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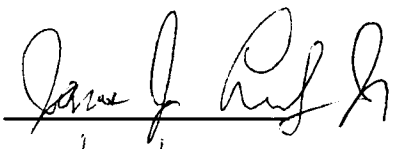
Signature 

Date 7/13/92

ENVIRONMENTAL ISSUES IN RAPID GROWTH AND DEVELOPMENT: THE CASE OF MADISON, ALABAMA

A Thesis

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Degree

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James J. Lumley, Jr.

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ABSTRACT

This study analyzed the environmental issues associated with rapidly growing communities. The research involved the use of data from Madison, Alabama, a small community undergoing intense development pressures from the expanding City of Huntsville. Since the community had very little environmental information available, the research identified the major issues by using interviews and data from previous research efforts. This compilation of data led to the development of alternatives that could be used to guide growth into areas that cause little environmental damage.

It was concluded that the city should attempt to mitigate problems concerning drainage patterns, groundwater supply and quality, and airport noise. It was also concluded that greater intergovernmental cooperation was necessary to achieve higher protection standards in the community.

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CHAPTER 1

INTRODUCTION

The management of growth is a pressing concern in many areas of the country. Improperly managed growth can lead to serious infrastructure problems, environmental deterioration, and ultimately, affect the health and welfare of the general public. Because of these factors, it is important for communities to develop and apply environmental protection techniques as part of a comprehensive planning program.

Although land development and environmental protection are often viewed as opposing concepts, ideally, they should share a common concern for development that does not render the environment less suitable for human habitation. This concept is of utmost importance in Madison, Alabama, a community experiencing the rapid growth and associated consequences mentioned above. Located west of the City of Huntsville, Madison was incorporated in 1869 and served as a marketplace for nearby cotton farmers until the late 1950's, when the Redstone Arsenal was reactivated and provided employment to some of the townspeople (Madison Sketch Development Plan, 1972, p. 2). The reactivation of the Arsenal paved the way for the boom in the space industry in Huntsville, causing the town of Madison to change from an agricultural community to a "bedroom" community for individuals working

in space-related industries outside the city limits. In fact, the population of Madison has grown from 4047 in 1980 to an estimated 18,000 in 1992.

This surge in population has led to the placement of numerous subdivision units throughout the city and has also resulted in commercial strip development. These new subdivisions and areas of development have placed a great strain on public services, causing water shortages, transportation difficulties, and planning and engineering problems. Although it is readily apparent that growth has simply outstripped the town's ability to provide services, there are ecological implications of increased development that are not as obvious.

The thesis is structured as a case study of the environmental issues associated with the rapid growth of the City of Madison. The identification, discussion, and mitigation of these ecological implications is the focus of the work. The study ultimately recommends specific strategies that could be used in a growth management program for the City of Madison. At the present time, however, no comprehensive documentation on the natural environment in Madison is available. Thus, the initial stage involves gathering and assessing existing data pertinent to the identification of the city's environmental issues.

The second step analyzes the natural environment in greater detail by using a variety of techniques borrowed from current literature. It is important to note that not all the environmental features will be subjected to further testing; in fact, to do so would be beyond the scope of this thesis. Only those aspects deemed critical to the ecological balance in the community will be discussed in greater detail.

The third component is the development of strategies that will aid in protecting the natural environment. These strategies are basically management guidelines based upon the analyses performed in stage 2. Again, the goal is not a comprehensive environmental policy for the City of Madison, but the identification of certain strategies that could be used in a growth management program.

It is important to note that the management guidelines are based upon economic and political as well as environmental interests. Madison's location makes it a prime area for new development, and halting all development for environmental reasons could cost the city economic development opportunities. Therefore, the balancing of environmental cost and economic benefit is of utmost importance during the formulation of protection strategies.

Research Questions

In order to perform the study, several research questions were addressed. The main research question is:

> What are the environmental issues related to growth and development in Madison, Alabama?

To explore this question, several subsidiary questions were posed. These questions dealt with the natural environment of Madison, the environmental assessment and management techniques described in the literature, and the current political and economic concerns in the city. The subsidiary questions are as follows:

1) What are the critical environmental areas in the City of Madison that need to be protected?

This question is necessary to point out the unique environmental features within the city. Groundwater recharge zones, the lands adjacent to the Huntsville/Madison Jetplex, and wetlands areas are environmentally sensitive regions deserving special attention. These areas have already been impacted by development pressures and will need greater protection if growth continues.

2) What are the major threats to the environmentally sensitive areas?

This question points out the factors that now endanger the critical areas in Madison. The groundwater recharge zones in the city have been affected by new subdivisions. In addition, several key recharge areas outside the city limits may face possible alteration, causing additional water problems for residents in Madison. These problems are addressed to ensure that high quality, adequate water supplies will be provided for all residents.

The lands adjacent to the Huntsville/Madison Jetplex, although primarily agricultural at present, are subject to noise pollution from incoming aircraft. Two noise impact contours were identified in a 1988 study by the city (City of Madison, Land Use Plan Amendment, 1988, p. 4). However, due to anticipated increases in operations at the airport, numerous other contours have been projected. These contours, as well as other aspects of airport planning, are an essential part of the development strategies to be discussed.

Finally, wetlands in the community have been eliminated or drastically altered in developing residential areas. Continued destruction of these productive areas will upset the ecological balance of the community. In addition, wetlands also serve as

sponges for excess surface water making them valuable mechanisms in flood damage protection. With this in mind, the continued alteration of wetlands and other critical lowland areas must be curtailed to preserve the natural environment of the community.

3) What are the barriers to environmental protection in the community?

4) Who are the major actors and what are their roles in environmental protection in the community?

5) How does environmental protection affect developers in the community?

These questions focus on how the political and economic climate of the community effects environmental protection. At present, there appears to be little political support to control growth in the community. In addition, there is no special interest group focusing on environmental issues in the area, and a full-time planner was only recently hired in late 1989. This scenario must be changed to bring environmental protection to the forefront of political debate surrounding future community development.

However, the economic costs of environmental controls are also a major part of this scenario. Developers, the main beneficiaries of Madison's recent growth, need to be included in the environmental debate to guarantee that protection strategies serve all segments of the community in a fair and equitable manner. In addition, the inclusion of developers throughout the process helps to ensure compliance if environmental controls are implemented.

6) What environmental protection measures have been developed and which could be applied to Madison?

This question provides an overview of the environmental protection techniques described in the literature to determine their applicability to the City of Madison. These comparisons will help to structure the alternative management approaches that will help Madison protect its critical environmental areas.

Methodology

A variety of research techniques were used during the study. Initially a scan of available literature was undertaken to gain insight into the forms of environmental assessment and protection. This review also included environmental data on the City of Madison collected from various agencies, road surveys and local officials. This process was necessary to assist in setting priorities for more intensive analysis and to identify the major issues without becoming involved in a detailed analysis of a particular problem area.

The second stage involved higher-level testing of those areas prioritized in the initial scan. Carrying capacity analysis and other matrix techniques were used to evaluate water issues, the airport noise zones, and the various floodplains and wetlands. This analysis makes up a major component of the study by detailing the characteristics of the issues, determining who or what is involved in each, and outlining how they can be mitigated or resolved. In addition, professors at the University of Tennessee and experts at the Oak Ridge National Laboratory were consulted for assistance in interpretation of technical data. The overall purpose is

to comprehensively document all facets of the issue to ensure that environmental management decisions are based on sound factual information.

Finally, the third stage is the development of management guidelines based upon the information gathered in the study, current zoning and subdivision regulations, and protection techniques used in other localities. By giving full consideration to the opinions and needs of local developers, public officials, and citizens, these guidelines were tailored to fit the unique political and economic climate of the area. These management guidelines will serve as the basis for future growth management activities in the City of Madison.

CHAPTER 2

TECHNIQUES FOR ENVIRONMENTAL PROTECTION

The trend toward environmental protection in this country began with the passage of the National Environmental Policy Act (NEPA) in 1969. Generally speaking, this Act required that detailed analyses of proposed federal actions must be prepared if these actions would significantly affect the quality of the environment. Although this Act only pertained to federal actions, some state and local governments began to enact similar requirements for both public and private projects.

However, the state of Alabama has not adopted stringent guidelines requiring the preparation of environmental impact statements or other types of assessments. In fact, environmental protection is simply one of the many components of the regional planning function performed by the various Councils of Government, the Tennessee Valley Authority, or other state and federal agencies. With this in mind, it is important that local governments throughout the state emphasize environmental factors in the local planning process.

To emphasize these environmental concerns, many local governments have experimented with a variety of environmental planning techniques. The techniques fall under three main categories: 1) initial assessment techniques, 2) techniques for further analysis, and 3) management and implementation strategies. Initial

assessment techniques are used in the first stages of the environmental management process. These techniques normally involve the classification and preliminary evaluation of environmental areas to help define the issues needing further study. The second category, techniques for further testing, is made up of quantitative scientific concepts that can be applied to environmental problems. These techniques are mainly used when an initial assessment is not enough to thoroughly evaluate a problem area. The third group, management and implementation strategies, is comprised of techniques that can be used by local governments to protect the threatened areas defined by the other two groups. This chapter will provide an overview of the techniques and strategies commonly found in these categories.

Initial Assessment Techniques

One of the more popular means for performing initial assessment of natural areas is discussed in "Classifying and Evaluating Unique Natural Areas for Planning Purposes" by Sargent and Brande. The authors develop a classification system for natural land areas using ratings by both scientists and planners. The first step in the system is to decide which areas should be reviewed. A natural scientist is employed to determine the important natural features, and to classify each area according to whether it is high (5) or low (1) in an array of selected characteristics (Sargent and Brande, 1979, p. 135). The sum of the ratings in those characteristics is the natural science rating. The first column in Table 1 displays an example natural science classification and evaluation sequence.

Table 1. An example of a natural area evaluation, rating sheet.

Area Name: _____
Location: _____
Reference Number: _____

Ownership: Private _____ Public UVM _____ Mixed _____

	I. Natural Science Rating		II. Planning Rating	
1.	**Area (in acres)**		**Recreation Uses**	
	1,000 and over	5__	5 or more	5__
	500 to 999	4__	4 uses	4__
	100 to 499	3__	3 uses	3__
	10 to 99	2__	2 uses	2__
	Under 10	1__	1 use	1__
2.	**Elevation Above MSL**		**Education/Research Uses**	
	2,500 feet and over	5__	5 or more	5__
	1,500 to 2,499	3__	4 uses	4__
	Under 1,499 feet	1__	3 uses	3__
			2 uses	2__
3.	**Frequency of Occurrence**		1 use	1__
	Rare	5__	**Integrity**	
	Infrequent	3__		
	Common	1__	Safe, 5 years or less	5__
			Safe, 5 to 10 years	3__
4.	**Diversity**		Safe, indefinitely	1__
	High	5__	**Management Status**	
	Average	3__		
	Low	1__	Mismanaged	5__
			Poorly or unmanaged	3__
5.	**Established Significance**		Well managed	1__
	National	5__	**Planning Status**	
	Southeast Regional	4__		
	State	3__	A federal plan	5__
	Substate Regional	2__	Southeast regional	4__
	Local	1__	A state plan	3__
			Substate regional	2__
6.	**Fragility**		Local	1__
			No plan or designation	0__
	High	5__		
	Medium	3__	**Natural Cycle Protection**	
	Low	1__		
			High	5__
			Medium	3__
			Low	1__
TOTAL:		__		__

Combined total (Natural Science Rating and Planning Rating) = __

Source: Frederick O. Sargent and Justin H. Brande. "Classifying and Evaluating Unique Natural Areas for Planning Purposes." Management and Control of Growth. Vol. 4, Washington, D.C.: The Urban Land Institute, 1979.

The second step in the classification process is the addition of a planning rating based on the judgements of local planners about the characteristics of the natural area. The planning rating is based on six categories that represent the assumed public interest in natural areas (Sargent and Brande, 1976, p.137). The second column of Table 1 is an example of a planning classification and evaluation sequence.

The composite rating is the combination of the natural science rating and the planning rating. The highest score possible is a 60 and the lowest score is 11. Obviously, the areas in any particular community that score the highest are those deserving of most immediate attention. However, that does not mean that less highly rated areas will go unprotected. The rating procedure is simply a guide for planners and decision-makers to decide where to act first (Sargent and Brande, 1976, p. 139).

In addition, the weighting of the factors on the rating sheet is subject to dispute. The authors respond to the question on two accounts. First, the system is not excessively sensitive to the weight of any single factor because 12 factors are involved in the combined rating. By doubling or halving the rating of any single factor, the index does not change much, and the relative priority of the area will not change significantly (Sargent and Brande, 1976, p. 139). Second, the weighing problem is not critical because the initial selection of the areas is done by natural scientists or engineers, and all areas identified are areas that, in their judgement, should be protected (Sargent and Brande, 1976, p. 139).

Finally, special areas such as airport environs or archaeological sites are not included in the rating system. These types of areas must be classified and rated by special groups, organizations, or interests for special purposes (Sargent and Brande, 1976, p. 139). This factor will be evident in the upcoming chapters when the Huntsville/Madison Jetplex is analyzed using information previously gathered by a special planning task force. However, as a starting point, this rating system is an inexpensive and easy way to initially classify environmental areas.

Another initial classification/evaluation system that has gained popularity in recent years is the use of an Environmental Review Team (ERT) to assess environmental features. An ERT consists of professionals from a wide range of disciplines within the fields of natural resources, engineering, and planning, and involves the cooperation among several agencies at various levels of government (Lucas, 1977, p. 122). For example, personnel from the participating agencies may include a district conservationist, soil scientist, engineering specialist, and biologist from the Soil Conservation Service; a climatologist/environmentalist and landscape architect from the Cooperative Extension Service of the U.S. Department of Agriculture; a geologist/hydrologist, forester, wildlife biologist, fish biologist, and recreation specialist from the State Department of Environmental Protection; a sanitarian from the State Department of Health; and a community planner from the regional planning agency (Lucas, 1977, p. 123). Table 2 describes the suggested activities of each of these reviewers.

Table 2. Suggested activities of reviewers, by discipline

Reviewer		Activities
Soil Scientist/ District Conservationist	1.	Prepare detailed soils map, including information on soil types, slopes and seasonal groundwater levels.
	2.	Identify special soil conditions such as wetlands, flood prone areas, and land with significant potential for agriculture.
	3.	Comment on suitability of soil conditions for various land uses, point out favorable and unfavorable conditions.
Geologist/Hydrologist	1.	Describe and summarize general surficial and bedrock geology, topography, physiography, and slope of site, including interesting or unusual features.
	2.	Identify any surficial, bedrock, mineral resources and topographic conditions which are of particular importance to urban uses and the design for urban land uses.
	3.	Describe and summarize water drainage and surface water quality, including special conditions such as flood prone areas and wetlands.
	4.	Briefly describe movement of groundwater through ground materials and groundwater level.
Engineering Specialist/ Sanitarian	1.	Describe and summarize special topographic, ground material, and drainage conditions which are of particular importance for general design.
	2.	If through-flowing streams exist on the site, summarize flow characteristics.
	3.	Describe erosion and sedimentation problems and any storm water management measures that may be necessary.
Forester	1.	Prepare general vegetation map of the site, summarizing major vegetation types, including vegetation types on any wetlands.
	2.	Identify and describe interesting, unusual, and valuable vegetation types or conditions.
	3.	Describe limiting conditions which determine the potential for design and maintenance of vegetative cover.

Source: William Lucas, "Connecticut's Environmental Review Team Program." Management and Control of Growth. Vol. 4. Washington, D.C.: The Urban Land Institute, 1979.

Table 2. (continued)

Reviewer		Activities
Fish and Wildlife Biologist	1.	Map and summarize major habitats, including evaluation of land and vegetation ability to support existing animal populations.
	2.	Identify and describe interesting, unusual, and valuable animal populations (land and water).
	3.	Summarize potential for maintaining animal populations and the effect of surrounding land uses on local populations.
	4.	Identify land or water areas which support management populations.
	5.	Comment on the potential for animal pests (insect or otherwise).
Climatologist/ Environmentalist	1.	Identify site conditions which determine local climate, including topography, vegetation, and surrounding conditions.
	2.	Comment on local air quality and conditions influencing it.
	3.	Comment on noise.
Landscape Architect	1.	Describe site and local area features and conditions which could or should be incorporated in land use design.
	2.	Comment on scenic and visual considerations relative to the visibility of the site or areas visible from the site.
Community Planner	1.	Review and summarize elements of the master plan and existing zoning which apply to the site.
	2.	Summarize surrounding land use and current use of site, pointing out considerations which should be considered in site design and use.
	3.	Summarize local transportation facilities, point out how these should influence site design and use.

Source: William Lucas, "Connecticut's Environmental Review Team Program."

The main function of the ERT is to present only factual information highlighting potential problems, limitations, opportunities, alternatives, and areas of possible tradeoff for particular developments (Lucas, 1977, p. 122). The review process includes five steps:

1) **Formal request from affected agency or developer.** This request includes written permission to enter the property, a location map, and a statement of intended use and areas of concern. The request must come from both parties to allow for cooperation in reaching the best solutions to problems.

2) **Preliminary site investigation.** This step is performed by the ERT coordinator (in Connecticut, team coordinators are based in the offices of the regional planning agencies), and the SCS district conservationist. The purpose of the investigation is to check the existence and quality of a detailed soils map, and to determine the necessary make-up of the team for the project.

3) **Actual review of the site.** This review consists of the team coordinator guiding the town officials, developer, and team members over the site. Following the field review, a summary meeting is held at the site to discuss the various aspects of the development, with consideration given to potential problems, means of prevention or corrections, alternatives, and possible trade-offs.

4) **Preparation of individual reports by team members.** Each team member follows a standard format, and comments on his/her area of expertise (Table 3). These reports are submitted to the coordinator who compiles the final report.

5) **Wrap-up meeting.** This final meeting is attended by the coordinator, town officials, and developer. The coordinator, along with appropriate team members, if necessary, summarizes the report, highlighting major concerns and opportunities. The purpose of the meeting is simply to clarify the information contained in the final report, leaving the necessary decisions to the local government (Lucas, 1977, p. 123).

However, there are certain factors to consider when adapting the ERT process to other areas. The main concern is cost, because each professional will have to be

Table 3. Example of an ERT review worksheet

Reviewer	_____	Location	_____
Discipline	_____	Date	_____

General Statement - (including description of site relative to the specific discipline of the reviewer.)

	Specific Items for Evaluation		Concerns
1.	**Water supply**		
	(A)	Municipal or community service in area	Ability to expand service, feasibility of transmission lines
	(B)	On-site	Availability of supply relative to need, quantity, and quality
2.	**Waste disposal**		
	(A)	Sewers	Ability to expand service, feasibility of transmission lines
	(B)	On-site	Septic System adequacy and host conditions
3.	**Foundation development and graded conditions**		Substratum support, drainage, slope, stability, erosion, and sedimentation
4.	**Roads and utilities**		
	(A)	Existing	Increased design capacity, feasibility of physical expansion
	(B)	Additional	Functional roads' needs, feasibility of construction
5.	**Hazards**		
	(A)	Natural	Identification of natural hazards
	(B)	Man induced	Avoidance of produced hazards
6.	**Aesthetics and preservation**		
	(A)	Forestry	Unique and fragile features, ecological habitats, historic sites, vistas, etc.
	(B)	Wildlife	
	(C)	Fish	
	(D)	Other	
7.	**Climate**		Existing or resulting microclimate, if appropriate
8.	**Services to support development**		Do proper services exist; can they be expanded or supplied by developer?
9.	**Compatibility of surrounding land uses**		Compatible development
10.	**Alternative land uses for area**		Best use for land relative to existing resources, priorities on uses of land

Time Spent on Review Field: _____ Report: _____ Total: _____

Source: William Lucas, "Connecticut's Environmental Review Team Program." Management and Control of Growth. Vol. 4, Washington, D.C.: The Urban Land Institute, 1979.

compensated for their time and effort spent on the review. For smaller towns or smaller projects, the present day cost factor could prohibit reviews in many cases.

In addition, the geographical area to be covered could prohibit the establishment of the Environmental Review Team concept. If a team member's traveling time to and from a site exceeds time spent at the site, it may not be possible to justify his involvement (Lucas, 1977, p. 127). For instance, it is not practical for a specialist from the Soil Conservation Service (SCS) district office in Auburn, Alabama to drive to Madison for every review. The composition of the team would therefore vary according to the geographical area to be covered and the availability of personnel.

A third form of initial assessment is espoused by Chavooshian, Nieswand, and Norman in "Growth Management Program: A New Planning Approach." This concept differs from the others in that particular sites for protection or development are not assessed or reviewed. Rather, the authors suggest the delineation of critical resource areas based solely on standards mandated by federal, state, or regional agencies. For instance, 50 percent of all prime agricultural lands, 100 percent of all floodplains, 80 percent of all wetlands, and 60 percent of all aquifer recharge areas could be established as resource protection standards. As a result, all data gathered during a natural resource inventory would be used to delineate these pre-determined districts within each locality (Chavooshian, 1979, p. 120). If less than 100 percent of a critical area is to be preserved, the selection of the preserved area should also be

based on land-use principles determined by the governing agency (Chavooshian, 1979, p. 120).

After determining the resource protection standards, the initial step in the Growth Management Program involves an inventory and analysis of the natural characteristics of an area. This inventory addresses basically the same features as those listed in Table 1 and used by Sargent and Brande. However, the inventory is performed with a specific goal in mind: to develop a growth management map displaying those standard natural protection areas. Furthermore, the authors also feel that consideration should be given to the techniques, devices, and administrative procedures necessary to ensure objective, standardized inventory procedures (Chavooshian, 1979, p. 119).

The second step is the creation of the growth management map that delineates the resource protection areas. Since natural areas do not adhere to municipal boundaries, it is recommended that consideration be given to regional delineation and allocation of certain critical areas (Chavooshian, 1979, p. 120). In addition, beyond the areas that are mandated to be preserved, attention should also be given to those areas that should be preserved, such as steep slopes, scenic landscapes, historic areas and sites, etc. (Chavooshian, 1979, p. 120). This will ensure a complete look at all environmentally-related factors in the community.

The third, fourth, and fifth steps of the GMP actually deal with higher-level testing and protection techniques. The use of carrying capacity, growth-management regulations, and transfer-of-development rights is advocated by the authors to round

out the program. However, the main thrust of the argument, the setting of standard procedures for assessment and delineation of critical areas, displays another perspective on initial assessment that deserves mention in this section.

The authors' assumption that regional cooperation will take place in this procedure should also be examined. It is well known that regional cooperation is difficult due to the territorial nature of local communities. If this obstacle can be overcome, a sound growth management program can be created. If not, the standards set by the governing agency will be challenged frequently in court.

Higher Level Testing Techniques

Impact assessment and carrying capacity analysis are the two most popular means of high-level environmental testing. Impact assessment attempts to predict all the environmental consequences that are likely to result from a particular action, whether or not they are benefits, constraints, or just changes (Marsh, 1978, p. 205). Carrying capacity, on the other hand, attempts to determine the amount of activity a natural area can support without suffering irreversible harm (Nieswand, 1979, p. 140). Both methods operate by using data and preliminary evaluations gathered in initial assessment to provide in-depth analyses of certain issues or to point out less obvious environmental problems.

Impact Assessment

Environmental impact assessment and its embodiment, the environmental impact statement, have become synonymous with the environmental movement in this country. Many times the production of an environmental impact statement is a

costly and time-consuming venture, preventing a smaller unit of government from undertaking the process. However, fundamental impact assessment procedures can be used to analyze issues without culminating in an environmental impact statement.

The preparation of impact assessments or impact statements is to make planning processes more responsive to other values and issues that might be affected by development actions (Andrews, 1973, p. 152). There are three principles that are critically important in an impact assessment procedure:

1. **Predictive process.** The first principle is that impact assessment is primarily a predictive process and not an inventory procedure or evaluative system. The context of impact assessment and impact statements is planning; and planning is inherently future-oriented, trying to forecast future trends and events and formulate proposals for actions to influence them. In this context, the function of an impact assessment is to provide reliable predictions of the significant differential impacts of alternative proposals.

2. **Resource functions.** The second principle is that the impact assessment deals with resource functions, not on physical characteristics for their own sakes. Thus, the impacts that are ultimately addressed in an impact assessment are those that affect social values, even if they occur initially in the form of changes in biological variables or ecological systems. What matters are the functions the resources perform in social and natural systems or that they have the potential to perform. The point of this principle is that the resources to be inventoried and analyzed in the impact assessment or statement should be chosen selectively and carefully in each case, because of the relationships to the maintenance and enhancement of important resource functions, not just because they appear on some standard checklist of environmental items or characteristics.

3. **Systems thinking.** The third principle is an outgrowth of the second. Development activities impact not only directly upon discrete characteristics and conditions but, more importantly, upon systems. The items on an initial environmental checklist interact, sometimes in complex and unforeseen ways, which may either magnify or neutralize the direct impact that is initially apparent. For this reason, impact assessments must include attempts to describe or model these systems

> of relationships, not simply offer discrete predictions of direct impacts on individual items (Andrews, 1973, pp. 152-154).

These three principles are a useful guide to determine what should be discussed in an impact assessment. However, there are some general concerns when using impact assessment. Since its focus is on predicting impacts, it requires information about environmental processes over time, not merely descriptive inventories of existing conditions, constraints, or opportunities. For environmental conditions that are highly stable and that have directly identifiable relationships with a proposed action, information of a more or less static nature (e.g., related toward composition rather than processes) on features such as soils and geology may provide an adequate basis for prediction (Marsh, 1978, p. 205). Impacts on more dynamic conditions and on more complex relationships, such as hydrological or ecological systems, may require different kinds of information, analysis, and interpretation (Marsh, 1978, p. 205). At the very least, analysis of such conditions usually necessitates identification and documentation of seasonal variations in the intensities of processes such as stream flow and water-table fluctuation (Marsh, 1978, p. 205). Therefore, different matrices would have to be created at various times of the year, or the accompanying text must describe the variations in impact over time.

Second, impact assessments frequently are intended to illuminate alternative action proposals, which would achieve certain common goals in ways that would have greater, less, or simply different impacts upon environmental conditions (Marsh, 1978, p. 206). If this is the case, the collection and analysis of environmental information must be done selectively, focusing on the significant differences among

the alternatives rather than upon the exhaustive description of one of them (Marsh, 1978, p. 206). The information must also be comparable for each alternative both in its form and in its accuracy and reliability, if it is to play a valid role in the choice of one action over another (Marsh, 1978, p. 206). Finally, it must be phased over time to parallel the choice process, saving enough resources to invest in resolving vital uncertainties in the middle and late stages of planning rather than spending them all at the beginning of a comprehensive inventory or at the end of an after-the-fact justification study (Marsh, 1978, p. 206).

Finally, impact assessment in practice has frequently suffered from a serious conflict between its logical purpose of predicting consequences and its actual purpose of satisfying legal or administrative requirements (Marsh, 1978, p. 206). As a logical approach to the application of environmental analysis, impact assessment offers an appropriate response, though one whose concepts and techniques are only slowly being worked out and agreed upon (Marsh, 1978, p. 206). As a practical matter, however, this approach has been created far too rapidly, principally due to legal and administrative documentation requirements enforced by the threat of lawsuits. Under these conditions, impact assessments have frequently been viewed as a necessary evil or political nuisance, rather than as a positive approach to environmental analysis and decision making (Marsh, 1978, p. 206). Accordingly, many impact assessments have failed in varying degrees to incorporate the consideration discussed above in that they have made excessive use of descriptive inventories, given little attention to predictive methods, dismissed alternatives without

careful scrutiny, and in many cases, have even been carried out after a decision on a proposed action has already been made (Marsh, 1978, p. 206).

Carrying Capacity

The concept of carrying capacity was originally associated with ecosystems management. It can loosely be defined as the maximum population density for a given species in an environment which could be supported without degradation of that environment. Planners have enlarged the definition to include the many variables inherent in man-made systems. Carrying capacity, as the term is generally used by planners, may be defined as the ability of a natural or man-made system to absorb population growth or physical development without significant degradation or breakdown.

Carrying capacity analysis, as a planning tool, studies the effects of growth- amount, type, location, quality - on the natural environment in order to identify critical thresholds beyond which public health, safety, or welfare will be threatened by serious environmental problems unless changes are made in public investment, governmental regulation, or human behavior. Certain assumptions underlie the use of this concept in planning:

1. **There are limits to the amount of growth and development the natural environment can absorb without threatening public health, welfare, and safety through environmental degradation.** Emphasis on the environment's ability to withstand development as a prime consideration in land use planning represents an important reversal in thinking about growth. Previously, the development community and much of the planning community had seen the job of land use planning as the accommodation of as much growth as possible. The new attitude grew out of the environmental movement of the late

sixties, and is one of the main premises of carrying capacity studies.

2. **Critical population thresholds can be identified beyond which continuation of growth or development at greater densities will trigger the deterioration of important natural resources such as water or air.** Definition of population thresholds or densities, which can be different for each resource considered, is the principal output of many carrying capacity analyses. These thresholds can be viewed as population caps, but more frequently they are used to indicate stages in a community's growth when important decisions about accommodating growth must be made. For example, in comparing population projections with a population threshold which would threaten a serious decline in water quality, planners can pinpoint the year(s) in which new wastewater treatment facilities may have to be built.

3. **The natural capacity of a resource to absorb growth is not fixed, but can be altered by human intervention.** The fact that local governments have the ability to affect carrying capacities through public investment in water and sewage treatment facilities, for example, is a very important point made by those who use the carrying capacity concept in planning. These planners point out that there are a number of ways of increasing the natural environment's capacity to support growth, such as new pollution control technology, land use regulations, investment in public facilities or services, or changes in human behavior. These kinds of adjustments can effectively reduce the impact of growth on critical resources such as water quality and thus expand a community's ability to accommodate growth.

4. **The determination of the limit of capacity of a given system is, finally, a judgmental act.** Although grounded in scientific and engineering principles, choice is still required to draw the line between a "safe" and an "unsafe" and an "acceptable" environment. A community, depending on its values, can respond in a number of ways to the threat of environmental degradation such as reduced water quality. For example, it can institute development controls to reduce non-point-source water pollution; it can expand sewer treatment facilities to bring water quality to a given level; it can aggressively pursue acquisition of potential water supply impoundment sites for future supply needs; it can redefine its criteria for water quality; or it can

> refuse to intervene at all and accept a certain amount of water quality degradation. Because of its origins in the natural sciences, the term carrying capacity suggests an objectivity and precision that is not warranted by its use in the planning community (Thomas, 1992).

Obviously, the notion of carrying capacity usually focuses on natural systems. One result of analyzing the effects of land development on natural systems is the institution of land use controls that restrict development in particularly fragile or important resource areas, like wetlands, and set performance standards and density controls in others. The purposes of these development regulations are to minimize adverse environmental impacts such as erosion or water pollution. The connection between the concept of carrying capacity and the resultant regulations is not always made, but the basic assumptions are the same.

One method of performing carrying capacity analysis is outlined by Nieswand and Pizor in "How to Apply Carrying Capacity Analysis." The authors feel that current planning capacity (or current carrying capacity) is determined by three factors- water supply, water quality, and air quality (Nieswand, 1979, p. 141). An estimate of current planning capacity is arrived at by determining the carrying capacity for each of the three components and then setting the minimum equal to the lowest or most restrictive of these. The process takes five steps:

1) **Delineation of the appropriate resource area.** This step is actually taken care of if an initial assessment is performed. Resources tend to follow either a natural distribution such as a watershed or the dictates of utility suppliers. A determination should also be made of the manner in which the resource enters the planning jurisdiction.

2) **Availability of the resource.** Each factor must be represented in terms of its quantity and quality. For water supplies this may involve a flow through a pipeline system, the safe yield of an aquifer, or an allocation from a reservoir. For water quality the pertinent considerations might include soil septic suitability, the capacity of a sewage treatment plant, or the assimilative capacity of a stream. For air quality these characteristics may take the form of permissible deterioration increments for specific air quality parameters such as sulfur dioxide and particulates.

3) **Conversion to population equivalent.** This step helps to facilitate a comparison on the limits of availability mentioned above. This will involve the use of estimates of per capita water consumption rates for water supply, per capita waste water or waste load generation rates for water quality, and per capita air pollution parameter generation rates for air quality. These estimates will vary substantially depending upon the amount and type of industrial contributions and even on the degree of affluence of the area residents.

4) **Selection of the lowest population equivalent.** This simply involves the determination of the most limiting current planning capacity factor as an estimate of the planning jurisdiction's gross current planning capacity.

5) **Comparison to existing demand.** This involves a comparison of this estimate of gross current planning capacity with the existing demand (population equivalents) represented in the community. This will provide an estimate of net assignable current planning capacity for planning purposes. If this number is very small or negative, then limits have been reached or exceeded, and planning should focus on ways of stabilizing growth or expanding capacity limits. If this number is positive, then the municipality has a store of excess capacity which can be allocated through planning (Nieswand, 1977, p. 141).

The following example illustrates the current planning capacity analysis procedure. This process will be used in the next chapter to determine the CPC in Madison for water supply and quality. Assume that we are dealing with a community covering an area of 50 square miles having a current population of 38,000 (Nieswand,

1977, p. 142). With respect to water supply, a single aquifer with an estimated safe yield of 0.120 million gallons per day serves the community (Nieswand, 1977, p. 142). Additionally, a portion of the community is serviced by a water purveyor under contractual obligation to supply three mgd from sources outside the community's boundaries (Nieswand, 1977, p. 142). The water consumption for the area is 150 gallons per capita per day (gpcd) (Nieswand, 1977, p. 142). Thus, assuming the entire aquifer yield is available, an estimate of current planning capacity based on water supply can be calculated as:

(50 square miles x 0.120 mgd)/150 gpcd	= 40,000
3 mgd/150 gpcd	= 20,000
Water Supply Current Planning Capacity Population Estimate	= 60,000

With respect to water quality, 15 square miles of the community is serviced by a regional treatment plant under contractual obligation to accept four mgd of waste water from the community (Nieswand, 1977, p. 143). The per capita waste water generation estimate for the area is 100 gpcd (Nieswand, 1977, p. 143). Of the remaining 30 square miles, 10 square miles (6,400 acres) have minimum lot size recommendations of one unit/acre for septic system use, 20 square miles (12,800 acres) have recommendations of 0.25 units/acre, and five square miles (3,200 acres) are floodplain and marsh with no use of septic systems permitted (Nieswand, 1977, p. 143). With a unit occupancy estimate of 3.5 persons/unit assumed, an estimate of current planning capacity based on water quality can be calculated as:

4 mgd/100 gpcd	= 40,000
(6,400 acres x 1 unit/acre)/3.5 persons/unit	= 22,000
(12,800) acres x 0.25 units/acre)/3.5 persons/unit	= 11,200
(3,200 acres x 0 units/acre)/3.5 persons/unit	= 0
Water Quality Current Planning Capacity Population Estimate	= 73,600

With respect to air quality, sulfur dioxide is the only air pollution parameter being used as a basis for control in the region, and a permissible deterioration increment of 400 tons/year has been allocated to the community (Nieswand, 1977, p. 143). This is in addition to existing sulfur dioxide emissions of 570 tons/year. The per capita sulfur dioxide emission rate for the area is estimated at 0.015 tons/year (Nieswand, 1977, p. 143). Thus, an estimate of CPC based on air quality can be calculated as:

400 tons/year x 0.015 tons/capita/year	= 26,700
570 tons/year x 0.015 tons/capita/year	= 38,000
Air Quality Current Planning Capacity Population Estimate	= 64,700

Therefore, the gross current planning capacity estimate for the community for planning purposes is 60,000 persons as represented by the most limiting CPC factor, and the net assignable CPC estimate is 22,000 persons, or the difference between gross planning capacity and the current population.

It can be seen in the above examples that carrying capacity analysis can help quantify environmental factors for planning purposes. This helps to provide specific input for zoning decisions, input for subdivision regulations, and targets for strategies for managing growth. It is important to note that carrying capacity analysis is used in tandem with current planning procedures such as zoning and subdivision

regulations, with its purpose being to help legitimize their characteristics. In addition, carrying capacity analysis cannot take place until an initial inventory or assessment is performed to provide data input into the formula.

Also, there are usually many variables involved about which different assumptions can be made. For example, in determining the population a community can absorb without experiencing a decline in water quality, a number of important assumptions were left out. The effects of growth in adjacent communities is not considered, changes in the patterns of effluent discharge (i.e. more or less industrial waste, etc.), or an expansion of the current sewage treatment plant is not considered. While the variability of these assumptions make the process technically difficult, this same variability is what makes the analysis an attractive tool for planning. Any number of trade-offs and alternatives can be defined by experimenting with ways to alter capacity estimates.

Management and Implementation Strategies

The strategy a local government pursues in implementing and monitoring environmental controls is possibly the most important aspect of an environmental analysis. Generally speaking, this step sets two opposing views about land use against each other: those of the landowner, and those of the local planning board. Everyone agrees to platitudes that call for the protection of natural resources, yet, if it is our own land on which development is severely limited, we evoke the rights of property owners with equal or greater vehemence. In an attempt to mediate this situation,

John Hysom summarized three criteria that should be used when considering the establishment of environmental controls:

1) Is the control legally permitted? In some cases, the question is whether control requires enabling legislation and if the existing state law permits that control. In other cases, the question is whether the courts would support the practice. Many writers in the field of land use controls believe that local governments could impose a number of additional controls which do not require enabling state legislation. This is especially true if the local government has an adequate and supportable comprehensive plan.

2) How well does it fit into a package of controls? The approach to selecting controls should be a "package" approach. After deciding what legal limits are imposed on the development of a control system, the [governing body] should carefully define the objectives and criteria for a complete control system, and the package of controls should meet these objectives and criteria completely. The controls must complement each other and fit together in such a way that few, if any, gaps exist and each control performs specific functions.

3) Is the control administratively feasible? The control or controls should not place impossible or unreasonable demands on landowners, nor should they require excessive staff review (Hysom, 1973).

These criteria can serve as a useful guide to selecting an environmental management program. However, as mentioned before, the myriad of approaches that have been used by local governments is endless. The following sections will describe some of the more common and effective techniques.

Zoning Controls

Zoning is the most common technique used to implement environmental as well as land use controls. In fact, zoning is the focal point of most efforts to control growth. Zoning can be applied to reduce the intensity of use in parcels of land, designate areas for low or high densities of use, and designate open space or

agricultural uses. Recently, different types of zoning have been developed to further enhance the implementation of environmental controls. These are described in detail below.

Conservation Zoning, sometimes called natural resource zoning, is primarily intended for conservation use, although agriculture is often permitted. The purpose of a conservation zone is to prevent the construction upon or alteration of rural or natural environments which have natural conditions of soil, slope, susceptibility to flooding or erosion, geological condition, vegetation or an interreaction between these areas which makes such lands unsuitable for urban development (Bert, 1974, p. 345). These zones are also commonly used by local governments to protect open space and provide recreational opportunities.

Development District Zoning. Rather than divide land into traditional zoning districts, even though certain areas may not be developed for some time, an alternative is to divide land into development zones, based upon its readiness for development (Bert, 1974, p. 345). The primary aim of development district zoning is to prevent scattered development and urban sprawl while not discouraging development in general (Bert, 1974, p. 345). This can be accomplished by sequencing capital and service improvements in coordination with defined development zones (Bert, 1974, p. 346).

Planned Unit Development. Planned Unit Development is essentially an overall density restriction on a particular site. Developers have flexibility in

designing the site as long as the density restriction and other requirements for improvement are met (Bert, 1974, p. 346). This flexibility offers the potential for promoting environmental quality since development may be clustered and sensitive areas retained as open space (Bert, 1974, p. 346). Most planned unit development ordinances require the submission of a site plan as a prerequisite to approval (Bert, 1974, p. 346). Through site plan review, assurance can be made that the most optimum site design has been achieved (Bert, 1974, p. 346).

Zoning-Related Environmental Controls. These types of controls are actually special provisions for airport noise zones, floodplains, steep slopes, etc. While these controls may or may not be included in the local zoning ordinance, they nevertheless serve as additional restrictions on activities carried out under the ordinance (Bert, 1974, p. 346). They also may take the form of "floating zones" or "overlay districts" that allow development at presently zoned densities but add development controls to minimize the negative effects of the development (Bert, 1974, p. 346). For example, the airport noise influence zone in western Madison allows development within the prescribed limitations imposed by the zoning ordinance. However, depending upon the decibel level found in areas within the noise zone, noise abatement techniques such as special windows or sound proof walls may be required.

Subdivision Regulations

Subdivision regulations are the most commonly used environmental control device next to zoning. Conventional subdivision regulations are used to control the process of converting raw land into building sites (Einsweiler, 1977, p. 295). They provide the capability to ensure adequate public improvements; to enforce certain lot size, set back, and similar provisions in the zoning ordinances; to assure purchasers of developable, drained lots; and to enable the local government to coordinate the work of adjacent, separate developers (Einsweiler, 1977, p. 295).

Subdivision regulations have become more environmentally related in recent years because of the capability to require developers to dedicate land, money, or improvements to meet the needs generated by the new development. The mandatory dedication of land or capital facilities is most commonly used in relation to park lands, has now been extended to the dedication of other support facilities such as sewers, water, roads, and even schools (Einsweiler, 1977, p. 296). This requirement is to provide facilities which are needed to support the proposed housing even though that need is met off-site (Einsweiler, 1977, p. 296). Thus, the new development must show that it pays for the totality of the service or environmental impact it creates as a condition for plat approval.

Subdivision regulations that require the dedication of money enables greater flexibility in the event that a good park site, for example, is not available on the land owned by the developer (Einsweiler, 1977, p. 296). In the event that the development site is too small to warrant the donation of an adequate size park, the

money can be aggregated and a larger and properly located facility acquired (Einsweiler, 1977, p. 296). Many times, the dedications of land, money, or facilities have been combined with an official map or open-space plan to ensure for the public that the dedications occur where they are most needed, and to provide assurance to the developer that his contributions are going to facilities supportive of his development (Einsweiler, 1977, p. 296).

It needs to be noted that while zoning and subdivision regulations are the most common and easily applicable environmental management tools, there are other more restrictive, tougher types of controls. Although the abundance of different types and variations of these controls is too numerous to mention, two types, special preservation districts and resource management districts, will be mentioned here because they will be applied to Madison in upcoming chapters.

Special Preservation Districts

Special preservation districts are essentially a strict form of conservation zoning. Whereas conservation zones many times allow particular uses as long as performance criteria or minimum limits of protection are assumed, special preservation districts disallow certain uses with absolutely no exceptions. Special preservation districts can act as overlay zones or as stand alone mini-zones within a current zoning classification. Within these areas all development is essentially halted.

A current example of the use of special preservation districts is in the wetlands policy used by federal and state governments to protect salt and freshwater marshes and other similar areas. It has long been known that these areas provide

breeding grounds for many species of plants and animals, and a reduction in this type of habitat could result in a drastic decline in types of species and also upset the local food chains. The federal government has mandated that certain areas be preserved in their current state, or expanded upon to increase habitat, to protect these fragile areas from destruction. Under the auspices of the Army Corps of Engineers, and most recently the Environmental Protection Agency, these areas are being policed and special permits are required for development.

State governments have also taken the lead in preserving these types of areas. California, Florida, New Jersey, and Wisconsin have strict legislation that covers areas not covered by the federal legislation. These programs mainly involve the use of special commissions (i.e. The San Francisco Bay Commission) to oversee all activity within the wetland region. The commissions take a regional approach to preservation as well; by studying farming practices miles inland, the effects of agricultural spraying and runoff are taken into account. All factors are considered from both the federal and state standpoint to protect or improve upon a particular resource.

Special preservation districts can easily be applied to local government practice. The districts can be effectively used as a stop-gap measure by placing a moratorium on development while a particular zoning classification is being reviewed. For instance, an overlay district could be proposed for wetlands protection in a high-growth single-family residential classification. A special preservation district could be created while a study is performed to determine the amount of the resource

that needs to be protected. If sufficient evidence is found to allow development within certain guidelines, a conservation zone can be established. However, if serious environmental degradation has or could occur, a permanent preservation district can be established.

Resource Management Districts

Resource Management Districts are similar to preservation districts in that they address development issues from a natural resource limitations standpoint. However, RMD's do not protect resources by halting or curbing development like preservation districts; these districts take information gathered in carrying capacity studies and create a "density matrix" to determine the proper holding capacity for a particular region (Table 4). These matrices provide the backbone for a formal and systematic review process to evaluate development proposals within specified areas, and to insure that basic resources are conserved and utilized in an effective manner (Woolfe, 1977, p. 129).

The underlying philosophy of this approach is that "low" or any density designation could, in most cases, not be defined as a single figure for a specific area (Woolfe, 1977, p. 129). Instead, a range of figures could be appropriate based on the myriad of environmental characteristics that occur in a particular geographic area. For example, the matrix used in this example was created to support the open space/conservation element of the comprehensive plan in San Mateo County, California. This matrix contains all the environmental land characteristics that are crucial to the conservation of resources and open space in the county. Each

Table 4. Resource Management District Density Matrix Worksheet

Land Characteristics		Highest Permitted Residential Density for Acreage with Stated Credentials				Number of Acres	Accumulated Dwelling Units
(to be run through in sequence)		1 Unit per 40 acres	1 Unit per 20 acres	1 Unit per 10 acres	1 Unit per 5 acres		
1.	Land located within primary channel of 100 year flood plain	X*				100	2.50
2.	Land relatively inaccessible (greater than one mile from all weather roads or from level topography well served by public roads)	X				150	3.75
3.	Land under agricultural preserve contract	X					
4.	Land within special agricultural district on coastal terrace	X					
5.	Land in areas defined by USGS as having severe slope instability	X				150	3.75
6.	Land within rift zone of active fault	X				100	2.50
7.	Land with slope equal to or greater than 50%	X				150	3.75
8.	Land with slope equal to or greater than 30% but less than 50%		X			75	3.75
9.	Land with slope equal to or greater than 15% but less than 30%			X		125	12.50
10.	Land within adopted state scenic highways corridor			X			
11.	Land containing class I and II soils or class III soils rated good for artichokes or brussel sprouts within climatic restraint line			X			
12.	Residual after lands falling under above categories have been eliminated				X	150	30.00
				TOTAL		1,000	62.50
				BONUS CREDIT			12.50
				GRAND TOTAL			75.00

* Accumulates density at one dwelling unit per 40 acres to be allocated to buildable areas elsewhere on site.

Source: Donald A. Woolfe, "Resource Management District in San Mateo County," Management and Control of Growth. Vol. 4. Washington, D.C.: The Urban Land Institute, 1979.

characteristic represents a constraint on density and the sum total of these constraints determines the total density (holding capacity) for the RMD (Woolfe, 1977, pp. 131-132). To construct the matrix the following steps are necessary:

1. Site acreage which corresponds to the land characteristics is listed. Any segment of land which falls under one of the characteristics is removed from consideration when considering its characteristics. If several factors apply, the most restrictive characteristic establishes density.

2. The number of acres not conforming to characteristics are listed as residual.

3. The appropriate dwelling unit to area density for each characteristic is multiplied by the number of acres calculated for that characteristic and this whole or fractional sum is entered as "accumulated units."

4. Total dwelling units is determined by summing all accumulated units permitted.

5. Any specific development proposal is further examined to determine if clustering will leave at least 80% of the contiguous site in permanent open space, if the proposal will fulfill significant policies and criteria of the county's housing element, or if unique architectural or energy saving design has been proposed. If so, a density bonus of up to 20% may be granted (Woolfe, 1977, p. 132).

The calculated totals on the worksheet show the total amount of units permitted in the entire RMD, while the accumulated units totals display the number of units allowable in each land category. It is important to note that this district allows the clustering option which promotes increased environmental sensitivity by using planned unit developments within an already reduced density region.

This approach can be of extreme benefit when a locality has a large amount of sensitive land to protect. The RMD in San Mateo County has now become an ordinance in itself, replacing antiquated agricultural and open space zoning. All

development proposals for areas in the RMD are subjected to the applicable performance criteria on the worksheet. Thus, the approach can enhance planning decision-making by providing a rational problem-solving framework for resource management issues.

Citizen Participation

Citizen participation is necessary if any growth management or environmental protection program is to be successful in any community. Although citizen involvement may take many different forms, it is mainly used to help enforce and implement community-wide regulations. However, to develop a sound community participation program, citizens should be involved from the beginning of a project or study through its conclusion. The following model, adapted from the Journal of Urban Ecology, details the necessary components of a sound community participation program.

1) The objectives of community participation are the selection of:

   a) technologies or ordinances which are acceptable to the community, and which offer the benefits they consider important at a cost they can afford

   b) technologies or ordinances which can be operated and maintained by the local community with minimum input from outside agencies; and

   c) alternatives that offer the greatest amount of consensus in the community.

2) The scope of the program must include:

   a) identification of formal and informal community leadership and communication channels;

b) determination of existing practices and the community's attitudes towards them;

c) determination of the community's willingness to pay for desired improvements through cash contributions, labor, or other involvement; and

d) organization and execution of any agreed citizen input

3) Five tasks can be identified as the minimum for a community participation program to be successfully implemented:

a) unstructured interviews with community leadership and a limited number of citizens to identify user attitudes and preferences;

b) design and testing of a questionnaire for structured interviews;

c) structured interviews with a representative number of households;

d) organization between project or study leaders to execute the work;

e) continued operating, maintenance, or monitoring activities (Hengveld, et al., 1982, pp. 72-74).

With residents coming from all over the country to work in high-tech industries, the City of Madison could use this type of model to develop consensus within the community in regards to growth management or public works improvements. In this way, the community participation program could not only serve to help define environmental protection and growth guidance for the community, but allow residents to provide input directly into the decision making process.

The literature presented in this chapter is only a cross-section of the techniques used in environmental planning and management. No particular

technique is more correct or superior than another. The upcoming chapters will use elements of each category to enhance the understanding of Madison's natural environment. Chapter 3 will use initial assessment and high-level testing techniques to outline and analyze environmental issues in the community. Chapter 4 will use the different management and implementation strategies to develop alternatives for preserving critical environmental features. The main point is that each particular method has considerable merit, and with an ample amount of time and effort, each could contribute vitally to an environmental or growth management program.

CHAPTER 3

ENVIRONMENTAL ISSUES IN MADISON

Until about 1980, the natural environment of Madison was primarily rural and agricultural. Rolling farmlands dominated the countryside, with dense patches of woodland located along streambeds and around Rainbow Mountain. However, the drastic population increases of the past ten years have caused the emergence of some critical environmental issues. These issues have emerged so rapidly that previous environmental data on the area has been rendered obsolete. This chapter will present an initial assessment of the current environmental conditions in Madison, outline the critical environmental issues in the community, and test and analyze some of the available data. This process will provide the primer for future planning and engineering activities in the city.

The environmental components of Madison are divided into three sections for the purpose of analysis. The first section will look at the properties and characteristics of the local environment such as geologic associations, soils, woodlands, prime agricultural lands, climate, and open space. The second will look at surface and groundwater resources, including streams, ponds, wetlands, floodplains, and aquifers. Finally a third section will look at the airport planning zone to highlight the unique impact this areas has on the environmental situation in Madison.

Geology

Topography and Slope

The City of Madison lies entirely in the Highland Rim section of the Interior Low Plateaus. Elevations in Madison range from approximately 570 feet above sea level at Lady Ann Lake in the southeast portion of the city to 1150 feet above sea level on Rainbow Mountain in the northeast section. The gently rolling terrain, with slopes ranging from 1% to 10% is generally compatible for all land uses. However, there are a few areas containing slopes less than 1% or greater than 25%, and those areas pose natural constraints on land use. Slopes less than 1% restrict land use in that poor drainage conditions usually occur in these areas, while slopes greater than 25% severely limit land use, especially construction, because of the severity of the slope (Geological Survey of Alabama, 1975, p. 7).

Bedrock and Surface Geology

The rock formations in Madison are sedimentary in origin and were formed by the accumulation of fragments of previously existing rocks, by the accumulation of organic remains, or by chemical precipitation (Geological Survey of Alabama, 1975, p. 7). The principal rock types are shale, sandstone, limestone, and chert.

If analyzed cross-sectionally, the bottommost layer of bedrock is the Chattanooga Shale. This formation is made up of clay, mud, and silt and has a finely stratified or laminated structure, making it virtually impermeable to water. Because there is little likelihood of obtaining significant amounts of groundwater below the shale, it is an important indicator during groundwater exploration.

The shale is overlain by Fort Payne Chert in the western portions of the city. This formation is actually the reconsolidation of weathered limestone combined with small amounts of magnesium carbonate (Geological Survey of Alabama, 1975, p. 10). However, most of this formation within the city is not bedrock at all, and occurs as unconsolidated material on top of the Chattanooga Shale.

Tuscombia Limestone is prevalent in the eastern two-thirds of the city, excluding Rainbow Mountain. This limestone, formed from the remains of calcium rich organisms, is extensively fractured and contains many lenses and nodules. These lenses and nodules are the most productive groundwater beds in the entire county.

The final formation is the Hartselle Sandstone found atop Rainbow Mountain. This layer is made up of quartz sand grains cemented by calcium carbonate fragments from the underlying limestone (Geological Survey of Alabama, 1975, p. 10). This formation overlaps in many places and is extremely porous, causing it to be worn away by weatherization from air and water.

Above all the bedrock formations, excluding the sandstone, is a layer of unconsolidated material called the regolith. The regolith includes stream flood-plain deposits and materials which have moved down slope under the influence of gravity, but the bulk of regolith is derived from weathering of the bedrock in place (Geological Survey of Alabama, 1975, p. 19). In Madison, the weathering process involves the chemical decomposition and mechanical disintegration of limestone, followed by the removal of water soluble materials. This leaves an insoluble residue above weathered or partly weathered bedrock consisting of clay, silt, sand, and

scattered rock fragments (Geological Survey of Alabama, 1975, p. 19). Generally the regolith resting on solid bedrock has a higher concentration of rock fragments than that nearer the ground surface, but such zones may also occur higher in the regolith (Geological Survey of Alabama, 1975, p. 19).

Knowledge of the regolith is extremely important in studies involving foundation engineering, water supply, mineral extraction, and other aspects of land use. Foundation construction can usually be adapted to any regolith thickness, as heavy construction can be accommodated by the use of piles driven to solid bedrock, while lighter structures, such as highways and homes, can be placed directly on the regolith if bedrock is not close to the surface (Geological Survey of Alabama, 1975, p. 20). In addition, thick unconsolidated material may contain enough groundwater for moderate domestic needs, and may also help in recharging the underlying bedrock aquifer by releasing water to it during dry periods.

Soils

Soil refers to the uppermost part of the regolith where organisms and natural physical and chemical reactions have produced a zone that supports plants (Geological Survey of Alabama, 1975, p. 20). A group of individual soils geographically associated in a characteristic repeating pattern is termed a soil association (Geological Survey of Alabama, 1975, p. 20). An association consists of one or more major soils and at least one minor soil, and is named for the major soils (Geological Survey of Alabama, 1975, p. 20). In addition, the soils of a given association may be found in another association, but they occur in a different pattern

(Geological Survey of Alabama, 1975, p. 20). Figure 1 displays the predominant soil associations in the city.

Much of Madison's soils are classified as part of the "Decatur-Cumberland-Abernathy" association. The soils of this association are well-drained, fertile, and occur in thick proportions over limestone bedrock areas (Top of Alabama Regional Council of Governments, 1977, p. 6). The Decatur-Cumberland soils are found on nearly level to gently rolling terrain and have a high capacity for holding moisture, while Abernathy soils occupy positions in gentle depressions and sinks (Madison Sketch Development Plan, 1975, p. 5). Although this association is very conducive to urban development, care should be taken to minimize erosion, especially in floodplain areas.

The Hermitage-Talbott-Colbert association is located around Rainbow Mountain. These thin soils have a clayey texture and slow permeability, making them highly erodible and less fertile than most associations (Geological Survey of Alabama, 1975, p. 21). The depth to bedrock within this group ranges from less than two feet to about four feet and bedrock outcrops are common, especially in the Colbert soils (Top of Alabama Regional Council of Governments, 1977, p. 7). Development on Hermitage soils is restricted by the steepness of the slope on which they are located, while Talbott and Colbert soils impose severe limitations for all development due to their shallowness to underlying bedrock (Top of Alabama Regional Council of Governments, 1977, p. 64).

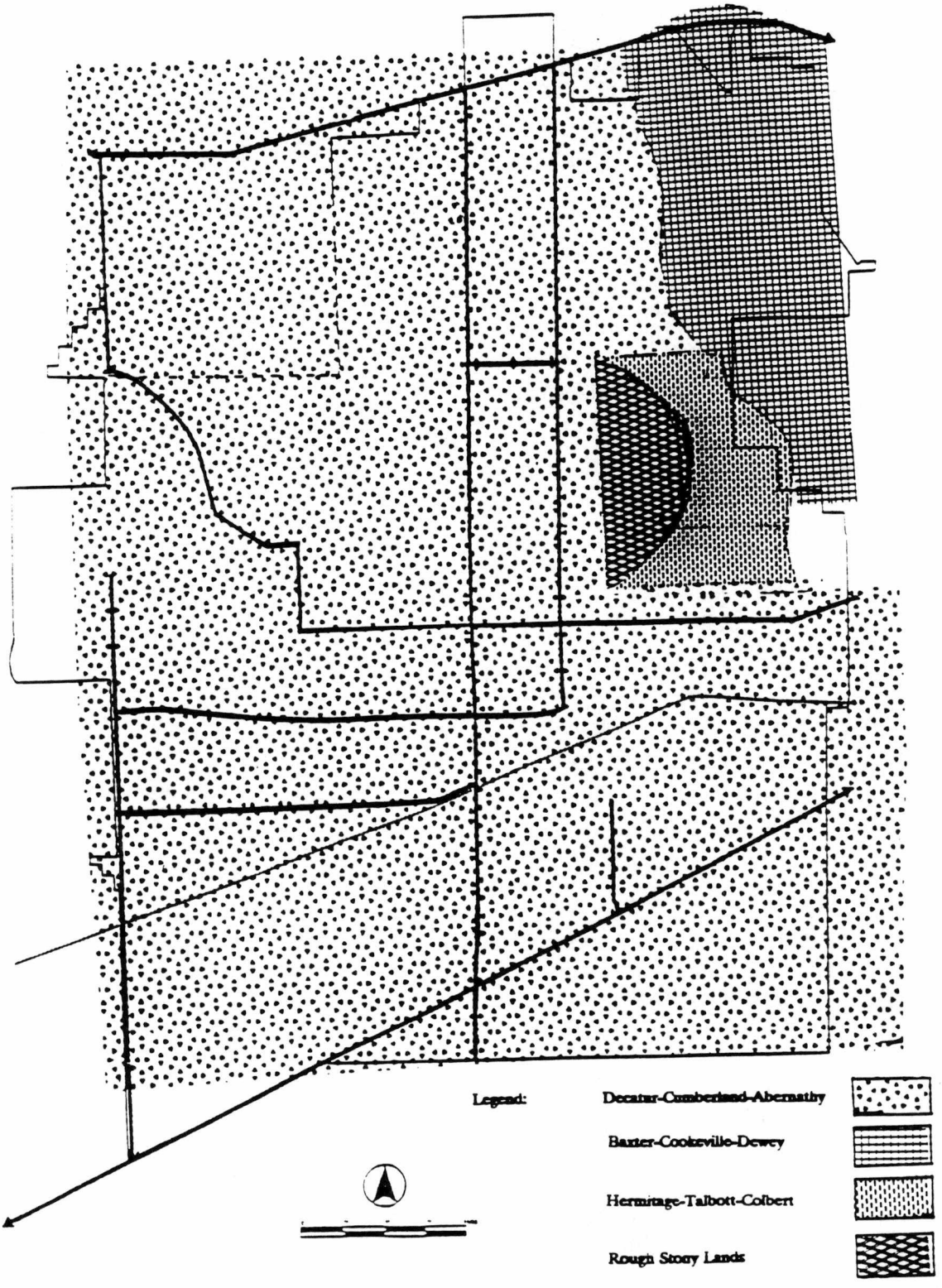

Figure 1. Soil Associations in Madison

A small area of Baxter-Cookeville-Dewey soils is found in the northeastern section of the town along Highway 72. These soils are well drained and moderately thick over limestone bedrock (Geological Survey of Alabama, 1975, p. 21). Although not quite as fertile as the Decatur-Cumberland-Abernathy group, this association is not very erodible and has the capacity to support all types of urban development (Top of Alabama Regional Council of Governments, 1977, p. 64).

The final association is the "Rough Stony Lands" that occupy steep mountain slopes. These soils exhibit poor soil qualities, including shallow depth to the underlying bedrock, and, due to the extreme slope, a high susceptibility to erosion (Top of Alabama Regional Council of Governments, 1977, p. 64). Most of these soils are covered with forest vegetation and should remain in their natural state to protect the mountainsides from erosions and landslides.

Open Space

Although Madison has experienced intense development pressures in the previous decade, about 50% of the land is still undeveloped. This undeveloped land is primarily wooded or cleared for agricultural purposes. Wooded areas cover portions of Rainbow Mountain and are along the stream valleys in the Bradford Creek drainage area in western Madison. Sporadic stands of trees are also intermingled with many subdivision units and apartment complexes to help serve as buffers between different land uses.

Open fields are primarily found in the central and western portions of Madison. These agricultural areas attest to the fertile soils in the area; however, they

also help preserve the rural character of the city. In addition, since the airport noise influence zone and Bradford Creek cover a large portion of this region, development pressure is not very intense.

Climate

The City of Madison has a humid, subtropical climate, with average temperatures of 62 degrees farenheight and mean precipitation of 48.7 inches (Geological Survey of Alabama, 1975, p. 9). During the winter cold air masses are overridden by warm moist air masses from the Gulf of Mexico, resulting in long periods of precipitation (Geological Survey of Alabama, 1975, p. 9). Summer precipitation is usually caused by rising air in convection cells causing thunderstorms of intense but often short duration. The amount of precipitation is significant, as saturated soils and flooding conditions can occur in the city throughout much of the year.

Hydrology

Groundwater Resources

Groundwater is the primary source for all public, domestic and industrial uses in Madison. Madison is served by an extensive underground aquifer buried approximately 50 to 70 feet underground. The protection of this resource is paramount to the maintenance of current supplies through the city and to ensure that potable new supplies will be available to support projected growth. However, before any protection measures can be taken, detailed knowledge of the local hydrologic conditions is necessary.

Initially, it is important to outline several concepts related to hydrologic studies. Regolith, as mentioned before, is the unconsolidated material above bedrock. Generally speaking, the lower part of the regolith is a cherty material that readily transmits water (Geological Survey of Alabama, 1975, p. 58). The upper part of the regolith is a clayey material that is much less permeable and acts as a confining layer to the upward movement of water (Geological Survey of Alabama, 1975, p. 58). Water confined under this layer is under pressure and will rise above the confining layer when penetrated during drilling (Geological Survey of Alabama, 1975, p. 58). The top of the saturated zone where no confining layer is present is the top of the water table.

However, the water table of Madison is difficult to determine because of problems in describing the direction, size, and extent of solution openings in which groundwater occurs (Geological Survey of Alabama, 1975, p. 64). It is known that groundwater occurs in permeable zones in the regolith in the western parts of the city, and in solution openings in the limestone areas in the central and eastern portions. In the cherty western areas, well yields are generally less than 50 gallons per minute, while the productive cavity systems in the central and eastern sections can produces yields of up to 2,000 gallons per minute (Quinn, 1988).

Recharge areas for the underlying aquifer are located throughout the northern and central half of Madison between Rainbow Mountain and the Bradford Creek drainage area (Figure 2). These areas should be protected from potential sources of contamination such as landfills, sewage lagoons, and septic tanks to insure good

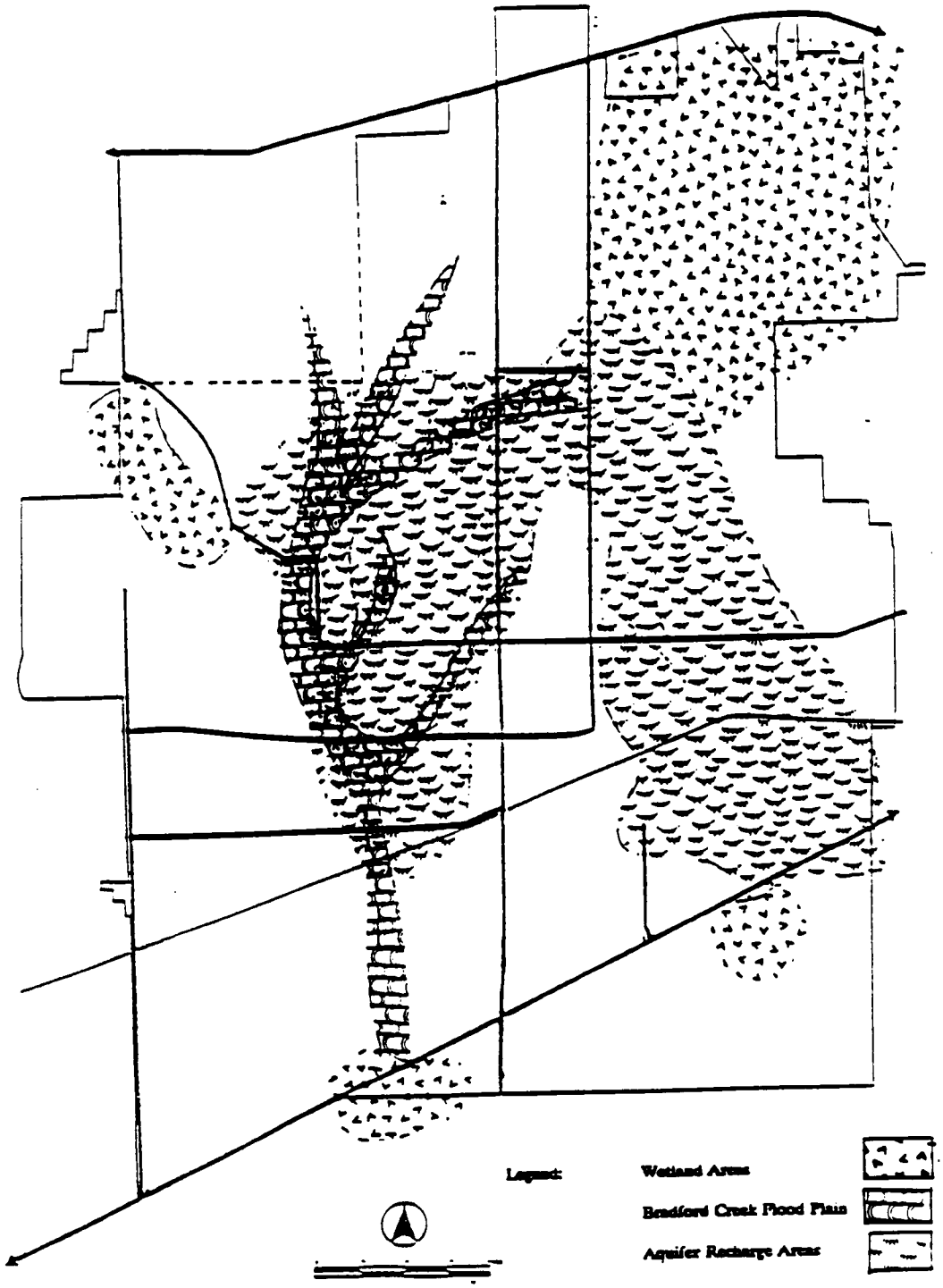

Figure 2. Critical Environmental Areas in Madison

quality water in the future. The thick regolith in this area provides good natural filtration for water percolating through it to the underlying openings in the limestone cavities (Geological Survey of Alabama, 1975, p. 60). However, even in areas of thick regolith, improperly constructed or abandoned wells can provide direct avenues for contaminants to enter the solution cavities, and this contaminated water can move rapidly to points of discharge (Geological Survey of Alabama, 1975, p. 60).

The entire recharge area is also underlain by Tuscumbia Limestone, which, as mentioned before, is highly susceptible to solution. This causes a substantial amount of karst topography, or sinkholes, throughout the city. These sinkholes act as major suppliers of water to the underground aquifer, and make construction activities very difficult. It is important to make test borings at prospective construction sites in these areas, especially at those intended for large structures. Cavities in the upper ten feet of the bedrock are of prime concern, but those in the zone from 10 to 25 feet can also impose limitations on the size and type of construction. These limitations on construction in karst areas ultimately could help preserve the recharge area by posing a natural constraint to development.

By applying a carrying capacity model to the current situation, the supply and quality of the groundwater in Madison can be analyzed. The Madison Planning Area includes a total of approximately 24,594 acres or 38.4 square miles. Of this total 11,922 acres or 18.6 square miles lie within the corporate limits and the remaining 12,672 acres or 19.8 square miles comprise the extraterritorial area. The City is served by an aquifer approximately 68 feet underground that can provide a safe yield

of about 350,000 gallons per day, and average per capita consumption is 150 gallons per person (Quinn, 1988). In addition, the City has about a 5.8 million gallon storage capacity with its five tanks. Thus, assuming the entire aquifer yield and stored supply is available, the planning capacity based on water supply is as follows:

(38.4 sq mi. x .35 mgd) / 150 gpcd	= 89,600
5.8 mgpd / 150 gpcd	= 38,667
Water Supply Estimate	128,267

This figure displays the great abundance of water in the area, as roughly 128,000 people could be supported with the current supply.

With respect to water quality, 12 square miles is serviced by a new treatment plant that can accept up to 3,000,000 gallons of waste per day. The per capita waste generation is approximately 100 gallons per capita per day. Of the remaining land area, 1350 acres are zoned low density residential, 255 acres are zoned medium density, and 50 are zoned high density. Thus, assuming these areas are developed and connected to the sewerage system, the planning capacity is calculated as follows:

3 mgd / 100 gpcd	= 30,000
(1350 acres x 2 units/acre) X 2.3 persons/unit	= (6210)
255 acres x 5 units/acre)x 2.2 persons/unit	= (2805)
(50 acres x 10 units/acre)x 2 persons/unit	= (1000)
Water Quality Planning Estimate	19,985

It can be seen that the current planning capacity for the area is 19,985 as represented by the water quality limiting factor. Although the city has plenty of water from a supply standpoint, to extend sewer to all new development will practically zero out current wastewater capability. From these figures it appears that an expansion of the

sewer system is mandatory, or growth must be guided into areas that have the ability to support septic fields. This strategy will be discussed in detail in the next chapter as a viable alternative for the city.

Surface Water

Surface water resources are less vital as a potential potable water resource for the city, but are extremely important in terms of flood protection, scenic beauty, and agricultural use. There are four main stream drainage areas in Madison:

1) Bradford Creek, which drains about 70% of Madison, and covers the central and western portions of the city (see Figure 2);

2) Rainbow Mountain, which drains about 20% of the land area, can be subdivided into two areas. One sub-area drains into Indian Creek at a point between the Southern Railway tracks and Highway 20, while the second sub-area drains into Indian Creek in a northwardly direction near Highway 72;

3) Betts Creek, defined by Betts Mountain and the Redstone Arsenal, drains into Bradford Creek south of the city limits; and

4) Knox Creek, located along Highway 72 in the northern tip of the city, drains a small portion of the land in the north (City of Madison Sketch Development Plan, 1972, p. 8).

These four stream drainage basins are the only major surface water resources in the city. However, several ponds, wetlands, and floodplain areas exist throughout the city and play a vital role in the ecosystem management. Although commonly thought of as mosquito-ridden, disease-infected swamps, these regions provide flood control, groundwater recharge, and a habitat for a variety of plant and animal species. There are three main areas of wetlands within the city of Madison - the floodplain around Bradford Creek, the Wild Hog Swamp, and the intermittent wetlands at the western

end of Rainbow Mountain, stretching northward and eastward (see Figure 2). Using the classification system identified in the previous chapter, tables 4, 5, and 6 display natural science and planning ratings for the three wetland areas.

The Wild Hog Swamp rates as the most critical of the wetland areas, primarily due to its natural science rating. The "Swamp" is located due south of the Bradford Creek lowlands and forms the southwestern edge of the Bradford Creek drainage area. This wetland is significant because of its flood control and natural filtering mechanism. Motorists along I-20 frequently encounter a flooded roadway in periods of heavy rain; however, without the Wild Hog "sponge," fast flowing water would rush across the roadway and create more hazardous conditions. As a filtering system, the swamp helps remove surface pollutants before they enter groundwater. For instance as motor oil and other toxic debris are washed off the roadway during thunderstorms, the polluted water collects and is soaked up by the swamp. As the water seeps into the ground below, the pollutants from the oil and other discharges get caught in the silty layer at the bottom of the swamp. Thus, this layer of protection filters out most of the impurities before they can enter the underlying water supply.

The second critical area is the intermittent wetlands and ponds in the Madison Recharge Area. This area is significant for planning rather than natural science reasons. The integrity, natural cycle protection, and management status of the area have all ben affected by the residential growth along Hughes Road and Wall-Trianna Boulevard. Continued encroachment upon these wetlands will have an impact on the

Table 5. Wild Hog Swamp Rating Sheet.

Area Name: Wild Hog Swamp
Location: SW Madison
Reference Number: _____

Ownership: Private _____ Public UVM ✓ Mixed _____

	I. Natural Science Rating		II. Planning Rating	
1.	**Area (in acres)**		**Recreation Uses**	
	1,000 and over	5	5 or more	5
	500 to 999	4	4 uses	4
	100 to 499	3	3 uses	3
	10 to 99	2 ✓	2 uses	2
	Under 10	1	1 use	1 ✓
2.	**Elevation Above MSL**		**Education/Research Uses**	
	2,500 feet and over	5	5 or more	5
	1,500 to 2,499	3	4 uses	4
	Under 1,499 feet	1 ✓	3 uses	3 ✓
3.	**Frequency of Occurrence**		2 uses	2
			1 use	1
	Rare	5 ✓	**Integrity**	
	Infrequent	3		
	Common	1	Safe, 5 years or less	5
4.	**Diversity**		Safe, 5 to 10 years	3 ✓
			Safe, indefinitely	1
	High	5 ✓	**Management Status**	
	Average	3		
	Low	1	Mismanaged	5
5.	**Established Significance**		Poorly or unmanaged	3 ✓
			Well managed	1
	National	5	**Planning Status**	
	Southeast Regional	4		
	State	3	A federal plan	5
	Substate Regional	2	Southeast regional	4
	Local	1 ✓	A state plan	3
6.	**Fragility**		Substate regional	2
			Local	1
	High	5 ✓	No plan or designation	0 ✓
	Medium	3	**Natural Cycle Protection**	
	Low	1		
			High	5 ✓
			Medium	3
			Low	1
TOTAL:		19		15

Combined total (Natural Science Rating and Planning Rating) = 34

Source: Adapted from Frederick O. Sargent and Justin H. Brande. "Classifying and Evaluating Unique Natural Areas for Planning Purposes." Management and Control of Growth. Vol. 4, Washington, D.C.: The Urban Land Institute, 1979.

Table 6. Recharge Area Wetlands Rating Sheet.

Area Name: Recharge Area Wetlands
Location: East Central Madison
Reference Number: _____

Ownership: Private _____ Public UVM _____ Mixed ✓

I. Natural Science Rating

1. Area (in acres)

1,000 and over	5
500 to 999	4
100 to 499	3 ✓
10 to 99	2
Under 10	1

2. Elevation Above MSL

2,500 feet and over	5
1,500 to 2,499	3
Under 1,499 feet	1 ✓

3. Frequency of Occurrence

Rare	5
Infrequent	3
Common	1 ✓

4. Diversity

High	5
Average	3
Low	1 ✓

5. Established Significance

National	5
Southeast Regional	4
State	3
Substate Regional	2 ✓
Local	1

6. Fragility

High	5 ✓
Medium	3
Low	1

TOTAL: 13

II. Planning Rating

1. Recreation Uses

5 or more	5
4 uses	4
3 uses	3
2 uses	2
1 use	1

2. Education/Research Uses

5 or more	5
4 uses	4
3 uses	3
2 uses	2
1 use	1 ✓

3. Integrity

Safe, 5 years or less	5 ✓
Safe, 5 to 10 years	3
Safe, indefinitely	1

4. Management Status

Mismanaged	5 ✓
Poorly or unmanaged	3
Well managed	1

5. Planning Status

A federal plan	5
Southeast regional	4
A state plan	3
Substate regional	2
Local	1 ✓
No plan or designation	0

6. Natural Cycle Protection

High	5 ✓
Medium	3
Low	1

17

Combined total (Natural Science Rating and Planning Rating) = 30

Source: Adapted from Frederick O. Sargent and Justin H. Brande. "Classifying and Evaluating Unique Natural Areas for Planning Purposes." Management and Control of Growth. Vol. 4, Washington, D.C.: The Urban Land Institute, 1979.

Table 7. Bradford Creek Floodplain Rating Sheet.

Area Name: Bradford Creek Floodplain
Location: Central + Western Madison
Reference Number: _____

Ownership: Private _____ Public UVM _____ Mixed ✓

I. Natural Science Rating

1. Area (in acres)

1,000 and over	5
500 to 999	4
100 to 499	3 ✓
10 to 99	2
Under 10	1

2. Elevation Above MSL

2,500 feet and over	5
1,500 to 2,499	3
Under 1,499 feet	1 ✓

3. Frequency of Occurrence

Rare	5
Infrequent	3
Common	1 ✓

4. Diversity

High	5
Average	3
Low	1 ✓

5. Established Significance

National	5
Southeast Regional	4
State	3
Substate Regional	2 ✓
Local	1

6. Fragility

High	5 ✓
Medium	3
Low	1

TOTAL: 13

II. Planning Rating

1. Recreation Uses

5 or more	5
4 uses	4
3 uses	3
2 uses	2 ✓
1 use	1

2. Education/Research Uses

5 or more	5
4 uses	4
3 uses	3
2 uses	2 ✓
1 use	1

3. Integrity

Safe, 5 years or less	5 ✓
Safe, 5 to 10 years	3
Safe, indefinitely	1

4. Management Status

Mismanaged	5
Poorly or unmanaged	3
Well managed	1 ✓

5. Planning Status

A federal plan	5
Southeast regional	4
A state plan	3
Substate regional	2
Local	1 ✓
No plan or designation	0

6. Natural Cycle Protection

High	5
Medium	3 ✓
Low	1

13

Combined total (Natural Science Rating and Planning Rating) = 26

Source: Adapted from Frederick O. Sargent and Justin H. Brande. "Classifying and Evaluating Unique Natural Areas for Planning Purposes." Management and Control of Growth. Vol. 4, Washington, D.C.: The Urban Land Institute, 1979.

future supply and quality of the aquifer. Sewer expansions into this area have already helped the quality side of the equation, but larger minimum lot sizes may be necessary to free up additional land areas for recharge purposes.

Furthermore, runoff from Rainbow Mountain in the rainy winter and spring months causes many areas of localized ponding. The rain also spawns a few springs from the hillside. It is important to manage this area throughout the summer even through dryer conditions prevail. These intermittent ponds and springs serve the same purposes as those at Wild Hog Swamp, although to a lesser degree.

The final wetland areas is actually the floodplain surrounding the Bradford Creek Drainage basin. At the present time, this area has received only minor pressure from the burgeoning Madison population. The two most productive wells in the city are located in this area, indicating the presence of abundant water supplies. However, the new sewage treatment plant uses the topography of the area to run lines to collect wastewater and feed the plant. The city must continue to obtain land in this area to prevent unwanted developments, and subsequent increased demand on the system.

Airport Noise

A substantial portion of western Madison is affected by operations at the Huntsville-Madison County Jetport. The location of the runways, the type and frequency of various aircraft, and airport operating procedures make certain areas of western Madison incompatible with certain types of land use activity. The Airport Noise Compatibility Planning Study for the Huntsville-Madison County Jetplex was

initiated in 1984 upon the premise that at certain high levels aircraft noise does adversely affect the health and welfare of exposed individuals (Land Use Plan Amendment, 1988, pg. 2).

An individuals perception of noise is dependent upon several measurable characteristics of sound. These are:

1) Intensity. In general, a ten decibel increase in intensity may be considered a doubling of the perceived loudness or noisiness of a sound. Psychoacoustic evidence suggests, however, that a greater than 10 decibel increase in peak levels of aircraft flyover noise is required to produce a perceived doubling of the noisiness. In rural areas of Madison and Limestone Counties, ambient levels can be found down to 45 decibels. A jet aircraft flyover can peak at 85 to 90 decibels in some of these areas. This would cause not only a doubling of the perceived loudness, but at times a tripling or quadrupling of the perceived loudness.

2) Frequency Content. Sounds with a concentration of energy between 2000 Hertz (cycles per second) and 8000 Hertz are perceived to be more noisy than sounds of equal level outside of this range. The characteristic whine of a jet engine concentrates its energy between 3500 and 4000 Hertz. This definitely would be perceived as more noisy than a sound pressure level of equal magnitude but with a frequency below 2000 or above 8000 Hertz.

3) Changes in Sound Pressure Level. Sounds that are increasing in level (such as takeoff or reverse thrust noise) are judged to be somewhat louder than those decreasing in level.

4) Rate of Increase in Sound Pressure Level. Impulsive sounds, or ones that reach a high peak very abruptly, are usually perceived to be very noisy (Land Use Plan Amendment, 1988, pg. 2).

To quantify the environmental impact of noise associated with any noise source is difficult due to difference in community opinion. However, cumulative noise exposure techniques, which consider the noise generated by all aircraft over a

twenty four hour period, have been developed for analyzing aircraft noise impact upon land use and associated human activities. These indices are:

1) Noise Exposure Forecast (NEF). This is a scale presently used by the Federal Aviation Administration (FAA) for land use planning in connection with airports. In the NEF scale, the basic measure of magnitude for individual noise events is the effective perceived noise level which is expressed in units of EPNdb.

2) Composite Noise Rating (CNR). This is a scale that takes into account the totality of aircraft operations at an airport in quantifying the total aircraft noise environment. It was the earliest method for evaluating compatibility around airports and is still used by the Department of Defense in predicting noise impacts around military airfields. To calculate a CNR value, one begins with a measure of the maximum noise magnitude from each aircraft flyover and adds weighting factors that sum the total effects of all flights. The scale used to describe individual noise events is perceived noise level (PNL) which is expressed in PNdb. PNdb is a quantity measured in decibels that provides a subjective assessment of the perceived noisiness of aircraft.

3) Day-Night Average Sound Level (Ldn). This is a 24-hour average sound level expressed in A-weighted decibels, with a ten decibel penalty applied to noise events from 10:00 PM to 7:00 AM. The penalty for nighttime noise events accounts for the for the increased sensitivity of most people to noise in the quiet evening hours. Unlike the CNR and NEF scales, the Ldn can be used to express the noise impact of other noises in addition to aircraft noise. Therefore, by using the Ldn scale a common denominator can be obtained for expressing the acoustic impact of all segments of the noise environment. The Huntsville/Madison County Jetport uses Ldn as its official descriptor of existing and cumulative noise exposure in airport environs (Land Use Plan Amendment, 1988, p. 4).

The Noise Compatibility Study also outlines the existing and projected noise impact contours based on the Ldn scale. Figure 3 displays the potential 1995 Jetport

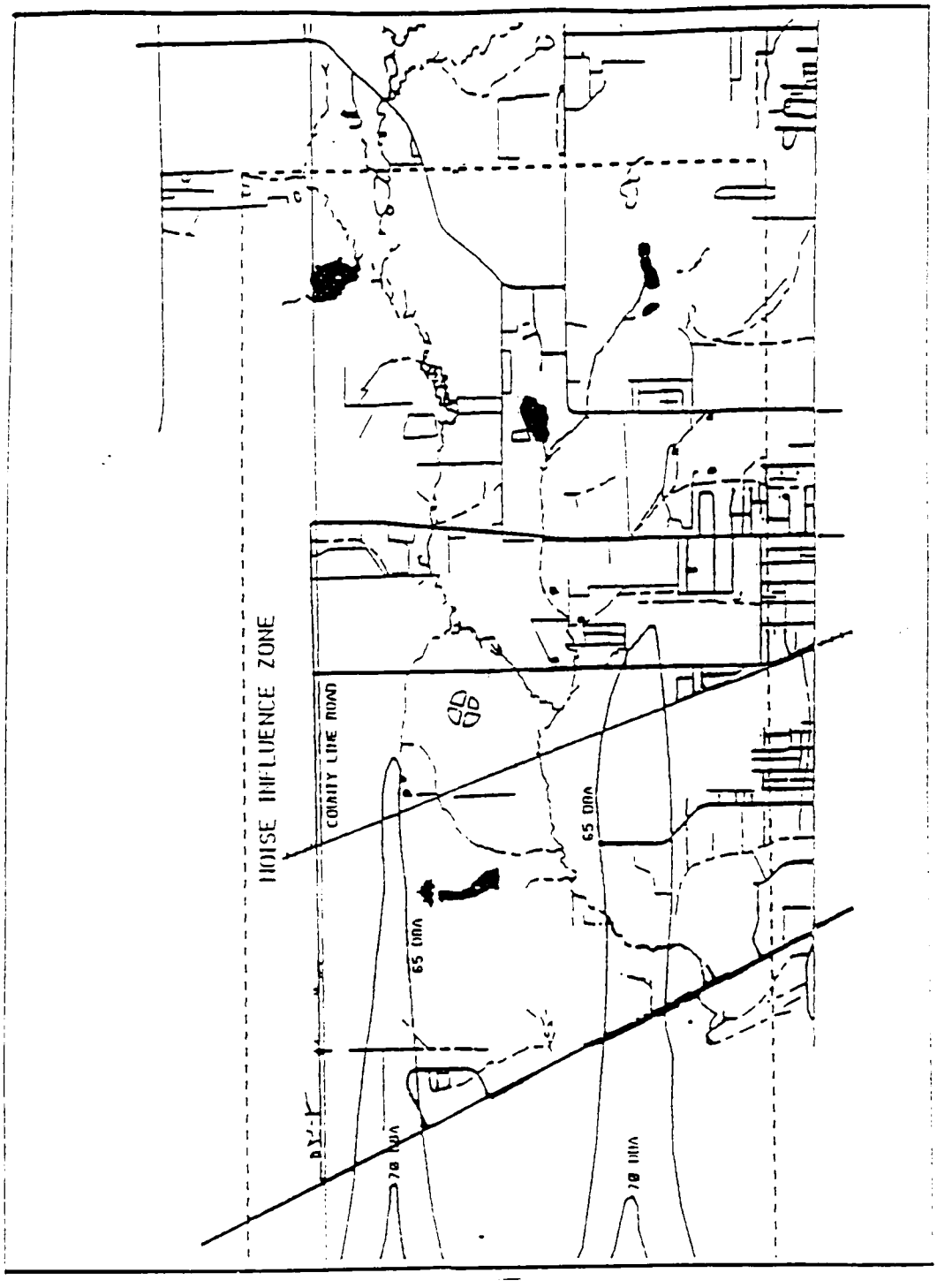

Figure 3. Potential 1995 Jetport Noise Impact Corridors

Noise Impact Contours in western Madison. The inherent variability in the reactions of individuals exposed to noise under different conditions has revealed that the point at which overall human perception of aircraft noise as an annoyance or serves to interrupt human activity is around 65 Ldn (Land Use Plan Amendment, 1988, pg. 6). The airport planning strategies in the following chapter will use these guidelines as a benchmark for growth management in the area. Continued validation of this data is necessary to ensure accuracy in future planning or growth management studies in the noise influence zone, as changes in airport operations take place.

A composite constraints map can be used to display the major barriers to development discussed in this chapter. Figure 4 combines soil constraints, the airport noise zone, the aquifer recharge area and various floodplains and wetlands. The two darker shaded areas in central and eastern Madison occur where three of these constraints overlap. The area in central Madison occurs in the confluence of the airport noise zone, aquifer recharge area, and Bradford Creek floodplain. The area in eastern Madison occurs where poor soil conditions, the aquifer recharge area, and the floodplain converge. These areas may require additional protection when growth guidance alternatives are considered.

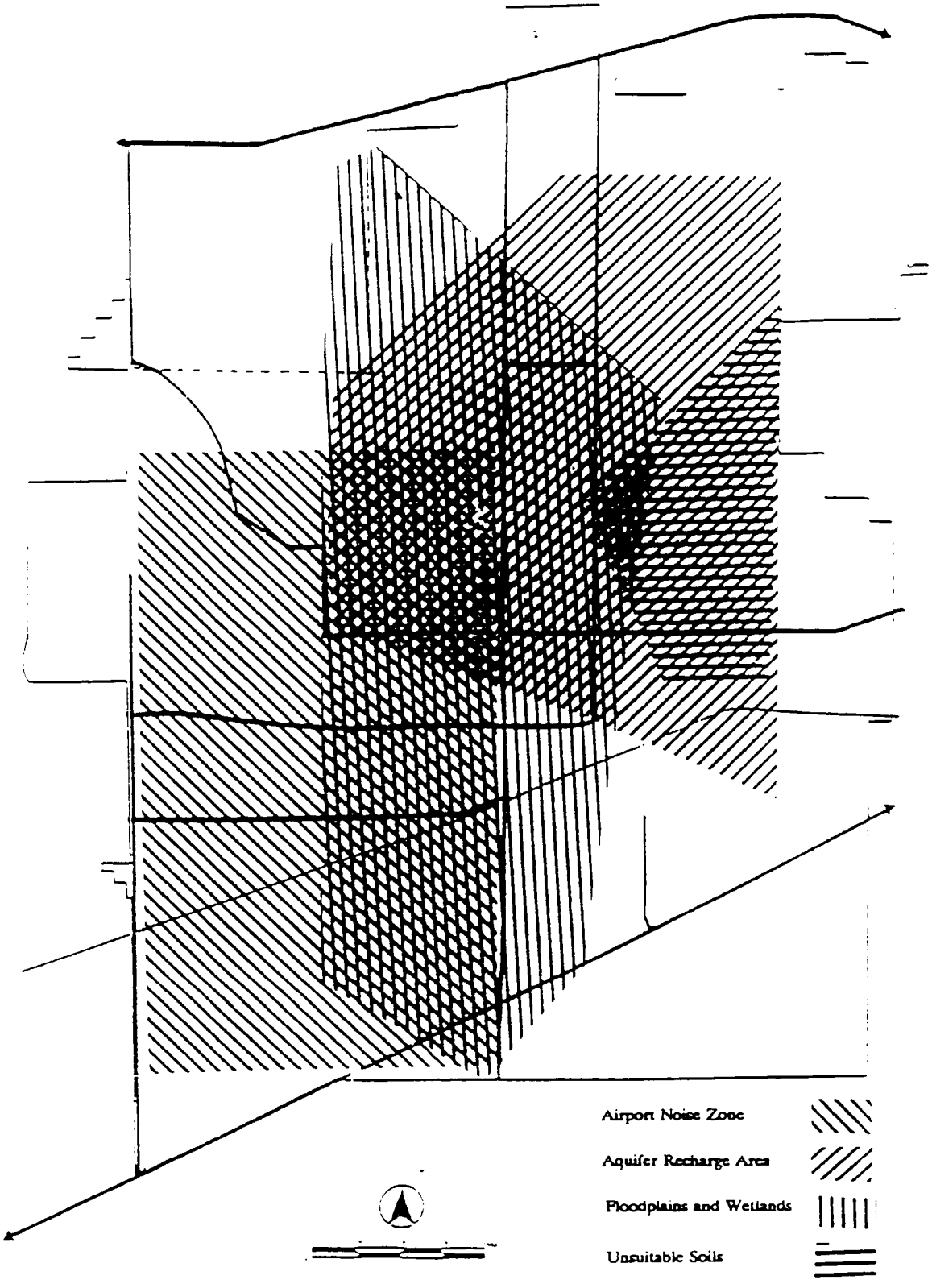

Figure 4. Composite Contraints in Madison

CHAPTER 4

GROWTH GUIDANCE ALTERNATIVES

The analyses in the previous chapter are the basis for the development of strategies that call attention to environmental issues while allowing economic growth and prosperity to continue. Although the city has benefitted greatly from the collection of fees and taxes from the burgeoning homebuilding industry, the data presented previously displays a need for growth guidance in certain areas. The purpose here will be to address this need by proposing strategies that consider the major environmental issues and the political, economic, and legal challenges associated with each. The strategies are not meant to be a growth management blueprint for the city, but as suggestions toward the development of more comprehensive growth guidance mechanisms that can be included within the current institutional framework.

Current Conditions

The City of Madison has historically implemented environmental controls through the zoning ordinance, subdivision regulations, the comprehensive plan, and water and sewer board rules. The following section discusses these documents and their relationship to environmental regulation within the airport influence area and the protection of groundwater and surface water resources.

Airport Influence Zone Regulations

The Airport Influence Zone is addressed in both the zoning ordinance and the comprehensive plan. The zoning ordinance contains regulations that primarily deal with the height and location of buildings near and around the aircraft landing areas. These types of regulations are established by the FAA and implemented and monitored by local governments. Appendix A contains all the sections of the zoning ordinance that apply to the airport zone.

The comprehensive plan discusses noise abatement techniques in greater detail. Table 8 displays the land use compatibility of different types of development with airport noise. It is interesting to note that unlike the restrictions on allowable heights of structures and other physical improvements, the FAA guidelines on compatibility do not constitute a federal determination on what is a proper or improper use of land. The responsibility for determining the acceptable and permissible land uses remains with the local authorities. Thus, although federal regulations control the height and location of physical structure within the zone, the noise compatibility problem is entirely a local matter.

The City of Madison has addressed the noise compatibility problem by requiring full disclosure of noise levels to prospective purchasers of residential units. The City also requires certain acoustical treatment requirements for hotels, motels, and institutional uses. The disclosure statements and other requirements are found in Appendix B. However, these requirements are based upon the potential 1995 noise contours discussed earlier, and increases in airline traffic or landing patterns

TABLE 8. LAND USE COMPATIBILITY WITH YEARLY DAY NIGHT AVERAGE SOUND LEVELS

Land Use	Yearly Day-Night Average Sound Level (L_{dn}) in Decibels					
	Below 65	65-70	70-75	75-80	80-85	Over 85
Residential						
Residential, other than mobile homes and transient lodgings	Y	N(1)	N(1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
Public Use						
Schools, hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Governmental services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
Commercial Use						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail - building materials and farm equipment	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail trade - general	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
Manufacturing and Production						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
Recreational						
Outdoor sports arenas and spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parts, resorts and camps	Y	Y	Y	N	N	N
Golf courses, riding stables and water recreation	Y	Y	25	30	N	N

(Numbers in parentheses refer to notes.)

Source: Adapted from City of Madison, Alabama, "Land Use Plan Amendment." City of Madison Planning and Zoning Commission, 1988.

TABLE 8. (CONTINUED).

Notes for Table 8

1. Where the community determines that the residential uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 db and 30 db should be incorporated into building codes and be considered in individual approvals. Normal construction can be expected to provide a NLR of 20 db, thus, the reduction requirements are often stated as 5, 10, or 15 db over standard construction and normally assume mechanical ventilation and closed windows year around. However, the use of NLR criteria will not eliminate outdoor noise problems.

2. Measures to achieve NLR of 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where normal noise level is low.

3. Measure to achieve NLR of 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where normal noise level is low.

4. Measure to achieve NLR of 35 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where normal noise level is low.

5. Land use compatible provided special sound reinforcement systems are installed.

6. Residential buildings require a NLR of 25.

7. Residential buildings require an NLR of 30.

8. Residential buildings are not permitted.

9. The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses remains with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

Source: City of Madison, "Land-Use Plan Amendment."

could cause variations to these contours in the future. This is significant since most of the land area outside the 65 dba contours is currently zoned residential, although most of the land is still undeveloped.

Groundwater Resource Regulations

Regulations affecting groundwater supply and quality are found in both the subdivision regulations and the Water and Sewer Board rules and regulations. The subdivision regulations impose development standards that determine appropriate lot sizes and required improvements. Section 5-6, part g is particularly appropriate:

> "All residential lots shall have an area of at least seven thousand, five hundred (7500) square feet. Additional lot area is required when:
>
> 1) A lot is served by public water but not public sewer. In such case, said lot shall not be less than fifteen thousand (15,000) square feet in area.
>
> 2) Public water or sewer is not provided. In such case, said lot shall not be less than twenty thousand (20,000) square feet in area (Subdivision Regulations, 1986, p. 31).

The references to size are important when applied to groundwater recharge areas. Since recharge areas are not delimited by lot boundaries, additional protection is necessary in these areas. In fact Section 6-1-6 discusses required improvements concerning sewerage facilities with little regard for the recharge area:

> " General Requirements. The applicant shall install sanitary sewer facilities in a manner prescribed by the City of Madison construction standards and specifications. All plans shall be designed and approved in accordance with the rules, regulations, and standards of the City of Madison.
>
> Sanitary sewers shall be provided where a public sanitary sewerage system is reasonably accessible as determined by the Planning Commission and Water and Sewer Board. Individual disposal systems shall be used in instances where no public sanitary sewerage system is available providing approval is

> received from the State and County Health Department (Subdivision Regulations, 1986, p. 35).

The State and County Health Department has approved numerous individual disposal systems within the recharge area. Figure 4 shows the current sewer lines in the city. At the current time, not all homesites in the recharge area are "reasonably accessible" to sewer lines, yet units continue to be built. Mechanisms to reverse this trend will be discussed later in the alternative strategies.

Wetlands and Surface Water Regulations

The wetlands and surface water regulations are primarily contained in the subdivision regulations. The regulations deal with drainage and inundation to a large degree to protect homeowners from natural hazards and inconveniences. However, the regulations do little to preserve surface waters and wetlands; in fact, the regulations allow dredging and filling in most cases.

An example of this lack of systems thinking occurs in section 5-8 of the subdivision regulations:

> Low areas subject to periodic inundation shall not be developed or subdivided unless and until the Planning Commission establishes that:
>
> a. The nature of the land use (i.e., recreational areas) would not lend itself to damage by water inundation to an appreciable extent;
>
> b. The area may be filled or improved in such a manner to prevent such periodic inundation; or

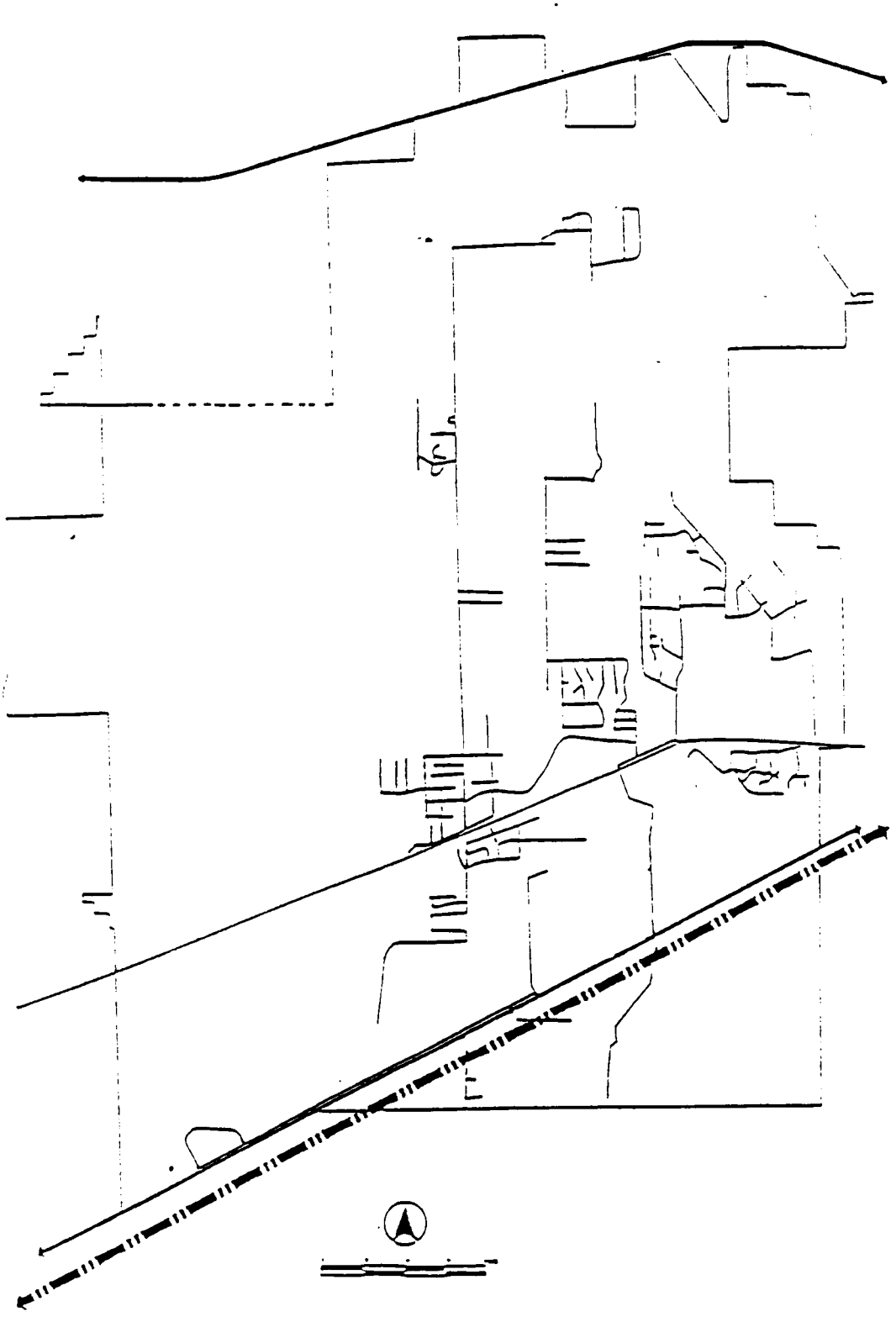

Figure 5. Existing Sewer Lines

c. Minimum floor elevations be required to prevent damage to buildings and structures, on site or adjacent thereto (Subdivision Regulations, 1986, p. 32).

The regulation goes on to state that in areas of questionable drainage, "lakes, ponds, and similar areas will be accepted for maintenance (by the city) only if sufficient land is dedicated as a public recreation area," or if the area "constitutes a necessary part of the drainage control system." (Subdivision Regulations, 1986, p. 32). Obviously, by allowing existing lakes and ponds to be part of the drainage control system, the natural functions these areas perform will undoubtably be altered.

The regulations do in fact help to preserve environmental features in some cases, particularly in the floodplain overlay zone. Section 6-1-9, Number 6, contains the following section on floodway areas:

> The Planning Commission may when it deems necessary for the health, safety, or welfare of the present and future population of the area and necessary to the conservation of water, drainage, and sanitary facilities, prohibit the subdivision of any portion of the property which lies within the floodway of any stream or drainage course. These floodway areas shall be preserved from any and all destruction or damage resulting from clearing, grading, or dumping of earth, waste material, or stumps, except at the discretion of the Planning Commission (Subdivision Regulations, 1986, p. 37).

This regulation provides a preservation function for the major stream drainage areas of the city, and could be used as the basis for additional protection measures. The following strategies will attempt to increase the amount of protection for all wetland and surface water regions with respect to water quality. These strategies should also help maintain property values and protect natural systems within the city.

Alternatives for Growth Guidance

Water Quality Planning Strategies

With diminishing sewer capacity, a heavily impacted recharge area, and drainage problems from new development, the city faces a monumental task in preserving its hydrologic system. Since the carrying capacity analysis in the last chapter identified the planning capacity of the current sewer system at 19,000 persons, the city must either expand this capability or guide growth into areas that can support septic systems outside the recharge area. The identification of possible mechanisms to guide this growth is mandatory to maintain the high quality of life in the city.

The overlay zone has been used successfully in Madison with respect to floodplain protection. This type of strategy is normally applied to protect a single resource through the creation of a zoning classification that overlays the base zoning district, whether it is residential, commercial, industrial, or agricultural. The subdivision regulations that accompany the floodplain overlay zone provide additional environmental safeguards by requiring special construction techniques and Planning Commission approval. However, additional benefits could be realized if another overlay zone is created for the Madison recharge area.

This overlay zone would limit development to residential with public sewers to preserve the good quality water the city maintains. Although some previous planning documents have suggested control of development in the recharge area, no comprehensive strategy has been implemented. An overlay zone in this area is

logical since sewer service is proposed for the area already, and the current zoning is low density residential. In addition, property values should rise in this area as septic systems and their associated environmental consequences are eliminated.

The zone could also contain provisions to help protect other areas from unwanted suburban sprawl. For instance, if karst topography or wetland area exists within the overlay zone, an extension of sewer lines could be denied into that area. This would serve the general purpose of preserving the recharge area and the other critical features that occur within the overlay zone.

Cluster zoning could also be used in tandem with the overlay zone. The planned unit development process in Madison adds requirements that developers go through a special exception procedure to allow the city to further scrutinize the site plan itself. This process has been used in some areas of the city to enhance open space and wooded areas in neighborhoods but not to directly protect wetlands or groundwater recharge areas. Although it would seem to be ideal for protecting critical areas associated with hydrology in the city, the problem remains that the use of density, like large lot zoning, is at best a surrogate for environmental impact. If the environmental impacts of development had a direct relationship with the number of dwellings and no relationship to the manner in which the dwellings were placed on the ground, then clustering and planned unit development would be no better than straight zoning. However, by combining the overlay zone with a clustering option, developers could realize greater financial benefits through higher densities away from recharge areas.

In addition, the city could also take a more aggressive stance when reviewing PUDs by attaching additional conditions to the site plan. The criteria or standards for approval cannot be too vague to permit desired results or too rigid to permit good design. It appears that a PUD process depends largely on the quality of the review board, the preciseness of the standards, and the ability to quantify the level of protection. The PUD ordinance in Madison is precise with regard to design standards concerning traffic circulation patterns and open space provisions, but critical environmental features are treated in a somewhat arbitrary fashion. By incorporating resource protection standards into the PUD ordinance or as part of the overlay zone, these critical areas can be preserved.

As mentioned before, the idea of setting standards was developed in large measure to provide an alternative to traditional zoning approaches that would indeed protect environmentally sensitive lands. In order to protect water quality, standards could be applied to all specific resources that affect the hydrology of the city. For instance, floodplains, wetlands, drainageways, and aquifer recharge areas could be assigned the following values:

Floodplains	100%
Wetlands	70%
Drainageways	70%
Aquifer Recharge Areas	100%

These standards have a tremendous advantage in that they apply not to the zoning district but to discrete environmental units themselves. Unlike an overlay zone which

can also be applied to environmental features, there is no need to map each particular resource. This means that the resource protection scheme can be tailored to meet the needs of very complex environments (i.e. where wetlands, drainageways, and an aquifer recharge zone converge), and protect them in a variety of zoning districts.

Most conventional standards in the form of setbacks can also be integrated into a performance standards system. In some cases, a prescriptive setback in the form of a minimum distance for a given environmental feature may be appropriate and considered suitable to provide adequate protection. However, the distance between the structure and the floodplain is less important than the manner in which the use is designed and constructed. If significant erosion occurs at the dwelling site, the stream bed could become silted lessening its capacity to drain the area and causing more severe flooding at the site or at points downstream.

Given the ability of a performance standards approach to reflect the inherent capacities and constraints of a given site to support or limit its development potential based on environmental concerns, such standards appear to be the most appropriate means for providing protection to critical areas in the city. These standards can be applied citywide throughout any zoning classification, overlay district, or planned unit development, and enable the city to guide growth into areas that achieve desired environmental objectives.

Airport Noise Planning Strategies

Conservation zones could be utilized to limit the amount of development in the noise corridor. The Comprehensive Plan Amendment for western Madison, of which the airport zone is a part, proposes residential land that could be impacted by changes in landing patterns or increases in operations at the airport. This residential land ranges in density from .2 units per acre to eight units per acre (Land Use Plan Amendment, 1988, p. 21). To meet the higher density areas, the sewer system will have to be extended, while the lower densities can rely on septic disposal, since the area is outside the primary recharge zone. It is this authors opinion that large lot zones, and corresponding lower densities, should be used wherever residential land is proposed in western Madison. These densities should probably not exceed two dwelling units per acre, and should be supplied with public water wherever possible. This strategy would serve a three-fold purpose- 1) limit the amount of impact from airport operations, 2) allow the city to use the remaining sewer capacity to bring all customers on-line in the recharge area first, and 3) protect open space and the rural character of the region. This will also allow the city time to extend infrastructure to the airport related industrial zones within the noise influence area which will provide tax revenues that can benefit all public works.

Conservation zones could also be used throughout the northern areas of the city. The soils in this area are very well drained, the land lies outside the recharge area, and wetlands are minimal. Since septic systems are appropriate if the lots are made large enough, the city could concentrate its water quality efforts in the more

important recharge area. Also, by guiding growth into this northern area, the city can maintain steady growth while completing infrastructure improvements to other critical areas.

Challenges to Growth Guidance Alternatives

Economic Challenges

The ultimate challenge for the city is probably the continued need for expanded sewer capability. As can be seen in the strategies mentioned above, sewer expansion is necessary to preserve water quality in the city, and to bring septic systems in the recharge area on-line. The cost of this action could result in raising property taxes in the city above the current seven mil rate. This low property tax rate has attracted new development to the city and provided enough revenues for the expansion of the sewer plant in 1989; however, the three million gallon plant is nearing capacity.

This challenge has been an on-going dilemma for the city. As early as 1988, the Commissioner of Public Works identified the need for an expansion to five million capacity by 1995. However, the city was only approved to dump three million gallons per day into Bradford Creek from its sewage facility. To meet environmental protection standards set forth earlier, the city must get additional approval to release more outflow into the creek. In fact, if the city expanded its lines to bring all residents on-line, the plant would probably exceed its capacity. Therefore, without placing a moratorium on growth, the city must guide development to the north where large lot zones and septic systems could support the growth.

Political Challenges

The primary political challenge to the above strategies could come from the implementation of additional performance standards before final approvals of new developments. The city has already faced this challenge in 1988 when a severe drought and lack of water storage capacity caused the city to prohibit final approval until both the planning and zoning board and water and sewer board had signed the agreement. In addition, approvals were given with the recommendation that certificates of occupancy would not be issued by the City before October 1, 1988. This was in response to the fact that the Rainbow Mountain storage tank was "zeroed-out" with regard to source supply and other areas of the city were also critical.

The Huntsville/Madison County Builders Association reacted to this process by requesting postponement of these actions until further studies could be conducted. With a potential loss of jobs and income, the developers had a reasonable argument; however, the city was also losing income from the impact fees it charges to use the public services. This same type of challenge could result if sewer services are "zeroed-out" and occupancy permits are delayed.

The solution to this problem would be to involve landowners and developers in the studies that affect environmental issues throughout the city. For instance, the city could combine with the homebuilding industry to perform a study of the environmental impact of development on wetlands areas in the city. It seems that few could understand a wetland's function better than a developer who must pay a

consultant to perform an assessment of one as part of plat approval. To attempt to control homebuilding through temporary stop-gap measures causes both parties to get bogged down in controversy. By tackling these issues together, a workable policy can be developed to protect both parties interests.

Legal Challenges

Since actions to protect natural resources and the environment ultimately result in more restrictive zoning or development standards than presently exist in Madison, an understanding of the legal aspects of growth guidance is necessary. Environmental regulations usually result in restrictions as to what can be done with property. Any environmental strategy must be carefully planned to insure that regulations are legally defensible. There are three main areas in which environmental regulations are subject to stringent review; deprivation of property through arbitrary and capricious action, exclusionary zoning, and taking.

An evaluation of these three concepts is central to understanding the challenge of implementing environmental protection strategies.

Deprivation of Property

The deprivation of property is a substantive due process concern that questions whether the governmental response to a problem is, in fact, appropriate. It generally requires a several stage test:

Stage 1: Is there a valid public purpose?

Stage 2: Are the interests of the public generally distinguished from those of a particular class such that they require the regulation?

Stage 3: Is the mechanism used for achieving the public goal a reasonable approach?

Stage 4: Are the means used to achieve the goal in balance with the public benefits?

Stage 1 - Clearly, the protection of natural resources should constitute a valid public purpose. The City of Madison has already taken steps to protect resources in its zoning and subdivision regulations so the valid public purpose is evident.

Stage 2 - Most of the environmental issues raised in this study involve the preservation of resources important for groundwater preservation or flood protection. In some cases, the courts found it easy to say that in its natural state wetlands had no value and that value could only be created through habitat destruction. It appears that it is an adopted common sense approach that the Constitution does not protect as a right this sort of value enhancement. In most of the critical areas of Madison, the resources have been modified by man and the original habitats disturbed. They are highly varied as to their resource value and the impacts that might occur through development. Some of the strategies mentioned earlier raise the question as to whether the real purpose of the regulations is to benefit those with very high incomes (by increasing lot size minimums), or developers (by allowing higher densities through clustering). These challenges are central to the

determination that the technique offers real protection to the resource and is not a counter-productive strategy.

Stage 3 - To determine whether the mechanism used is reasonable, the courts give the benefit of the doubt to the elected officials that develop and implement the regulation. However, if the strategy does not really relate to the achievement of the desired objectives, the courts could find the regulations arbitrary.

In dealing with environmental protection issues, it is critical to focus on the resources and the exact form of protection that they need. In general, this would indicate different zoning districts for each unique resource or environmental unit. If the regulations fail to recognize the dramatic differences between critical environmental areas in Madison, then the charge that the decision is arbitrary could be made. Eliminating the arbitrary charge and adopting workable environmental protection regulations is the crux here.

Stage 4 - Any technique that does not balance the means used for protection with public benefits derived from protection has overreached the powers granted by the Constitution. When Stage 4 may result in deprivation of property, it is obvious that there are two separate sides to the issue. On the one hand, there is a requirement to measure the extent to which the regulation results in a loss of value. The greater the economic loss imposed by the regulations, the greater the

likelihood that a deprivation has occurred. The other side of the test is to determine how well the regulation succeeds in its goal and to measure the degree to which alternative strategies actually protect the resource. The ideal regulation is clearly one that provides maximum levels of protection with minimal adverse economic impacts. Generally speaking, a reduction in value of only twenty to thirty percent by environmental regulations will clearly not be a deprivation of substantive due process; however, reductions of fifty percent or more may result in findings that a deprivation has occurred.

Exclusionary Zoning

Exclusionary zoning is essentially a challenge applied to conservation zones that seek to increase minimum lot sizes and vastly reduce density for environmental reasons. While the regulations often profess to protect the environment, they may have little positive effects. The impact of such regulations is that the land costs associated with each dwelling unit are driven up to the point where only the extremely rich can afford to buy home sites.

The practice of large and very large lot zoning has resulted in the creation of exclusionary zones where only limited economic groups have access to housing. If environmental protection strategies inadvertently create a "snob" zone of high land values, it may be argued that the rights of low and medium income persons to locate in these areas of Madison are being violated.

The Taking Issue

This issue is also related to the concept of deprivation. It seems to arise whenever a proposed zoning policy results in a significant downward change in development expectations. The term "taking issue" refers to a reduction in land values through downzoning or regulations. It has been argued that this is a violation of the U.S. Constitution; but, although much litigation has failed to develop a specific definition of when a taking occurs, it is clear that very substantial reductions in property value have not been considered to be a taking as defined in the Fifth Amendment.

Unfortunately, the courts from the U.S. Supreme Court on down have added to the confusion. Justice Brennan, for example, in his famous dissent in San Diego Gas and Electric v. City of San Diego first notes that the Supreme Court has been unable to develop any "set formula to determine where regulation ends and taking begins," and in another footnote adds, "After all, if a policeman must know the Constitution, why not a planner?" (Callies, 1986, p. 450). Consequently, each case is decided on its merits, leaving both municipal lawyers and the landowners' attorneys free to argue their positions.

While there is no hard and fast rule about what is definitively a taking, it is important to note that most cases involve two basic tests- 1) does the regulation bear a reasonable relation to the public health, safety, and welfare, and 2) does it provide a reasonable beneficial use of the land. The courts have continued to expand the concept of a reasonable relationship to public health, safety, and welfare. This area

is unlikely to cause any problem in relation to environmental protection. Note, even in the first zoning case heard by the Supreme Court, it was made clear that a mere diminution of value does not in itself constitute a taking. Although there is no set formula for this, in the Supreme Court case upholding zoning, Village of Euclid v. Ambler Realty Co., the landowners's property value was reduced by 75% and reductions of up to 90% have been sustained. In fact, since environmental matters bear great relation to public health, safety, and welfare, it appears that any regulations must prohibit all beneficial uses to constitute a taking.

The question of what is the value of property is not as simple as it may seem on the surface. The speculative or development expectations of the landowner may not serve as the basis for measuring value reduction. In wetlands cases, there has been a recognition that critical lands may not be destroyed to create value. Simply put, the owner of a swamp owns a swamp and the Constitution does not protect his expectation of converting the swamp by filling it in.

What does all this mean to the regulation of sensitive environmental areas? Not much has changed substantively in the context of the taking law throughout the years although regulations for sensitive resources may be a taking in limited circumstances where a landowner is denied all use of land. But, even where all economic use is prevented, there may be no taking if the landowner's interest in the land is limited by public ownership of waters, navigable servitude, or public trust, if the landowner proposes a use that threatens public safety or may cause a nuisance, or if their proposed use or uses are otherwise unreasonable.

In addition, the Madison Planning Commission must understand that government liability from the taking of private property through regulation is only part of the problem. Liability of another and even more serious sort may result from uncontrolled or unplanned public and private development. A terrific amount of litigation is occurring as a result of damages to development in areas caused by natural hazards. Both governments and private landowners are being successfully sued for blocking drainage, increasing flood heights, causing erosion, causing landslides, inadequately maintaining drainage ditches, and approving private subdivisions and roads which increase damages from natural hazards. In contrast to only a handful of successful taking judgements against governments to date (probably less than fifty), there have been thousands of successful liability suits in recent years based upon common law theories of negligence or nuisance. Although a detailed discussion of these suits is beyond the scope of this discussion, the threat of successful suits against local governments is very real. Sound planning and performance standard regulations can reduce potential government liability from hazards while achieving broader environmental goals with practically no chance of successful takings challenge.

CHAPTER 5

FUTURE DIRECTIONS

The previous chapters have provided a framework for analysis and implementation of growth guidance and environmental protection measures for the City of Madison. Identification of goals, action plans, and key players on the specific issues is a way to define strategic steps the City can take with respect to the environmental issues. By setting a limited number of well-defined priorities, the City can incorporate the environmental issues into the political decisions in the future.

The City of Madison also needs to involve its citizens in a more active role if the aforementioned strategies are to work. The following action items attempt to involve citizens, developers, and local government officials in an attempt to begin the process of formulating growth guidance alternatives. By doing so, these items can also serve as the impetus to form committees and study groups to monitor the critical issues identified in this thesis and implement the growth guidance strategies in a timely manner.

Action Items

Goal Statement: To preserve the rural character of western Madison by promoting environmentally sound uses, particularly in the Jetport Noise Influence Zone.

Action Plan:

a) Work with the FAA and Jetplex officials to review and update planning procedures and changes in the noise influence area.

b) Have periodic breakfast meetings or lunches to informally identify and discuss issues and problems to foster better communication.

c) Acquire and dedicate more land in the area for greenways and recreational uses.

Role Players: City Planning and Zoning Board
Jetplex Administration
Local FAA Administration
City Planner

Goal Statement: Adequate, high quality water supply for all Madison residents and surrounding areas.

Action Plan:

a) The City of Madison should investigate the possibility of using provisions of the Water Quality Act of 1987, primarily its Grants.

b) Begin investigative work with the City of Huntsville in developing a Countywide Water Supply and Quality Commission.

c) Require subdividers and developers to perform environmental assessments for any project within the groundwater recharge area.

Role Players: City Planning Commission
City Administration
Madison Sewer and Water Board
Surrounding Cities

Goal Statement: To develop a comprehensive database of vital environmental information about the Madison Planning Area initially, and then expand to a Planning Information System containing all community data.

Action Plan:

a) Contract with a consultant to analyze needs and develop requirements for the information system

b) Use city planner's expertise in the community to provide a more detailed breakdown of available data.

c) Develop training program for City Employees to use and articulate information system data.

Role Players:

City Planning Commission
City Administration
City Planner
Technical Advisors (possibly University-related)
Chamber of Commerce

Goal Statement: To prohibit land uses that diminish present or prospective aesthetic, recreational, or ecological values of stream banks, surface waters, wetlands, or floodplains.

Action Plan:

a) Vegetative cover near watercourses should be preserved, protected, and replanted when necessary to prevent erosion.

b) The County Soil and Water Conservation District should review all subdivision plats and rezoning applications where drainageways are needed or required.

c) Floodplains should be preserved in their natural state with only limited development consisting of agricultural use and outdoor recreation use.

d) Natural Area Review Sheets should be used to prioritize critical ecological areas.

Role Players:

Soil Conservation District Official
City Planner
Huntsville-Madison County Builders Association
City Planning Commission

Goal Statement: To create an engineering development plan for Sanitary Sewer, Storm Sewer, and Water Utilities.

Action Plan:

a) The City will hire a professional engineering consultant to oversee the creation and implementation of a Master Utilities Plan.

b) The City will continuously update the Master Utilities Plan.

c) In the implementation of the plan, attempt to comply with the engineering parameters of the plan to keep political and land-use decisions separate.

Role Players:

City Administration
City Planning Commission
Madison Water and Sewer Board
Private Consultants

Goal Statement: To keep public roadways and thoroughfares pleasing, uncluttered, barrier free, with easily understandable graphics and signage.

Action Plan:

a) The City should develop a Community Forestry Program to foster the growth of trees everywhere in the city, particularly along streets and highways.

b) The City should become a participant in the "Tree City U.S.A." Program.

c) The City should develop a continuous program for trash removal along public ways, thoroughfares, and city parks, and to hire additional personnel as necessary.

d) Formulate ordinances to maintain natural and unobstructed views of Rainbow and Betts Mountains, to enhance and protect this mountain backdrop.

e) Develop a plan to eliminate from view existing overhead utilities and place them underground.

f) Develop a community beautification board of private citizens to help enforce beautification measures.

Role Players:
City Administration
City Planning Commission
Madison Builders Association
Local Power Board
Community Beautification Board

Summary

It can be seen that the action items mentioned above involve levels of cooperation from all major actors associated with growth guidance in Madison. This cooperation should foster an increasing awareness of the issues mentioned in this study and provide a vehicle for gathering, updating, and monitoring environmentally-related data. This process can also help Madison maintain its status as a governmental unit separate from the City of Huntsville.

The City of Huntsville has already annexed vast amounts of land to the north and south of Madison, and with Limestone County boundary to the west, the Madison planning area has become an island within the region. In fact, the original impetus for this study came from the former members of the planning commission, who identified a need for Madison to establish a competitive position with regard to the Huntsville urban sprawl. This study has shown that the City of Madison has the natural resources to maintain its autonomy, and by applying growth guidance measures these resources can be maintained into the future.

However, it is important to note that the maintenance of high-quality water supplies could involve cooperation with Huntsville. Madison may have difficulty getting additional discharge permits for its wastewater facility due to more stringent EPA guidelines for municipalities with over 10,000 residents. If additional discharge becomes necessary, the City of Huntsville may be able to provide the service as an interim measure while other wastewater treatment strategies are considered.

On the other hand, by creating an Engineering Development Plan and Planning Information System, Madison may be able to manage its capital improvements to keep pace with its growing sewerage needs. The City can use the information gathered by these studies to determine if different methods of sewage treatment are viable alternatives. For instance, by running wastewater through a wetland-type land disposal system, the City could maintain is three million gallon per day discharge allotment into Bradford Creek, yet allow a greater amount of waste to be treated. In this scenario, regional cooperation with Huntsville would not be necessary, and complete independence in providing services could be maintained.

Obviously, by acting upon the goals mentioned above, the City of Madison can budget its environmental resources into the planning process. By constantly monitoring existing conditions, the City can use the process to take a proactive approach to environmental management and growth guidance, and maintain its status as a viable governmental entity. The identification of the major actors and issues in this thesis is only the first step in achieving environmental protection goals. By continually merging planning and resource functions, Madison will not only maintain

its autonomoy, but will also become a model of environmentally sound land use planning for the entire region.

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APPENDICES

APPENDIX A

ZONING REGULATIONS IN THE AIRPORT INFLUENCE ZONE

Section 5-21. Regulations Relating to Airport Obstruction and Clear Zones

The general purpose and intent of this Section is to provide regulations for limiting the height of structures for the protection of the health and welfare of the public and aircraft safety in the approach paths shown on Attachment A to the Official Zoning Map, City of Madison, Alabama.

5-21-1 Establishment of Baseline Measurement Criteria

1. Airport reference point is established and described as follows:
   Latitude 34° - 38' - 35"; Longitude 86° - 40' - 20".

2. The airport elevation is hereby declared to be 638' mean sea level.

3. The elevation of runway 18R for this Ordinance is hereby declared to be 616.9' mean sea level.

4. The elevation of runway 36L for this Ordinance is hereby declared to be 616.9' mean sea level.

5. The elevation of runway 36R for this Ordinance is hereby declared to be 591.3' mean sea level.

6. The elevation of runway 18L for this Ordinance is hereby declared to be 606.4' mean sea level.

5-21-2 Establishment of Air Space Zones

1. Approach - Departure Zone: This zone is established at each end of the runway for landings and takeoffs. The approach - departure zone shall have a width of 1,000 feet at a distance of 200 feet beyond each end of the runway, widening thereafter uniformly to a width of 16,000 feet at a distance of 50,200 feet beyond each end of the runway, its centerline being the continuation of the centerline of the runway.

2. Horizontal Zone: This zone is established as the area within a configuration which the perimeter is constructed

by swinging arcs with a radius of 10,000 feet from the center of each end of the primary surface of each runway of the airport and connecting the adjacent arcs by lines tangent to those arcs.

3. Transitional Zones: These zones extend outward and upward from both sides of the primary surface to an intersection with the horizonal zone. Transitional zones adjacent to the approach - departure zones extend outward and upward from the edge of the approach - departure zones, beginning at the periphery of the horizontal zone, to a distance of 5,000 feet measured horizontally.

4. Conical Zone: This zone is established commencing at the periphery of the horizontal surface and extending outward to a horizontal distance of 4,000 feet.

5-21-3 Establishment of Surfaces and Height Limitations. Except as otherwise provided in this Ordinance, no structure or tree shall be altered, allowed to grow, or maintained in any zone created by this Section to a height in excess of the height elevation hereby established for such zone.

1. Primary Surface: The Primary Surface of runway 18R/36L is 1,000 feet wide with its centerline being the runway centerline and extends 200 feet beyond each of the runway to a length of 10,400 feet.

2. Primary Surface: The Primary Surface of runway 18R/36L is 1,000 feet wide with its centerline being the runway centerline and extends 200 feet beyond each end of the runway to a length of 8,400 feet.

3. Approach - Departure Surface Runway 18R: This surface increases one (1) foot in height for each one hundred (100) feet in horizontal distance beginning at an elevation of 628.1 feet mean sea level and a distance of 200 feet beyond the end of said runway and extending 50,200 feet beyond the end of said runway to an elevation of 1,128 feet MSL.

4. Approach - Departure Surface Runway 18L: This surface increases one (1) foot in height for each one

hundred (100) feet in horizontal distance beginning at an elevation of 607.4 feet mean sea level and at a distance of 200 feet beyond the end of said runway to extending 50,200 feet beyond the end of said runway to an elevation of 1, 106 feet MSL.

5. Approach - Departure Surface Runway 36R: This surface increases one (1) foot in height for each one hundred (100) feet in horizontal distance beginning at an elevation of 591.3 feet mean sea level and a distance of 200 feet beyond the end of said runway and extending 50,200 feet beyond the end of said runway to an elevation of 1,090 feet MSL.

6. Approach - Departure Runway 36L: This surface increased one (1) foot in height for each one hundred (100) feet in horizontal distance beginning at an elevation of 616.9 feet mean sea level and a distance of 200 feet beyond the end of said runway and extending 50,200 feet beyond the end of said runway to an elevation of 1, 114 feet MSL.

7. Transitional Surface: This surface increases one (1) foot in height for each seven (7) feet in horizontal distance extending outward and upward from the primary surface until intersection with the horizontal surface. Transitional surfaces for the approach - departure zone extend from the edges of the approach - departure increasing only one (1) foot in height for each seven (7) feet in horizontal distance, extending to a distance of 5,000 feet measured horizontally from the end of the approach surfaces.

8. Horizontal Surface: This is a horizontal plane 150 feet above the established airport elevation and is bounded by the perimeter of the horizontal zone. The maximum elevation of structures or trees located thereunder shall be 778 feet mean sea level.

9. Conical Surface: This surface extends upward and outward form the periphery of the horizontal surface, increasing one (1) foot in height for every twenty (20) feet in horizontal distance for 4,000 feet in distance

measured horizontally, commencing at 778 feet mean sea level and the perimeter being 978 feet mean sea level.

5-21-4 Use Restrictions. Notwithstanding any other provisions of this Ordinance, no use may be made of land within any airport hazard zone in such a manner as to create electrical interference with radio communication between the airport and aircraft, make if difficult for flyers to distinguish between airport lights and others, result in glare in the eyes of flyers using the airport, impair visibility in the vicinity of the airport, or otherwise endanger the landing, taking-off, or maneuvering of aircraft. Nothing in this Ordinance shall be construed as prohibiting the growth of any tree to a height of fifty (50) feet or the construction of any structure to a height of thirty-five (35) feet above the surface of the land.

5-21-5 Hazard Marking and Lighting. The owner of any structure or tree is hereby required to permit the installation, operation and maintenance thereon of such markers and lights as shall be deemed necessary by the Airport Manager or Federal Aviation Administration to indicate to the operators of aircraft in the vicinity of the Airport, the presence of airport hazards.

5-21-6 Non-Conforming Uses. The regulations prescribed by this Ordinance shall not be construed to required the removal, lowering or other chances or alternations of any structure or tree not conforming to the regulations as of the effective date of this Ordinance, or otherwise interfere with the continuance of any non-conforming use. Nothing herein contained shall require any change in the structure, alternation, or intended use of any structure, the construction or alteration of which was begun prior to the effective date of this Ordinance and is diligently executed.

APPENDIX B

DISCLOSURE STATEMENTS FOR PROSPECTIVE PURCHASERS OF LAND IN THE AIRPORT INFLUENCE ZONE

A. ACOUSTICAL TREATMENT REQUIREMENTS FOR EDUCATIONAL AND INSTITUTIONAL USES, HOTELS AND MOTELS, AND RESIDENTIAL STRUCTURES WITHIN THE 70-75 dBA-Ldn RANGE *

If the anticipated exterior noise levels resulting from aircraft flyovers fall into the 70-75 dBA-Ldn range and the development is in accordance with all other existing codes, ordinances and comprehensive plan provisions, the following requirements will apply:

1. In order to achieve a maximum interior noise level of 45 dBA in all units located within the 70-75 dBA-Ldn portion of the Huntsville-Madison County Jetport Noise Impact Area, all units in the development shall have the following acoustical attributes:

   a. Roofs and exterior walls shall have a laboratory sound transmission class (STC) of at least 45; and

   b. Doors and windows shall have a laboratory sound transmission class (STC) of at least 37.

2. Construction drawings for all units shall be submitted to the City for review and certification that the proposed materials and construction techniques appear to be satisfactory for the desired acoustical treatment and in conformance with all applicable provisions of the state building code.

3. Within 30 working days of receipt of appropriate construction drawings, the City shall approve or reject the drawings based upon the ability of the proposed construction materials and techniques to adequately insulate the interior of all structures as set forth in requirement 1 above. In the event that the drawings are rejected, the reasons for this action shall be submitted to the builder/developer in writing. No construction of units shall occur prior to the approval of appropriate construction drawings.

4. No occupancy permit shall be granted for any unit in this development until the unit has been officially inspected by the City and it has been determined that the unit has been constructed in accordance with all specifications of the approved construction drawings referenced in requirements 2 and 3 above.

5. The City shall have the right to inspect all residential units in this development at any time prior to occupancy.

B. FULL DISCLOSURE REQUIREMENTS TO PROSPECTIVE PURCHASERS OF RESIDENTIAL UNITS WITHIN THE HUNTSVILLE/MADISON COUNTY JETPORT NOISE IMPACT AREA OF THE CIRCUMSTANCES OF THE AIRCRAFT NOISE IMPACT

In the event that, pursuant to adopted City of Madison policy existing at the time of subdivision, any portion of the property to be subdivided lies within the 70-75 dBA-Ldn range according to the Huntsville-Madison County Jetport Noise Impact contours for the post-year 1995 period, the following statement shall be included in the subdivision plat of dedication under the caption "Disclosure":

> *"This property is located near the Huntsville-Madison County Jetport and the project of aircraft noise is in the 70-75 dBA-Ldn range according to the Huntsville-Madison County Jetport Noise Impact contours for the post-year 1995 period. If the noise level projection continues at this level, certain acoustical treatment which is designed to insure normal livability within the house will be installed by the builder but not such measures have been or can be accomplished with regard to the exterior."*

In the event that, pursuant to adopted City of Madison policy existing at the time of house construction, any lot lies within the 70-75 Ldn range according to the Huntsville-Madison County Jetport Noise Impact contours for the post-year 1995 period, to insure full disclosure to prospective buyers of said lot(s) in any house sale contract of this fact, a statement shall be obtained by the developed from each purchaser and submitted to the City as a prerequisite to issue of the Certificate of Occupancy stating that:

1. full disclosure has been made to the prospective purchaser that the subdivision in which the dwelling is located is near the Huntsville-Madison County Jetport and the projected level of aircraft noise is in the 70-75 dBA Ldn range according to the Huntsville-Madison County Jetport Noise Impact contours for the post-year 1995 period; and that

2. certain acoustical treatment of the house has been installed by the builder to insure normal livability within the house but that no such measures have been or can be accomplished with regard to the exterior of the house.

* These acoustical treatment requirements also are applicable to offices, personal, business and professional services, retain commercial uses, movie theaters, and restaurants in the over 75 dBA Ldn zone.

C. ACOUSTICAL TREATMENT REQUIREMENTS FOR EDUCATIONAL AND INSTITUTIONAL USES, HOTELS AND MOTELS, AND RESIDENTIAL STRUCTURES WITHIN THE 65-70 dBA-Ldn RANGE*

If the anticipated exterior noise levels resulting from aircraft flyovers fall into the 65-70 dBA-Ldn range and the development is in accordance with all other existing codes, ordinances and comprehensive plan provisions, the following requirements will apply:

1. In order to achieve a maximum interior noise level of 45 dBA in all units located within the 65-70 dBA-Ldn portion of the Huntsville-Madison County Jetport Noise Impact Area, all units in the development shall have the following acoustical attributes:

    a. Roofs and exterior walls shall have a laboratory sound transmission class (STC) of at least 39; and

    b. Doors and windows shall have a laboratory sound transmission class (STC) of at least 28.

2. Construction drawings for al units shall be submitted to the City for review and certification that the proposed materials and construction techniques appear to be satisfactory for the desired acoustical treatment and in conformance with all applicable provisions of the state building code.

3. Within 30 working days of receipt of appropriate construction drawings, the City shall approve or reject the drawings based upon the ability of the proposed construction materials and techniques to adequately insulate the interior of all structures as set forth in requirement 1 above. In the event that the drawings are rejected, the reasons for this action shall be submitted to the builder/developer in writing. No construction of units shall occur prior to the approval of appropriate construction drawings.

4. No occupancy permit shall be granted for any unit in this development until the unit has been officially inspected by the City and it has been determined that the unit has been constructed in accordance with all specifications of the approved construction drawings referenced in requirements 2 and 3 above.

5. The City shall have the right to inspect all residential units in this development at any time prior to occupancy.

D. FULL DISCLOSURE REQUIREMENTS TO PROSPECTIVE PURCHASERS OF RESIDENTIAL UNITS WITHIN THE HUNTSVILLE/MADISON COUNTY JETPORT NOISE IMPACT AREA OF THE CIRCUMSTANCE OF THE AIRCRAFT NOISE IMPACT

In the event that, pursuant to adopted City of Madison policy existing at the time of subdivision, any portion of the property to be subdivided lies within the 65-70 dBA-Ldn range according to the Huntsville-Madison County Jetport Noise Impact contours for the post-year 1995 period, the following statement shall be included in the subdivision plat of dedication under the caption "Disclosure":

> *"This property is located near the Huntsville-Madison County Jetport and the projection of aircraft noise is in the 65-70 dBA-Ldn range according to the Huntsville-Madison County Jetport Noise Impact contours for the post-year 1995 period. If the noise level projection continues at this level, certain acoustical treatment which is designed to insure normal livability within the house will be installed by the builder but no such measures have been or can be accomplished with regard to the exterior."*

In the event that, pursuant to adopted City of Madison policy existing at the time of house construction, any lot lies within the 65-70 Ldn range according to the Huntsville-Madison County Jetport Noise Impact contours for the post-year 1995 period, to insure full disclosure to prospective buyers of said lot(s) in any house sale contract of this fact, a statement shall be obtained by the developer from each purchaser and submitted to the City as a prerequisite to issue of the Certificate of Occupancy stating that:

1. full disclosure has been made to the prospective purchaser that the subdivision in which the dwelling is located is near the Huntsville-Madison County Jetport and the project level of aircraft noise is in the 65-760 dBA-Ldn range according to the Huntsville-Madison County Jetport Noise Impact contours for the post-year 1995 period; and that

2. certain acoustical treatment of the house has been installed by the builder to insure normal livability within the house but that no such measures have been or can be accomplished with regard to the exterior of the house.

* These acoustical treatment requirements are also applicable to offices, personal, business and professional services, retain commercial uses, movie theaters, and restaurants in the over 70-75 dBA-Ldn zone.

E. FULL DISCLOSURE REQUIREMENTS TO PROSPECTIVE PURCHASERS OF RESIDENTIAL UNITS WITHIN THE HUNTSVILLE/MADISON COUNTY JETPORT NOISE IMPACT AREA OF THE CIRCUMSTANCES OF THE AIRCRAFT NOISE IMPACT

In the event that, pursuant to adopted City of Madison policy existing at the time of subdivision, any portion of the property to be subdivided lies within the Noise Influence Zone but outside of the 65-70 dBA-Ldn range according to the Huntsville-Madison County Jetport Noise Impact contours for the post-year 1995 period, the following statement shall be included in the subdivision plat of dedication under the caption "Disclosure":

> *"This property is located within the Noise Influence Zone as defined by the Huntsville-Madison County Jetport Authority but outside the 65 dBA-Ldn Noise Impact contour."*

VITA

James Joseph Lumley, Jr. was born on June 12, 1963 in Reading, Pennsylvania. He graduated from Boyertown Area High School in June of 1981, and Albright College in 1985 with a degree in Political Science. In 1986 he entered the Graduate School of Planning the University of Tennessee in Knoxville and in August of 1992 received a Master of Science Degree in Planning. He is currently employed as a Research Associate with the Energy, Environment, and Resources Center at the University of Tennessee.