AN ENVIRONMENTAL PARAMETERS DESCRIPTOR

by

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Introduction

Urbanized areas of the world, and those in the process of becoming urbanized, are currently enjoying an importance unparalleled in the span of their history. Although cities have been the foci of human activity for thousands of years, the industrial and technological revolutions of the past 125 years have given them a much greater significance in human affairs. The radical change in structure of employment since 1850 has caused cities in industrialized nations to become the dominant environment of human habitation.[1]

Concomitantly, cities have undergone great increases in size as a result of technological and industrial attributes of urbanization. The magnitude of the change in size of cities has fostered considerable interest in the processes and constraints which contribute to, and affect, their growth. There are numerous aspects of this growth which may be investigated: economy, demography and political processes to name a few. To urban planners, the basic concern is physical planning within the urban framework, or, as Lapatra states:

> The activity of planning covers a broad spectrum of topics, but its intent is as always to promote better performance of physical environment, in accordance with a set of broad aims and specific objectives.[2]

It is within this orientation that the present study is suggested, i.e., to promote better performance of the physical environment.

In professional and popular literature concerned with this particular branch of urban affairs, various aspects of physical environment have received an overwhelming amount of attention. Much of the publicized material has been of the type that relegates the natural environment to a secondary status when placed in a tangential role with the needs (or desires) of man in relation to the urban landscape.

Recent accumulative evidence indicates that this blatant disregard for the natural environment is beginning to reap unexpected dividends of a catastrophic nature. It was the purpose of this paper to investigate a course of future interrelationships between the natural environment and the man-made environment within a context of "spatial equilibrium."[3]

CHAPTER I

SCOPE AND DEFINITION OF THE STUDY

Section A

Environmental Parameters As a Means of Controlling Urban Character

To understand the need for an Environmental Parameters Descriptor (Model), it was necessary to first consider certain aspects of the history of planning theory and practice as developed in this country. Urban planning in North America, from 1600 to 1850, had always been somewhat different than the planning practices in Western Europe and England. One of the most important differences was the "open city" concept used in the development of urban areas in North America as opposed to the planning principles developed upon medieval traditions prevalent in European cities.

Briefly, the "open city" concept allowed for easy and rapid physical growth simply by clearing and developing the fringe lands surrounding the urbanized areas. This was possible because there were no "permanent" walled cities needed to protect the citizens from warring neighbor principalities and city states.[4] True, there were military outposts and forts. However, shortly after settlement such streets as "Wall Street" in New York City no longer carried its original significance.[5]

With the advent of the industrial revolution and various technical revolutions since 1850, emphasis had been developed in three areas of study. These were:

1. Physical form, i.e., the Architect.
2. Growth Potential, i.e., the Economists.
3. Spatial Delineation, i.e., the Geographer.

Although these three disciplines have continued to play a major role in the development of urban study, the Architect, per se, has taken a back seat role to Economists and Geographers (as well as many other more quantifiable disciplines) in studying and explaining urban phenomenon. The result has been that much planning theory was based first upon Economic models, then upon Geographic models, and more lately upon Transportation models.

The result has been a historical cityscape that is developed upon the premise that economic considerations are initially the most important variables in determining growth and growth potential.[6] For example, Dr. Colin Clark has developed a theory of the modern city (i.e., the industrialized city) which views urban growth potential as a cause/effect relationship. He cites three economic activities as causality for growth. These three economic activities are:

1. Direct exploitation of natural resources.
2. Manufacturing.
3. Services (Service Industries).[7]

Dr. Clark suggests that if any of these three activities can be animated, the net effect will be growth in both spatial and economic terms. Dr. Clark concludes his theory by outlining the economic result of such growth. He totally ignores:

A. The spatial implications of growth.

B. The resultant environmental implications of spatial growth.

C. The environmental implications of "Direct exploitation of the natural resources."

This particular study by Dr. Clark is neither special nor unusual in not considering growth impact upon the total environment. In the majority of urban modeling theory, the thrust of the work focuses on the man-made environment. This is logical, however, most models subvert the natural environment to man's needs. That is, exploitation of the natural environment has precedent over conservation and environmental enhancement. Although this was not logical, it was certainly steeped in historical precedent. The pragmatic result of the application of such planning theory has been a general degradation of the total environment, both human and naturalistic.

The blame for this does not totally lay with the many students of urban phenomenon nor does it lay totally with the administrative and political factions which have made use (and misuse) of this information. However, guidelines for determining growth and growth potential within a context of environmental conservation is a field that is currently beginning to receive investigative study and theorizing.

Guidelines for Generating Environmental Parameters

Some Architects, with an eye upon the micro-environment of the individual site, have made a small attempt to consider the interrelationships between the naturalistic and man-made environs. As F. L. Wright stated years ago:

> One must have a freedom to use the land; within a relationship with all kinds of living growth.[8]

Or more recently:

> No environment, natural or man-made, can withstand the presence and sound of crowds and machines that it was not intended to accommodate.[9]

It is as an extension of these two statements that have suggested a set of guidelines for generating environmental parameters. These guidelines are:

1. The region to be developed (or which has potential) is "beautiful" but not vulnerable to exploitation.
2. Development is inevitable and must be accommodated; therefore, planned growth is more desirable than uncontrolled growth.
3. Environmentally unconstrained growth is inevitably destructive.
4. The region can absorb all prespective growth without despoliation.[10]

1. <u>The region to be developed is beautiful but vulnerable to exploitation</u>

Although wide differences in taste will continue to exist in the design and use of man-made spaces, appreciation of the natural landscape seems to be an aesthetic area in which a consensus can more easily be reached.[11] By describing the landscape in generic terms, one can reach certain conclusions about its form and variety. At the same time, there are specific compositions which should not be ignored as lessons in the art of environmental design. Beautiful landscapes can be found in all parts of any given region, even though possibly isolated and atypical. If there are not enough of these areas to dominate a given region then they are subject to immediate exploitation as the region becomes a part of the urban fringe and eventually a part of the urban landscape.[12] A set of parameters can be generated which begin to control the exploitation of such areas.

2. Development is inevitable and must be accommodated; therefore, planned growth is more desirable then uncontrolled growth

Anticipating the future is becoming a necessary part of any urban planning scheme. But the question arises: How can we suggest a future before it occurs? The need is to be able to make far reaching and concrete decisions before the actual development begins and at the same time to be flexible enough to accommodate technological changes that are bound to occur.[13]

As an example of an early attempt to plan for inevitable growth, consider New York City. In 1797 the Taylor-Roberts Plan and again in 1811 the Commissioner's Report suggested schemes for developing Manhattan Island. These are extremely far sighted plans, as New York City, at that time, had a population of less than 70,000 people.[14]

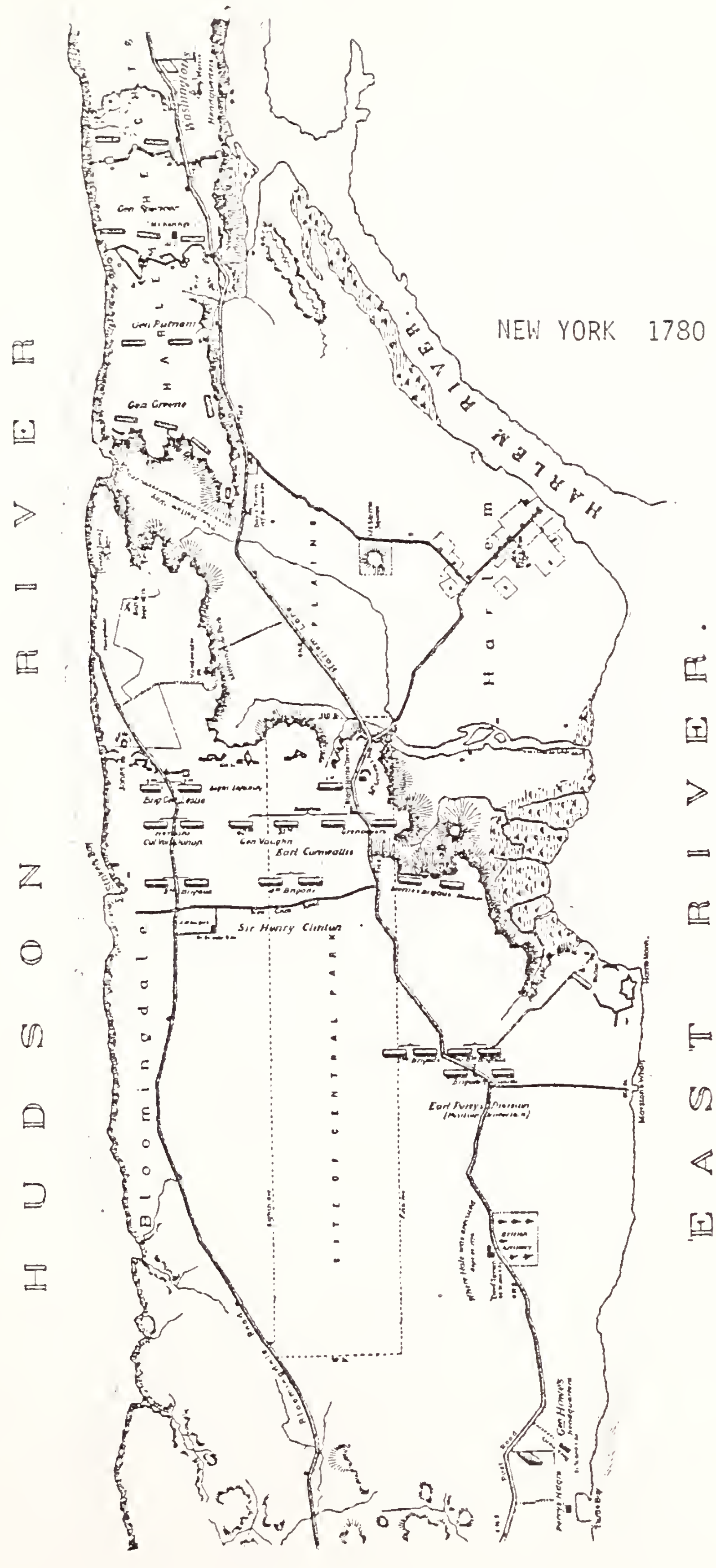
The 1811 report suggested a principal scheme that is substantially that which we know today. In retrospect there are many things wrong with the scheme; it is monotonous and did not allow for the technological innovations that would change the total view of the urban landscape. However, it very rigidly allowed for the establishment of a variety of park spaces and allowed the city to expand at a prodigious rate.[15]

London in 1810 has a population of one million, Paris of five-hundred thousand and, again, New York of about seventy thousand. By 1940 New York had equaled the London population of eight million people and had grown twice as

EXPLANATION OF PLATE I

Fig. 1. New York City, 1780.

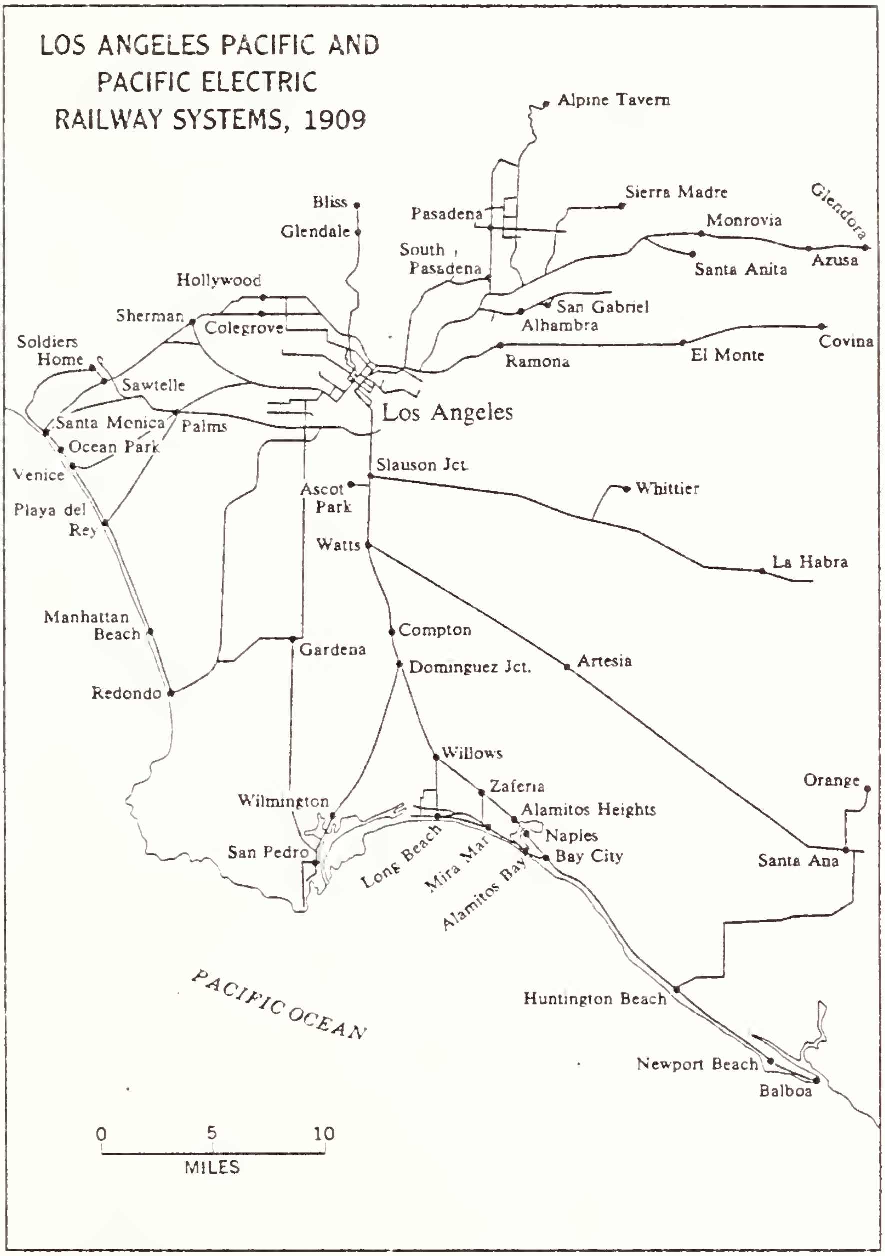
PLATE I


HUDSON RIVER
EAST RIVER
HARLEM RIVER
NEW YORK 1780
Bloomingdale
Harlem
HARLEM HEIGHTS
HARLEM PLAINS
SITE OF CENTRAL PARK
Sir Henry Clinton
Earl Cornwallis
Gen Vaughn
Gen Putnam
Gen Greene

EXPLANATION OF PLATE II

Fig. 2. Los Angeles, 1909

PLATE II


LOS ANGELES PACIFIC AND
PACIFIC ELECTRIC
RAILWAY SYSTEMS, 1909
Alpine Tavern
Sierra Madre
Glendora
Bliss
Pasadena
Monrovia
Glendale
South Pasadena
Azusa
Santa Anita
Hollywood
San Gabriel
Sherman
Alhambra
Colegrove
Covina
Soldiers Home
El Monte
Ramona
Sawtelle
Los Angeles
Santa Monica
Palms
Ocean Park
Venice
Slauson Jct.
Whittier
Ascot Park
Playa del Rey
Watts
La Habra
Manhattan Beach
Compton
Gardena
Artesia
Dominguez Jct.
Redondo
Willows
Orange
Zaferia
Wilmington
Alamitos Heights
Naples
San Pedro
Bay City
Santa Ana
Long Beach
Mira Mar
Alamitos Bay
PACIFIC OCEAN
Huntington Beach
Newport Beach
Balboa
0
5
10
MILES

large as Paris, which had a population of about four million people. It has been suggested by a variety of sources that this rapid growth was made possible, in part, because a total (physical) plan for the financial and economic center, i.e., Manhattan Island, had already been developed, and that the political warring that is common during most urban expansion was mostly averted.[16]

To bring all of this into the context of this study, a (day to day) whole view of a city is necessarily political; only a long range view can recognize environmentally sound possibilities.[17] Therefore, environmental parameters need to be developed in a context of anticipated future long range growth and growth potential, prior to political intrusion into the physical growth process.

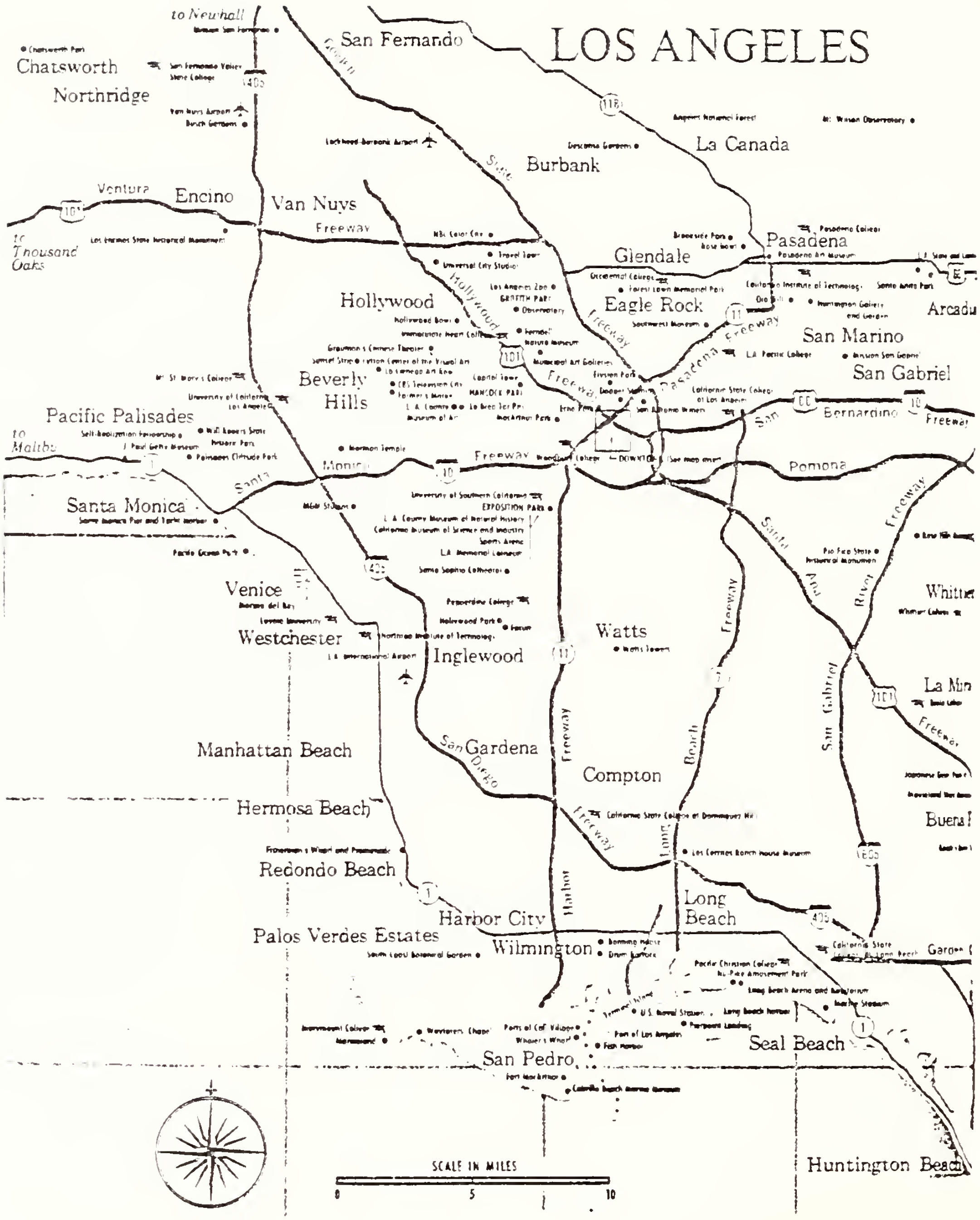
3. Environmentally unconstrained growth is inevitably destructive

Although most urban areas have developed in a generally unconstrained manner, none has expanded as rapidly as Los Angeles (city and county). In 1900 the total population of Los Angeles was approximately two hundred thousand. By 1940 the population was about five million or equal to that of Paris, France.[18] By 1970 the total population of Los Angeles had grown close to seven million people. The physical growth of the city and county has also been tremendous. Currently, Los Angeles (city and county) covers a large portion of Southern California, with the city being a strip roughly one hundred miles long and averaging less than ten miles in width. The width has been curtailed by the Coast Range of the Sierra Nevada branch of the Rocky Mountains. The length is controlled by approaching encroachment upon San Diego on the South and more mountains on the North.[19]

EXPLANATION OF PLATE III

Fig. 3. Los Angeles, 1975

PLATE III


LOS ANGELES
to Newhall
San Fernando
Chatsworth
Northridge
La Canada
Burbank
Ventura
Encino
Van Nuys
Freeway
to Thousand Oaks
Glendale
Pasadena
Hollywood
Eagle Rock
Arcadia
San Marino
San Gabriel
Beverly Hills
Pacific Palisades
to Malibu
Bernardino
Freeway
Pomona
Santa Monica
Venice
Westchester
Inglewood
Watts
Whittier
La Mirada
Manhattan Beach
Gardena
Compton
Hermosa Beach
Buena Park
Redondo Beach
Long Beach
Harbor City
Palos Verdes Estates
Wilmington
Seal Beach
San Pedro
Huntington Beach
SCALE IN MILES
0
5
10

The end result of Los Angeles' "planned" growth has been appalling. Rising sea winds and the Sierra Nevada Mountains hold the air pollution over the city, while ocean currents push the water pollution back into the city. Vegetation is dying off, animal and bird life is dying or leaving the region and human life is weakening and dying.[20] This is a result of man's lack of forethought in planning (or allowing for) urban growth in a context of environmental constraints.

4. The region can absorb all prospective growth without despoliation

By developing as recommended, despoliation can be averted. The key word is "recommended," for only by developing a given area within a framework of conservation principles can unnecessary destruction be averted and environmental enhancement procured.

However, this particular guideline can only be achieved by following a linear progression from guideline one thru guideline four. To bypass guidelines one, two and three would be to ignore the philosophy and thrust for developing a set of environmental parameters.

These guidelines have suggested that urban character can be developed as a function of environmental parameters. However, in order to do so it was necessary to develop them into some form of investigative mode that would allow for their application in an interaction between the naturalistic and the man-made environs.

Section B

A Simulation Model As a Means of Investigation

Because of the vast amounts of data and information required to study environmental parameters, it has been decided that the best technique to develop this approach is the simulation model.

The rationale for choosing a model as a means of investigation for this study follows general arguments for the use of models:

> Models are made necessary by the complexity of reality. They are...for the researcher a source of working hypotheses to test against reality. Models convey not the whole truth but a useful and comprehensible part of it.[21]

Modeling, therefore, begins with the abstraction and simplification of a great deal of related variables. A simulation model, such as the one developed in this study, was no different:

> A simulation is a model of a system. Models may attempt to represent a system through verbal means, mathematical means, or pictorial means. Simulation involves the abstraction of certain aspects of the system one is studying and an attempt to replicate these aspects by other means, such as words or mathematical symbols. The variables that have been selected are given values within the simulation and the relations among the values specified.[22]

The exact conditions for the justification of a simulation model in this investigation were:

1. A mathematical solution is impossible because too many variables are involved.
2. The relationships between variables may not be simple linear ones.

3. The model is dynamic and the important lags are long ones.

4. The results are probabilistic.

1. <u>A mathematical solution is impossible because too many variables are involved</u>

There is a need for a large number of interrelated variables within each study matrix. Many of these variables are not mathematically oriented. That is, they are not easily quantifiable nor can they be easily inserted into a set group of formulas. For example, a particular model component of one of the descriptive models has over 150 suggested possible variables for <u>each</u> matrix unit. This type of information cannot readily be placed into a mathematical mode nor can mathematical formulas be gererated from the information.

2. <u>The relationships between variables may not be simple linear ones</u>

There is the implication with this condition that environmental constraints, or the lack of them, is a very circumlocutory problem area. To the contrary, the problems are not devious, they are very straightforward. However, the solution to a given environmental problem is often not clearcut, and the relationships between interplaying variables neither distinct nor precise. Thus, there is a lack of linearity between problems and possible solutions.

3. <u>The model is dynamic and the important lags are long ones</u>

The model being suggested is dynamic, as opposed to being static. That is, there is a constantly changing group of variables. Seasons, Time, Climate and Land Use are just a few of the many dynamic variables that need to be considered within the structure of this model.

The time lags involved within this model can vary with any given simulation or study area. However, whether the model operates in real time or an abstract time,[23] the time considerations are long. This is because environmental problems and solutions do not have immediate results or consequences. There are long real time lags for environmental changes to occur or be forced.

4. The results are probabilistic

In many ways the model output will be stochastic, as the results will deal with probable "futures." Thus, the results are probabilistic and not absolute. This is obvious by the very nature of a simulation model of environmental possibilities.[24]

Further, the urban models in existance are not adaptable to the needs of this study because they cannot deal with the parameters in the specific manner required. Therefore, a specialized model will be developed which can perform three functions that provide the nucleus of this investigation. These functions are:

1. Make particular form comparisons.
2. Identify patterns.
3. Generate a particular cause-effect relationship.

It becomes obvious that a simulation model is a rather high order of modeling and must be constructed out of a more simplistic base. In this case, a set of descriptive models.

The Descriptive Models

There are two basic functions that the descriptive models must perform. First, such modeling allows one to make a comparison of various fixed urban physical relationships of form, both natural and man-made. Such a comparison allows the model maker to better understand locational requirements for man-made structures, or forms, as well as to understand the effects of placing such structures within a given environment.

Second, a descriptive model can be used to identify and develop patterns.[25] Within the limits of pattern development, a descriptive model can be used to perform a variety of functions. However, by understanding the particular patterns concerned with, or caused by, human land usage, one can better advance an understanding of the effects of such land use development upon the environment.

The Simulation Model

A simulation model not only allows one to perform the functions of the descriptive model but to also be able to generate cause-effect relationships. The particular cause-effect relationship to be developed within the framework of this study is to consider the phenomenon of urban growth and the resulting negating effects of such growth upon the environment.

Among the negating effects to growth upon the environment to be considered are:

A. Air pollution.

B. Water pollution.

C. Noise pollution.

D. Visual pollution.

E. Soil erosion/Land pollution.

Variables such as these were considered within the composition of the work plans for the analytical sections of this study.

It should be noted at this point that this particular model was developed as a means to project (simulate) expected environmental consequences of urban growth and not to simulate the growth itself.[26] By understanding the environmental consequences of urban growth, one can establish parameters to restrict growth in terms of the various negating effects within each study unit (matrix). Further, in this respect, the model is conditional, i.e., it shall be assumed that each study matrix can, and will, be developed to a maximum allowable as determined by the environmental parameters. This follows logically from guideline four of the preceding section.

Section C

Operational Ranges of the Model

Form of the Environmental Parameters

The expression of environmental constraint, as it relates to urban growth, used in this study is the environmental parameter. This type of representation allows one to make direct comparisons of various parts of the urban landscape as well as presenting a coherent picture of the total environment. Each parameter shall be the coding of a particular set of information as it is acted upon by the descriptive models under the auspices of the guidelines for generating parameters.

The coding information is then used in the simulation model to compare the parameter with the negating environmental consequences of growth. This information can then be used to determine an optimal physical growth and density limit for a given area, without upsetting a planned balance between the naturalistic and the man-made environment within that study area. The parameter structure is to be iterative to take into account the commonly observed fact that urban growth is a cumulative process.[27]

Operation in Space

The model operates in a general or abstract space and utilizes no particular metric. By doing so, many of the environmental factors are put on a common ground for most of these activities may well have similar effects in abstract space.[28] A general space makes possible comparisons among differing parameters and consolidation among similar ones.

Operation in Time

The model is to operate in a non-metric or abstract time. For any given simulation, this time is assumed to be uniform and is divided into equal intervals, each of which corresponds to one iteration of the simulation model.

The increments of time may thus have different values for different simulations. It is further assumed that the operations performed by the model are the same at each iteration.

These assumptions imply a constant rate of change through time. Observation of urban spatial growth and the resultant negating consequential effects appear to deter these assumptions, for growth has not always occurred at the same rate within the same urban area. It should be remembered, however, that this study is dealing with two sets of factors, growth and the consequential environmental effects, that is, the operators and the parameters upon which the growth operates. The relationship between these two, i.e., the operators and the parameters, has not been established with respect to time. Therefore, it is simplest to assume constant operators with parameters which may vary over time in response to cultural and technological change.[29]

FOOTNOTES

[1]Buchard, John; The Historian and the City; Cambridge, Mass.: The MIT Press; 1963, p. 237.

[2]Lapatra, Jack A.; Applying the Systems Approach to Urban Development; New York: Dowden, Hutchinson and Ross; 1973, p. 106.

[3]"Spatial Equilibrium" is a term that has been used in a variety of urban studies, most commonly Economics and Geography, to mean a variety of nuances concerning urban character. In this paper it has been defined as a concerned balance within the total environment between the human and naturalistic environs of the urban landscape. For additional references see: Alanso, 1964; Muth, 1961, 1967, 1969 and Wingo, 1961.

[4]Churchill, Henry S.; The City is the People; New York: W. W. Norton and Company; 1962, p. 31.

[5]Tunnard, Christopher; The City of Man; New York: Charles Scribner's Sons; 1970, p. 13.

[6]Ibid; p. 19.

[7]Clark, Colin; "The Economic Functions of a City in Relation to Its Size"; Econometrica; Volume XIII; 1961, p. 97.

[8]Wright, Frank L.; The Natural House; New York: Mentor Books; 1954, p. 89.

[9]Chermayeff, Serge and Christopher Alexander; Community and Privacy; Garden City, New Jersey: Anchor Books, Doubleday and Company; 1963, p. 43.

[10]McHarg, Ian; Design with Nature; Garden City, New York: The Natural History Press; 1972, p. 82.

[11]Pushkarev, Boris and Christopher Tunnard; Man-Made America, Chaos or Control; New Haven: The Yale University Press; 1967, p. 121.

[12]Ibid; p. 31.

[13]Exline, G.; "The Speculative Design of High Density Environments for Cities of the Future"; University of Illinois, Urbana; course syllabus, 1973.

[14]United States. Bureau of the Census. Twentieth Census of the United State States: 1970. Population; Volume III.

[15]Churchill, Henry S.; The City is the People; New York: W. W. Norton and Company; 1962, p. 40.

[16]Exline, G.; "The Speculative Design of High Density Environments for Cities of the Future"; University of Illinois, Urbana; course syllabus, 1973.

[17] Ibid.

[18] Paris had a population of one million as early as 1800.

[19] Higbee, Edward; The Squeeze; New York, New York: William Morrow and Company; 1960, p. 14.

[20] Over two hundred deaths in LA during 1974 were directly attributed to air pollution.

[21] Haggett, Peter; Locational Analysis in Human Geography; New York: St. Martin's Press; 1966, p. 19.

[22] Verba, Sidney; "Simulation, Reality and Theory in International Relations"; World Politics; Volume 16, No. 3; 1967; p. 32.

[23] See Chapter I, Section C, "Operation in Time."

[24] Harris, L. C.; "A Stochastic Process Model of Residential Development"; Journal of Regional Science; Volume 8; 1968.

[25] Patterns will be defined as a set of values, each value tagged by geographic location and/or calendar data of occurrence.

[26] Robbins, Calude L.; "Micro Scale Residential Environment; A Case Study of Manhattan, Kansas"; Procedures and papers from the EPA Conference on Social Studies and the Environment; 1973; p. 5.

[27] Vance, James, Jr.; "Geography and Urban Evolution in the San Francisco Bay Area"; The San Francisco Bay Area: Its Problems and Future; ed. Stanly Scott; Institute of Governmental Studies, University of California, Berkeley; 1971; p. 3.

[28] Yuill, Robert S.; A General Model for Urban Growth: A Spatial Simulation; Ann Arbor, Michigan: Michigan Geography Publication, University of Michigan Press; 1970, p. 11.

[29] Ibid; p. 11.

CHAPTER II

LIMITATIONS OF THE MODEL

Section A

Identification of Environmental Factors

Although we speak about the environment of an organism or a population, we know that there is no such thing. A population of individuals lives in a range of environments, and adaptability is just as much a matter of being adapted to environments which differ from place to place as to environments which change from time to time.[1]

Environmental factors are complex and not easily separated from other urban components. Time, physical space and climatology are just a few of the many areas that must be considered. However, within the framework of developing a model that can be used to investigate the relationships between urban growth and the resulting negating environmental consequences, one must be primarily concerned with physical space and spatial equilibrium.

Physical Space

Space is abundant, even within the urbanized (metropolitan) regions there is plenty of land. According to the French urban geographer, Jean Gottman, perhaps only 1.8% of the United States was urbanized by 1960.[2] For example, within the Philadelphia SMSA, only 3,500 square miles-less than 20%-was urbanized by 1970. Should the Philadelphia population increase to over six million there would remain over 2,300 square miles of open space in Philadelphia.

Therefore, one might ask, wherein lies the problem?

> Simply in the form of growth. Urbanization proceeds by increasing the density within and extending the periphery, always at the expense of open space. As a result, unlike other urban facilities, open space is most abundant where people are scarcest.[3]

Traditionally, when studying physical space one either considers <u>form</u> or <u>process</u>. Form represented by man-made or naturalistic forms, and process meaning the physical growth processes or acquisition processes.[4] This study shall consider both form and process, within a context of spatial equilibrium and the value of natural places.

Spatial Equilibrium

The term spatial equilibrium was first considered in the introduction of this paper and was defined as a considered balance within the total environment between the human and naturalistic environs of the urban landscape. Spatial equilibrium is immersed in an understanding of space usage. However, as man-made spaces.are developed upon natural spaces, it is first necessary to consider the dominant aspects of certain natural spaces and their intrinsic suitability for human usage. Therefore, spatial equilibrium can only be studied by classifying and investigating the natural environment and then repeating the process within the framework of the man-made environment.

As this model is to be a general investigator, it is necessary to divide the lithosphere and hydrosphere into three categories representing the Natural Environment and three categories representing the Man-Made Environment.

Natural Environment

A. Hydrous Regions

B. Hydro-Terra Regions

C. Terrene Regions

Man-Made Environment

A. Urban Confine

B. Rural Confine

C. Unconfined Human Usage

Each of the Natural Environment categories has its individualistic dominant characteristic which separates it from any other natural category. The man-made environs are not as clearly defined and tend to overlap. However, if particular dividing lines between man-made areas are not well defined, it does not negate the value of this study as this investigation is more concerned with future urbanization and equilibrium potential.

Natural Environment

A. Hydrous Regions

In principle, only land that is inseparable from surface water shall be considered as a Hydrus Region. However, in order to develop a set of environmental descriptors for Hydrus Regions, it is necessary to sub-divide it into two categories: Salt Water and Fresh Water.

B. Hydro-Terra Regions

Land areas that are neither Hydrus or Terrene but have some characteristics of both shall be placed in this grouping. This would include areas that are seasonably wet (or dry) and areas that are subject to less regular changes within the ecosystem structure. There are five sub-divisions in this category: Swamps, Marshes, Bogs, Floodplains and Shorelines.

C. Terrene Regions

Areas that are characterized by land masses shall be considered as Terrene Regions. Such areas would include: Plains, Forests and Slopes.

Man-Made Environment

A. Urban Confine

The area fundamentally devoted to urban activity and occupation outside which lies the land areas primarily devoted to non-urban and agricultural interests.[5]

B. Rural Confine

That area which is devoted to agricultural and non-urban activity. Also, in the United States, any administrative area with a population of 2000 persons or less and all unadministrated areas.

C. Unconfined Human Usage

All areas of human land use that:

(a) fit into both the urban and rural landscape, or

(b) areas that do not fit into either definition.

An example might be an oil field which fits both definitions of the unconfined group.

To reiterate, in more detail, the two groups of categories into which the lithosphere can be subdivided, see Figure 4.

Natural Environment

A. Hydrus Region
 - A1. Surface Water: Salt
 - A2. Surface Water: Fresh

B. Hydro-Terra Regions
 - B1. Swamp
 - B2. Marsh
 - B3. Bog
 - B4. Flood Plain
 - B5. Coastline

C. Terrene Regions
 - C1. Plains
 - C2. Forests
 - C3. Slopes

Man-Made Environment

A. Urban Confine

B. Rural Confine
 - B1. Agricultural
 - B2. Non-urban
 - B3. Population 2000 or less
 - B4. Unadministrated

C. Unconfined Human Usage

Fig. 4. Natural/man-made environments.

Suitability for Urban Usage

To determine which areas are intrinsically suitable for urban usage is now reasonably easy. That is, Terrene regions are most suitable, Hydrus regions least suitable, and Hydro-terra regions have a marginable suitability. A listing from most suitable to least suitable would be as follows:

Most Suitable:	Plains
	Forests, Woodlands
	Slopes
	Flood Plains and Shoreline
	Marshes
	Swamps, Bogs
Least Suitable:	Surface Water

Fig. 5. Suitability for urban usage

It should be noted, however, that technological innovations in physical design may allow surface water to be as suitable as flat lands in future suitability studies.

The regional categories as well as a scaling of the suitability of various lands will be used, in conjunction with a set of design criteria, to determine the premises and input criteria of each component simulation model as outlined in Chapters III, IV, V and VI.

Section B

General Classification of Parameters

Traditionally, planners have dealt with environmental concerns when in a state of environmental crises. Only when an environmental condition becomes hazardous has there been any attempt to develop a study technique and control system.[6] Even these embronic efforts to work with the environment is on a piece-meal basis, with each urban center developing its own techniques for handling each environmental problem.

Concomitantly, the problem of the designer of urban form is that given design requirements, expressed as either: A) a set of design standards of land use or B) a set of needs or demands for land use, he must attempt to lay down an arbitrary design for a given region.[7,8] It might be best to consider the plan that nature has already designed.

McHarg considers the problem of the naturalistic development of a region and calls it "physiogramic determinism" or, roughly, nature ought to come first. This study shall bring together the concepts of environmental enhancement and physiogramic considerations and call it "spatial equilibrium" and the attempt to develop a given area in this matter "equilibrium potential."

It has already been stated that spatial equilibrium shall be considered in terms of the natural environment and the man-made environment and that the study of each of these environs is paramount to the developing of a group of environmental parameters.[9]

Therefore, in order to understand how a general set of parameters is to be developed, consider the following diagram.

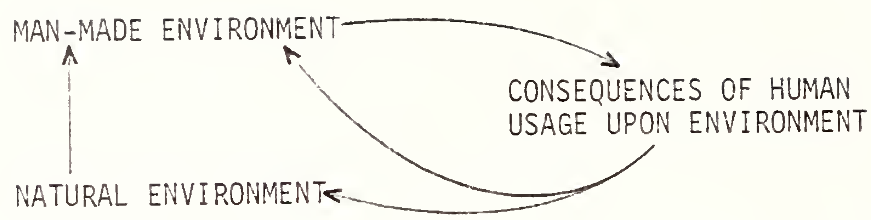


Fig. 6. Environments and consequences.

This diagram is a verbal display of how the man-made environment and the natural environment interact. That is, developed upon the natural environment is the man-made environment, and the interaction feedback (consequences) is a loop that affects both environs. This is not a closed system, but it is a very difficult chain to break.

What is needed is a two-way feedback and regulatory system. Consider the following diagram.

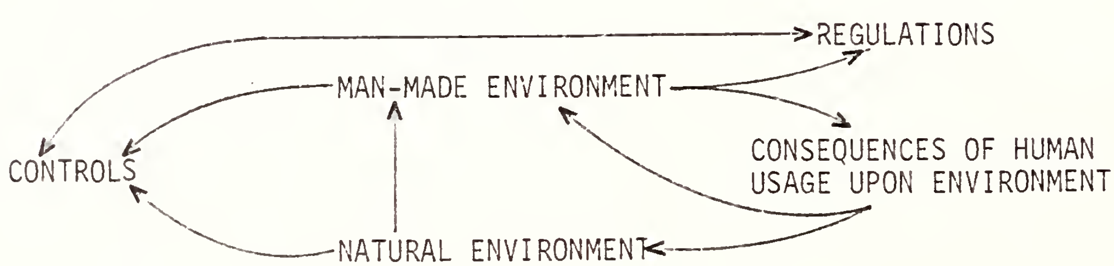


Fig. 7. Environments, consequences, controls and regulations.

In this system we still have the loop of Natural Environment/Man-Made Environment/resulting consequences. However, there are two additions. First, a set of controls offering feedback to the naturalistic environment from the man-made environment. Second, a set of regulations restraining the amount of interactive consequences between the natural and the man-made environs.

Thus, in this investigation consideration of the following general environmental parameters is of primary importance.

A. Analytical parameters...to study and code the natural and man-made environments.

B. Interactive consequential parameters...to study the results of the interaction between the naturalistic and the man-made environs.

C. Control parameters...to provide positive feedback to the nautral environment.

The results of the investigation of these parameters will suggest a set of regulatory constraints for anticipating the interaction between the man-made and the natural environments in the future.

However, there are two basic problems that need to be considered prior to the individual investigations of each of these parameters. These problem areas are the aggregation problems incurred and the human factors affecting urban growth.

Aggregation

A major problem with any urban study is the bringing together of a variety of unrelated bits and pieces of the urban continuum. In most urban studies, there are three aggregation problems. These are:

1. Level of spatial aggregation.
2. Number of variables.
3. Aggregation over time.

As each of these specific problems needs an individual answer, let us consider them in order.

1. Level of Spatial Aggregation

The number of sub-regional divisions comprising a given forecast area is a definite problem.[10] A spatial delineation matrix must be able to define macro- as well as micro-environments. This study, in order to be a general investigator, cannot suggest one particular matrices as being all inclusive. Each study case will have to consider a matrix system that fits the particular urban region and environmental characteristics.

2. Number of Variables

Most models are too highly aggregated in terms of variables. For example, the EMPIRIC models of (economic) urban growth considered only seven located variables.[11] Although it appears that this investigation has only three general parameters, each of these basic categories has many subdivisions, making the total number of variables very large.

3. Aggregation over Time

Most models employ five- or ten-year periods in their time considerations. Long range models may consider much larger groups of time, possibly as much as one hundred years.[12] A disaggregation, with respect to this feature of this model, would pose serious problems in regard to data for parameter estimating for future growth. However, as this model is to be nonmetric in regard to time, a given simulation can consider any proposed time range.[13]

Human Factors

The human factor is almost the "odd-man out" in most urban models. This is because it is almost impossible to unerringly develop a system to consider human interaction in urban problems. There will be no attempt to develop a one-dimensional man that is prevalent in many urban models.[14] However, only four human factor elements will be considered in relation to this study:

1. Political environmental exploitation.
2. Population growth.
3. Technological change.
4. Economics.

Actually, consideration will be made of how these human factors affect the input of the model, not the output. If the model is successfully developed, the regulatory and control considerations will constrain the human intervention level, in relation to environmental concerns, within the urban landscape.

1. Political Environmental Exploitation

For the exploitation of the environment, there are four possible political systems. These systems, and some of their characteristics, are displayed in Diagram II, c. However, Case IV seems to be a class without real members. It is included in the diagram only for logical completeness and will not be further enumerated upon.[15]

See Figure 8 on page 38.

Case I..Private enterprise

Individual ownership; individual gain.

Case II..Socialism

Group ownership; group gain

Case III..Tragedy of the commons

A system whereby an informal group is formed to the advantage of each participant.[16]

Each of these systems has one attribute in common, the gain for the environment is nil. Therefore, it is obvious that if any environmental enhancement is to be accomplished it must be done prior to the intervention by a political system. Thus, the parameters must be conditional, i.e., it must be assumed that environmental considerations can be made prior to, or to the exclusion of, major political intervention by an urban government.

EXPLANATION OF PLATE IV

Fig. 8. Exploitation of environments.

PLATE IV

CASE	EXPLOITATION BY:		GAIN BY:		RESULTS:	
	INDIVIDUAL	GROUP	INDIVIDUAL	GROUP	OVERALL GAIN FOR ENVIRONMENT	NAME OF SYSTEM
I	X		X		-	Private Enterprise
II		X		X	-	Socialism
III		X	X		-	Tragedy Of The Commons
IV	X			X	-	?

2. Population Growth

There are two poles of population considerations. On the one hand is population growth, represented by birth, in-migration and, in some part, inter-city migration. On the other hand is the concept of Zero Population Growth, along with death and out-migration. Population growth causes urban growth, whereas population decreases tend to cause urban stagnation.[18] In order for this model to be useful to its fullest extent, it will have to be assumed that urban growth will continue, unabated, during the given study period. A stopage in growth, or a decrease, will not negate the model; it will just render it dormant until there is another increase in population causing growth along the urban fringe or within the rural confine.

3. Technological Changes

There are two areas of technological capability which have immediate impact upon the environment. First, there is the possibility of a new building technique or the development of a new system of urbanization. Most often such technological innovations tend to be exploitive of the natural environment. The second technological change is the possibility of new innovations in comfort. Such technological gains often cause individuals and groups to become "energy slaves." That is, the new technological gain causes an additional drain on energy resources.[19] Obviously, such technological usage has effects upon the consequential interaction between the man-made and the naturalistic environs.

4. Economics

Actually, this study is not dependent upon economics for guidelines or a major amount of input. However, the reasoning for not considering economics should be mentioned. Basically, this study is dependent upon maximizing the relationship between the environment of a given area and the potential growth capability. Economics allows for the maximizing of a given land area at the expense of the environment thru exploitation of natural resources. Although this model and economic systems are not mutually exclusive, there is little current economic theory that is applicable to the development of this investigative study.

Thus, each general parameter should be considered in light of the limitations placed upon the model by internal structuring as well as the conditionality created by the vastness of environmental concerns.

FOOTNOTES

[1]Medawar, Peter B.; "The Future of Man"; Reith Lectures; 1959, Tape recording.

[2]Gottman, Jean; Metropolis; New York: The Twentieth Century Fund; 1961, p. 26.

[3]McHarg, Ian; Design with Nature; Garden City, New York: The Natural History Press; 1972, p. 108.

[4]Yuill, Robert S.; A General Model of Urban Growth: A Spatial Simulation; Ann Arbor, Michigan: Michigan Geography Publications, University of Michigan Press; 1970, p. 11.

[5]Monkhouse, F. J.; A Dictionary of Geography; Chicago: Adline Publishing Company; 1970, p. 364.

[6]Linton, Ronald M.; Terracide: America's Destruction of Her Living Environment; Boston: Little, Brown and Company; 1970, p. 335.

[7]Whyte, William H.; The Last Landscape; Garden City, New York: Doubleday and Company; 1968, p. 182.

[8]Schlager, K. J.; "A Land Use Plan Design Model"; Journal of the American Institute of Planners; Volume 31, Number 2; May 1965.

[9]It should be noted that environmental parameters are not a new concept. The environmetric considerations of the CITY I and METROPOLIS gaming models attempted to bring some parametric considerations into environmental concerns of urban growth. However, these environmetric considerations were very basic and most closely follow the physiogramic considerations of McHarg's studies. See: King, 1972.

[10]Alanso, William; "The Quality of Data and the Choice and Design of Predictive Models"; Highway Research Board Special Report; Washington DC: Highway Research Board; 1972, p. 18.

[11]Ibid; p. 19.

[12]Ibid; p. 19.

[13]See Chapter I and Chapter IV.

[14]Consider, for example, Alanso's "Economic Man." See Alanso, 1961.

[15]Hardin, Gerret; "The Tragedy of the Commons"; G. Hardin, ed.; Population, Evolution and Birth Control; San Francisco: Freeman and Company; 1969, p. 61.

[16]Lloyd, William Foster; "Two Lecture on the Checks to Population"; Oxford, 1833; G. Hardin, ed; Population, Evolution and Birth Control; San Francisco: Freeman and Company, 1969.

[17]Hardin, Gerrett; "Population, Pollution and Political Systems"; Noel R. Hinrichs, ed.; Population, Environment and People; For the President's Council on Population and Environment; 1971, p. 162.

[18]Shinn, Roger L.; "Population and Ecology, Dual Threat and Response"; Noel R. Hinrichs, ed.; Population, Environment and People; For the President's Council on Population and Environment; 1971.

[19]Logan, James P., Jr.; "The Dilemma of Technology"; Noel R. Hindrichs, ed. Population, Environment and People; For the President's Council on Population and Environment; 1971.

PART B

INPUT OF THE DESCRIPTIVE MODELS

Introduction

All things considered, the previous chapters of this paper have been necessarily general in putting forth the scope and limitations of a particular simulation model. There has been an attempt to suggest the operational ranges of such a model, as well as identify particular problems that are congruent with the investigation. It is next necessary to consider how all of the general information can be put to various specific uses.

As was detailed in Chapter I, there are three functions of the simulation model. These are:

1. Make specific form comparisons.
2. Identify urban and naturalistic patterns.
3. Generate a growth/consequence, i.e., cause/effect relationship.

Two of these functions are accomplished by the various descriptive models, i.e., to make form comparisons and to identify patterns. The third function is accomplished by the simulation model.

Model Hierarchy

The design criteria will structure the premises around which the model functioning components will be formed. The various components will, as necessary, be developed into a series of component models. The component or component models will be grouped into three descriptive models. These models, in turn, will be grouped together to construct the ENVIRONMENTAL PARAMETERS DESCRIPTOR, i.e., the simulation model,[1] hereafter referred to as EPD.

CHAPTER III

ANALYTIC PARAMETERS MODEL

Because of the analytical nature of certain aspects of form comparisons and pattern identification, these particular areas of study will be grouped together in one particular descriptive model titled "Analytical Parameters Model," hereafter abbreviated as the APModel.

Design Criteria of the APModel

There are five basic design criteria upon which the APModel is developed. Each of these design criteria shall be expanded into at least one component. These design criteria/components are:

1. Code the study matrix in terms of the Natural and Man-Made Environmental Classifications.

   Component name: Regional Morphology Component.

2. Code the study matrix in terms of water and land composition.

   Component names: Regional Composition:Earth and Regional Composion:Water.

3. Code the study matrix in terms of natural events of human importance.

   Component name: Destructive Phenomenon Component.

4. Code the study matrix in terms of existing climatological conditions.

   Component name: Climatology Component.

5. Code the study matrix in terms of a series of defined values.

   Component names: Value of Land Component; Value of Nature Component; and Value of Time Component.

All of this information shall be scored in a system that allows for intra-model comparisons and model hierarchy composing.

These five design criteria shall be grouped into two component models. The first of these models shall contain all components of a geographic or spatial absolute pattern or form. This component model shall be titled "Geomorphology Component Model," hereafter abbreviated as GcoModel. The second component model shall contain all components of a non-absolute nature. This model shall be titled "Values Component Model," hereafter abbreviated as VcoModel.

Each of these two component models shall be discussed in great detail and at some length, during the remainder of this chapter, beginning with the components of the GcoModel.

APModel verbal display is on the following page.

ANALYTIC PARAMETERS MODEL

(APModel)

Section A

Geomorphology
Component Model

(GcoModel)

Components:

Regional Morphology

Regional Composition:
Water

Regional Composition:
Earth

Destructive Phenomenon

Climatology

Section B

Values
Component Model

(VcoModel)

Components:

Value of Land

Value of Nature

Value of Time

Fig. 9. APM/verbal display.

Section A

Geomorphology Component Model

(GcoModel)

Regional Morphology Component

Because there is a need to understand each matrix unit, as well as be able to classify groups of matrices, a series of (physical) structure defining investigations shall be conducted upon the study area. The Regional Morphology Component performs the most basic of these examinations. It defines each matrix unit, or part of a unit, by existing land form. This information is extracted from both the naturalistic and the man-made environs.

It is necessary to consider all reasonable land forms as part of this component. However, in order to control the vast amount of input data and to provide for better model applicability, it is necessary to develop a general coding hierarchy for inputing information.

Coding Hierarchy

The coding hierarchy to be adopted within this component is also to be applied to the remaining components of the GcoModel, as well as the components of the VcoModel. In addition, the same system shall be followed by the other descriptive models as outlined in Chapters 4 and 5.

Each study area, i.e., matrices, shall be considered at three levels of coding hierarchy. These are:

1. Regional level.
2. Intra-Matrix level.
3. Micro-Environmental level.

In order to forestall any possible errors in coding a given study matrices, each of these three levels for coding matrix data shall be carefully defined.

1. Regional level of data classification

The regional level of data classification shall be the highest order of matrix input data. The Regional classification is normally represented by the consensus of the Intra-Matrix level classifications. That is, each matrix unit will be classified by the particular data being compiled, and the sum of these individual data bases will suggest the total number of Regional level data groups within a given study area.

It is possible for a study area to consist of more than one Regional designation. The limits of the number of possible regional designations that can define a study area is restricted only by the different groups of Intra-Matrix level and Micro-Environmental level data for a particular component. That is, if a component has only one set of data sources that can be generalized to a regional level of classification, then there can only be one regional classification within that component matrices. Conversely, if a component has twenty (or more) sets of data that can be generalized to a regional level of classification, then there can be twenty Regional classifications within the matrices for that particular component.

In addition there are to be certain groups of information that are to be considered solely at the Regional level. That is, they have no Intra-Matrix or Micro-Environmental counterparts. An example of this type of Regional classification would be an earthquake zone. This is because an earthquake extends its influence far beyond its epicenter and even beyond the particular fault lines that created it.

2. Intra-Matrix level of classification

Each matrix unit shall be carefully scrutinized and the existing geomorphological data of interest to this investigation shall be divided into primary and secondary groups. The primary group is defined as the single major representation of a given data base. That is, only data that is representative of 51%, or more, of a given matrix unit shall be considered as the primary matrix unit data class. If a given unit has no primary data base, it shall consist solely of secondary matrix unit data classes. A secondary data class is defined as any data representative of 50%, or less, of a single matrix unit.

In addition, a given matrix unit may contain one primary and numerous secondary Intra-Matrix level data bases, as well as part of, or all of, a Micro-Environment.

3. Micro-Environmental level of classification

A Micro-Environment shall be defined as:

A. Any atypical data source found within a given study area, or

B. Any typical Regional or Intra-Marrix level of data that is atypical for a given study area.

Data sources that are atypical for a given study area can be considered at several levels of confidence. Any information that is unusual for a "larger area," of which the study area is only a small part, would quality as a Micro-Environment. However, one should take note that "a larger area" can define anything from slightly larger than the study area to possibly the entire continental shelf or the whole globe.

For example, an active Volcano (or volcanic area) would possibly qualify as an atypical environment for most of the Continental US. However, they are common on certain Islands of the Hawaiian chain. Even though common in Hawaii, volcanic action is so rare on a world scale that they should be considered as micro-environments. Volcanic areas are not usually habitable for humans, however, it is a clear example and easily explains one aspect of the coding level of micro-environments.

A typical Regional or Intra-Matrix level of data might possibly be atypical for a given study area. Flowing water, i.e., rivers and streams, is common throughout most parts of the United States. However, in a desert environment a River might be very atypical and thus a Micro-Environment.

Both of the above examples bring forth the idea that Micro-Environments are both inter-matrix as well as single-unit in scope. The size of a particular Micro-Environment is, obviously, independent of the matrices used to organize information about a given study area.

Numeric Notation

In order to better control data and to maintain internal consistency throughout the study, the land forms and patterns will be coded from the

Natural and Man-Made Environments as suggested by the concepts of spatial equilibrium (see Chapter II).

However, in order to use this information in a systematic study, each coded land area is given a numeric notation. This notation does not represent either a hierarchy or value or worth. It does maintain a gradation from Regional classification levels to subdivisions of Intra-Matric classifications.

Each Regional level of classification shall be assigned a number, followed by a decimal point and the number zero.

Each Intra-Matrix level of classification shall be considered as either general, non-specified classifications, or under a general heading with specific subdivisions.

Additional Intra-Matrix sub-groups can be notated under each specific Intra-Matrix classification.

Sample Classification

13.0 Shoreline

13.1 Foreshore

13.1.1 Shoreline of submergence

13.1.1.1 Submerged mountains

Fig. 10. Sample classification.

Classification Notation

13.0 = Regional level of classification

13.1 = Intra-Matrix, General

13.1.1 = Intra-Matrix, specific subdivision

13.1.1.1 = Intra Matrix, specific subdiv., sub-group

Fig. 11. Classification notation.

If a particular Intra-Matrix level of classification, i.e., General, Specific subdivision or Specific subdivision subgroup, has a <u>variable</u>, or indeterminent, number of possible headings, the notation shall be given a designation of "n" (lower case N). For example, 2.n would be a General Intra-Matrix level of land form classification with a variable number of possible headings; 2.1.n or 2.1.1n might represent special cases of variable Specific Intra-Matrix classifications.

Because of the value and rarity of micro-environments in a given ecosystem, all <u>major</u> micro-environments, in a given study area, shall be extracted from their individual parent class and shall be grouped separately as Micro-Matrix levels of land form classification. This topic shall be discussed in greater depth during a later section of this paper.

Natural Environment

To reiterate, the Natural Environment has been subdivided into three basic categories:

1. Hydrus Regions.
2. Hydro-Terra Regions.
3. Terrene Regions.

Each of these categories can be examined in terms of the coding system and the numeric notation as suggested by the previous two sections of this investigation.

TABLE I

HYDRUS REGIONS

(Surface Water:Salt)

1.0 OCEANS

- 1.1 Anarctic
- 1.2 Atlantic, North
- 1.3 Atlantic, South
- 1.4 Indian
- 1.5 Pacific, North
- 1.6 Pacific, South

2.0 SEAS

- 2.n

3.0 GULFS

- 3.n

4.0 INLAND SEAS

- 4.n

(Surface Water:Fresh)

TABLE I
(continued)

5.0 LAKES-general

5.1 Finger or Trough
5.2 Glacial
5.3 Landslide
5.4 Oxbow
5.5 Playa
5.6 Water Table

6.0 FLOWING WATER

6.1 Rivers-general

6.1.1 Alluvial Rivers
6.1.2 Tidal Rivers

6.2 Streams

6.2.1 First Degree Stream
6.2.2 Second Degree Stream
6.2.3 Third Degree Stream
6.2.n

7.0 SPECIFIED MICRO-ENVIRONMENTS

7.1 Barrier Island

7.2 Bar-general

7.2.1 Costal Bar
7.2.2 Bayhead Bar
7.2.3 Baymouth Bar
7.2.4 Cuspate Bar
7.2.5 Looped Bar
7.2.6 Mid-Bay Bar

7.3 Bay

7.4 Coral Reef

7.4.1 Barrier Reef
7.4.2 Fringing Reef
7.4.3 Shoreline Reef
7.4.4 Lagoon

7.5 Cove

7.6 Fjord

TABLE I
(continued)

7.7 Groin

7.8 Salt Lake

7.n

8.n UNSPECIFIED MICRO-ENVIRONMENTS

TABLE II

HYDRO-TERRA REGIONS

9.0 SWAMPS-general

10.0 MARSHES

10.1 Salt Marshes
10.2 Inland Marshes

11.0 BOGS-general

12.0 FLOODPLAINS

12.1 Yearly average floodplain
12.2 Twenty year floodplain
12.3 Fifty year floodplain

13.0 SHORELINE

13.1 Foreshore

13.1.1 Shoreline of Submergence

13.1.1.1 Submerged Mountainous
13.1.1.2 Submerged Coastal Plain

13.1.2 Shoreline of Emergence

TABLE II
(continued)

13.1.2.1 Emerging Coastal Plain-
Plain of High Relief
13.1.2.2 Emerging Coastal Plain-
Plain of Low Relief

13.1.3 Neutral Shoreline

13.1.3.1 Alluvial Fan

13.1.4 Backshore

13.1.4.1 Storm Surge

13.2 Beach

13.2.1 Shingle
13.2.1 Strip

14.0 SPECIFIED MICRO-ENVIRONMENTS

14.1 Peat Bogs

14.2 Meander

14.2.1 Alluvial
14.2.2 Cutoff
14.2.3 Entrenched

14.3 Shoreline

14.3.1 Foreshore

14.3.1.1 Shoreline of Submergence-
Fjordal Shore
14.3.1.2 Shoreline of Submergence-
Glacial Deposit

14.4 Fault Shoreline

14.5 Barrier Island Shoreline

14.6 Beach

14.6.1 Bayhead Beach
14.6.2 Bayside Beach
14.6.3 Pocket Beach

TABLE II
(continued)

15.n NONSPECIFIED MICRO-ENVIRONMENTS

TABLE III

TERRENE REGIONS

16.0 PLAINS (0% to 6% average slope)

16.1 Coastal Plains (up to 599 ft elev. above sea level)

16.1.1 Backshore

16.2 Upland Plains (600+ elev. above sea level)

16.2.1 Alluvial Plain
16.2.2 Desert Plain
16.2.3 Highland Plain
16.2.4 Prairie Plain
16.2.5 Tundra Plain

17.0 FORESTS

17.1 Boreal
17.2 Broadleaf
17.3 Deciduous
17.4 Elfin
17.5 Equatorial
17.6 Evergreen
17.7 Evergreen, Hardwood
17.8 Laurel
17.9 Mangrove
17.10 Monsoon
17.11 Montane
17.12 Mossy
17.13 Needleleaf
17.14 Sclerophyll
17.15 Summergreen
17.16 Temperate Evergreen
17.17 Tropical
17.18 Tropical Evergreen

TABLE III
(continued)

18.0 SLOPES (6%+ Grades)

- 18.1 6% to 12% slopes
- 18.2 12%+ slopes
  - 18.2.1 Hills
  - 18.2.2 Mountains
  - 18.2.3 Valley walls

19.0 SPECIFIED MICRO-ENVIRONMENTS

- 19.1 Block Montane
- 19.2 Bluff
- 19.3 Butte
- 19.4 Canyon
- 19.5 Cavern
- 19.6 Cave, Limestone
- 19.7 Cliff
- 19.8 Crader
- 19.9 Dam, Natural
- 19.10 Delta
  - 19.10.1 Arcuate
  - 19.10.2 Cuspate
  - 19.10.3 Esturine
  - 19.10.4 Glacial
  - 19.10.5 Tidal
- 19.11 Depression
- 19.12 Dome
- 19.13 Flat
- 19.14 Island
  - 19.14.1 Atole
  - 19.14.2 Barrier
- 19.15 Mesa
- 19.16 Spit
- 19.17 Terrace
- 19.18 Valley
  - 19.18.1 Anticline
  - 19.18.2 Hanging
  - 19.18.3 Honocline
  - 19.18.4 Syncline

20.n NONSPECIFIED MICRO-ENVIRONMENTS

In reviewing how each of the various Regional and Intra-Matrix sets fit into the various classes, one will find that most of the sections are self-explanatory. However, there is a need for some specific verbal detailing of each Table.

Table I

1.0; Oceans, this is a finite listing of world Oceans.

2.0; 3.0; 4.0; these salt water Regional divisions have extremely large numbers of possible specific Intra-Matrix divisions. However, a US Geodedic survey map can provide all of the detail for these Divisional groups.

5.0; Lakes are simply defined as water filled hollows.

6.0; Rivers and Streams are both defined as water flowing in definite channels toward the sea. Streams have a further definition of being a body of water covering all scales from a small rill to a river. Streams are coded by degree, i.e., from the initial small branch to the main root.

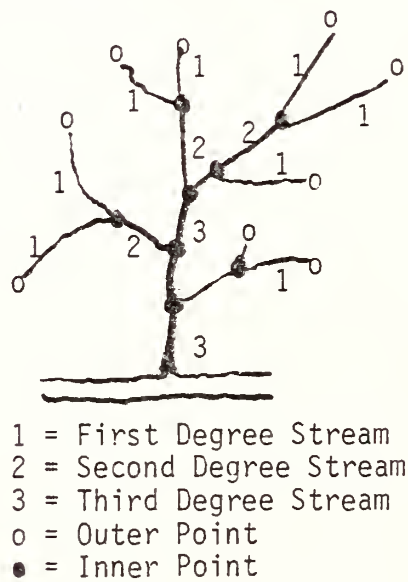


Fig. 12. Stream classification.

7.0; The specified Micro-Environments is a listing of the Hydrus regions that are atypical or rare.

8.n; The nonspecified Micro-Environment allows one to make additions to the 7.0 list as well as provide space for typical Regional and Intra-Matrix classifications, i.e., 1.0 thru 6.0, that are found atypically in a given study area.

Table II

9.0; 10.0; 11.0 Swamps, Marshes and Bogs are all generally related. Swamps are permanently water logged areas; a Marsh is only temporarily inundated and a Bog has decayed vegetation as well as being inundated.

12.0; 13.0 Floodplains and Shorelines perform similar functions; Floodplains are regularly flooded fresh water areas and Shorelines are regularly flooded salt water areas.

14.0; 15.0 The two classes of Micro-Environments represent either atypical land formations or typical land formations that are atypical for a given location.

Table III

16.0 Plains are defined as continuous tracts of comparatively flat land; grass areas are included with this definition. Forest areas are separated.

17.0 Forests and Woodlands are defined as standing tree groups, both regular and irregular, usually of some commercial value.

18.0 Slopes are defined as having an absolute value of over 6% of slope over a given slope line.

19.0; 20.0 Micro-Environments are similarly defined as 7.0; 8.0; 14.0; and 15.0.

Man-Made Environment

To again reiterate, from Chapter I, the Man-Made Environment has been subdivided into three basic categories. These categories are:

1. Urban confine of human land usage.
2. Rural confine of human land usage.
3. Unconfined human land usage.

Each of these broad categories has been carefully detailed following the same basic numeric coding system developed for the Natural Environment section. However, in order to maintain a clear understanding of the particular land areas that are for human usage and to follow the same format as outlined in the Natural Environment section, an additional category shall be introduced. That is, the Micro-Environments of special human usage or simply Micro-Human Environments.

In addition, each category of human land usage shall be given an alpha (letter) designation, as well as the numeric designation. These alpha designations are as follows:

1. U..Urban confine of human land usage.
2. R..Rural confine of human land usage.
3. C..Unconfined human land usage.
4. M..Micro-Human environments.

TABLE IV

URBAN CONFINE

(Incorporated Population Foci-
Greater than 2000 Pop..)

U 1.0 RESIDENTIAL

- U 1.1 Single family dwelling, permanent
- U 1.2 Multi-family dwelling, permanent
- U 1.3 Mobile dwelling space

U 2.0 COMMERCIAL

- U 2.1 Retail
  - U 2.1.1 Building Materials
  - U 2.1.2 Clothing and Apparal
  - U 2.1.3 Eating and Drinking
  - U 2.1.4 Food and Kindred Products
  - U 2.1.5 General Merchandise
  - U 2.1.6 Michinery
  - U 2.1.7 Motor Vehicles
  - U 2.1.8 Petroleum Products
  - U 2.1.n
- U 2.2 Wholesale
  - U 2.2.1 Building Materials
  - U 2.2.2 Clothing and Apparal
  - U 2.2.3 Eating and Drinking
  - U 2.2.4 Food and Kindred Products
  - U 2.2.5 General Merchandise
  - U 2.2.6 Machinery
  - U 2.2.7 Motor Vehicles
  - U 2.2.8 Petroleum Products
  - U 2.2.n as related to all U 2.0 land uses
- U 2.3 Office
  - U 2.3.n as related to all U 2.0 and U 3.0 classifications
- U 2.4 Financial

TABLE IV
(continued)

- U 2.5 Service
  - U 2.5.1 Lodging
  - U 2.5.2 Personal
  - U 2.5.3 Business
  - U 2.5.4 Medical, Health
  - U 2.5.n

U 3.0 MANUFACTURING

- U 3.1 Aerospace
- U 3.2 Aircraft
- U 3.3 Apparel and Allied Products
- U 3.4 Boat and Ships
- U 3.5 Cement and Concrete
- U 3.6 Raw Chemicals
- U 3.7 Drugs
- U 3.8 Fabricated Metals
- U 3.9 Food Processing
- U 3.10 Machinery
- U 3.11 Paper and Allied Products
- U 3.12 Printing and Publishing
- U 3.13 Petroleum and Oil Products
- U 3.14 Railroad Products
- U 3.15 Rubber and Plastics
- U 3.16 Smelting Mills and Processing Plants
- U 3.17 Textile Processing Mills
- U 3.18 Vehicle Man
- U 3.n

U 4.0 UTILITIES

- U 4.1 Communications
- U 4.2 Telephone
- U 4.3 Telegraph
- U 4.4 Electricity
- U 4.5 Gas
- U 4.6 Water
- U 4.7 Sanitation
- U 4.n

U 5.0 SERVICE INDUSTRIES

- U 5.n As related to all U 3.0 and U 4.0 classifications; also all R 10.0; C 11.0; C 12.0 and C 14.0 classifications

TABLE IV
(continued)

U 6.0 PUBLIC INSTITUTIONS

U 6.1 Governmental

U 6.1.1 Federal
U 6.1.2 State
U 6.1.3 County
U 6.1.4 City

U 6.2 Educational

U 6.2.1 Federal
U 6.2.2 State
U 6.2.3 County
U 6.2.4 City

U 6.3 Medical, Health

U 6.4 Military Installations

U 6.n

U 7.0 PRIVATE INSTITUTIONS

U 7.1 Education
U 7.2 Medical, Health
U 7.3 Non-Profit
U 7.n

TABLE V

RURAL CONFINE

R 8.0 INCORPORATED POP. FOCI-LESS THAN 2000 POP.

R 8.1n Residential
R 8.2n Commercial
R 8.3n Industry
R 8.4n Manufacturers

TABLE V
(continued)

R 8.5n Utilities
R 8.6n Public Institutes
R 8.7n Private Institutes

R 9.0 UNCORPORATED POP. FOCI

R 9.1n Residential
R 9.2n Commercial
R 9.3n Industry
R 9.4n Manufacturers
R 9.5n Utilities
R 9.6n Public Institutes
R 9.7n Private Institutes

R 10.0 FARM

R 10.1 Grain Crops
R 10.2 Plant Crops
R 10.3 Orchards
R 10.4 Vineyards
R 10.5 Inundated Crop Areas
R 10.6 Fallow Lands
R 10.7 Livestock Areas
R 10.8 Grazing
R 10.9 Structures

R 10.9.1 Dwellings
R 10.9.2 Shelters, Sheds, Barns

TABLE VI

UNCONFINED HUMAN LAND USAGE

C 11.0 MINING

C 11.1 Crude Oil and Natural Gas
C 11.2 Metalic Mining, Well
C 11.3 Mon-metalic Mining, Well
C 11.4 Strip/Surface Mining

TABLE VI
(continued)

C 12.0 QUARRY

- C 12.1 Sand
- C 12.2 Stone

C 13.0 WATER MANAGEMENT

- C 13.1 Dams
- C 13.2 Ponds
- C 13.3 Reservoirs
- C 13.4 Lakes, Artificial

C 14.0 TRANSPORTATION NETWORKS

- C 14.1 Motor Transportation
  - C 14.1.1 Major Highway
  - C 14.1.2 Secondary Highway
  - C 14.1.3 Major Collector
  - C 14.1.4 Secondary Collector
  - C 14.1.5 Parking Space
- C 14.2 Air Transportation
  - C 14.2.1 Runways
  - C 14.2.2 Pads (heli. & STAL)
  - C 14.2.3 Terminals, Towers
  - C 14.2.4 Hanger and Aircraft Storage
- C 14.3 Water Transportation
  - C 14.3.1 Docks
  - C 14.3.2 Dry Docks
  - C 14.3.3 Canals, Locks
  - C 14.3.4 Channels, Man-made
  - C 14.3.5 Lighthouses and Similar Devices
  - C 14.3.6 Storage
- C 14.4 Rail Transportation
  - C 14.4.1 Track, General
  - C 14.4.2 Yard Track
  - C 14.4.3 Terminals, Towers
  - C 14.4.4 Storage (engine, car, etc.)

TABLE VII

MICRO-HUMAN ENVIRONMENTS

M 15.0 VACATION SETTLEMENTS

- M 15.1 Permanent
- M 15.2 Seasonal
- M 15.n

M 16.0 HISTORICAL LANDMARKS

- M 16.1 National Historical Landmark
- M 16.2 Of National Interest
- M 16.3 of State Interest
- M 16.4 of Local Interest

M 17.0 PRISONS

- M 17.1 Federal
- M 17.2 State
- M 17.3 County, Community

M 18.0 ABANDONED MINES, any type

M 19.0 NUCLEAR REACTOR areas

M 20.0 CONTAMINATED AREAS

- M 20.1 Chemical
- M 20.2 Radiation
- M 20.3 Military
- M 20.n

M 21.0 NATIONAL PARKS AND FORESTS

M 22.0 STATE PARKS AND FORESTS

Each Region and Intra-Matrix subdivision is a logical breakdown of the Urban, Rural, Unconfined and Micro-Human land usages into set groups.

Table IV

U 1.0 Residential dwellings are only considered in terms of major land usage. No attempt is made to consider various economic or socio-economic motivations or locational considerations. Further, no attempt is made to consider possible further divisions of the listed Intra-Matrix classifications.

U 2.0 This listing is not a finite set of commercial subgroups. It was not meant to be, however, most major land uses are listed and the category is openended, i.e., it can be expanded.

U 3.0; U 4.0; U 5.0 Again, these listings are not finite listings and are openended.

U 6.0; U 7.0 These sets consider only major institutions and governmental land uses.

Table V

R 8.0; R 9.0 These classifications can be expanded to include all of the subdivisions and subgroups of U 1.0 through U 7.0, if need be.

R 10.0 The farm group considers only those general land usage specifically related to farming. A specific farm crop or livestock is not considered, except in the case of R 10.5 (Inundated Crop Areas); these are either Cranberry Bogs or Rice Fields.

Such land usages as Cattle feed lots or Grain elevators are considered as part of U 5.n, service industries group.

Table VI

C 11.0; C 12.0; C 13.0; C 14.0 These classifications are applied to land usages that are not bound, either traditionally or functionally, to Urban or Rural spheres of activity.

Table VII

M 15.0 through N 22.0 The Micro-Human Environments are areas of unusual or special human usage. These areas are considered separately because of possible special locational requirements or health and safety related considerations. In addition, protected lands are grouped in the Micro-Human Environment category.

Regional Composition Component

Historically, man's ability to expand and develop urban centers has been dependent upon two factors:

1. The availability of good, potable water.
2. The availability of arable lands.

Current population centers are surrounded by, or have within their domain, these two basic life support systems.[2]

More recently, a third equally important life support system has come under close scrutiny, i.e., the atmosphere. Thus, for the modern urban center, or population foci, the ability to maintain existing areas of past growth as well as to procure areas for future needs is dependent upon three factors:

1. The ability to maintain good, potable water.
2. The ability to maintain arable lands.
3. The ability to maintain atmospheric conditions congruent to all life forms.

This model component cannot begin to detail the vast amounts of information and data related to the intense study currently under way concerning these three life support systems. However, each can be studied in two ways that relate to this model. First, to summarize existing conditions and characteristics within and around urban areas and second, to compute how future urban growth will affect each of these systems, independently and collectively. The first study technique, i.e., summarization and characterization, can be performed at the descriptive model level. However, the second technique can only be studied as part of the growth/consequence, i.e., cause/effect study, a function of the simulation model.

Therefore, information concerning the summarization and characterization of existing water and land support systems shall be outlined within this particular component of the GeoModel. The atmospheric conditions are considered in the Climatology Component, see Section:D.

Regional Composition:Water

In addition to maintaining good potable water, which is a characteristic of fresh water, one must also consider the oceans. In fact, as all life comes from the oceans,[3] one should probably consider them first. However, as both Salt Water and Fresh Water are to be developed upon the same basic criteria, they can be discussed in general terms without being separated.

The basic attribute about water which this model is concerned with is quality. Specific determinants of water quality are the key to understanding the capacity of water areas, i.e., surface water, acquifier regions and sub-surface water, to support the existing natural environment and the existing and expanding man-made environment. One should consider three specific areas of study in determining water quality. These are:

1. Physical characteristics.
2. Chemical characteristics.
3. Bacteriological characteristics.

In addition, consideration should be made to determine if existing water areas support any special micro-environments peculiar to water areas.

1. Physical characteristics

Although physical characteristics and tests do not directly measure the capability of water to act as a life support system, they do give an indication of general acceptability. The physical qualities of concern are turbidity, color and temperature.

Turbidity is the general clarity of water. There are existing standards throughout the country concerning this particular area of study. Each existing major water area has been tested, and the information is available for public use.

Color, or more correctly, lack of color is another area of study which has been exhaustively treated in a large number of publications. Again, standards are existing to outline the minimum amount of color that is acceptable to standing bodies of water, both fresh and salt.

Temperature is a physical characteristic about which little can be done. However, there is a range of temperatures within which water should be maintained or is naturally maintained. Salt water can be found to be anywhere from 0° C (32° F) to 32° C (90° F). This is also true of naturally standing fresh water. Water management areas need to control temperatures to keep them 32° C (90° F), as temperatures above this make water unfit to drink because of the possibility of developing bacteria.[4]

2. Chemical Characteristics

Because this investigation is concerned with natural water areas and not maintained areas, one should consider the accepted standards for "raw water" as part of this study.

FRESH WATER[5]	SALT WATER[6]
Chemical Constituents	Chemical Constituents
Acidity/Alkalinity	Salinity
CO_2	O_2-CO_2 Cycles
pH	Organic Constituents
Phosphates	Radiation
Radiation	Inert Matter
Inert Matter	

Fig. 13. Water characteristics.

Existing standards set by HEW and the Public Health Service will provide data concerning maximum allowable levels concerning these various characteristics.

3. <u>Bacteriological characteristics</u>

Coliform bacteria and protozoans are regarded as indicators of the presence of human pathogens in both fresh and salt water.[7] These bacteria cause changes in the composition of the water and are dangerous to human and other lifeforms.

As before, this area of study has been exhaustively treated by a variety of special fields from biochemistry to Medicine. All of the information needed for any given area is readily available from a variety of sources, including the Public Health Service.

Regional Composition:Earth

The Earth's composition shall be considered in two ways, soil characteristics and drainage characteristics. These characteristics shall be developed in terms of the previously defined Natural Environment. They shall not be defined in terms of the Man-Made Environment because of the necessity of defining the earth's composition in terms suitable for human usage. Thus, the Man-Made environs, by definition, would already be included in the areas suitable for human usage.[8]

The reasoning for considering the earth's composition in terms of suitability for human usage is a logical extension from the basis of the entire

ENVIRONMENTAL PARAMETERS DESCRIPTOR. That is, the EPD is not a growth model but considers growth and the resulting environmental consequences (or constraints); thus the earth's composition is of interest to this study only in terms of its applicability to human usage and urban growth.

1. Soil Characteristics

The suitability of soil for human usage shall be investigated in three different categories.

A. Suitability for Agriculture.

B. Suitability for Construction.

C. Suitability for Transportation Networks.

Each of these shall be discussed in consecutive order.

A. Suitability for Agriculture

There are only two basic tests for determining the suitability of soil for agricultural uses. First, a determination of soil type and second, a determination of existing water table.

The soil scientists have subdivided all soils into three orders, known as Zonal, Intrazonal and Azonal orders. Zonal soils, formed under conditions of good soil drainage thru the prolonged action of climate and vegetation, are by far the most important and widespread of the three orders. Intrazonal soils are simply those formed under conditions of very poor drainage conditions, or upon limestone, whose influence is dominant.

Azonal soils have no well developed profile characteristic, either because they have insufficient time to develop or because they are on slopes too steep to allow profile development. Azonal soils include mountain soils, alluvial materials and dune sands.[9]

Existing soil tables are available and provide all of the necessary information concerning suitability of soils for agricultural uses.[10]

See Plates on the following two pages.

Ground water is extracted for man's use from the upper boundary of the zone of water saturation or water table. If wells or core samples are numerous in a given area, then a representation of the regional water table is possible. As has been stated previously, the availability of water is mandatory prerequisite for the use of a given area of land for human usage.

B. Suitability for Construction

A great deal of the earth's surface is suitable for some form of human habitation. However, permanent structures require certain soil capabilities and strengths that are only found in certain natural conditions and locations. In order to fully understand the suitability for human usage of a given study matrices, each matrix unit should be tested and classified as suitable for construction.

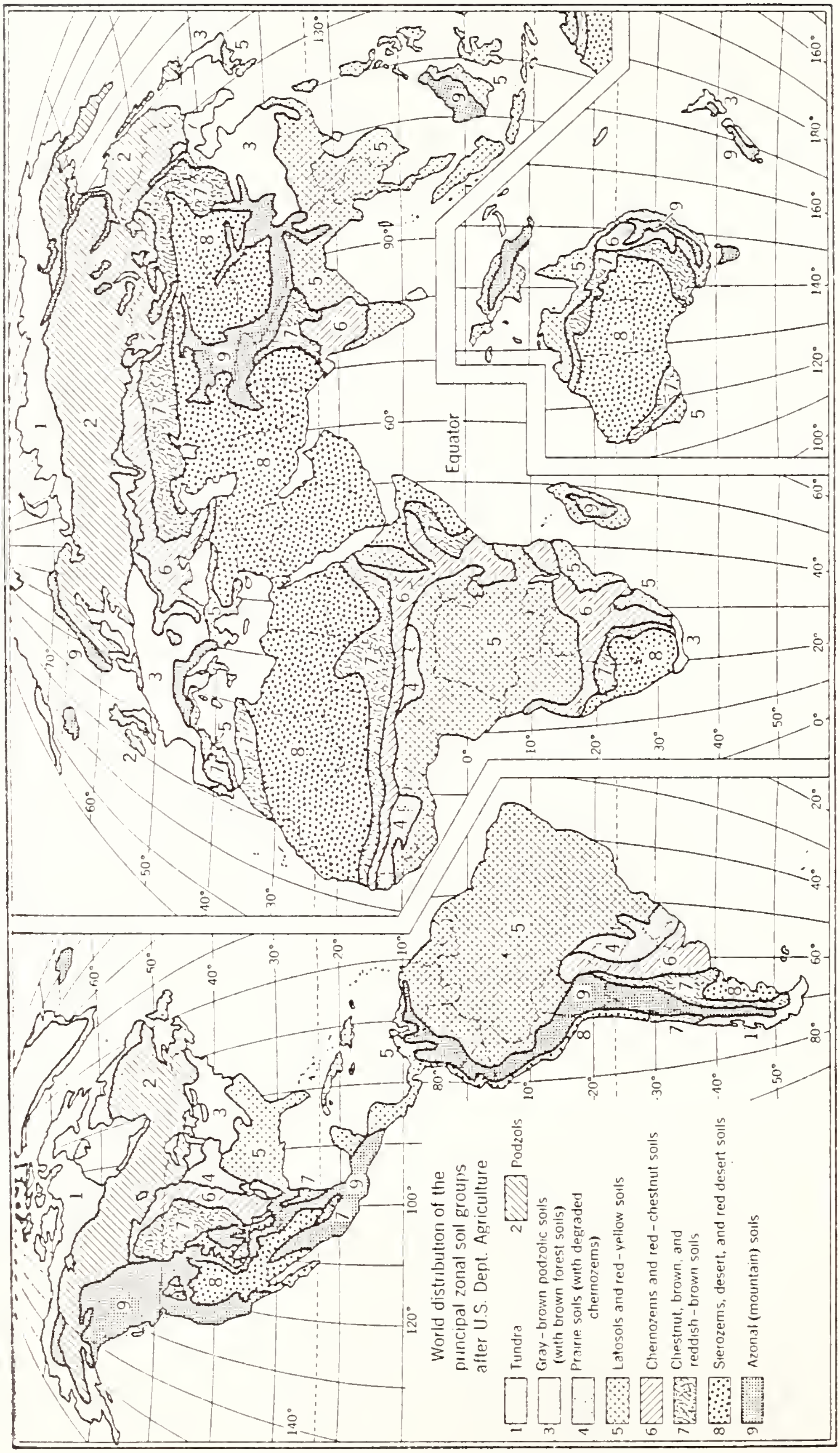
The field of soil mechanics provides us with a variety of possible tests to determine the suitability of a given area for various forms of habitation. These tests provide information in terms of the capacity of the soil to withstand and stabilize a given load. There are four tests that need to be performed. These are:

1. Compressive ability of soil.
2. Hydrostatic ability of soil.

EXPLANATION OF PLATE V

Fig. 14. Soil table.

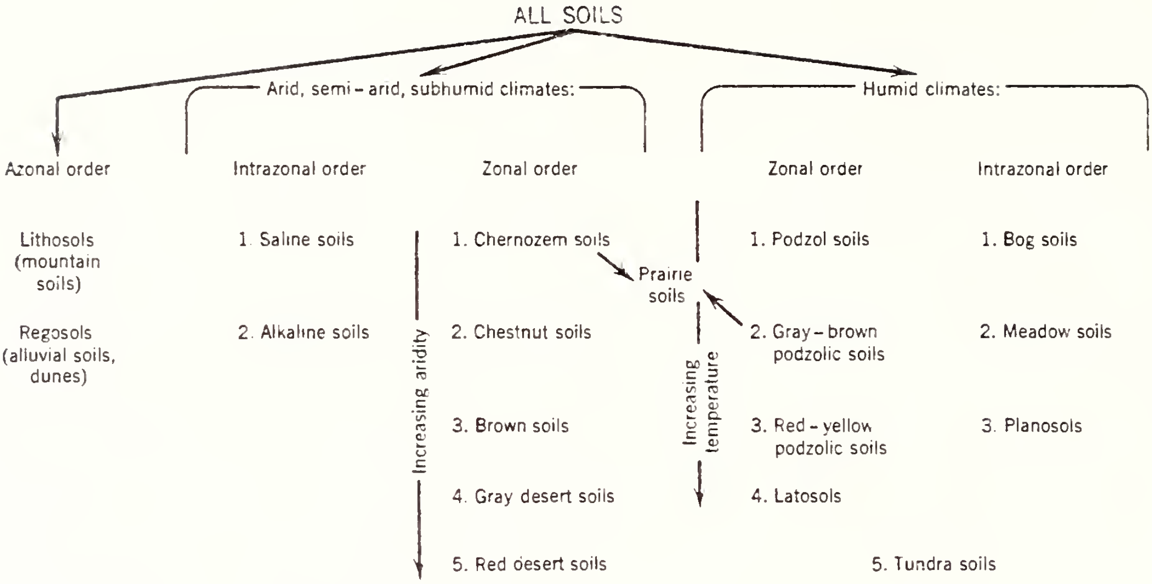
PLATE V

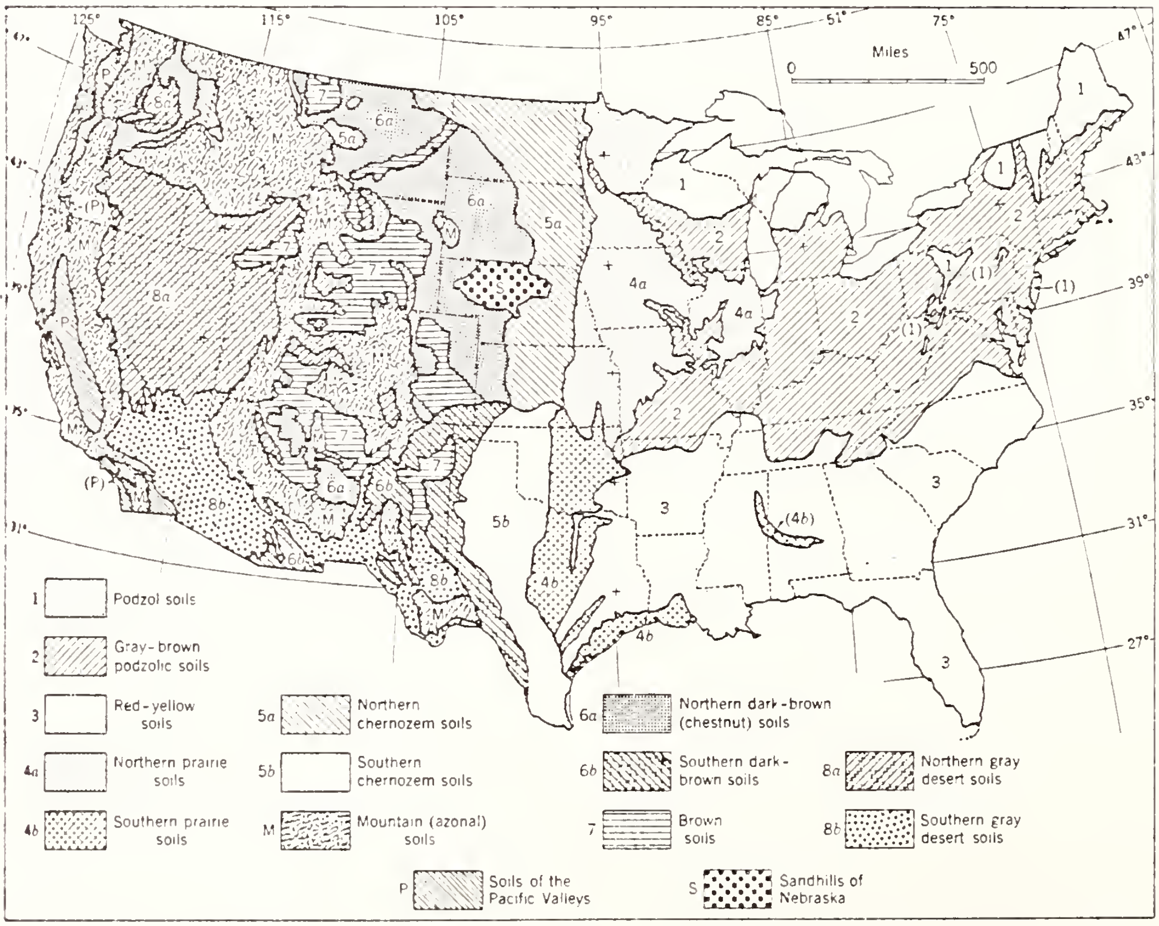

World distribution of the principal zonal soil groups after U.S. Dept. Agriculture
1 Tundra
2 Podzols
3 Gray-brown podzolic soils (with brown forest soils)
4 Prairie soils (with degraded chernozems)
5 Latosols and red-yellow soils
6 Chernozems and red-chestnut soils
7 Chestnut, brown, and reddish-brown soils
8 Sierozems, desert, and red desert soils
9 Azonal (mountain) soils
Equator

EXPLANATION OF PLATE VI

Fig. 15. Soil table.

PLATE VI


ALL SOILS
Arid, semi-arid, subhumid climates:
Humid climates:
Azonal order
Intrazonal order
Zonal order
Zonal order
Intrazonal order
Lithosols (mountain soils)
Regosols (alluvial soils, dunes)
1. Saline soils
2. Alkaline soils
Increasing aridity
1. Chernozem soils
2. Chestnut soils
3. Brown soils
4. Gray desert soils
5. Red desert soils
Prairie soils
Increasing temperature
1. Podzol soils
2. Gray-brown podzolic soils
3. Red-yellow podzolic soils
4. Latosols
5. Tundra soils
1. Bog soils
2. Meadow soils
3. Planosols


Miles
0
500
1 Podzol soils
2 Gray-brown podzolic soils
3 Red-yellow soils
4a Northern prairie soils
4b Southern prairie soils
5a Northern chernozem soils
5b Southern chernozem soils
M Mountain (azonal) soils
6a Northern dark-brown (chestnut) soils
6b Southern dark-brown soils
7 Brown soils
8a Northern gray desert soils
8b Southern gray desert soils
P Soils of the Pacific Valleys
S Sandhills of Nebraska

3. Perculative ability of soil.

4. Maximum average winter freeze depth.

In addition, the tests provided by the testing of soil for agricultural purposes should also be provided.

1. Compressive ability of soil

The ability for soil to withstand large amounts of continuous vertical force without shifting vertically or becoming considerably more compact is the particular interests of the compressive test.

2. Hydrostatic ability of soil

In relationship to the study of soil, the Hydrostatistician is concerned with the capability of soil to reach an equilibrium state with surrounding water and the ability of soil to absorb precipitation. For example, a soil type which cannot absorb any water might be a poor consideration for some forms of human habitation; conversely it might be a good choice for a future reservoir area.

Within the framework of this study, I am concerned with the ability of soil to reach an equilibrium state as well as be able to absorb water.

3. Perculative ability of soil

If a soil is porous enough to allow for the absorption of effluent waste from septic systems, sewage systems and any other waste disposal systems, it is said to be perculatory.

A series of simple tests, as outlined by HEW, can be applied on a grid unit by grid unit matrix examination.[11]

4. Maximum average winter freeze depth

This can be done on a regional basis, as the average freeze line depth will not change very much over a rather large area.

B. Suitability for Transportation Networks

The only transportation network parts considered for this test are the motor ways, rail beds and yares and aircraft runways.

There are only two tests that are needed to fulfill the needs for determining a basic suitability for transportation networks. These tests are the compressive ability test (as outlined previously) and the soil stability test.

The soil stability test provides information concerning the capability of a given soil to provide stability in the case of laterally applied loads.

Soil Drainage Characteristics

The ability for surface areas to provide for the runoff or absorption of percipitation (or flood waters) is the drainage characteristics that are of interest to this study. Runoff characteristics are considered surface drainage and absorption is considered soil drainage.

Any water place on a given surface will seek the lowest point on that surface. Therefore, natural drainage channels become the paths by which the water will seek lower standing levels. These channels follow valley cuts and down slopes. This information can be obtained by following the down slopes on USGS maps or by on site observation.

Soil drainage considers the capability of water to be absorbed and flow to the water table. This information can be provided by the perculative tests and the hydrostatic tests performed as part of the previous section.

The chart of the following page is a general reference that covers most all of the various areas of study of the Regional Composition Component.

Coding Hierarchy:Regional Composition Components

All areas of information of the Regional Composition Component should be considered at the Intra-Matrix level, with the exception of the Freeze line data, which is considered at the Regional Level.

It is necessary to consider the majority of this information at the Intra-Matrix level because of the need to perform a unit by unit investigation to compile all of the information required.

The possibility of Micro-Environments can be ascertained upon reviewing all of the collected data. Micro-Environments, in terms of composition, shall be treated as all other forms of Micro-Environmental information is treated.

A consensus of data to be collected on the Intra-Matrix scale is as follows:

EXPLANATION OF PLATE VII

Fig. 16. Soil characteristics.

PLATE VII

SUITABILITY AND DRAINAGE CHARACTERISTICS OF SOILS[12]

Soil class:	Suitability when loaded	Suitability when frozen	Drainage	As a bearing for foundations or a road	As a base course for permanent roads	As a material for light roads, if stabilized
GW/GP	E	G-E	E	GW:E GP:G-E	GW:G GP:P-F	G
GM/GC	G	F-G	N-F	G	GM:P-G GC:P	G
SW/SP	E	G-E	E	SW:G SP:F-G	SW:P SP:N-P	G
SM/SC	F-G	P-G	N-F	F-G	SM:N-P SC:P-F	G
ML	F-G	N-F	P-F	P-F	N	F
MH	P	N-F	P-F	P	N	P
OL	P-F	P-F	P	P	N	N
CL	F	P-F	N	P-F	N	P
CH/OH	P	F	N	N-P	N	N
Pt	N	G	P-F	N	N	N

E = Excellent; G = Good; F = Fair; P = Poor; N = Very poor not suitable

GW = clear gravels, well graded
GP = clear gravels, poorly graded
GM = gravel w. 10%+ silt
GC = gravel with 10+ clay
SW = sand, well graded
SP = sand, poorly graded

SM = sand with 10%+ silt
SC = sand with 10%+ clay
ML = nonplastic silts
MH = plastic silts
OL = organic silts
CL = nonplastic clays

CH = plastic clay, 50%+ liquid, predominantly inorganic clay
OH = plastic clay, 50% liquid, predominantly organic matter
Pt = peat and muck

TABLE VIII

Regional Composition:Water

A. Physical Characteristics

- A1. Turbidity
- A2. Color
- A3. Temperature

B. Chemical Characteristics

B1. Fresh Water

Chemical Constituents
Acidity/Alkalinity
Carbon Dioxide
pH
Phosphates
Radiation
Inert Matter

B2. Salt Water

Chemical Constituents
Salinity
Oxygen/Carbon Dioxide Cycles
Organic Constituents
Radiation
Inert Matter

C. Bacteriological Characteristics

C1. Bacteria Level, type

TABLE IX

Regional Composition:Earth

A. Suitability for Agriculture

   A1. Soil Type
   A2. Water Table

B. Suitability for Construction

   B1. Compressive Test
   B2. Hydrostatic Test
   B3. Perculative Test
   B4. Freeze Line-Regional Level Input

C. Suitability for Transportation Networks

   C1. Compressive Test
   C2. Stability Test

D. Soil Drainage

   D1. Surface Drainage
   D2. Soil Drainage

Destructive Phenomenon Component

Seasonal storm areas, natural fault areas and other earthborn phenomenon have been studied by earth scientists for many years. A great deal of statistical information and material is currently available concerning these areas.[13] However, it is not necessary to review, in great depth, a large quantity of this information within the context of this study. What is needed is a general understanding of the seasonability, or regularity (i.e., the pattern), of such occurrences.

There are four natural phenomenon that are of interest to this paper because of the effects they generate upon urban centers and/or how they might possibly curtail urban growth, i.e., spatial and economic growth. Or, how urban physical expansion should be restricted in order not to overlay known areas of such natural phenomenon (see Chapter VI). The particular phenomenon can be grouped into two headings, as follows:

A. Violent Convective Phenomenon

A1. Hurricanes

A2. Tornadoes

B. Earthborn Phenomenon

B1. Earthquakes (tremors and quakes)

B2. Volcano eruptions

It is not necessary to consider the causes of each of these phenomenon, as little can be done to correct or negate the primary causes for their being. However, each study matrices should be viewed in terms of the probability or possibility of such natural phenomenon occurring.

Violent Convective Phenomenon

Sir Napier Shaw[14] coined the phrase violent convective phenomenon to characterize particular storm activities which are formed under rather unusual circumstances. That is, unusual and violent thunderstorm type occurrences that frequent only certain geographic and climatological areas.

Such weather systems have been known in general terms successively as: "storms," "cyclones," "lows," "depressions," "troughs," and "disturbances."

Essentially, any of these represents an active relationship between two air masses and is thus recognized as a pattern of events or, more specifically, a pattern of air motion.[15]

There are two violent convective phenomenon that need to be considered in this component: Hurricanes and Tornadoes. A Hurricane (tropical rotating storm) is essentially a maritime phenomenon or, as Maury[16] puts it, "Hurricanes prefer to place their feet in warm water." They appear in full fury at irregular intervals along tropical coast areas, and the net result, in terms of interrelating with the Man-Made Environment, can be summed up in one word.. Catastrophe.[17]

Danger arises from three quite distinct factors: the force of the wind, the action of the sea and the volume of the intense precipitation. The wind being the least dangerous to human life and property.[18]

Hurricanes represent the most violent of all natural phenomenon. The Kinetic energy of a single hurricane (full blown) is equal to 10^{12} Kilowatt hours per day. This is equal to more than the entire energy production of man over the whole globe during the same time span.[19]

Tornados are extremely violent but very localized storms that are commonly associated with thunderstorm activity. In American experience,[20] the damage follows along a path about one-sixth of a mile wide and from two to four miles long. The devastation is so complete that most instrument observations are completely out of the question.

From the nature of Tornado damage, it is possible to infer the conditions necessary to cause such destruction. First, wind pressure on the order of 100 to 500 psf. Next, sudden falling in atmospheric pressure. This extremely rapid fall has an explosive power of over 50 psf. Third, and last, is the updraft, or suction, prevalent within the Tornado formation.[21]

Waterspouts are mild tornados developing over the Oceans. Although considered dangerous during the sail era of shipping, it is now known that the visible pendant is merely a cloud or light precipitation and sea spray, and there is no real danger to shipping.

Earthborn Phenomenon

Of all of the Natural Destructive Phenomenon, the Earthquake is the most unpredictable. Fortunately, they are limited in that they cannot appear and disappear at will but are found only in well defined fault belts around the globe.

The initial shock wave of an earthquake can be determined and measured and is extremely destructive to the man-made environment. However, it is often the secondary effects that cause the most death and destruction.[22]

There are three secondary effects that must be expected after the initial shock or earth tremor of an earthquake. First, earth slides caused by the weakening of the rock and soil structure by the initial shock. Second, an appreciable rise in the water table (or level). Third, and last, the landward movement of large seismic waves, sometimes called Tsunami. It is the impossibility of being able to totally protect oneself or property against an earthquake that make them so very dangerous.

Although not found in most of the Continental United States, there are still active volcanoes in Hawaii and Alaska. Volcanoes are built by the eruption of molten rock and heated gas under pressure from a relatively small pipe or vent leading from the Magma reservoir or chamber.[23]

As with other Destructive Phenomenon, it is the secondary effects of a Volcano eruption that are most dangerous to human habitation. These secondary effects include lava, C_2SO_4 gas and ash. In addition, there is the possibility of a volcanic calderas. That is, a volcanic explosion that destroys the central portion of the volcano. Because of the proximity of water to many volcanoes in Hawaii (causing superheated steam), there is the possibility of a volcanic calderas in one of these volcanoes.[24]

Coding Hierarchy:Destructive Phenomenon Component

Because of the widespread effect of each of these natural patterns, they shall be considered only at the Regional level. As was outlined in an earlier section of this chapter, special patterns and forms that only affect large areas can cause an entire section or possibly all of a matrices to be classified as part of that particular region.

To be more specific and detail each phenomenon separately:

1. Hurricanes: Because of the vastness and extreme power of these storms, any study area within a hurricane zone shall be classified accordingly.
2. Tornados: A study area that is within those goegraphic and climatological areas in which Tornados occur shall be classified accordingly. However, it should be noted that tornados follow valley floors and painas and tend to avoid steep sloped areas.
3. Earthquake: Only those matrix units along or near a fault line shall be classified as earthquake prone.

4. Volcano: Existing volcanoes and the areas which they dominate can be so classified. However, it is impossible to determine in advance when or where a new volcano will erupt.

All of this information shall provide additional data which will help to determine additional areas that are unsuitable for human habitation during future periods of spatial growth around urban centers.

Climatology Component

Climate is a basic environmental factor. Components that describe or classify climate are mostly used to describe the atmosphere at a given time. Thus, logically one must first consider aspects of atmospheric study before trying to develop a workable concept of which particular climate model one wishes to draw upon for climatic information.

The atmospheric layer that surrounds the earth extends over 6000 miles into space, however, it is only the bottom most layer, the Hemisphere, that affects man's conception of climate and atmospheric conditions. Within the Hemisphere there are three subdivisions: the Troposphere, the Stratosphere and the Mesosphere. Again, it is the bottom layer, the Troposphere, because of its closeness to the Earth, that most affects weather and climate, as well as plant, animal and human life.[25]

There is an interrelationship between the Troposphere and plant and human life that needs to be considered in selecting an appropriate climate model. Man is most dependent upon the primary producers, i.e., plant life, for survival. It is logical, therefore, that components of climate that are vital to plant life are vital to man. Within this context there are two plant life chains that need to be considered. These are land based plant life and ocean based plant life. Because of man's dependence upon land based plant life, the land-atmosphere interface will be considered of primary importance and the ocean-atmosphere interface of secondary importance and, therefore, not further discussed.

Climate Classes

There are three climate classes that are developed upon the interface of land-atmosphere conditions. These are:

1. Low latitude climates.
2. Middle latitude climates.
3. High latitude climates.

Although there are fifteen subgroups that these three classes can be divided, only those that describe climatic conditions within the United States shall be considered.

1. Low latitude climates

Low latitude climates are controlled by equatorial and tropical air masses. Only one subdivision of this class can be found within the US. This is the Tropical Desert. Characterized by high pressure systems and semi-arid climatic conditions with maximum temperatures and moderate temperature range.[26]

2. Middle latitude climates

Middle latitude climates are controlled by both tropical and polar air masses. There are five subdivisions of this class; all of them are represented within the US.

First, there is the Humid Subtropical Climate. Characterized by high rainfall and warm temperatures. Winters are cool with frequent polar air mass invasions. There are also frequent cyclonic, i.e., Hurricane or Tornado, storms.

Next, is the Marine West Coast Climate. This climate zone can be described as being temperate and rainy, with warm summers and frequent cyclonic storms. The annual temperature range is small for middle latitudes.

Third, is a Mediterranean type Climate. Characterized by wet winters and dry summers. Cyclonic storms are frequent and there is a moderate temperature range.

Next, is the Middle-Latitude Desert Climate. Interior, middle-latitude deserts are dominated by continental tropical air masses in summer and continental polar air masses in the winter. Great annual temperature range, i.e., hot summers and cold winters.

Fifth, and last, is the Humid Continental Climate. Seasonal contrasts are strong and weather highly variable.

3. High latitude climates

High latitude climates are controlled by polar and arctic air masses. There are five subdivisions within this class also. Within the continental US there is only one subdivision that needs to be considered. This is the

Highland climates. These are characterized by cool and cold moist climes, occupying high-altitude zones of the world's mountain ranges.

Coding Hierarchy:Climatological Component

All of the climate subdivisions shall be considered as Regional classification. However, there are two special cases that need to be considered. First, where two regions meet there will be a need to conduct an Intra-Matrix investigation to better delineate the two (or more) Climate regions. Second, the possibility of special micro-climates may require additional individual matrix level investigations.

This climate information can be used to develop a hierarchy of agricultural land uses. That is, the climatic conditions can help to determine the controls and amounts of human intervention within a study area. See Chapters V and VI.

Climate modification

The possibility of climate modification by developing urban centers is not being overlooked. This information shall be reviewed and considered as part of the cause effect aspects of the simulation modeling. See Chapter VI.

Section B

Values Component Model

(VcoModel)

During the first few pages of this Chapter, an outline was suggested of the criteria by which one could group information in order to establish two independent component models. The GcoModel was defined as all of those components of a geographic or spatial absolute pattern or form. The VcoModel was to include all of those components of the APModel that were of a non-absolute nature.

The word absolute, in relation to the VcoModel, is actually an improper term because one can relate the various value components to an absolute scaling system thus making them absolute. What is being strived for by calling the GcoModel absolute and the VcoModel non-absolute is the idea of non-changing. Any values sytem, i.e., VcoModel, is subject to change or refinement (within the system).

Further, value systems are generally regarded with the preconceived assumption that they are all subjective. That is, the ideal of goodness, justice and beauty are all Subjective, i.e., a value judgement, therefore, any system of study based upon values must be subjective. One should hope to be able to refudiate this thesis by defining the ways in which one can view the "value" of something.[27]

The concept of "values" can be viewed in terms of philosophy, ethics or morals. The value of something is a philosophical concept, which has been studied extensively by two internationally renowned contemporary philosophers, Karl Aschenbrenner[28] and Risiere Frondizi.[29]

Although these two scholars brought forth their philosophical treatises independently, their combined efforts suggest that there are three ways to view the value of something.

Their three value systems can be key-worded as follows:

1. Gestalt Value.
2. Polarity-Hierarchy.
3. Objective/Subjective.

To reiterate, the reason for developing these philosophical concepts in this model is basic. Within the Planning context, value systems have been attacked by lay persons (i.e., non-planners or urban philsophers) as being subjective and possibly unrealistic. Or, value systems have been negated because they try to investigate "subjective" matter.

This component model is developed on a series of value systems that are not subjective by nature and can be related to some form of absolute control or scaling system. However, one must first understand the ways in which one can view values in order to try and decrease the (apparent) inherent preconceptions about value systems in Planning.

1. Gestalt value

When a new field of study is discovered, two contrary philosophies about it are generally produced. One tries to see everything in terms of what has just been discovered and endeavors to see older realities in terms of the new concepts. The second attempts to reduce the new to the old, i.e., a new name to an older mode of being.

According to the latter conception, values are reduced to experience. In direct opposition to this is the concept of values as essences. Values do not exist by themelves but depend upon some value carrier or support. Thus beauty, for example, does not exist by itself but depends upon the existance and embodiment of some physical object, i.e., value object.[30]

Thus, values are potentials, i.e., unreal quantities. They are unreal in the sense that they do not constitute part of the object in which they are embodied. One may take the value out of an object without destroying its parts, but the whole is more "valuable" than the parts. In planning terms, one might consider the viewing of the urban landscape in terms of existing areas that have retained their value as opposed to those that have lost their value. Value could be economic, aesthetic quality or even usefulness. These things in terms of Being/Gestalt value can be viewed objectively.

2. Polarity/Hierarchy

A basic characteristic of values is polarity. It has been pointed out that polarity implies a break with indifference. In the presence of objects of the physical world, we can be indifferent. The moment a value attaches itself to an object, indifference is broken and we seek to place a positive or negative connotation upon the object. In addition to this, values have a ranking. No two values or value objects are on the same level. There seems to be a hierarchy in the nature of values and value objects.[31]

In planning terms, such a concept might be used to define a land use program, i.e., hierarchy of land use.

3. Objective/Subjective

Value is "objective" if its existence and nature is independent of the subject; conversely, it is "subjective" if it owes its existence or its validity to the feelings or attitudes of the subject.[32]

Thus, Frondizi very clearly states a value can be viewed objectively if it is independent of the subject. Planning (i.e., Regional or Community Planning) is a study of, or promotion of, better performance of the physical environment.[33] Thus, values that are of interest to Planners are objective, not subjective, because the physical environment is a value object(s).

The distinction between an object and an environment is critical. Objects require subjects, whereas an environment surrounds. Environments are necessarily larger than that which they surround and only in special cases can object perception apply to environmental perception.[34]

One of those situations in which object perception can be applied to environmental perception is in the specific study of value objects. This is because a value object does not have to represent a "thing" but can represent groups or sets of "things." This is a Gestalt value system.

A Gestalt value system is a good way to perceive the environment, both Natural and Man-Made. This is because any environment has more meaning and is more important than any one part, i.e., object or set. However, only by studying the individual parts can one begin to evaluate the whole, as the environmental whole provides too much simultaneous input data to be studied collectively.

Many aspects of an environment's physical characteristics were considered in the GeoModel. The VeoModel considers the value of the environment to itself, to man and through time. Although the Gestalt value system is a good way to view the collective environmental situation, it does not always work when one is trying to explain various components of an environment. This is because when seen from the viewpoint of the participant, i.e., one surrounded by an environment, the surroundings typically are neutral within the environmental process. They enter into awareness only when they deviate from some adaptation level.[35]

The viewpoint, proposed by Proshansky, would suggest a polarity-hierarchy value system for studying certain value characteristics of the environment. The particular value characteristics that have been considered in a Polarity value scheme are:

1. Value of Space.
2. Value of Nature.
3. Value of Time.

Value Scales

In order to control the model and keep any one component from outweighing other areas of input, one should assume that all of these value inputs are of equal importance. Thus, specific values, i.e., Land values and the value of the Man-Made continuum, cannot be given importance beyond the actual role they play within the total environment.

Each value component shall be considered in terms of the scale of a given study area. That is, within a given study area, on a Regional and/or Intra-Matrix level, all of the value components have some input. However, some of the input relates to an area larger than the study area. That is, some input data is so specialized that its relationship to the study area is overshadowed by its relationship to a larger region, i.e., a county, state, continent, hemisphere or globe.

In order to maintain all of this information in proper perspective and to consider a group of input that is represented by a variety of different naming systems (dollars, years, etc.), all of this information can be ranked in terms of a Polarity/Hierarchy values concept from a high Positive Polarity to a high Negative Polarity.

Figure 17 is a verbal display of such a system.

POLARITY/HIERARCHY DESIGNATION	SCALED VALUE
Very High Positive	7
High Positive	6
Positive	5
Slightly Positive	4
Slightly Negative	3
Negative	2
High Negative	1
Very High Negative	0

Fig. 17. Polarity/hierarchy scale.

How this value scaling system is related to each component of the VcoModel shall be discussed on an individual component basis.

Value of Space

In terms of this general model, when one speaks of the value of space one can consider two distinct areas of study. First, The Value of Space as land values, and second, the Value of Space as suitable for urban usage.

Land value is usually expressed as a monetary value. In a large number of past urban models, any urban (or natural) quantity that can be expressed as some "real" value (in this case dollars) often is given a predominant place in the development or quantifying of the model. This is often done for two reasons, first, the ready availability of such data, and second, the ease of understanding this type of data by lay persons.

Although the modelmaker does not desire to make this model so complex that others cannot comprehend the total concept, in addition there is a desire to try and develop a balanced model. That is, a model that expresses <u>all</u> input on an equal level.

In the particular case of land values, one can convert the monetary v values into the value system similar to that expressed in Fig. 17. In order to accomplish this, the average monetary value of each intra-matrix unit will first have to be computed. Then the Scaled Value shall be computed by the following formula.

(3.2) $$V_L = \log X_a$$

Where: V_L = Scaled Value of Land

X_a = Actual average monetary value of matrix unit

By using formula 3.2, one can maintain the actual land values in some semblance of their real value to a total environment. By using the log of the actual value, one can keep most non-urban land values within the Value scale as suggested by Fig. 17.[36] Thus, for a given matrix unit to have a $V_L = 6.0$ or higher, the actual land value would have to be equal to 1 million dollars or more. Although this might be common within the man-made environment (especially the urban confine), it would be very unusual for the natural environment. This, logically, deserving the 6.0 value.

The above computation will be applied to each individual matrix unit, thus providing the model maker with a scaled land value for each unit.

The suitability for urban usage was discussed in Chapter II. In Chapter II, the following listing from most suitable (for urban usage) to least suitable was suggested:

Most Suitable:	Plains
	Forests, Woodlands
	Slopes
	Floodplains & Shorelines
	Marshes
	Swamps, Bogs
Least Suitable:	Surface Water

Fig. 18. Suitability for urban use

This chart can readily be converted into a scaled value system.

POLARITY DESIGNATION	HIERARCHY LEVEL	NAME	SCALED VALUE
Very High Positive	Most Suitable	Plains-Coastal & Upland	7
High Positive		Forests	6
Positive		Slopes	5
Slightly Positive		Floodplains; Shorelines	4
Slightly Negative		Marshes	3
Negative		Swamps and Bogs	2
High Negative		Surface Water-Fresh & Salt	1
Very High Negative	Least Suitable	Special (a)	0

(a) Represented by land areas that absolutely cannot be used for urban usage. An example might be from the Destructive Phenomenon Component: A Volcano.

Fig. 19. Scalar values suitability.

The data needed to complete this particular component can be supplied from the information gathered from the Regional Morphology Component of the GeoModel.

Value of Nature

In order to develop this component, one must make a second assumption. This assumption is that the natural environment is as important as the man-made environment. This does not mean that natural environment is as important to its normal inhabitants as the man-made environment is to its normal inhabitants.

This component shall give a high positive polarity to natural areas that are free (as much as possible) from human intervention, in terms of spatial arrangements. In addition the Micro-Environments, as outlined in the GeoModel, shall be alloted the highest positive polarity because of their rarity on a large scale than that suggested by the study area. See Fig. 20 below.

Value of Nature

POLARITY DESIGNATION	HIERARCHY LEVEL	NAME	SCALED VALUE
Very High Positive	Special Nat. Envir.	Specified Micro-envir.	7
High Positive	Special Nat. Envir.	Nonspecified Micro-envir.	6
Positive	100% Nat. Surroundings	Natural	5
Slightly Positive	75% Nat. Surroundings	Slightly Natural	4
Slightly Negative	50% Natural Surroundings	Slightly Urban	3
Negative	25% Natural Surroundings	Urbanized	2
High Negative	0% Natural Surroundings	Most Urbanized	1
Very High Negative	No Natural	Total Urbanization	0

Fig. 20. Value of nature.

As each individual matrix unit is surrounded by 8 other matrix units, it is fairly easy to suggest a hierarchy level within the context of this component.

1	2	3
4	X	5
6	7	8

Fig. 21. Grid.

For example, in Fig. 21, if unit "X" was totally surrounded by natural units[37] (assuming that X is natural), then it would have a value of 5. If one of the surrounding units was of some Man-made environment classification, then the value would be 4.5; 2 units (75% natural) 4; 4 units (50% natural surroundings) would have a value of 3; etc.

The Specified (Natural) Micro-Environments[38] would be given a value of 7, and the Nonspecified (Natural) Micro-Environments[39] would be given a value of 6, irregardless of the surrounding matrix unit classifications. This is justified by the fact that the various micro-environments are rare or unusual environments that may have very few duplicates elsewhere.

Value of Time

The value of time shall be considered in two ways. The value of urban places, i.e., historic value, and the value of aged natural places, i.e., acquired natural value.

Each of these shall be considered in a similar manner. A general consensus of the age of man-made spaces and existing natural areas will be conducted on a matrix scale. The youngest matrix age will be given a scale value of "0." The other matrix ages will be given values according to the following formulas:

3.3a (Urban) $$V_{ut} = \log (X_{ut})^2 \text{ or } V_{ut} = 2 \log (X_{ut})$$

Where: V_{ut} = scaled value of aged urban areas

X_{ut} = actual age of matrix unit

3.3b (Natural) $$V_{nt} = \log (X_{nt})^2 \text{ or } V_{nt} = 2 \log (X_{nt})$$

Where: V_{nt} = scaled value of aged natural areas

X_{nt} = actual average age of matrix

To better evaluate the effectiveness of formulas 3.3a and 3.3b, consider the following table:

POLARITY DESIGNATION	HIERARCHY LEVEL	ACTUAL AGE X_{ut} or X_{nt}	ACTUAL VALUE V_{ut} or V_{nt}
Very High Positive	Oldest	3333 years old	7.0
High Positive		1000 years old	6.0
Positive		333 years old	5.0
Slightly Positive		100 years old	4.0
Slightly Negative		33 years old	3.0
Negative		10 years old	2.0
High Negative		3 years old	1.0
Very High Negative	Youngest	1 yr. or less	0

Fig. 22. Value of time.

It is evident from Table 22 that natural form or urban form that are 100 years or more in age are considered of positive polarity. This allows for two factors. First, usually between the age of 10 years (2.0 value) and 100 years (4.0 value) man-made areas tend to go through a degenerative period. Man-made forms that remain after they are 100 years old are often rejuvenated or may possibly be declared some form of landmark.

Natural areas also require great amounts (by human standards) of time to mature. A natural pine forest will be fully matured only after about 75-80 years. By that time the pine forest has, thru natural processes, destroyed most of the tree killing undergrowth and brush and is a true "forest."

APModel:Conclusions

The APModel provides a variety of data and information that is useful to the general model.

First, each matrix unit was given a specific name, providing the EPD with not only an exact description of the form but a system for establishing priorities of form. This was accomplished in the Regional Morphology Component. Next, an exact description of the composition of each unit of study, as well as the climatological conditions and the restriction placed upon areas because of the likeness of natural destructive phenomenon, was outlined. All of this information was provided by the Regional Composition Component, the Natural Destructive Phenomenon Component and Climatological Component. All of these components formed the GcoModel, i.e., the Geomorphological Component Model of the APModel.

Last, each matrix unit was considered in terms of its value to the total environment; this information was provided by the VcoModel, i.e., the Values Component Model.

All of the information provided gives the model maker a rather complete picture of the total physical environment. The next phase is to consider how the Natural and Man-Made Environs may interact. This information is provided in the Interaction Parameters Model in the following chapter.

FOOTNOTES

[1]For additional information about urban modeling see the following: Cercine, 1967; Hufschmidt, 1966; Lowry, 1965; Orcutt, 1961. All of these publications represent major initiative contribution to the development of urban modeling.

[2]Zajic, J. E.; Water Pollution, Disposal and Reuse; New York: Marcel Dekker Inc.; 1971, p. 1.

[3]Harvey, H. W.; Chemistry and Fertility of Sea Water; London: Cambridge University Press; 1969, p. 23.

[4]Zajic, J. E.; Water Pollution, Disposal and Reuse; New York: Marcel Dekker Inc.; 1971, p. 7.

[5]See the following: Durgan, 1972; Kitrell, 1969; Zajic, 1971.

[6]See Harvey, 1969.

[7]Durgan, Patrick R.; Biochemical Ecology of Water Pollution; New York: Plenum Press, 1972, p. 7.

[8]In reality a paradox is created as some areas that are already inhabited are inherently not suitable for human usage. However, by definition, all existing inhabited areas are "suitable for human usage."

[9]Strahler, Arthur N.; Physical Geography; New York: John Wiley and Sons; 1975, p. 304.

[10]For additional information see: US Government, USDA, 1973.

[11]See any of the following: Bendixen, 1948; Salvato, 1958; USDA, 1951.

[12]Lynch, Kevin; Site Planning; Cambridge, Mass.: The MIT Press; 1971, p. 59.

[13]See: Battan, 1974; Flohn, 1969; L. Smith, 1968.

[14]Shaw, Sir Napier; Selected Meterological Papers of Sir Napier Shaw; London: Macdonald; 1965.

[15]Crowe, P. R.; Concepts in Climatology; London: Longman Group Ltd.; 1971, p. 352.

[16]Maury, M. F.; The Physical Geography of the Sea; London: Sampson Low; 1858, p. 330.

[17]Crowe, P. R.; Concepts in Climatology; London: Longman Group Ltd.; 1971, p. 386.

[18]Ibid; p. 399.

[19]Flohr, Hermann; Climate and Weather; translated from the German by B. V. deG. Walden; New York: McGraw-Hill, World University Library; 1969, p. 141.

[20]Tornados seem to be only part of the American weather spectrum. They do not occur, except in extremely rare cases, in any other part of the world. (Crowe, 1971, p. 384)

[21]Crowe, P. R.; Concepts in Climatology; London: Longman Group Ltd.; 1971, p. 384.

[22]Strahler, Arthur N.; Physical Geography; New York: John Wiley and Sons; 1975, p. 499.

[23]Ibid; p. 507.

[24]Crater Lake in Oregon is an outstanding example of a calderas. The event occurred about 6600 years ago.

[25]Strahler, Arthur N.; Physical Geography; New York: John Wiley and Sons; 1975, p. 239.

[26]Ibid; p. 247.

[27]Frisken, William R.; The Atmospheric Environment; Baltimore: Johns Hopkins University Press, Resources for the Future, Inc.; 1973, p. 3.

[28]See: Aschenbrenner, Karl; The Concepts of Value: Foundations of Value Theory; Dordrecht, Holland: D. Reidel Publishing Co.; 1971.

[29]See: Frondizi, Risieri; What is Value?; LaSalle, Ill.: Open Court Publishing Co.; 1971.

[30]Ibid; p. 5.

[31]Ibid; p. 11.

[32]Ibid. p. 19.

[33]Lapatra, Jack A.; Applying the System's Approach to Urban Development; New York: Dowden, Hutchinson and Ross; 1973, p. 106.

[34]Ittelson, William H., ed.; Environment and Cognition; New York: Seminar Press, 1973, p. 13.

[35]Proshansky, Harold M., ed.; Environmental Psychology: Man and His Physical Setting; New York: Holt, Rinehart and Winston; 1970, p. 36.

[36]Natural environmental classification numbers are: 1.0 thru 6.0; 9.0 thru 13.0; and 16.0 thru 18.0.

[37]Natural environmental classification numbers are: 1.0 thru 6.0; 9.0 thru 13.0; and 16.0 thru 18.0.

[38]Specified natural micro environment classification numbers are: 7.0; 14.0; and 19.0.

[39]Non-specified micro environment classification numbers are: 8.0; 15.0; and 20.0.

CHAPTER IV

INTERACTIVE PARAMETERS MODEL

Introduction

In the APModel (Chapter III), all of the emphasis was placed upon the existing physical setting, and components were developed to describe that setting. In the Interactive Parameters Model, hereafter referred to as the IPModel, the lifeforms that exist within the Natural and Man-Made environments, both human and non-human, were studied.

Although the IPModel is very analytical, much as the APModel was analytical, the particular data it provides is somewhat different than that supplied by the APModel. However, the two descriptive models combine together to provide a complete picture of many environmental aspects of a given study area.

Design Criteria of the IPModel

There are to be three design criteria upon which the IPModel is to be developed. Each of these criteria shall be expanded into at least one component. These three design criteria/components are:

1. Code the study area in terms of a series of scaled values defining the capacity for human/non-human lifeform interaction.
   Component name: Shared Space Component.

2. Code the study area in terms of a series of scaled values defining the compatability of human life with rare non-human life-forms.

   Component name: Rare Species Component.

3. Code the study area in terms of a series of scaled values defining the areas of depleted species, incompatable with human life.

   Component name: Depleted Species Component.

Unlike the APModel, the components of the IPModel shall not be restructured into a series of component models. That is, because of the close interaction between the three components, they shall be grouped only under the heading of the IMPodel, i.e., the descriptive model.

<u>Interactive Parameters Model</u>
(IPModel)

<u>Components</u>:

Shared Space

Rare Species

Depleted Species

Fig. 23. IPModel.

<u>Interaction:Compatability</u>

Interaction, or interactive capacity, shall be defined as compatability. Unfortunately, compatability is a very overused and misused term in urban studies. Intra-Urban research often attempts to develop an intra-compatability between urban land uses and spaces.[1] Values are applied to these "compatability" groups on a more or less arbitrary basis[2] and often do not represent a particular situation which can be modeled. That is, one could argue, in terms of locational and spatial terms, that many land uses do not follow a strict deterministic pattern.[3] Instead, they depend upon nondeterminant variables such as personal locational preferences and availability of space (thru time).

Compatability, in terms of Man-Made/Natural space interaction, has been studied by McHarg,[4] among others. He calls the attributes of such study "physiogramic determinism" and develops a series of various categories to outline this concept. He does not really develop a true value scale system but attempts to scale the information he basis his model upon.

One can agree with many of the various categories of study he suggests, however, this thesis does not adhere with the logic of one of the basic assumptions upon which he basis many decision making processes. It was his judgment that, although not quantifiable by nature, a trained observer can make objective appraisals of various (environmental) characteristics.

> It would appear that the perceptive (architectural) student can perceive environmental variations...this would provide an objective basis for the practice of City Planning, Landscape Architecture and Architecture.[5]

It is thought that basing spatial decisions upon this type of information is invalid because the system is not a true objective/subjective system, as was defined in Chapter II, because the data is opinionated by the "objective" appraiser's personal preferences and aesthetic perceptions.

Within the framework of this investigation, one can develop compatability studies on a completely different information base. This can first be accomplished by developing the IPModel components in terms of the dictionary definition of compatability. That is, "the capability of existing together in harmony." Further, the various components shall be developed in terms of the capability of human and non-human lifeforms to share space, i.e., coexist. The human attribute of this form of compatability shall be called the Gestalt dynamism of space, whereas the non-human constituent shall be called territoriality.

Gestalt Dynamism of Space

The dynamism of space is a phrase coined by Edward Hall (1969) to define his four "distances in man." Briefly, Hall developes a thesis that there are four distinct hierarchies of human spatial interaction. He calls these: "intimate distance, personal distance, social distance and public distance." Each of these concepts is actually describing a particular spatial concept, i.e., intimate space, personal space, social space and public space. Within the framework of this investigation, one can add another level to this chain of spatial hierarchy. One can call it the Gestalt Dynamism of Space. The phrase is valid in that the idea of a Gestalt applies to the concepts of a dynamism of space. It is valid within the framework of this model because of the influence the Man-Made environment has over the Natural environment.

The Gestalt of space implies that the total space is of more value or has a greater collective potential than the individual spaces. Thus, although the Man-made environment upon contact, i.e., physical contact, with the Natural environment most always has a dominant role, in reality one environment cannot survive without the other. On the surface this seems invalid because of the logic of the possibility of the Natural environment easily surviving without the Man-Made environment. However, once there has been some form of interaction between the two environments, both become dependent upon the other.[7]

Because the EPD is not a growth model, it does not attempt to prodict the amount of space that will be used by growth of the Man-Made environment. However, following guideline Four (Chapter I), it can be assumed that each matrix unit will be maximized. Therefore, one could develop a series of polarity-hierarchy value scales that consider the maximizing of human usage of space at one pole and the non-human maximizing of space at the other pole. The non-human maximization is to be called territoriality.

Territoriality

Territoriality is a basic concept in the study of animal behavior and is usually defined as behavior by which an organism characteristically lays claim to an area and defends it against members of its own species.[8] However, it is necessary to refine this definition in order to bring it into context with the human/non-human lifeform interaction. Therefore, species territoriality shall be considered in a context of an area shared with, or protected from, human interaction. One can consider the shared spaces in the Shared Space Component and the protected spaces in the Rare Species and Depleted Species Components.

Interactive Value Scale

To determine a values scale, it is first necessary to determine which area should be considered as most positive polarity and which should be considered as most negative polarity. This scale could be developed with the human usage of land as being most positive or the non-human usage as being most positive. The choice will actually be made easier by the way in which one states the values. Thus, the highest positive polarity is that value which represents the least interaction between human and non-human lifeforms and the highest negative polarity to that value which represents the most interaction between human and non-human lifeforms. The values will be used to determine the capability of spatial interaction.

Therefore, the sample matrix shown in Fig. 24 has been used to generate a general compatability (polarity/hierarchy values) scheme.

1	2	3
4	Y	5
6	7	8

Fig. 24. Grid sample.

It is easiest to develop this general scheme by first considering a study matrices in which a group of grids have been classified part of the natural environment, i.e., no human intervention upon the given matrix unit being studied. It would be impossible to apply a scalar test to each individual lifeform found in such an area. Elton[9] suggests that each such habitat contains <u>characteristic sets of animals</u> and that as a habitat is determined by its geographic and climatological characteristics; it is possible to determine which particular sets of lifeforms are present by knowing such data. All of this data is provided by the APModel. In addition, the American Bureau of Biological Survey has made detailed studies of these characteristic sets of lifeforms and can provide detailed information concerning their capability to interact with man.

Thus, in regard to Fig. 23, a <u>set of lifeforms</u> that is considered able to interact very well with man would be able to have human interaction in all grids surrounding the grid being studied, i.e., 100% interaction. On the opposite end of the scale, a set of lifeforms that do not interact well with humans might have no grids surrounding their territory occupied by humans; this would be considered 0% interaction.[5]

A general interactive scheme would be verbally displayed in Fig. 25.

GENERAL INTERACTIVE SCHEME

(polarity/hierarchy values)

POLARITY DESIGNATION	HIERARCHY LEVEL	NAME	SCALED VALUE
Positive	0% Interaction	Shy set of lifeforms	5
Slightly Positive	25% Interaction	Slightly shy set of lifeforms	4
Slightly Negative	50% Interaction	Slightly social set of lifeforms	3
Negative	75% Interaction	Social set of lifeforms	2
High Negative	100% Interaction	Domesticated	1

Fig. 25. General interaction scheme

Using this general scheme, one can develop the three components of the IMPodel.

Section A: Shared Space Component

The actual capability for a given set of lifeforms to share space with man is the best way to insure that the given set of lifeforms will not become depleted or extinct. Thus, sets of animals that have some general capacity to share space with man can be given a scalar value in terms of that capacity. The less their ability to share space, the greater their need for protection. However, animals that absolutely cannot share space will be considered on an individual basis in the other two components of this descriptive model.

Fig. 26 is a verbal display of the value scaling of the capacity to share space.

Shared Space Component

POLARITY DESIGNATION	HIERARCHY LEVEL	NAME	SCALED VALUE
Positive	0% capacity to share space	Shy set of life-forms	5
Slightly Positive	25% capacity to share space	Slightly shy set of lifeforms	4
Slightly Negative	50% capacity to share space	Slightly social set of lifeforms	3
Negative	75% capacity to share space	Social set of lifeforms	2
High Negative	100% capacity to share space	Domesticated	1

Fig. 26. Shared space component.

Section B: Rare Species Component

Rare species of non-human lifeforms are those that either have never been abundant, without our knowledge, or have been so depleted in numbers that their existence is endangered. Those naturally rare may be limited in numbers by factors that are unknown or by conditions over which no human control can be effective. In addition, species that are known to have been abundant but are now depleted, by the actions of humans, can often be restored if man can correct or control the conditions he himself has produced.[10]

Each of these two specific cases shall be considered separately, as they have different mitigating circumstances. This component shall consider only those that are naturally rare, and the Depleted Species Component shall consider those lifeforms that fit into that category.

Rare species can share space with humans. That is, as their rarity is not caused by known human action, it is possible for these species to have some interaction with people. However, because there is the possibility that such creatures could become depleted in numbers, it is necessary that they be carefully observed and cared for.

As was alluded to in the previous section, both the Rare Species Component and the Depleted Species Component shall consider lifeforms on a singular basis instead of in lifeform sets. However, these individual species shall be further grouped into two classes: resident and migratory. Resident lifeforms are those that live within the confines of a given territory on a permanent basis. Migratory lifeforms do not remain in one given area on a permanent basis but move from one territory to another depending upon their migratory que.

Migratory species are much harder to care for and reserve space for than Resident lifeforms for two reasons. First, their absence allows man to use the land while they are gone, thus destroying their habitat. Secondly, because they are not resident, it is difficult to study them and determine their exact needs and problems. Therefore, rare migratory species shall be considered of a higher positive polarity than rare resident species. Further, both of the categories shall be considered of higher positive polarity than the sets of lifeforms sharing space with man.

RARE SPECIES COMPONENT

POLARITY DESIGNATION	HIERARCHY LEVEL	NAME	SCALED VALUE
Very High Positive	Special Case	Very Rare Migratory	7
High Positive	Special Case	Very Rare Resident	6
Positive	0% capacity to share space	Shy Rare Species	5
Slightly Positive	25% capacity to share space	Slightly Shy Rare Species	4
Slightly Negative	50% capacity to share space	Slightly Social Rare Species	3
Negative	75% capacity to share space	Social Rare Species	2
High Negative	100% capacity to share space	Domesticated	1

Fig. 27. Rare species.

Depleted Species Component: Section C

Depleted species are those that are on the verge of extinction. Only through immediate and extensive care and protection can such species be saved. As was defined in the previous section, depleted species are those that cannot interact with man. Therefore, only by total protection of species territoriality can extinction be prevented. Fig. 28 is a verbal display of scalar values for depleted species.

DEPLETED SPECIES COMPONENT

POLARITY DESIGNATION	HIERARCHY LEVEL	NAME	SCALED VALUE
Very High Positive	Closed Grid	Depleted Species: Migratory	8
High Positive	Closed Grid	Depleted Species: Resident Species	7
Positive	0% Compatability Partial Interaction	Migratory Route	6

Fig. 28. Depleted species.

Coding Hierarchy:IPModel

Each of the components of the IPModel have been considered on a grid by grid basis, and the information shall be considered in terms of the following formula.

4.1 $$I_a = \frac{S(A_s) + S(R_s)}{(n_a + n_r)} + I_d$$

If I_d greater than 0 then grid is closed to human usage

Where: I_a = actual interactive value of grid

A_s = value of abundant sets of lifeforms

R_s = value of rare species

I_d = value of depleted species

n_a = number of abundant sets

n_r = number of rare species

S = summation

This formula provides a single scaled value that can be used to determine the interaction value of each grid. Such interaction would be in line with Fig. 24, which gives the general interaction scheme.

Conclusions:IPModel

The IPModel provides a variety of data that can be used in a multitude of ways. Because the data is treated as empirical, it can be tested using all types of statistical analyses. For example, data concerning the possible degradation of the natural environment can be provided by plotting the value of species interaction against urban growth.

All of the information provided by both the APModel and IPModel gives the model maker a rather complete set of data concerning the total environment. In order to provide a proper balance between the Natural and Man-Made environments, it is necessary to develop a set of controls that can be applied to any given study area within which the Man-Made environment is expected to expand. This information shall be provided in Chapter V, the Controls Parameters Model.

FOOTNOTES

[1] Among many, see: Gallion, 1961; Reinemann, 1960.

[2] For example, as an undergraduate, I have worked with a compatability chart for scaling the compatability of different commercial land uses. Such a system would give a high value to the relationship between a shoe store and a leather shop and a low value to the relationship between a shoe store and a grocery store. This type of information is abstract, i.e., unreal, in that it does not model any real urban system. Nor does it have any real practical application because there is no way to test the system to prove validity.

[3] Still, Bayrd; Urban America; Boston: Little, Brown & Co.; 1974.

[4] McHarg, Ian; Design with Nature; Garden City, N. Y.: The Natural History Press; 1972.

[5] Ibid; p. 59.

[6] Hall, Edward T.; The Hidden Dimension; Garden City, N. Y.: Anchor-Doubleday Co.; 1969, p. 113.

[7] The man-made environment is dependent upon the natural environment because of a need for water, food, etc. The natural environment cannot survive without the aid of the man-made environment because of the imbalances that the human intrusion upon nature creates (Gabrielson, 1959, p. 8).

[8] Hediger, H.; "The Evolution of Territorial Behavior"; S. L. Washburn, ed.; Social Life of Early Man; New York: Viking Fund; 1961.

[9] Elton, Charles; Animal Ecology; London: Methuen & Co., Ltd.; 1926; 2nd ed. 1971.

[10] Gabrielson, Ira N.; Wildlife Conservation; New York: Macmillan Co.; 1972, p. 182.

CHAPTER V

CONTROL PARAMETERS MODEL

Introduction

Both the APModel and the IPModel were developed to detail a series of parameters that pertained to specific areas of study. The APModel described physical parameters, and the IPModel detailed lifeform parameters. However, neither of these descriptive models had a specific function to describe areas of control or constraint. This function is provided by the Control Parameters Model, hereafter referred to as the CPModel.

Because the APModel and the IPModel were a reflection of specific "real" world information, it was necessary to try and consider "real" world areas of control and constraint in the development of the CPModel. That is, specified areas of control were developed from current and proposed solutions that have been tried or have been accepted as sound solutions to specific Natural/Man-made Environment interaction problems. There are two areas of control that were considered in the development of this descriptive model. They are:

A. Planning.

B. Environment.

Each of these specific areas of study was used as a particular focus for external model control. That is, the optimal set of controls that could be derived from each of these particular disciplines of study was used to establish control parameters.

The relationship of the CPModel to the EPD is critical. It is the only descriptive model that is not influenced or dependent upon a particular study area. That is, the controls are not generated by the given criteria of the particular interactive problems of a given matrices. Instead, to reiterate, the control parameters are external and should be applicable to a wide variety of possible sets of information as provided by the APModel and the IPModel.

Design Criteria of the CPModel

There are two areas of control that were considered as input in the development of a set of control components. These two areas of control were considered as basic design criteria upon which the CPModel was constructed. Each design criteria was considered as a model component. These criteria/components are:

1. Specific external control provided by the development of a set of controls dependent upon Planning criteria.

   Component Name: Human Demand Component

2. Specific external control provided by the development of a series of controls dependent upon environmental balance criteria.

   Component Name: EIZ: Environmental Influenced Zoning

As was the case in the IPModel, the CPModel has no subordinate substructuring, i.e., the components were not regrouped into specific component models.

Controls Component Model

(CPModel)

Components:

Human Demand

EIZ: Environmental Influenced Zoning

Fig. 29. Verbal display CPModel.

Coding Hierarchy: CPModel

Unlike the previous descriptive models, the CPModel does not provide the model-maker with numeric data.[1] Instead, it provided for matrix unit development control. That is, human development control in a spatial context. This control is stated in terms of the anticipated growth of the man-made environment. As spatial growth of the man-made environment has been associated with the spatial growth of urban centers, i.e., population foci. It is within this context that the EPD was conceived and that the CPModel is specifically intended.

Human Demand Component

To increase the population of an urban area and to thereby raise the nominal value in land area rent is almost a moral imperative in American communities. That is why zoning laws, which attempt to regulate the human use, i.e., demand, of land have proved inadequate in the past to meet the needs of a total community.[2] However, of all of the regulatory powers that urban government possessed, zoning is by far the most inclusive one which deals with the physical environment. To date its provisions and patterns have not been based upon predictive or testable theories, rather, they have been based upon precedent and tradition. Zoning can be related to the fundamental needs of a total environment, resulting in a divergent pattern of such (urban) growth.[3] Such Zoning has been designated Environment-Influenced Zoning or EIZ.

Zoning controls have been instituted in the past to attempt to guarantee every man a "better environment." They have only been successful to a limited degree. Often decisions of an economic and political nature have not clearly put forth the environmental impact associated with zoning control.[4]

Existing urban centers have a fixed street pattern and topography which cannot be easily changed. As their population increases, density increases. Thus, spaces that were appropriate for lower densities are stressed further by new buildings which are usually taller and have greater coverage.[5]

Zoning laws are employed as the prime means of controlling the arrangement of spaces and buildings in an attempt to benefit the urban environment, often to the detriment of the natural environment.

Therefore, this investigation shall consider the grouping of zoning laws into two groups: urban defining and non-urban defining. The urban group is represented by three basic types of zoning situations. These are:

1. Housing.
2. Commercial.
3. Industrial.

These three subdivisions of urban defining zoning laws are often considered in terms of either population density (housing) or a grouping/separating (commercial, industrial) polarity.[6]

The non-urban defining zoning laws are represented by three basic types of situations. These are:

1. Natural Resources.
2. Agriculture.
3. Open Space.

In addition we must consider those areas with non-urban attributes that are not zoned. All of these non-urban areas of zoning interest (or unzoned areas) are defined by specified land usage.

Neither the Urban defining subdivisions nor the non-urban (and unzoned) areas actually provide information or constraints that are environment oriented. To develop a set of Environment Influenced Zoning laws, we must consider two possibilities.[7] These are:

1. Maximization of control in terms of space.
2. Maximization of control in terms of the density of usage.

Both of these attributes were considered in the two preceding chapters of this paper. The APModel was developed in terms of space definition and delineation, and the IPModel was developed in terms of defining specified density of human/non-human usage. Thus, it is possible to determine a set of spatial and density constraints/controls that can apply to study areas under scrutiny within the context of the APModel and the IPModel.

EIZ: Environmental Influenced Zoning Component

There are three areas in which control can be ascertained in terms of EIZ. These broad categories are:[8]

1. Preservation.
2. Conservation.
3. Spatial Equilibrium Development.

A key concept in the actual implementation of such a system of zoning would depend upon local government. However, the system is workable, and similar ones have been actualized.[9]

Therefore, the above listed categories can be considered in terms of the APModel and IPModel.

Preservation

Preservation is generally defined as "the act of" preserving something. In this case, it is the act of preserving specific areas (spaces) from future human development. Thus, those areas that are preserved represent spaces in which there is no human intrusion into the natural environs of a specific naturalistic pattern.

Within the terms of the EPD, there are three specific spatial patterns that suggest a need for preservation. These are:

1. Micro-environments.
2. The value of natural historic spaces.
3. The value of rare and depleted species.

1. Micro-Environments

There are several different micro-environments, as defined in Chapter III of this investigation, that need to be considered. First are the micro-environments of form. These micro-environments were given the numeric coding of 7.0, 8.0, 14.0, 15.0, 19.0 and 20.0. These represent the natural environment micro-environments. Also to be considered are the micro-environments as represented by climate cells (climes), i.e., micro-climates, within a given region.

Both the micro-environments of form and the micro-climates are to be preserved if they conform to the following constraints. First, the preservation of such environs does not endanger the general health or preservation of human life. Second, if the micro-environment is essential to the health or preservation of lifeforms living in a given area as a result of the micro-environment. Third, and last, spaces are to be preserved if they have acquired land values greater than 5.0.[3]

In addition, micro-environments are represented by the earthborn destructive phenomenon of earthquakes and volcanos are to be preserved.

2. The value of natural historic places

All natural historical places are to be preserved if they have a value of 5.0 or higher. Natural historical places that have a value of less than 5.0 may be conserved.

3. The value of rare and depleted species

All rare species that fall into the category of being either migratory or shy (value of 7.0 or 6.) shall be preserved. All depleted species (both migratory and resident) shall be preserved.

These species shall be preserved without constraints, as were imposed upon the micro-environments. This is because, first, rare and depleted species do not represent a health or preservation problem to humanity.

Conservation

Conservation is considered as the planned management of natural resources. In order to better delineate between preservation and conservation, it can be assumed that there is limited human use, i.e., planned interaction, in conservation areas. This interaction does not exist in preservation areas.

Conservation, therefore, can be considered in the following terms:

1. Suitability of land for urban (human usage).
2. The historic value of land.
3. Geomorphology.

1. Suitability of land for urban usage

Within the framework of the value of land, as outlined in Chapter III, one can develop a scalar value to suggest the capacity of various land form types to be able to easily support urban development, i.e., man-made environments. Within the frame of said scale, there is an obvious breakpoint between landforms that are suitable for urban (human) usage and those that are less suitable. Those that are suitable are discussed in the following section (Spatial Equilibrium Development); those that are less suitable are to be conserved. That is, a limited amount of human interaction is planned, however, the landforms are not suited for development and should be recognized as such. Therefore, all landforms that have a scalar value of 0.0 to 4.0 are to be conserved. These landforms are generally headed by the following numeric code headings: 1.0 Oceans; 2.0 Seas; 3.0 Gulfs; 4.0 Inland Seas; 5.0 Lakes; 6.0 Flowing water; 9.0 Swamps; 10.0 Marshes; 11.0 Bogs; 12.0 Floodplains; 13.0 Shorelines.

2. The historic value of land

To reiterate, the VcoModel specifically delineates a technique to scale the historic value of land in terms of its natural form and man-made forms. The value of natural historic places, if they had a scalar value greater than 5.0 was preserved. All other natural historic places are to be conserved. That is, there is only a limited amount of planned interaction between these places and man-made environments.

In addition, urban areas of high historic value (5.0+) are to be conserved. This would include all National Historical Landmarks as well as areas designated as historical by various federal, state and local government officials.

3. Geomorphology

There are a variety of specific land uses that by their use (or form) that should not accommodate a great amount of man-made forms and/or environment. These specifically include the following land form/uses:

A. R 10.0 FARM

- R 10.1 Grain Crops
- R 10.2 Plant Crops
- R 10.3 Orchards
- R 10.4 Vineyards
- R 10.5 Inundated Crops
- R 10.6 Fallow Lands
- R 10.7 Livestock Areas
- R 10.8 Grazing Land

B. C 13.0 WATER MANAGEMENT

- C 13.1 Dams
- C 13.2 Ponds
- C 13.3 Reservoirs
- C 13.4 Lakes, Artificial

C. 12.0 FLOODPLAINS

- 12.1 Yearly Average Floodplain
- 12.2 20 Year Floodplain
- 12.3 50 Year Floodplain

D. 13.0 SHORELINES

- 13.1 Foreshore
- 13.2 Beach

Constraints on conservation areas are similar to those placed upon preservation areas. First, the conservation of such environs does not endanger the general health or preservation of human life. Second, the establishment of a series of water test standards (as described in Chapter III). These tests are to provide a constraint in terms of acceptable levels of physical, chemical and bacteriological interaction with existing surface water areas and flowing water areas.

There is also to be a restriction on conservation in terms of areas of restricted human usage. That is, the contaminated areas as defined by numeric code "M 20.0." These areas are to be blocked and neither preserved, conserved or developed. That is, they are to be held in statis.

Spatial Equilibrium Planned Development (SEPD)

All planned development, i.e., urban or man-made environments, is to be considered in terms of a balanced system. That is, in terms of the spatial equilibrium concepts that have been one of the basic tools of this investigation. SEPD can occur within the following context:

1. Lands suitable for urban development.
2. Soil characteristics suitable for urban development.
3. Available potable water.
4. Suitable atmospheric conditions.

1. Lands suitable for urban development

Again, referring to the respective value scale, the following represent the landforms most suitable to urban development and man-made environments/forms.

A. 16.0 PLAINS (0% to 6% average slope)

16.1 Coastal Plains (less than 599 ft in elevation)

16.1.1 Backshore

16.2 Upland Plains (greater than 600 ft in elevation)

16.2.1 Alluvial Plain
16.2.2 Desert Plain
16.2.3 Highland Plain
16.2.4 Prairie Plain
16.2.5 Tundra Plain

17.0 FORESTS

17.1 Boreal
17.2 Broadleaf
17.3 Deciduous
17.4 Elfin
17.5 Equatorial
17.6 Evergreen
17.7 Evergreen, Hardwood
17.8 Laurel
17.9 Mangrove
17.10 Monsoon
17.11 Montane
17.12 Mossy
17.13 Needleleaf
17.14 Sclerophyll
17.15 Summergreen
17.16 Temperate Evergreen
17.17 Tropical
17.18 Tropical Evergreen

18.0 SLOPES (6%+ average grades)

18.1 6% to 12% slopes
18.2 12%+ slopes

It should be noted that Forested areas can also be either preserved or conserved. However, not all of any given forest area can conform to the constraints and restrictions that determine whether a given parcel of land is to be preserved, conserved or developed. In addition, it should be remembered that forested areas also have large expanses of "open space" that readily conforms to the needs of urban areas.

2. Soil characteristics suitable for urban development

As part of the GeoModel, this investigation provided for the analysis of soil characteristics on the basis of suitability for a variety of human uses. In terms of urban growth or the development of man-made forms and environments, there are two specific soil characteristic categories that need to be reviewed as part of the SEPD. These two categories are: the suitability for construction and the suitability for transportation networks.

3. Available potable water

The importance of potable water was discussed in Chapter III. It is sufficient to state that the availability of potable water and the capability to keep it potable is a result of water conservation and management principles. The availability of potable water is information provided by the GeoModel, i.e., the Regional Water Characteristics Component and the Geomorphological Component.

4. Suitability of climate

The physical parameters of climate, as provided by temperature means, humidity, annual rainfall, average amounts of sun/shade, wind and a variety of other physical properties that are part of atmospheric conditions, provide data that can help determine the possibility of Climate modification as a result of urban development.[10]

Climate modification not only creates hardship to the natural environment and lifeforms, but it also causes hardships, illness and death in human beings. Thus, it is necessary to determine urban growth in terms of the suitability of a given set of climatic and atmospheric conditions to be able to adjust to the modification of land form.

EIZ/SEDP:Conclusions

In terms of the urban group of related zoning laws, i.e., Housing, Commercial and Industrial, and the non-urban zoning laws, as well as the unzoned areas, the zoning suggestions as provided by the EIZ programs begin to control the thrust of urban growth and balance the effects of such growth.

Although it would be a difficult struggle to immediately provide for all of the zoning suggestions as provided by this investigation, there is a need to begin to move further in the direction of a balanced total environment as suggested by the concepts of spatial equilibrium.

FOOTNOTES

[1]Mumford, Lewis; Sticks and Stones: A Study of American Architecture and Civilization; New York: Dover Publications; 1955.

[2]Alberts, David S. and Davis, John M.; "Environment-Influenced Zoning"; Journal of Environmental Systems, Volume 1, Part 4; Dec. 1971, pp. 375-389.

[3]IBID.

[4]Siegan, Bernard H.; Land Use Without Zoning; Lexington, Mass.: Lexington Books-D.C. Heath and Co.; 1973.

[5]Alberts, David S., etc.

[6]Florida Costal Coordinating Council (FCCC); "Escarpsa: A Preliminary Study of Costal Zone Management Problems and Opportunities in Escambia and Santa Rosa Counties, Florida; Tallahassee; 1971.

[7]IBID.

[8]This information is determined in terms of the following regional classifications: Oceans; Rivers; Swamps; Marshes; Floodplains; Costal Plains, etc.

P A R T   C

T H E   S I M U L A T I O N   M O D E L

CHAPTER VI

DESCRIPTIVE MODEL INTERACTION

Section A

Planned Interaction

The three basic descriptive models outlined in Part B (see pg. 45) provide input in terms of environment (APModel), life forms (IPModel) and control (CPModel). Each of these models can be studied and maintained independently of the others. That is, each of them each provides a rather finite amount of information that can be used singly or together. When the data are collated, the resultant is the Environmental Parameters Descriptor, i.e., the EPD.

As the EPD is build up upon the interaction of the three descriptive models, it is necessary to first outline how this interaction is to be developed. It will be considered in terms of three basic links and one administrative link. The three basic links are "action" links, i.e., they require some input from a given test area. The administrative link is used to provide the model maker with information about where and how information should be used in the other three links. The three basic "action" links are:

1. Mathematical link.
2. Command link.
3. External link.

Introduction

Part A (The General Model) and Part B (Input of the Descriptive Models) of this paper have provided the background and the basic foundation of the simulation model. Part C is an overview of the simulation model. First, however, a point needs to be further clarified about the model and its development.

It should be remembered that this paper is setting forth a proposed simulation model. No attempt is being made, at this time, to activate the proposed model.[1] This concluding section of this thesis deals with the interaction of the various descriptive models as well as some basic conclusions that can be drawn from the overall model.

The simulation model is developed in terms of:

1. Planded descriptive model interaction.
2. The implications of the interaction.

In addition consideration is made for possible future research and development.

The administrative link is called the cross-over link.

The limitations that are placed upon the action links are based upon the limitations of the model as defined in Part A (The General Model, pg. 26) as well as other applicable information. These limitations are:

1. Limited by the level of spatial aggregation.
2. Limited by the aggregation over time.
3. Limited by human factors.
4. Limited by required coding heirarchy of a given descriptive model component.

In order to avoid any misunderstanding about the extent of these limiting factors, each shall be further defined.

1. Limited by the level of spatial aggregation

The spatial aggregation is defined by the number of sub-regions used to delineate the study area.[2] Although no specific spatial aggregation is usable in every study area, a maximum limit would be dependent upon the time available and the sophistication of the equipment used to study each matrix of a given study area.

2. Limited by the aggregation over time

As the proposed model is non-metric in regard to time, no definitive time limit shall be placed upon the model. However, the maximum ranges should be well within a range that is compatable with excepted forecasting techniques.

That is, a maximum of twenty-five years had a working range of from 5 to 10 years.[3]

3. <u>Limited by human factors</u>

The human factors have been previously defined as:

A. Political environmental exploitation.

B. Population growth.

C. Technical change.

D. Economics.[4]

It is not necessary to reiterate the statements put forth about these particular factors again. However, it should be remembered that each has a major affect upon the basic model without necessarily being included within the context of any of the individual descriptive models.

4. <u>Limited by the required coding requirements of a given descriptive model component</u>

The coding requirements have been individually defined, by component, within the context of each descriptive model. These intra-model commands will not be individually listed at this time as they have already been adequately covered in Ch III, IV and V.

Action Links

To reiterate, the action links are:

1. Mathematical links.
2. Command links.
3. External links.

1. Mathematical links

The mathematical links shall be defined in terms of the abstract definition of mathematical, i.e., rigorously exact or precise, rather than the mathematic (addition, subtraction, etc.) definition. Thus, those parts of the model that require a precise and exact definition of information shall be included in the section of mathematical links.[5] This section also includes those obvious mathematic sections of the model.

Those parts of the three descriptive models that fit into this set of model links are:

A. APModel:

Value of Land Component

Value of Nature Component

Value of Time Component.

B. IPModel:

Shared Space Component

Rare Species Component

Depleted Species Component.

Each of these descriptive model components requires a precise definition of input, all of which is interlocked in providing a reasonable picture of spatial equilibrium.

2. Command links

The command links shall be defined as those model components that are decisionless, i.e., there is no choice of action. Those components that fit into this category are those that cannot be overriden within the framework of the model. Thus a command link can override all other sets of conditions that might affect a study area.

Those parts of the model that fit into this set of model links are:

A. Limitations of the model:

Requirement for spatial equilibrium

Suitability for urban usage.

B. APModel:

Destructive Phenomenon Component

Climatology Component.

C. IPModel:

Shared Space Component: values over 7

Rare Species Component: values over 7

Depleted Species Component: values over 7.

D. CPModel:

Human Demand Component

EIZ Component.

Each of these descriptive model components requires that the model perform within a narrow frame of reference. In addition there are other command links as provided by each component model that requires that a particular matrix be blocked to possible growth. Those are intra-model links, whereas the above list is inter-model links.

3. External links

The external links shall be defined as those components that are outside the control of the model or those components that would remain unchanged by the model. Thus, certain natural phenomenon that cannot be controlled by man or machine, as well as those components that define conditions prior to additional human intrusion, would be considered as control links.

Those parts of the three descriptive models that fit into this category are:

A. APModel

Regional Composition: Earth Component

Regional Composition: Water Component

Destructive Phenomenon Component

Climatology Component

Value of time Component; those with a value of 7+ as well as specified existing federal, state and local historical landmarks.

Administrative Links

To reiterate, the only administrative link was the cross-over links. Cross-over links shall be defined as those components that equally apply to all of the action links. That is, those components that provide some foundation information that must be determined prior to the determination of the descriptive component models.

Those parts of the three descriptive models that fit into this category are:

A. APModel

Regional Morphology Component.

Section B

Implications of Interaction

The implications of the model are an attempt to stricture the amount of environmental degradation by modifying the growth potential to better concur with the environmental capability of a given matrix unit to sustain such growth. It should be implicit in any growth scheme that environmental degradation need to be an externality of urban growth.

There are four basic implications of the proposed inter-model interactions. These are:

1. Cause-effect relationships.
2. Environmental balance.

3. Human interaction.
4. The EPD as a holistic and deterministic simulator.

1. <u>Cause-effect relationships</u>

The cause-effect relationships within the EPD are initially based upon the guidelines that were used to generate the environmental parameters. In addition, the "cause" is provided by the three descriptive models, i.e., the APModel, the IPModel and the CPModel.

The guidelines that generated the environmental parameters provided a response to an expected effect of human interaction within "natural" environments. These guidelines are:

1. The region to be developed (or which has the potential) is "beautiful" but vulnerable to exploitation.
2. Development is inevitable and must be accommodated; therefore, planned growth is more desirable than uncontrolled growth.
3. Environmentally unconstrained growth is inevitably destructive.
4. The region can absorb all perspective growth without despoliation.[6,7]

These guidelines are suggesting one set of possible effects if unconstrained growth proceeds or continues. Other negative effects on urban growth are:

A. Air pollution.
B. Water pollution.
C. Noise pollution.
D. Visual pollution.
E. Soil erosion/land pollution.[8]

The causes that in the past have generated these effects are suggested within the framework of each descriptive model. That is, existing patterns of growth and environmental degradation and fixed relationships of form.[9]

The basic effects of the simulation model are in terms of the forecasting ability of the model to predetermine the resultant of human intervention within a given area. Although these results are probabilistic, they represent a reasonable expected consequence.

In addition, the effect of the model will be to:

1. Block growth in areas that are naturally undesirable from the human standpoint for a variety of reasons that range from human health factors to the inability of the soil to carry man-made structures.
2. Block growth in areas that it is undesirable to human intervention to interfere with existing micro-environments.
3. Allow managed growth, in terms of development and conservation constraints (see Ch V), in areas that are suited for urban structures as well as expected environmental changes.

2. Environmental balance

All of the various components of the descriptive models provide an evenly distributed environmental model, in terms of the summation of all of the components into a simulation model. The model provides environmental balance in terms of spatial equilibrium. That is, as a concerned balance within the total environment between the human and naturalistic environs.

This balance is first considered in terms of the suitability of land for urban usage[10] and is such areas as the VcoModel of the APModel[11] and the Human Demand and EIZ components of the CPModel.[12]

3. Human interaction

The effect of human interaction, whether it be in terms of limits placed on the model or the result of urban growth, is studied, in some manner, by each descriptive model. When these models are linked together, they provide a picture of the implications that human interaction will play in the future of any given matrix unit within a study area.

4. The EPD as a holistic and deterministic simulator

The EPD is, to some extent, more than the sum of its parts. That is, the intermeshing of the descriptive models can provide information that each model separately cannot provide.

In addition, by studying the past and existing conditions within each matrix unit, it is possible for the EPD to provide a probabilistic future for each unit. Although such determinism assumes that annocedent causes will affect the future of each matrix unit, this is a logical procedure that is used in other models.[13]

FOOTNOTES

[1]See Chapter VII.

[2]Alanso, William; "The Quality of Data and the Choice and Design of Predictive Models"; Highway Research Board Special Report; Washington, DC: Highway Research Board; 1972, p. 18.

[3]IBID., p. 19.

[4]Chapter II, p. 36.

[5]Components may fit into other categories better than this category which explains why not all of the possible "mathematical" components are found in this category.

[6]Chapter I, p. 7.

[7]McHarg, Ian; Design with Nature; Garden City, NY: The Natural History Press; 1972, p. 82.

[8]Chapter I, p. 20.

[9]Chapter I, p. 21.

[10]Chapter II, p. 31.

[11]Chapter III.

[12]Chapter IV, p. 129.

[13]See: Alanso, 1964; Muth, 1961, 1967, 1969 and Wingo, 1961.

CHAPTER VII

PROGRESS: TOWARD THE FUTURE

Section A

Progress: At What Cost?

In many respects this paper has to do with what is sometimes called the "quality of life." Not only in terms of which communities are perceived by their residents as being pleasant places in which to live and do business but also by advocates who would have others buy anything from automobiles to ecology.

Inherent in many of these concepts is that of "progress," which is more difficult to define than either the automobile or ecology and which seems to have a lot to do with the quality of life.

For a good many years progress was simply economic growth to most people. It was easy to measure. If the GNP was up or a business took in more this year than the last, it was progress. If not, no progress. Money was the way the score was kept.

But more recently, progress, when there was any, has been the result of a series of tradeoffs and, when measured in the old terms, has been much less significant. Economics may have increased the options at any given time, but the means by which that sort of "progress" is achieved may have exacted a cost of its own which in turn diminished the final result. There's pollution, for example, encroachment on public domain and plants and animals that will never be seen again.

Progress, by whatever the term, is largely the result of an emotional assessment, even as is the quality of life. Attempts to measure such values in concrete terms probably are doomed to endless controversy.

This does not make the need for progress any less real. Improvements of the quality of life may be the result of a change in values as different as the various beholders.

The Environmental Parameters Descriptor, i.e., the EPD, is a model that is directed at the concepts of a quality of life and at different values besides economic.

Section B

Progress: Future Development of the EPD

The proposed future development of this model is simple and very time consuming. The three easy (?) steps are:

A. Operationalize each descriptive model, independently.

B. Computerize each descriptive model.

C. Operationalize the simulation model.

Because I have been working on this thesis for almost 2 years, progress has already been made towards the completion of step A. To be specific:

A. The APModel is in the process of being operationalized by a grant from the Engineering Research Institute of Iowa State University, Ames, Iowa.

B. The IPModel is to be funded as part of a grant that will commence during the 1976-77 school year.

C. In addition, two papers have already been published as a result of the partial operationalizing of the APModel.

Although the conceptualization of the EPD model is the basis of this thesis, it should be realized that this paper represents a starting point not an end.

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AN ENVIRONMENTAL PARAMETERS DESCRIPTOR

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AN ABSTRACT OF A MASTER'S THESIS

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ABSTRACT

The magnitude of urban growth in the twentieth century has fostered considerable interest in the processes and form of that growth. To the Urban Planner, the processes as they affect the form are of particular interest. Within this context, the specific focus of the study is an investigation of the natural environment/man-made environment interaction with that structure and form.

The vehicle of investigation is a deterministic simulation model which will operate on a matrix representative of three parameters:

A. Physical parameters.

B. Lifeform parameters.

C. Control parameters.

Each unit of the matrix represents a unit area in which development can occur. Further, the model structure is conditional; the model is not to simulate patterns of growth but to allow for maximized growth within the constraints of spatial equilibrium. This relationship can be expressed in a hierarchy of environmental influences contributing to the control of the growth potential of a matrix unit. These influences range from the sensitivity of "micro-environments," within a matrix unit, to the environmental trends surrounding the entire study area.

This information is developed into a set of exogeneous inputs, for each matrix unit, which represents a possible modification of the growth potential within that unit. These inputs reflect an attempt to structure the amount of environmental degradation by modifying the growth potential to better concur with the environmental capability of a cell to sustain such urban growth.

The spatial implication of the exogeneous inputs, when applied to the study area, represent a hypothetical thrust for urban growth that allows for effective environmental protection. The resultant of these procedures will be evaluated in terms of Planning, environment and human usage considerations. These should indicate that environmental degradation need not be an externality of urban growth.