria applied to both the first and second highest ranking of value increase cannot be applied to the sample areas serviced by a combination of gas and water utilities only.

4. Transportation - In the transportation category, quarter sections serviced by local arterials ranked third highest in terms of relative real property value change for the thirteen-year period. Local collectors provide lesser arterial service at a local level; more emphasis in placed on land access than in any other transportation category. In Saginaw County, local arterials constitute primary county roads and minor portions of the road system in the semi-urbanized areas. The relative increase of real property values in this instance can be related more to the adjacent land use pattern than to the basic qualities of the local arterial system.

5. Zoning - Quarter sections zoned to a combination of residential and commercial land uses experienced a third highest increase in real property values. This sample of quarter sections included primarily

existing commercial land uses, such as small grocery stores, gasoline stations and small service shops located at main intersections of local arterial routes. Often these commercial land uses are service centers for the surrounding area. The actual commercial zoned areas in this quarter section sample represent existing commercial land uses in combination with isolated residential and open space land uses. In many instances the residential zoning designation is not reflective of either residential development potential or the existing land use character of the area.

Fourth Highest Increase of Real Property Values 1955-1968

The fourth or the lowest increase of real property values has taken place in what can be defined as open space and agricultural areas in the county. Urban development activities that have taken place in these two land use categories consists primarily of single family housing. In terms of location, the quarter section samples for each of the five sub-growth variables included in this ranking are not influenced by any urban development activities. The quarter section samples included in this ranking are too remote for either land speculation or any other land use but single family housing and open space. The qualitative attributes of each of the five sub-growth variables included in this ranking are as follows:

1. Soils - Soil Are 2 was the lowest ranked sub-growth variable in the overall soils grouping in terms of relative rank of real property value change. Quarter sections included in Soil Area 2 constitute the bulk of prime agricultural soils in Saginaw County. This soil area has slight limitations for agricultural uses but severe

limitations for urban development activities.

2. Rivers - Quarter sections traversed by the Shiawassee River also experienced the lowest relative increase in real property values over the thirteen-year period. Again, areas traversed by the Shiawassee River are not conducive to urban development activities nor do they hold any promise for future development activities. Large areas traversed by the Shiawassee River are located in the Shiawassee Wildlife Game Refuge area and thus permanently protected from private development activities. This, plus the extremely adverse drainage and periodic flooding of the adjacent land areas, precludes any extensive development activities at this time. Areas traversed by the Shiawassee River are remotely located from the urbanized areas in the county, and generally are not served by any public utility (excluding electricity). Access to these areas is haphazard over predominantly unimproved roads and trails.

3. Utilities - As can be surmised, quarter sections not serviced by any of the three utility services either singularly or in combination experienced the least increase in real property value over the thirteen-year period. Areas not serviced by any of the three utilities have some attributes in common with areas included in the sample quarter sections of the soils category and the Shiawassee River. Areas not served by utilities are more remote in terms of location and distance from the nearest urban concentration. Due to other factors such as soil characteristics, physiographic features, and general amenities these areas did not experience the same rate of development as the foregoing discussed rankings of real property value increase.

4. Transportation - Principal collectors also ranked lowest in the rate of real property value change. Roads designed as principal collectors provide service between minor population and economic centers within the county. Traffic mobility and trip continuity are not as essential as on other road designations. Access controls are not provided, thereby permitting a high level of service to adjacent properties.

5. Zoning - Quarter sections zoned to a combination of residential and agricultural land uses also ranked lowest in relative real property value increase. This low increase is primarily the result of inflation of real property values. In general terms, both zoning designations as defined and used in Saginaw County allow a very broad range of land uses. The prime restriction included in these zoning designations is the prohibition against junkyards and specific commercial uses. In many instances both zoning designations represent a "catch-all" for all other land uses contained in the current rural zoning ordinance for townships and villages in Saginaw County.

Conclusions

The three major null hypotheses tested in the investigation were disproved by the results of the study. The first null hypothesis was disproved for each of the five major urban growth variables in that significant statistical changes in real property value did occur between 1955 and 1968. These changes could be attributed to the characteristics of each major urban growth variable. The changes could also positively be attributed to the characteristics of the sub-growth variables defined to a major urban growth variable.

The second null hypothesis was disproved in that the mean acre real property value between 1955 and 1968 did not remain equal for all the sample populations included in each major growth variable. This indicates that each growth variable exerted a different rate of change upon the mean acre value for each quarter section in the county.

The third null hypothesis was also disproved in that no inter-reaction effects could be discerned between the first and second null hypotheses that were tested. All mean acre real property values increased proportionally, although not equally during the intervening thirteen-year period.

Overall, the study results seem to suggest that the degree of real property value change is closely related to the intensity of the existing land use pattern.

The study results suggest that very little if any correlation exists between the basic natural characteristics of the land and change in real property values. Manmade features and desires seem to have a greater effect on real property value change than adverse physiographic conditions.

The study results as depicted on Map 12 also suggest that a positive relationship exists between the proximity of intensive land use activities and real property value change of adjacent land areas.

Application of the Study Results to Land Use Development Decisions

The study results have demonstrated that a significant statistical relationship exists between the increase of real property values to the differing qualitative characteristics of the five selected growth variable. This differential increase of real property values over the thirteen-year period has three basic applications to the formulation of land use development decisions.

An important assumption which must be accepted as true in the application of the study results is that the differing qualitative influence of each growth variable on the change of real property values will continue to hold true in the future. Another assumption which must be accepted is the relationship of real property value change to land use intensity.

Description of practical application of the study procedure and findings to the formulation of land use development decisions is as follows:

1. Implementation of local development plans. A basic problem which confronts local planning commissions is the implementation of adopted land use development plans. The study has shown that the differing rates of real property value increase can be related to the differing qualitative attributes of each discussed growth variable. By creating or providing selected attributes of one or more growth variables to a given area, a desired land use intensity can be created;

reflective of the increase in real property values. Through a public capital improvements program, the provisions of man-made growth variables such as utility and transportation systems; future land use development activities can be channelled as to conform to the intent of the comprehensive land use plan.

2. Maximizing use of public resources in the provision of public improvements and services. The increase of real property values for given locations in Saginaw County can serve as an index for gauging the future demand for extensive capital improvements projects and public services. Public demands for parks, roads, utilities, and public services are generated in response to the needs of developing areas. The rate of future development in turn is closely correlated with existing and the probable rate of real property value increase. The need for public improvements and services can thus be interpreted or planned for. Thus, areas which have experienced the highest rate of real property value increase over the thirteen-year period will also demand a priority in the allocation of public funds and resources. Areas which experienced the lowest increase of real property value will require a commensurate lesser share of available public resources. The study results can thus be considered as a tool in capital improvements budgeting.
3. Objective use of governmental police powers. In certain instances, selected land use development activities can be termed as detrimental to the public welfare. This may especially hold true for

Saginaw County. A heavy public liability may be incurred if the current rate on the floodplain areas is to continue as reflected by the rate of real property value increase. Given the recreational and open space land use potential and the current undeveloped nature of county floodplains, the police powers of zoning and eminent domain can still be used without extensive public counter pressures. By prohibiting all urban development activities on floodplains through the zoning of floodplain areas in local zoning ordinances a potential public liability related to floodplain development may be averted. Also, through a combined use of the power of eminent domain and public spending power, selected portions of the floodplain areas can be acquired and converted for public recreational purposes. Public expenditures required to convert portions of floodplains to public recreational use will continue to increase over time. As indicated by study results, the higher the current value or use, the higher the probable future rate of real property value increase. Public spending and police powers could similarly be used to deter the growth of areas adjudged to be contrary to the public welfare. Isolated and scattered intensive land use activities requiring or presupposing extensive public resources or services could be cited as an example. The study results could be used as a basis to facilitate a more objective use of governmental powers.

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