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CARRYING CAPACITY AS A CONSTRAINT AFFECTING LAND USE

by

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CHAPTER I

INTRODUCTION

Carrying capacity is regarded as a constraint affecting land use. Carrying capacity refers to the ability of the natural and man-made systems of an area to support a certain intensity of use and activity.

Some areas such as floodplain, aquifer recharge area, or ecologically sensitive area are particularly vulnerable, sensitive, or hazardous for development. Man-made systems such as provision for water, provision for waste disposal, transportation systems and utilities etc. all have carrying capacity imposed by their design. Developing land without considering the carrying capacity of the natural and man-made systems of an area would result in environmental degradation or loss of non-renewable resources.

In evaluating the carrying capacity of these systems, human judgement is needed. People's vision of "a healthy, safe, and acceptable environment" varies with the existing technology, economy, life style and other cultural elements of a society. Carrying capacity is a flexible not static concept.

Some terms used in this report are defined in the following paragraphs.

A. Terminology

Environment

Environment is defined as the sum of all external conditions and influences affecting the life, development, and ultimately the survival of an organism.[1]

The term is meant to be interpreted broadly to include physical, social, cultural and aesthetic dimensions. Examples of environmental considerations are: air and its quality, water and its quality, erosion control, natural hazards, conservation of flora and fauna, overcrowding, scenic or natural beauty of an area, noise pollution, and highway congestion etc.[2]

Environmental Impact Statement (EIS)

A detailed statement setting forth the environment effects and considerations ancitipated by a proposed action, policy or project which has been determined to be "a major federal action significantly affecting the environment" under the provisions of the National Environmental Policy Act.[3]

Carrying Capacity

Carrying capacity was originally associated with ecosystems management. In land-use planning and growth management, the term can be defined as the ability of natural and man-made systems to support various uses without significant degradation or breakdown. The essence of the concept is that natural and man-made systems have only specific ability to support human uses, beyond which change--development, growth and/or

decline--would cause degradation of the environment or loss of non-renewable resources.

Natural Systems

Natural systems refer to those natural phenomena such as climate, air, hydrology, geology, soils, vegetation, wetlands, wildlife etc. which together form the natural environment. Emphasis, here, is put on those phenomena which may be related to land development and growth.

Man-made Systems

Man-made systems refer to those man-made elements which may be related to land development and growth. Examples of the man-made systems elements are: water mains, sewer lines, solid waste disposal systems, utilities, transportation network etc. Certain related services such as fire and police protection, education, and health care, etc. are also included.

B. Statement of the Problem

Carrying capacity has been an important concept in land use planning. The concept emerged due to the fact that different lands have different abilities to withstand varying types and intensities of uses. Without using the term "carrying capacity," architects, planners, landscape architects, and engineers had long since had the concept in minds as they managed land uses. Water pollution, soil erosion, and highway congestation are just some of the adverse effects which would appear if lands are managed without properly considering their

capacities.

Ian McHarg, in his book, Design with Nature, tried to determine what specific tracts of lands have to offer, what their limitations are, and where developments might best fit in. Many scholars and planners have applied the concept to land use in different ways. Measurement of land capacity ranged from subjective interpretations of natural resources inventories to complicated computer modeling.

The "carrying capacity" concept affects land use in ways of regulating land development and controlling growth. Hawaii, Vermont, and Florida are among some of the states which apply the concept to land use regulations. However, this concept has some limitations in practice. Technical, legal, and political problems may all limit its use to some extent.

C. Assumptions

There are three assumptions to this paper:

1. "Carrying capacity" is an intrinsic concept in any reasonable land use decision-making.
2. The concept is useful, but it has some limitations in application.
3. Due to environmental awaking, "carrying capacity" will play an increasing important role in land-use decision-making.

D. Scope and Method

A search of bibliographic materials has been conducted to study the concept of "carrying capacity." Relevant books, periodicals, papers, and legislation have been studied in such a manner as to show how the concept is related to land use, its applications, its limitations, and its future prospects etc.

Many scholars have defined the term, "carrying capacity," in different ways. Some restrict it to natural systems, and some expand it to include many social and economic factors. In fact, there has not been an universally accepted definition of the concept. In this report, the author is going to analyze the concept, only based on the definition which has been set in this chapter. The author is not intending to include all carrying capacity related issues in this report. Instead, he only addresses those important issues. Hopefully, through this report, we may have a better understanding of the concept of carrying capacity.

The study area is confined to the United States.

CHAPTER II

ENVIRONMENTAL CONCERN

A. Environmental Crisis

Some human activities produce enormous amount of pollutants. According to one statistician, the combined sources of pollutants annually discharged the following into the air of the United States in 1970:

100.7 million tons of carbon monoxide
33.4 million tons of sulphur oxides
22.1 million tons of nitrogen oxides
27.3 million tons of hydrocarbons
25.5 million tons of particulate matter

The yearly quantity of pollutants received by the atmosphere from the above sources totaled 209 million tons.

The magnitudes of the water pollution problem is even greater than air pollution in terms of estimated remedial cost, but is more difficult to measure. Types of pollution include the discharge of industrial wastes, municipal sewage, thermal pollution, drainage from mines, oil fields, and other areas high in chemical contaminants, feedlot pollution, agricultural wastes, sewage and wastes from water-craft, sedimentation and erosion from storm water drainage, and pollution from storm water runoff from urban watersheds.

The two largest sources of waste discharges are industrial waste and municipal sewage. It is estimated that in 1973, 24 percent of the U.S. population, totaling 47 million

people, were unsewered. Industrial waste represents about three times as much waste as is discharged by all persons served by domestic sewers. There are over 300,000 water-using factories in the United States, which discharge more than 51 separate polluting agents into the nation's water supplies.[1]

The pollution of the environment is a coast to coast phenomena. In some areas, the pollution has reached the crisis stage and threatens the safety, health, and morale of the residents. People must begin to think about measures to improve the situation. The movement for environmental improvement has grown in scope and intensity and is reflected at national and state levels in an increasing volume of legislation on air and water quality, solid waste management, highway beautification, and establishment of open space reserves, parks and wildlife and wilderness areas, etc. People are trying to remedy the defects accumulated by years of misuse of the environmental resources.

B. Federal Responses to the Environmental Crisis

The decade of the 1970's ushered in a wide range of federal legislation and new agencies to deal with problems of the environment. In the following paragraphs, we shall briefly describe the major federal legislation dealing with environment and the Environmental Protection Agency.

The National Environmental Policy Act (NEPA)

The National Environmental Policy Act marked the

beginning of a major new commitment of federal resources and policies to reduce pollution and to alter both public and private courses of action that had led to environmental degradation. The act requires that all agencies of the Federal Government shall prepare environmental impact statement (EIS) on all policies which they propose or actions which they take which will significantly effect the environment.[2]

Environmental Protection Agency

Approximately eleven months after NEPA was signed into law, on December 2, 1970, the Environmental Protection Agency was created. EPA is responsible for setting standards and regulations for air pollution, water quality (including ocean dumping), solid waste, noise, pesticides, and environmental radiation.[3]

The Clean Air Act of 1970

The Clean Air Act passed in 1970 requires the administration of the U.S. Environmental Protection Agency to establish national ambient air quality standards for six major air pollutants: carbon monoxide, particulates, hydrocarbons, sulfur oxides, nitrogen dioxide, and photochemical oxidents. These standards set the maximum concentration or concentrations of each pollutant to be allowed in ambient air - that is, in the air we breathe.[4]

The Federal Water Pollution Control Act Amendments of 1972

The 1972 amendments rejected the concept that certain waters can be remain severely degraded to permit industrial and other uses. As Senator Muskie put it, "Our

streams and rivers are no longer to be considered part of the waste treatment process." The key goal of the 1972 amendments is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Six National policies are set out as means by which this goal can be achieved.[5]

The Coastal Zone Management Act

The Coastal Zone Management Act of 1972 was passed by congress to encourage the coastal states to preserve and protect the resources of the coastal zone. Basically, it makes funds available to the state for the development and implementation of comprehensive land and water use control and management plans for their coastal areas.[6]

The National Flood Insurance Program

The National Flood Insurance Program contains requirements of great significance for land use control in floodplain areas. The program was established by the National Flood Insurance Act of 1968, under which federally subsidized flood insurance was made available to residents of communities which participate in the program. The subsequent Disaster Protection Act of 1973 increased both the benefits and sanctions of the program.[7]

The Wild and Scenic Rivers Act

The 1968 Congress passed the Wild and Scenic Rivers Act establishing the national policy:

> That certain selected rivers of the Nation, which with their immediate environments, possess out-

> standingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations.[8]

Ocean Dumping Controls and the Marine Protection Research and Sanctuaries Act of 1972

This water pollution control measures is intended to protect both U.S. controlled ocean waters and the high seas where the U.S. can exercise jurisdiction from pollutants dumped by ships. This law focuses on three major problems: regulation of dumping, research to discover the means for ending all ocean dumping, and the creation of marine sanctuaries.[9]

C. State Responses to the Environmental Crisis

Areas of Major State Concern

The range of state concerns for the environment are broad in scope. Areas of major state concern include the following eight:

1. Urban and suburban growth.
2. Rural settlement and conservation of quality agricultural lands and other natural resources.
3. Water and air pollution.
4. Pollution, brutalization, and scarring of the earth in mineral extraction processes.
5. Recreation and tourism impact.
6. Conservation of fragile environmental elements, including

coastal zones,wetlands, and alpine regions.

7. Activities that have a "larger than local" impact such as international airports, power plants, large reservoirs, and regional recreation facilities such as Disney World in Florida.
8. Other issues of special state concern include natural hazard areas, urbanization generators such as highway interchange areas,and mass or rapid transit corridors, and areas of historical, archeological, and natural scenic significance.

In addition to these types of activities, which require special attention in state and local planning, some states are confronted with unique environmentable problems of substantial magnitude. These problems have induced individual states to develop several types of state and local programs.

State Activities with Environmental Concern

The newest areas of state activity with environmental concern include the following:

1. Cooperative efforts with federal agencies in programs to abate air, water, and other environmental pollution.
2. Environmental impact assessment requirements for all state and private actions that significantly affect the environment.
3. Identification and protection by the state of areas of special environmental concern,such as coastal zones and

geologic hazard areas.

4. State involvement in issues that have a "larger than local concern" such as power plant sites and international airports.
5. State and regional land use planning, including growth controls and urbanization policies based on regional carrying capacity and urban suitability assessments.[10]

CHAPTER III

HOW CARRYING CAPACITY MAY AFFECT LAND USE

A. Carrying Capacity as a Planning Concept

The concern over environment brings attention to the concept of carrying capacity. The underlying theme of the concept is that natural and man-made systems have only specific ability to absorb human use, beyond which human activities would result in the degradation of the environment or loss of non-renewable resources. The concept is related to land use; it may either define the type, intensity, rate, and location of land development or set a limit on growth in an area, based on the area's carrying capacity. Any reasonable land use decision should not ignore the carrying capacity of the concerned area.

The notion of carrying capacity usually focuses on natural systems. However, man-made systems can not be excluded from the capacity study because both systems work together to support change: development, growth, and/or decline. A breakdown of either system may cause environmental degradation. Further more, the two systems are interrelated in a complicated way. The man-made systems may be altered to affect the capacity of the natural systems and they may also contribute to the degradation of the natural systems.

In the next two sections, we shall discuss how the carrying capacities of these two systems may affect land use.

B. Natural Systems Vis-A-Vis Land Use

Some human activities may hurt certain natural phenomena, while others may not. Even when they may not cause harm, nature still has its limit to sustain the intensity of that use. Bruce Hendler, in his book, Caring For the Land, identifies six environmental sensitive areas which should receive special attention. They include ecologically sensitive areas, hazardous areas, valuable natural resources areas, historic/scientific resources areas, recreational opportunities areas, and visual resources areas. These areas, due to their specific nature, are particularly vulnerable, sensitive, or hazardous to new development. We should set a limit on the developments from these areas, or at least set limit on the intensity of their uses.

As Bruch Hendler points out, lack of planning or overdevelopment along the coast or on an island may disrupt the freshwater/salt water balance of the water table. This leads to the contamination of the water supply to the residences and increases dangers of coastal flooding. Steeply sloped areas increase construction costs and are more likely to erode or slump when disturbed, thus causing loss or damage to development.[1] Development in major gullies is subject to periodic flooding. On steep slopes, the hazard is also great, since even on "good" soils, there is a danger of slumping in very wet times.[2] The list of misuse of land resources could be endless. Neglecting an area's carrying capacity will damage both the natural systems and human properties.

Ian McHarg matches eight natural phenomena with recommended land uses as follows:

1. Surface water and riparian lands

   Recommended land uses : Ports, harbors, marinas, water treatment plants, water-related industry, open space for industrial and housing use, agriculture, forestry, and recreation.

2. Marshes

   Recommended land uses: Recreation and aquatic food source

3. 50 year floodplains

   Recommended land uses : Ports, harbors, marinas, water treatment plants, water related and water-using industry, agriculture, forestry, recreation, institutional open space for housing.

4. Aquifers

   Recommended land uses : Agriculture, forestry, recreation, industry that does not produce toxic or offensive effluents, all land uses within limits set by percolation.

5. Aquifer recharge areas

   Recommended land uses : As aquifers

6. Prime agriculture lands

   Recommended land uses : Agriculture, forestry, open space for institutions, housing at 1 house per 25 acres.

7. Steep lands

   Recommended land uses : Forestry, recreation, housing at maximum density of 1 house per 25 acres, where wooded.

8. Forestry and woodlands

   Recommended land uses : Forestry, recreation, housing at densities not higher than 1 house per acre.[3]

Areas most suited for urbanization are determined separately for the two major components of urbanization : residential and commercial/industrial developments. For each of these, the most permissive factors are identified. These are:

1. Residential

   senic land features

   riparian land

   good bedrock formation

2. Commercial/industrial

   good soil foundations

   good bedrock foundations

   navigation channels

The most restrictive factors which are common to these developments are also identified:

   slopes

   forested areas

   poor soil drainage

   areas susceptible to erosion

   areas subject to erosion

The composite suitability for urbanization is arrived at by combining these factors.[4]

C. Man-made Systems Vis-A-Vis Land Use

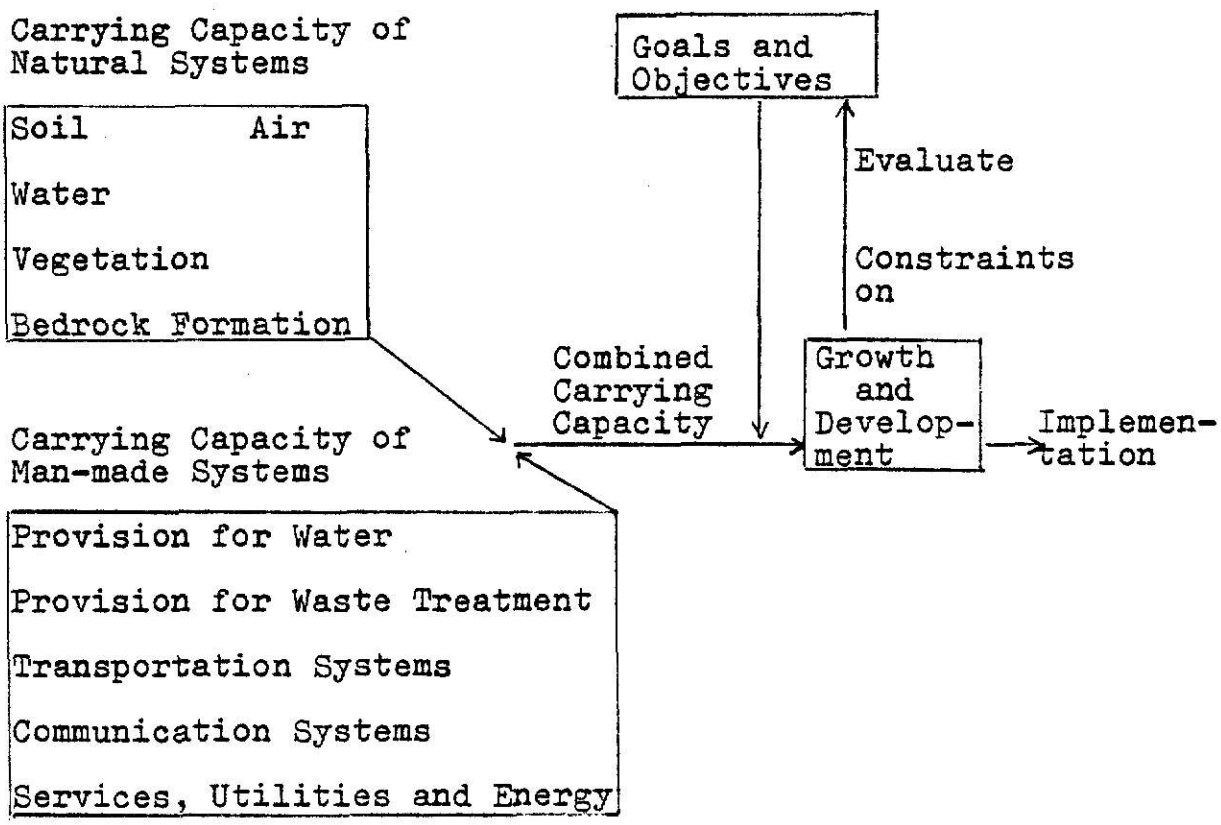
All man-made systems have capacities imposed by their design. Usually these capacities are converted into population equivalents. This will involve the use of estimates of per capita water consumption rates for water supply or per capita waste water or waste load generation rates for water quality. The population equivalent of each of these systems represents their respective capacities. The man-made systems would be overloaded if population in an area exceeds that equivalent given their current capacities. In other words, the current capacities of the man-made systems have imposed a limit on an area's population growth or the intensity of its land use. The current man-made systems may also direct the whereabouts of developments as the support of man-made systems are essential to all developments. The access to water, waste treatment, storm drainage, or transportation are the basic requirements for all developments. The required facilities and services could be expanded to include schools, health, police, fire, and cultural establishments,etc. They are all designed with certain capacities.

Certainly we may raise capacities of these man-made systems. But to do so is frequently expensive and time consuming. And the results of expansion may not always be rewarding. For example, the construction of a new freeway simply invites more traffic. It does not relieve the traffic congestion as expected. Beside traffic congestion, its expansion may also lead to further urban sprawl and increased air pollution.[5]

D. Conclusion

The natural systems and the man-made systems work together to support human activities and they interact with each other. Alteration of either systems may affect the another. So we should study the two systems together. When we talk about an area's carrying capacity, we mean the combined capacity of both the natural and man-made systems of the area. The combined carrying capacity of these systems may constrain an area's development and growth. Following is a figure to show the relationship.

Figure 1 Relationship Between Carrying Capacity and Growth and Development



The carrying capacity of an area does not necessarily restrict the area to a single type of land use. A variety of uses could be permitted to the area. For example, an area may be suitable for both residential and commercial, but may not be suitable for industrial use. In studying the Potomac River Basin, Ian McHarg used the term "optimum multiple land uses" to show the various compatible uses which could be permitted to an area.

He indicated that an area that had been shown to have a high potential for forestry would also be compatible with recreation, including wildlife management. Within it there might well be opportunities for limited agriculture-pasture in particular - while the whole area could be managed for water objectives. Yet in another example, an area that proffered an opportunity for agriculture as dominant use could also support recreation, some urbanization and limited exploitation of minerals. He used a matrix to show the various compatible uses which a unit of land may support. In every case the dominant or codominant are associated with minor compatible land uses. A place must be understood to be used and managed well.[6]

CHAPTER IV

WAYS TO APPLY THE CARRYING CAPACITY APPROACH

A. General Interpretation of the Concept

The concept of carrying capacity may be inserted in national and state legislation or local zoning ordinances in the form of goals and policies statement. They are mostly subjective interpretations about protecting the environment, the philosophical base of which is carrying capacity.

Title I of the National Environmental Policy Act of 1969 contains the following language:

> "The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high density urbanization, industrial expansion, resources exploitation, and new expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the Federal Government, in cooperation with state and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic and other requirements of present and future generations of Americans."[7]

Many states have adopted state environmental policies, most patterned after the National Environmental Policy Act. Most states follow the NEPA statue very closely. The bulk of the states have policy declarations which are substantially

identical with NEPA or follow the NEPA lead. Others appear to be less strong. The major thrust of the policy declaration is to ensure that agencies weigh environmental values in decision making.[2]

A community development plan might contain clauses of environmental concern in the goals and objective section to keep development from ecologically sensitive areas or hazard areas. These interpretations are subjective, and the results are unpredictable and unseen.

B. Preparation of Environmental Impact Statement (EIS)

Section 102 (C) of the National Environmental Policy Act (NEPA) of 1969 imposes the environmental impact statement requirement on "proposals for legislation and other major Federal actions significantly affecting the quality of the human environment."

The act requires all agencies of the Federal government shall "utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on man's environment."[3]

Eighteen states and the commonwealth of Puerto Rico had adopted some form of statutory environmental policy act by August 1974. In three additional states - Michigan, New Jersey, and Texas - the policy took the form of an

executive order. All eighteen states have an environmental impact statement (EIS) requirement as a part of their act. Most states follow the NEPA pattern and limit the EIS requirement to agencies of the state, without specifically defining whether this includes cities, counties, and other governmental subdivisions below the state level. Only the California, Massachusetts, and Washington acts specifically include local governments.[4]

The philosophical framework of an EIS is to provide Federal and state decision makers and the public with a complete understandable discussion of an activity's environmental issues. Decision makers should have full understanding of the environment's carrying capacity in dealing with EIS. The comprehensive nature of the EIS analysis provides a forum for people to balance all aspects of the impact of an activity so that a better decision can be made.

The content of EIS as delineated in the CEQ (Council on Environmental Quality) guidelines includes the following points:

I. A description of the proposed action;

II. The probable impact of the proposed action on the environment;

III. Any probable adverse environmental effects which can not be avoided should the proposed action be implemented;

IV. Alternatives to the proposed action;

V. The relationship between local short-term

uses of man's environment and the maintenance and enhancement of long term productivity;

VI. Any irreversible and irretrieveable commitments of resources which could be involved should the proposed action be implemented; and

VII. Where appropriate, a discussion of problems and objections raised by other Federal, State, and local agencies and private organizations and individuals in the review process and the disposition of issues involved.[5]

C. Arithmetic Calculation

This technique employs quantifible standards in an ordinance. Bucks County, Pennsylvania, followed this practice in "performance zoning," a model ordinance which has served as the basis for locally adopted zoning ordinance. Performance zoning is based on a county natural resources plan, and it contains open space ratios for specific natural resources. The heart of the Bucke County ordinance is a site capacity calculation geared to establishing the carrying capacity of any site.

Lane Kendig, in his article, "Carrying Capacity: How It Can Work For You" introduced this technique. The following example from the article demonstrates the step by step site analysis of site A.

1. Base Site Area

Certain portions of Site A are not usable for the activities proposed for the site. These are substracted from

the site area to determine base site area.

Table 1 Base Site Area

Take	site area		20.6 acres
Substract	unusable land*	-	.6 acres
Equals	Base Site Area		20.0 acres

*In this example, the unusable land contains land within ultimate right-of-way of existing roads, or utility rights-of-way or easement.

2. Resource Protection Land

All land within the base site area shall be mapped and measured for the purpose of determining the amount of open space needed to protect it.

Table 2 Resource Protection Land

Resource	Open Space Ratio	X	Acres of Land in Resource	=	Resource Protection Land (Acres in Resource x Open Space Ratio
Floodplain	1.00		.5		.5
Wetlands	1.00		.2		.2
Forest	.80		1.0		.8
Lake Shore	.70				
Steep Slope (15%)	.60				

Table 2 continued

Total Land with Resource Restriction	1.7	
Total Resource Protection Land		1.5

3. Recreation Land

There is a need for specific guidelines insuring that a minimum amount of land not restricted by step 1 or 2 above is retained for recreation purpose.

Table 3 Recreation Land

Take	Base site area	20.0 acres
Substract	Total land with resource restriction	- 1.7 acres
Equals	Total unrestricted land	= 18.3 acres
Multiple	Total unrestricted land by .2*	
Equals		= 3.66 acres

*The Planning Commission recommends that 20 percent (.2) of the buildable land (unrestricted land) be left as open space.

4. Determination of Site Capacity

Individual capacity is found by calculating net buildable site area.

Table 4 Determination of Site Capacity

Take	Resource Protection Land	1.5 acres
Add	Recreation land	+ 3.66 acres
Equals	Total open space	= 5.16 acres

Table 4 continued

Take	Base site area		20.0 acres
Multiply by	open space ratio*	x .4	
Equals	Minimum required open space	=	8.0 acres
Take	Base site area		20.0 acres
Substract	Total open space or minimum required open space, whichever is greater	-	8.0 acres
Equals	Net buildable site area	=	12.0 acres

* Each zoning district has minimum open space requirements as described in its zoning regulations. In this example, it is 40 percent (.4).

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5. Determination of Net density and Number of Dwelling Units

Having thus accounted for extreme carrying capacity limits of steep slopes and floodplains etc. then the carrying capacity of the example site of 12 net buildable area could be determined by closer examination of its soil, vegetation, bedrock, natural drainage and any existing man-made systems. This may result in differing maximum net densities, especially regarding the economics of man-made systems, in particular, changes in entire systems off-site such as water mains back to treatment plants or sewer mains to sewer treatment plants.

The man-made systems can be accommodated simply by modifying the density multiplier. It is also possible to calculate precise carrying capacities for roads and other utilities with the most limiting factors governing. Having considered all the related factors, the net density, in this example, was set at 2.4 dwelling units per acre.

Table 5 Determination of Number of Dwelling Units

Take	Net buildable site area		12.0 acres
Multiply	Net density	x	2.4
	(do not round up)	=	28.0 du/acres

In this form of capacity analysis, it is the developer's responsibility to survey his site and work out the calculations. Once the survey data are available, the calculations can be done in 10 or 15 minutes.[6]

D. Computer Modeling

More ambitious methods rely on computer models that describe natural and man-made systems. Comprehensive models, such as those developed for regional analysis of the South Florida Water Management District or the southeast sector of the Boston metropolitan area, attempt to bring together all the relevant aspects of the region's environment, land use and economic activity in search of factors that limit growth. Sector models, like those developed by Nassau and Suffolk Counties on Long Island, New York; and for Chambers County, Texas, single out a few critical environmental systems for detailed impact analysis.[7]

Here we briefly mention the approach adopted by Chambers County, Texas. This computer modeling approach to carrying capacity analysis and impact assessment was funded by

the National Science Foundation. The model can be used to assess the impacts of specific developments or to project the impacts of hypothetical development patterns for the area.

The environmental analysis is based on a natural systems inventory (including climate, hydrology, geology, soils, vegetation, wetlands, and wildlife) that statistically clusters together into environmental capability units those lands having similar environmental characteristics. Data are manipulated on the basis of a grid with 140 acre cells. Some data are represented by percentage present within cells. Data sources include hurricane studies, flood maps, geologic studies, soil surveys, Texas Water Development Board maps, U.S.G.S. maps. The land use data base is on a 10 acre grid cell. In addition to data on natural systems, data on agricultural activities, transportation, sewage treatment facilities, and recreation were also considered.

Computers are used to run the environmental impact assessment and for drawing maps. The system is designed to be used interactively with the user typing in characteristics of the proposed development. In the standard mode, the system asks questions and types out analyses in English, using a collection of built-in phrases and combination rules.

The model is transferable to other Gulf coast counties, and the basic structure is applicable in any geographic setting. Application to another Gulf Coast county might cost $50,000 - $100,000 for data collection.[8]

E. Interweaving Carrying Capacity into Land Use Planning Process

The concept of carrying capacity may be interwoven into just one step or several steps of the whole process. The procedure is shown as follows:

1. Interpret goals and objectives, addressing environmental concern.
2. Inventory natural and man-made system resources.
3. Analyze and synthesize inventory data, which will define carrying capacity.
4. Forecast population, employment, development, and other social/economic factors.
5. Convert these forecasts into demands for lands.
6. Project probable future land uses, based on projected demands.
7. Develop alternative land use plans, based on land development models, with carrying capacity as a constraint.
8. Draft environmental impact statement (EIS) for each alternative plan.
9. Evaluate each alternative plan along with its EIS.
10. Hold public hearings.
11. Make decision on plan, revise goals and objectives as necessary.

CHAPTER V

APPLICATIONS OF CARRYING CAPACITY APPROACH AT STATE, REGIONAL, AND LOCAL LEVELS

A. State Level

Traditionally, states have delegated land-use management power to localities through enabling legislations. For many years, states were reluctant to involve themselves in land-use matters or to interfere with the actions of local governments.

These circumstances have changed as many states regain their responsibilities regarding land-use problems and have passed legislation establishing statewide land-use programs or acts addressing particular issues.

The carrying capacity concept has been applied in land-use management in many states. Some states apply the concept directly, while others address environmental concern, the philosophical base of which is carrying capacity.

In the following paragraphs, we shall talk about several states whose land-use management measures are directly or indirectly related to the concept of carrying capacity.

Hawaii

Hawaii has the oldest and strongest land-use program in the nation having adopted statewide zoning in 1961. The prime motivation for this action was the desire to protect agricultural land, upon which the state's economy was based, from the effects of the booming growth that had begun in

Hawaii in the mid-1950's and was accelerated by the approval of statehood in 1959.[1] The state passed a Land Use Law in 1961. This law created a state Land Use Commission and directed it to divide the state into four districts: conservation, agricultural, rural, and urban. Urban district land is governed by county zoning regulations. Conservation districts are regulated by the State Department of Land and Natural Resources. Land in the agricultural and rural district is under the regulation of the State Land Use Commission, which also has the task of approving transfer of land from one classification to another.

In many respects the original Hawaiian approach is like a primitive carrying-capacity model. Agricultural districts were mapped on the basis of the information on the suitability of all islands for agriculture, provided by the Land Study Bureau of the University of Hawaii. Conservation districts include the state-owned forest and water reserves, mountainous areas of more than 20% slope, and a forty foot strip back from the shoreline around the entire coast. Urban districts include all presently built-up areas plus a reserve of land sufficient to accommodate urban growth for the next ten years.

In 1974, the state legislature passed a growth management resolution that turned to the carrying capacity approach. The state environmental agency was directed to prepare criteria for determining Hawaii's carrying capacity. The Central Oahu Planning Study estimated the holding capacity

of land based on four municipal services: water supply, sewage treatment, transportation, and schools, and demonstrated the costs to the public of five proposed land use alternatives. The Hawaii Environmental Simulation Laboratory estimated both the environmental and institutional carrying capacity of the Kaneohe Bay region, which promises some practical applications for policy making.[2]

Vermont

In response to the threat of invasion by large scale vacation home developers and land speculators, Vermont passed in 1970 one of the first statewide permit systems for large development. The Land Use and Development Act (Act No. 250) established a state environmental Board and eight District Commissions to issue permits for subdivision of ten or more lots and commercial and industrial developments over ten acres. In areas without local zoning (much of the state), developments over one acre require permits.

Before deciding on a permit application, the District Commission must find it to be consistent with the specific criteria, which directly relates to the carrying capacity concept.

The first four criteria are based on natural system's capacity (though that term is not explicitly used). The project must:

1. Not result in undue water or air pollution (considering elevation of the site, floodplains, soils and subsoils, slope, and the like);

2. Have sufficient water available;
3. Not cause an unreasonable burden on an existing water supply; and
4. Not cause unreasonable soil erosion or reduction in the capability of the land to hold water.

The next three criterias relate to man-made system's capacity. The project must:

5. Not cause unreasonable highway congestation
6. Not cause an unreasonable burden on a municipality's ability to provide educational services, and
7. Not place an unreasonable burden on the ability of the local government to provide municipal or governmental services.

Remaining criteria cover adverse effects on natural beauty and historic sites, and conformance to adopted state and local plans.[3]

Act 250 instituted a statewide program for the regulation of specified types of development and scheduled a three-stage planning program which was to culiminate in a state land-use plan.

The three-stage statewide planning process established by Act 250 called for the development and adoption of the following three plans:

1. An Interim Land Capacity Plan
2. A Land Capability and Development Plan
3. A Land Use Plan

The first of these plans were adopted in 1972. The

second plan was approved by the state legislative in April 1973, while the final plan has never made it through the Vermont legislative, failing in both 1974 and 1975. A number of reasons caused the failure. An important reason was that the downturn of the national economy and the impact of the energy crisis on the tourist industry have affected the climate of the opinion of the state, strengthening opposition to further restraints on development.[4]

Florida

In 1971, a severe drought occurred in south-eastern Florida. Scientific analysis of this experience identified its cause as the widespread destruction, through drainage, dredging, and filling,of the state's wetlands which are necessary for recharging the groundwater aquifer.[5]

In response to the crisis, the Florida Legislature enacted a series of acts. They include:

1. The Environmental Land and Water Management Act of 1972
2. The Land Conservation Act of 1972
3. The Water Resources Act of 1972
4. The Florida Comprehensive Planning Act of 1972

These acts together make up Florida's growth policy. The growth policy is relevant to carrying capacity in the following ways:

> The desired kind, rate and extent of growth shall be determined by the carrying capacity of natural and man-made systems of an area. Carrying capacity shall be based on availability of natural resources such as air, soils, water and space and may vary further depending on available energy, technology,

means of disposal and financial ability of an area.[6]

Maine

During the early 1970's, citizens of Maine perceived that development pressures were building to locate oil refineries and deepwater ports for supertankers along the scenic coast, as well as to construct large second-home subdivisions in the state. They realized that the absence of local controls left the state extremely vulnerable to these pressures. In an effort to protect the state environment, they initiated several programs to deal with the state's land use problem.

1. The Site Location of Development Act

Enacted in 1970, in response to the prospect of increased industrial development, this law requires that a permit be obtained for certain developments.

The act requires that the department's decision on permits must be governed by the following four criteria:

a. Financial capability

b. Traffic movement

c. No adverse effect on the natural environment

d. Soil suitability

2. The Maine Land Use Regulation Commission

The Main Land Use Regulation Commission was authorized in 1971 to develop land use controls for the state's unorganized areas, where no local governments existed. In 1975 the Commission submitted to the governor a plan in which 5 million acres of those lands would be classified for protec-

tion in their present wilderness state.

3. The Mantatory Shoreline Zoning and Subdivision Control Act

This act requires every municipality to adopt zoning and subdivision controls for all land that lies within 250 feet of any navigable pond, lake river, or saltwater body.

4. The State Register of Critical Areas Act

Enacted in 1974, this act provided $ 30,000 for the initiation of a state inventory of critical natural areas and important scenic, scientific, and historic areas. Once the area is designated, localities must develop plans to protect it within six months.

5. Protection of Coastal Wetlands

Since 1967 Maine has required that permits be obtained for alterations of coastal wetlands.[7]

The above mentioned acts were all motivated by the desire to protect the state's environments. The underlying concept for land use controls is an area's capability. In granting development permit, the Site Location of Development Act takes into consideration of both natural and man-made systems' capabilities. Maine does not have a single comprehensive statewide land use law, rather it resorts to strategically oriented piecemeal programs to achieve the purpose.

Many other states have actively pursued policies to protect their critical environment. In dealing with the environmental issues, they all refer to the concept of carrying capacity, either explicitly, or implicitly. It is

impossible to list them all in this report. Here we simply list some of the measures taken by those states to protect their environments. These measures include: protection of wetlands and shorelands, coastal zone management, floodplain controls, wild and scenic rivers, critical areas programs, fish and wildlife protection, protection of water resources, soil conservation, air pollution, solid waste management, noise pollution, state comprehensive planning,etc.[8]

B. Regional and State Level

It is worth mentioning some regional and local efforts to apply the carrying-capacity concept in land use management. Due to space limit, we only list one regional and one local example.

Lake Tahoe (region)

The Tahoe region stradles the California-Nevada border and was established by a bi-state compact. Soils in the region have great erosion potential. Local streams and the lake are extremely susceptible to damage from sedimentation and nutrients. Natural hazards endanger safety and property.[9] A land capability analysis was conducted in order to develop land development controls that would take into account the area's natural capability. The Tahoe Regional Planning Agency developed a Land Capability Map, a General Land Use Map, and a detailed implementing ordinance. Any

development must be screened through both maps, which are part of the ordinance. The Land Capability Map is based on the physical capacity of the land to tolerate development without undue damage. Seven general levels of land capability were defined according to frequency and magnitude of hazards to the ecological system. A wide range of scientific data was used to evaluate the risks associated with easily erodable soils, poorly drained soils, floods, landslides, high water table, and fragile flora and fauna.

The basin was divided into 22,000 units of 10 acres each. A land capability level was assigned to each unit, and so identified on the map. The degree of disturbance associated with each of the seven capability levels was expressed in terms of a percentage of impervious surface or coverage to be allowed. This was deemed the single most critical element related to the essential problems faced by the Tahoe basin, namely water quality degradation, flooding, and soil erosion. It was also considered "the most acurately measurable and constant expression of development impact." Thus the ordinance allows the coverage ranging from 1% for land classified as most sensitive (because of steep slopes or poor natural drainage, for example) to 30% for gently sloping foothills and the like.[10]

The Tahoe Regional Planning Agency ordinance was one of the first and best-known examples of basing land use regulations on assessments of the environmental carrying

capacity of the land.

Belle Isle (local)

Belle Isle is a small, new city on a barrier island connected by a causeway to the coast of a southern state under strong growth pressure. The city incorporated in early 1975,after the island residents had been repeatedly frustrated in their attempts to get the Commission of Boom County to adopt growth regulations that protected their unique natural environment.

Self-determination was considered necessary if more manageable limits were to be put on the rate, location, and amount of growth for Belle Isle. Under the county's intensive development zoning, some 30,000 dwellings could have been built on the island by allowing construction of condominiums on frontal dunes and conversion of wetlands to golf course subdivisions. Since there were only 4000 dwelling units on the island in 1975, and public facilities and environmental systems were already under pressure, the vision of development at full intensity was especially alarming to residents.

As soon as the new Belle Isle government took office, it declared a moratorium on new development and began to prepare a comprehensive land-use plan based on careful study of the natural and man-made system. The proposed plan expressed Belle Isle's major concern, to spell out the problems of protecting the health, safety, and welfare of present and future residents as they related to the fragile

and valuable natural systems of the island.

Three major types of policies were adopted. 1) Policies for growth thresholds; 2) Policies for protecting community health, safety, and welfare through management of natural and man-made systems; and 3) Policies for development regulation based on performance standards for ecological zones. In terms of the major policies related to growth issues, the island was viewed as a single, interrelated natural system. The plan was formerly adopted in 1976.

By mid 1976, only months after the Belle Isle plan was formerly approved, a suit was filed in circuit court by an owner of 400 acres of undeveloped land. The plaintiff alleged that the plan was without reasonable justification and violated his constitutional rights of due process, equal protection and it amounted to taking without just compensation. The circuit court ruled against the plaintiff and supported the plan.[11]

CHAPTER VI

POTENTIAL PROBLEMS WITH USING CARRYING CAPACITY APPROACH

A. Technical Problesm

The history of using carrying capacity as a land use management technique has not been very long. In many respects, the concept is still at an experimental stage, and inevitably, it has gone through a trial and error process.

The first potential problem with its use by professionals is a technical problem. There are no universally accepted standard ways of conducting the study. Measurement of capacities ranges from subjective interpretation to sophisticated computer modeling. Choosing of variables may greatly influence the reliability of the results and the use to which they can be put. People are suspicious of the correlations between the variables and the carrying capacity, not without reasons. People may always raise these questions: "How much is too much?" It is difficult to set a limit on an area's carrying capacity. People may have difficulty in justifying some performance standards of carrying capacity and population cap. In fact, the population cap set in Baca Raton, Florida can be challenged both on legal and on technical grounds.

The next technical problem is the cost. It could take large amount of the time to collect the basic data and to conduct the study. The Florida experience shows that it took an estimated 3,500 hours of staff time simply to handle the

designation of a critical area.[1] The staff needs are great. In the Chambers County, Texas study, the initial application and development of a carrying capacity model costs about $ 550,000, but transfer to another county would only be $ 50,000 to $ 100,000. Planning agencies with some computer capability or fully developed geographic data would probably find it less costly to use one of the models or to develop techniques for determining carrying capacity than agencies without these resources.[2]

There is also an institutional coordination problem. As we know, the ecological boundary is not always identical with the political boundary. In using this approach, we may have to cross the community's, county's, and even the state's boundary lines. So many political entities are involved that we may have to first overcome the institutional coordination problems before using the approach.

B. Legal Problems

When carrying capacity results are translated into growth control schemes, they are likely to run into resistance from legal challenges. The carrying capacity related growth control schemes have been challenged on grounds of violating the constitutional rights of equal protection, due process, and freedom to travel and that it amounts to taking without just compensation.

In the Golden vs planning Board of Town of Ramapo case, the special permit process which controlled growth according to adequacy of facilities and services was challenged as taking without just compensation.[3] The population cap set bu the city of Boca Raton, Florida was challenged as violating the constitutional rights of equal protection and due process.[4] In the famous Petaluma, California case, the growth control through annual building process was challenged on grounds of violating the right to travel and interfering with interstate commerce.[5] The Belle Isle Plan, designed to protect their unique natural environment was challenged on grounds of violating the constitutional rights of due process, equal protection and it amounts to taking without just compensation.[6]

In these cases, people questioned whether a community had the right to set the type, rate, location, and extent of growth in relation to its natural and man-made systems. Since American constitution protects individual rights, people would not hesitate to bring about legal action against any growth control measure which, they think, would hurt their interests. The testing place is the court. Professionals must be prepared to face possible challenge of this sort. The technical arguments for growth management and the attitude of judges toward growth control could play an important role in the final outcome.

C. Political Problems

Another problem associated with using the carrying capacity approach is a political problem. In applying the approach to land uses, we automatically put the environmental concern at the first priority. However, this is not necessarily true in many communities. Many interest groups are concerned with land uses. Developers, builders, residents, government officials, and planners, etc. may all differ in their view toward land use management. To some developers, the maximum economic benefit from the land is their first concern, while a healthy and safe environment could be a planner's major concern. A recent land-use policy of cities has been the encouragement of specific use in order to improve the fiscal condition of the local government. The advocates of the policy estimate the costs of the city and the revenues earned by the city by all possible uses and then gear zoning ordinances and capital improvement programs to encourage the fiscally most "profitable" uses. A financially troubled local government is easily inclined to adopt such an expedient land use approach. Local authorities tend to zone more land for commercial, industrial, and high density residential uses. Inevitably, this policy would lead to the confronation between the finance advocates and the environment advocates.[7] Furthermore, in some areas where lands are scarce, the development pressure would be great. To some people, environmental purity is just a luxurious thing. People often seem to care more for their

present housing than they worry about lung cancer twenty years from now.

So, it is apparent that many interest groups and many concerns are at stake in a land use decision. So long as the environment is not the sole concern in an area, we can not make a land use decision simply based on an area's carrying capacity.

CHAPTER VII

FUTURE PROSPECTS AND CONCLUSION

A. Toward a New Concept of Land

At the present, less than 20% of the land in the United States is relatively unscathed. The bulk of these areas are on the public lands, most of them in Alaska.[1] In some other areas, intensive human land uses have caused considerable degradation of the environment. Public health and safety are threatened as a result of it. It was the environmental concern which first brought into being the carrying capacity approach of land use control.

A new concept of land has emerged. Its new meaning is hard to define with precision, but it is not hard to illustrate the direction of the change. Basically, we are doing away from the 19th century idea that land's only function is to enable its owner to make money.[2] Land is a resource to be conserved, rather than a commodity for trading. The environment is a common belonging to all the people, where use is granted according to publicly set guidelines. This new attitude toward land provides the philosophical base for guiding land-uses according to its carrying capacity.

B. Overcoming the Problems

American citizens are entitled to the constitutional rights of equal protection, due process, and freedom

to travel, etc. Private interests may not be totally ignored in pursuit of public interests. The court has become the testing ground of the public interest vis-a-vis the private interests. The judges have to weigh the interests of the two in making the final decision. Before, the conservative judges were the stanch guardians of the private interest.However, they have been under great pressure in face of the public cry for a healthier and safer environment. We believe that, as a result of the environmental awakening, the future trend of the courts ruling on land uses would tend to favor more stringent public controls over land uses. The carrying capacity approach, along with other public land-use control measures, may foresee more court acceptance in the future.

Other problems mentioned in the previous chapter, such as costs, institutional coordination problems, and political problems,are not insurmountable and there is room for improvement. For instance, the U.S. Department of Interior has been developing the Resources and Land Information Program (RALI),which will coordinate and systematize huge amounts of land use data for a wide range of users, and remote sensing, using high attitude and space vehicles to provide astouding amounts of information on vegetation, soils, pollution, current land use, and land use classification. The assistance provided by RALI would greatly reduce the costs of carrying capacity study by some communities.[3]

In a democratic society, it is natural to see some of the political problems emerge. Negotiation is American

way of getting things done. Every interest should be represented and voiced. This is the essence of the so-called "advocacy planning." The final decision could be worked out through a negotiating process. Here again, we understand that "carrying capacity" is just one of the many constraints which might affect land use. The institutional coordination problem in using carrying capacity approach may also be worked out through joint efforts or some institutional innovations.

C. Role Played by the Planner

Now we may review the role which should be played by a planner in the carrying capacity approach. Apparently, a carrying capacity study would be a multidisciplinary one. A planner is not an expert in everything and he does not have to be one as such. A planner should be an organizer or a coordinator in a carrying capacity study.A carrying capacity study will provide a meeting ground for scientists, architects, planners, governmental officials, engineers, and private citizens,etc. In this sense, a planner is more a generalist than a specialist. He needs to have some general ideas of all the carrying capacities of the natural and man-made systems and he would see them from a planning perspective.

D. Conclusion

Carrying capacity is a promising planning tool. It provides an objective and equitable calculus for land use

decision. It tells the trade-off between the increment of development and the loading ability of the environment. Properly used, it can remove some of the arbitrariness from development regulations, and it can enable both public and private decision makers to predict the impacts of their plans on the natural and man-made systems. It broadens the horizons of planning to include supply as well as demand factors. It provides some scientific and objective determinants as the basis of land use management. Carrying capacity analysis offers more defensible foundations, not previously available in the planning field, for land use policy. A land use policy based on carrying capacity analysis will be more acceptable to the public.

David Godschalk has done an extensive research on numerous applications of carrying capacity analysis in the United States. After reviewing 28 plans and studies applying the carrying capacity at the state level, he was oonvinced that the bulk of the applications are sound and that the approach itself is reasonable and promising.[4]

The author firmly believes that the concept of carrying capacity will play an increasing important role in the planning field.

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APPENDIX A

LAND USE CONTROL TECHNIQUES

I. Zoning

1. Density Regulations
2. Use Regulations
3. Performance Standards
4. Other Zoning Methods of Use Control
   - The special use zone
   - The special use permit or conditional use
   - The floating zoning
5. Planned Unit Development
6. Neighborhood Standards
7. Other Types of Zoning Control
   - Miscellaneous controls
   - Special-purpose controls
   - Agriculture and forestry zones
   - Aesthetic and historic zoning
8. Nonconforming Uses
   - Nonconforming use of open land
   - Nonconforming signs, advertisements, and similar light structures
   - Nonconforming use of a nonconforming building
   - Nonconforming use of a building specially designed for that purpose
   - Building conforming as to use but not in conformance with dimensional or other requirements of a physical character

II. Subdivision Regulations

1. Development Standards
2. Programming Developments
3. Preservation of Open Space
4. Private Controls: Restrictive covenants

III. Fiscal Policies

1. Capital Improvement Programming
2. Special Assessments
3. Tax Policies Including Preferential Texation
4. Economic Growth and Employment Objectives
5. Cost-benefit Analysis

IV. Control of Environmental Degradation

1. Air and Water Quality Control
2. Surface and Subsurface Pollution Control
3. Solid Waste Management
4. Protection of Fragile Environmental Elements
5. Control of Critical Environmental Elements and Developments of Regional Impacts
6. Carrying Capacity as a Regulatory Tool

V. Urban Renewal

1. Slum Clearance and Urban Redevelopment
2. Urban Conservation and Rehabilitation

VI. Official Map

1. Existing and Future Streets
2. Existing and Future Facilities
3. Existing and Future Utilities

VII Comprehensive Code Programs

1. Zoning Codes

2. Housing Codes

3. Building Codes

4. Utility Construction Codes

VIII Comprehensive Planning

A community planning effort combining some of the above in a comprehensive program for growth and development based on predetermined values and goals.

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4. Moss Elaine, Land Use Controls in the United States (New York, The Dial Press, 1977) pp.339-340.

APPENDIX B

TECHNICAL ASSISTANCE SOURCE FOR ENVIRONMENTAL INFORMATION

Individuals

Planning and Design

- Landscape Architects
- Planners
- Architects

Soils

- Civil engineers
- Local plumbing inspectors
- Sanitary engineers: state and private
- Soil scientists: private or U.S. Department of Agriculture soil scientists are a principal source of much specific site information

Water Resources

- Geologists: state and private
- Sanitary or civil engineers: state, municipal, or private
- Local licensed plumbing inspectors

Woodlot Management

- Consulting foresters: state or private

Plant Materials

- Landscape Architects
- Nurserymen

Agencies

Septic Facilities

- Health department: for septic tanks and other onsite

disposal systems

- Environmental protection agency: For systems discharging into water
- State (and district) soil conservationist: For soil suitability relating to septic disposal

Soils

- State Soil and Water Conservation Commission; district offices of the U.S. Soil Conservation Service:

  These can usually be found in county seats. Besides being the principal source of soils information, they also help landowners develop individual land-use plans based on soils information and can help interpret information on maps and plans.

Water Resources

The U.S. Soil Conservation Service (listed above) helps landowners locate and engineer farm and wildlife ponds. State geological or water surveys can supply information on groundwater, especially wells.

Wildlife Habitat

- Departments of inland fisheries and game, regional fish and game biologists
- Fish and game clubs
- Audubon Society
- National Wildlife Federation
- Izaak Walton League

Marine Resources

- Departments of marine resources (may have extension agents)

Woodlot Management

State departments of conservation or natural resources may have foresters available to help planning agencies or landowners

General Conservation and Planning

These are all good sources of information on specific conservation practices and land use techniques:

- State Association of Conservation Commissioners (especially in New England and other northeast states)
- District conservationists; county soil and water conservation districts
- U.S. Department of Agriculture, Resource Conservation and Development projects (these are in selected areas of the country)

National Organizations

American Association of Nurserymen

230 South Building Washington D.C. 20005

American Forestry Association

1319 Eighteen Street N.W. Washington D.C. 20036

American Society of Landscape Architects

1900 M Street Washington D.C. 20036

American Society of Planning Officials

1313 East 60th Street, Chicago, IL 60637

American Shore and Beach Preservation Association

10 Rickenbacker Causeway, Miami, Fl. 33149

American Water Resources Association

206 East University Avenue, Urbana, IL 61801

American Water Works Association

2 Park Avenue, New York, N.Y. 10016

Izaak Walton League of America

1800 North Kent Street, Arlington, VA 22209

League of Woman Voters of the United States

1730 M Street, N.W. Washington, D.C. 22036

National Audubon Society

1130 Fifth Avenue, New York, NY 10028

National Water Well Association

Box 29168, Columbus, OH 43229

National Trust for Historic Preservation

748 Jackson Place N.W. Washington D.C. 20006

National Recreation and Parks Association

1700 Pennsylvanic Avenue, N.W. Washington D.C.20036

National Wildlife Foundation

1412 Sixteenth Street N.W. Washington D.C.20036

Soil Conservation Society of America

7517 Northeast Ankeny Road, Ankeny, IA 50021

Source: Bruce Hendler, Caring For the Land, (Boston, American Society of Planning Officials, 1977) pp. 88-89.

APPENDIX C

ENVIRONMENTAL IMPACT STATEMENT (EIS) PROCEDURE

1. Prepare planning grant application.
2. Collect, review, and categorize available data.
3. Decide on format of EIS and identify data gaps.
4. Prepare internal project work program based on identified data gaps.
5. Prepare the preliminary version of each EIS.
6. Circulate preliminary version of each EIS selected groups for informal review.
7. Prepare draft version of each EIS.
8. Submit each draft EIS to the State A-95 reviewing agency.
9. Prepare management strategies for public hearing on each project and synthesize responses to the A-95 review.
10. Conduct the public hearings.
11. Prepare hearing summary and responses to issues arising at each hearing.
12. Submission of draft EIS by the lead agency for review by other federal/state agencies.
13. Respond to comments made during federal/state review.
14. Submission of final EIS to the lead agency.

Source: Lee Kaiman, Environmental Impact Statement, (Boston, Environmental Design and Research Centre, 1974),pp.16-64

APPENDIX D

NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

Public Law 91-190

January 1, 1970
[S. 1075]

AN ACT

To establish a national policy for the environment, to provide for the establishment of a Council on Environmental Quality, and for other purposes.

National Environmental Policy Act of 1969.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "National Environmental Policy Act of 1969".

PURPOSE

SEC. 2. The purposes of this Act are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality.

TITLE I

DECLARATION OF NATIONAL ENVIRONMENTAL POLICY

Policies and goals.

SEC. 101. (a) The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

(b) In order to carry out the policy set forth in this Act, it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may—

(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

(2) assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;

(3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;

(4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice;

(5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and

(6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

(c) The Congress recognizes that each person should enjoy a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment.

Administration.

SEC. 102. The Congress authorizes and directs that, to the fullest extent possible: (1) the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act, and (2) all agencies of the Federal Government shall—

(A) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment;

(B) identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations;

(C) include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on—

(i) the environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Prior to making any detailed statement, the responsible Federal official shall consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved. Copies of such statement and the comments and views of the appropriate Federal, State, and local agencies, which are authorized to develop and enforce environmental standards, shall be made available to the President, the Council on Environmental Quality and to the public as provided by section 552 of title 5, United States Code, and shall accompany the proposal through the existing agency review processes;

Copies of statements, etc.; availability.

81 Stat. 54.

(D) study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources;

(E) recognize the worldwide and long-range character of environmental problems and, where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment;

(F) make available to States, counties, municipalities, institutions, and individuals, advice and information useful in restoring, maintaining, and enhancing the quality of the environment;

(G) initiate and utilize ecological information in the planning and development of resource-oriented projects; and

(H) assist the Council on Environmental Quality established by title II of this Act.

Policy review.

SEC. 103. All agencies of the Federal Government shall review their present statutory authority, administrative regulations, and current policies and procedures for the purpose of determining whether there are any deficiencies or inconsistencies therein which prohibit full compliance with the purposes and provisions of this Act and shall propose to the President not later than July 1, 1971, such measures as may be necessary to bring their authority and policies into conformity with the intent, purposes, and procedures set forth in this Act.

SEC. 104. Nothing in Section 102 or 103 shall in any way affect the specific statutory obligations of any Federal agency (1) to comply with criteria or standards of environmental quality, (2) to coordinate or consult with any other Federal or State agency, or (3) to act, or refrain from acting contingent upon the recommendations or certification of any other Federal or State agency.

SEC. 105. The policies and goals set forth in this Act are supplementary to those set forth in existing authorizations of Federal agencies.

TITLE II

COUNCIL ON ENVIRONMENTAL QUALITY

Report to Congress.

SEC. 201. The President shall transmit to the Congress annually beginning July 1, 1970, an Environmental Quality Report (hereinafter referred to as the "report") which shall set forth (1) the status and condition of the major natural, manmade, or altered environmental classes of the Nation, including, but not limited to, the air, the aquatic, including marine, estuarine, and fresh water, and the terrestrial environment, including, but not limited to, the forest, dryland, wetland, range, urban, suburban, and rural environment; (2) current and foreseeable trends in the quality, management and utilization of such environments and the effects of those trends on the social, economic, and other requirements of the Nation; (3) the adequacy of available natural resources for fulfilling human and economic requirements of the Nation in the light of expected population pressures; (4) a review of the programs and activities (including regulatory activities) of the Federal Government, the State and local governments, and nongovernmental entities or individuals, with particular reference to their effect on the environment and on the conservation, development and utilization of natural resources; and (5) a program for remedying the deficiencies of existing programs and activities, together with recommendations for legislation.

Council on Environmental Quality.

SEC. 202. There is created in the Executive Office of the President a Council on Environmental Quality (hereinafter referred to as the "Council"). The Council shall be composed of three members who shall be appointed by the President to serve at his pleasure, by and with the advice and consent of the Senate. The President shall designate one of the members of the Council to serve as Chairman. Each member shall be a person who, as a result of his training, experience, and attainments, is exceptionally well qualified to analyze and interpret environmental trends and information of all kinds; to appraise programs and activities of the Federal Government in the light of the policy set forth in title I of this Act; to be conscious of and responsive to the scientific, economic, social, esthetic, and cultural needs and interests of the Nation; and to formulate and recommend national policies to promote the improvement of the quality of the environment.

SEC. 203. The Council may employ such officers and employees as may be necessary to carry out its functions under this Act. In addition, the Council may employ and fix the compensation of such experts and consultants as may be necessary for the carrying out of its functions under this Act, in accordance with section 3109 of title 5, United States Code (but without regard to the last sentence thereof). 80 Stat. 416.

SEC. 204. It shall be the duty and function of the Council— Duties and functions.

(1) to assist and advise the President in the preparation of the Environmental Quality Report required by section 201;

(2) to gather timely and authoritative information concerning the conditions and trends in the quality of the environment both current and prospective, to analyze and interpret such information for the purpose of determining whether such conditions and trends are interfering, or are likely to interfere, with the achievement of the policy set forth in title I of this Act, and to compile and submit to the President studies relating to such conditions and trends;

(3) to review and appraise the various programs and activities of the Federal Government in the light of the policy set forth in title I of this Act for the purpose of determining the extent to which such programs and activities are contributing to the achievement of such policy, and to make recommendations to the President with respect thereto;

(4) to develop and recommend to the President national policies to foster and promote the improvement of environmental quality to meet the conservation, social, economic, health, and other requirements and goals of the Nation;

(5) to conduct investigations, studies, surveys, research, and analyses relating to ecological systems and environmental quality;

(6) to document and define changes in the natural environment, including the plant and animal systems, and to accumulate necessary data and other information for a continuing analysis of these changes or trends and an interpretation of their underlying causes;

(7) to report at least once each year to the President on the state and condition of the environment; and Report to President.

(8) to make and furnish such studies, reports thereon, and recommendations with respect to matters of policy and legislation as the President may request.

SEC. 205. In exercising its powers, functions, and duties under this Act, the Council shall—

(1) consult with the Citizens' Advisory Committee on Environmental Quality established by Executive Order numbered 11472, dated May 29, 1969, and with such representatives of science, industry, agriculture, labor, conservation organizations, State and local governments and other groups, as it deems advisable; and 16 USC 17k note.

(2) utilize, to the fullest extent possible, the services, facilities, and information (including statistical information) of public and private agencies and organizations, and individuals, in order that duplication of effort and expense may be avoided, thus assuring that the Council's activities will not unnecessarily overlap or conflict with similar activities authorized by law and performed by established agencies.

Tenure and compensation.

Post, p. 864.

SEC. 206. Members of the Council shall serve full time and the Chairman of the Council shall be compensated at the rate provided for Level II of the Executive Schedule Pay Rates (5 U.S.C. 5313). The other members of the Council shall be compensated at the rate provided for Level IV or the Executive Schedule Pay Rates (5 U.S.C. 5315).

Appropriations.

SEC. 207. There are authorized to be appropriated to carry out the provisions of this Act not to exceed $300,000 for fiscal year 1970, $700,000 for fiscal year 1971, and $1,000,000 for each fiscal year thereafter.

Approved January 1, 1970.

Source: U.S. Office of the Federal Register, National Archives and Record Service, "Public Law 91-190, National Environmental Policy Act of 1969" 1st Session, (Washington D.C., U.S. Government Printing Office, 1969) pp.852-855.

CARRYING CAPACITY AS A CONSTRAINT AFFECTING LAND USE

by

WILSON WU-CHUN CHANG

B.A., National Taiwan University, 1960

AN ABSTRACT OF A MASTER'S REPORT

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MASTER OF REGIONAL AND COMMUNITY PLANNING

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Modern people are faced with an increasing number of environmental problems. The pollution of air and water, the destruction of vegetation, the depletion of aquatic and terrestrial wildlife, and the overcrowding and traffic congestion in some areas have downgraded the environment where we live. They are widespread phenomena, and in some areas the problem has reached the crisis stage.

People begin to think about measures to improve the situation. The concern over environment brings attention to the concept of carrying capacity. In land use planning and growth management, carrying capacity can be defined as the ability of natural and man-made systems to support various uses without significant degradation or breakdown. The essence of the concept is that the natural and man-made systems have only specific ability to support human uses, beyond which change--development, growth and/or decline--would cause degradation of the environment or loss of nonrenewable resources.

Carrying capacity involves value judgement. It is not fixed once and for all but depends on the conditions of human society at any specific time and place. It has something to do with the existing technology, economy, life style, and other cultural elements of a society. Human judgement is needed to draw the line between a "safe" and "unsafe" and an "acceptable" and "unacceptable" environment.

The concept is related to land use; it may either

define the type, intensity, rate, and location of land development or set a limit on growth in an area.

The environmental movement starting in the 1960's has provided new vitality and greater dimensions to the concept. Many states have applied carrying capacity to land use management. Hawaii, Vermont, and Florida are among some of the states which have adopted the concept of carrying capacity in their land use management.

However, there are some potential problems with using the concept. Technical, legal, and political problems may all limit its use to some extent. Like many land use management techniques, it has gone through a trial and error process. As experience increases, the art of using the approach will improve, and it continues to be a promising land-use management tool.

Carrying capacity tells the trade-off between the increment of development and the loading ability of the environment. Carrying capacity analysis offers more defensible foundations, not previously available in the planning field, for land use policy. A land use policy based on carrying capacity analysis may be more acceptable to the public.

The author firmly believes that the concept of carrying capacity will play an increasing important role in the planning field.