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Theme:
"Beyond The Bicentennial:
The Transportation Challenge"

October 28-29-30, 1976
Sheraton-Boston Hotel
Boston, Massachusetts

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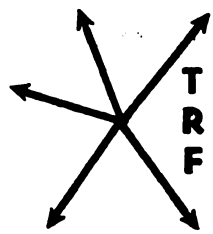

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Model Airport Land Use Control System

*by Max A. Wolfe**

THE MODEL AIRPORT land use control system is a comprehensive method of land use evaluation and control for large airports used primarily by civil air carriers. The system was devised by Howard Needles Tammen and Bergendoff for use by the Lake Erie Regional Transportation Authority as a tool in the site selection and feasibility study for a new air carrier airport for the Cleveland service area.

The system consists of ten zones: three noise intensity zones, a bird hazard zone, two public safety zones and four obstruction hazard zones. Zones may overlap a zone or zones of another type.

The noise zones are based on ASDS (Aircraft Sound Description System) and NEF (Noise Exposure Forecast) contours, the ASDS 85dbA contour providing the outer limit of the low intensity zone with the NEF 30 and NEF 40 contours delineating the medium and high intensity zones. The bird hazard zone is a 10,000 foot radius oval around each runway; the public safety zones together make up a trapezoid extending 2.5 miles from runway end; the obstruction hazard zones are based on Part 77 of the Federal Aviation Regulations.

A matrix of the 74 land-use categories arrayed against the six zones (not including obstruction zones) provides the central recommendations of the system. Also included is a series of guidelines for consideration of smoke, glare, fog and electro-magnetic interference. The model airport land use control system is written so that it can be incorporated into a community zoning ordinance with minor modifications.

INTRODUCTION

The mutual compatibility of airports and their surrounding land uses has long been a subject of concern to aviation planners. The first major technique affecting airport land use occurred in 1950 with the adoption by the Civil Aeronautics Administration of Technical Order N-18, "Criteria for Determining Obstructions to Air Navigation."[1] This Order, a forerunner to Part 77 of the Federal Aviation Regulations,[2] sought to protect aircraft and ground occupants alike from the hazards of aircraft collisions with obstacles. The decade of the 1960s saw several important techniques developed to forecast aircraft noise and to control land use development through such systems as the Composite Noise Rating (CNR) and the Noise Exposure Forecast (NEF).[3] Further research in the 1970s resulted in the development of other noise description and forecasting methods, most notably the Aircraft Sound Description System (ASDS)[4] adopted for use by the Federal Aviation Administration.

Throughout these three decades, and before, attention was also given to a variety of other land-use related hazards to aviation including smoke, glare, birds, electro-magnetic interference, and fog. In spite of the great progress made in dealing with these problems individually, much remains to be done in dealing with aircraft noise and aviation hazards in a single, comprehensive airport land use planning system.

This paper discusses the development and uses of the Model Airport Land Use Control System, a comprehensive system designed for use in the siting, evaluation and land use control for large air carrier airports The system was designed for use by the Lake Erie Regional Transportation Authority, its consultants, and others having an interest in LERTA's Airport Site Selection and Feasibility Study for a new air carrier airport to serve northeastern Ohio but is equally applicable to other similar airports.

BASIS OF THE SYSTEM

The Model Airport Land Use Control System is based on a hypothetical large airport used primarily by civil air carriers and having multiple, precision instrument runways; the specific airport examples shown are based on runway lengths of 12,000 feet. The system consists of ten zones: three noise intensity zones (low, medium and high); a bird hazard zone; two public safety zones (Zones A and B); and four obstruction zones (precision instrument runway approach, transitional, horizontal and conical). Also included in the system are series of guidelines for dealing with land-use related aviation hazards which do not lend themselves to zoning techniques.

NOISE INTENSITY ZONES

The purpose of the noise intensity zones is to protect the physical and men-

**Senior Planner, Howard Needles Tammen & Bergendoff, Suite 918, 33 Public Square, Cleveland, Ohio.*

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tal health of residents, employees and visitors in the zones from the noise of aircraft operating on, to or from the airport for which the zones were delineated; and to protect the community from the adverse effects of blight resulting from the development and consequent deterioration of land uses incompatible with aircraft noise.

The Low Intensity Noise Zone is the area expected to be impacted on a regular basis by noise levels of 85dbA or greater but experiencing a noise impact of less than NEF 30. The "worst case" aircraft selected for the 85dbA footprint was the Boeing 727-200, retrofitted with quiet nacelles, which produced the longest contour of all aircraft meeting the requirements of Part 36 of the Federal Aviation Regulation.[5] The inner contour, NEF 30, represents the point at which substantial interference with land uses begins to occur.[6] The Low Intensity Noise Zone is an area which is suitable for all land uses except those which are highly sensitive to aircraft noise, regardless of the frequency of aircraft passage overhead.[7]

The zone outline on Exhibit 1 was based on the average of noise contour forecast for a proposed airport,[8,9] and was generalized to accommodate a variety of take-off flight tracks. The zones will normally be smaller at actual airports when specific take-off flight tracks are limited to designated departure patterns.

The Medium Intensity Noise Zone is the area between the NEF 30 and NEF 40 contours where substantial land use conflicts occur resulting in possible vigorous complaints and concerted group action. The zone was generalized in a manner similar to the Low Intensity Noise Zone.

The High Intensity Noise Zone is the area within the NEF 40 contour where noise is normally intolerable for residents.[10] The zone was generalized into a rectangular shape to account for slight bends of the leading edge of the contour to the left and right resulting from aircraft turns during departure.

BIRD HAZARD ZONE

The purpose of the Bird Hazard Zone is to protect against aircraft accidents, and the consequent peril to lives and property in the air and on the ground, resulting from collision with birds or from the ingestion of birds into aircraft engines.[11] The Bird Hazard Zone is an oval-shaped area resulting from a line drawn 10,000 feet from all points on the runway centerline. The distance criterion is based on the FAA's recommendation in their Order 5200.5 of locating sanitary landfills beyond that distance

MODEL AIRPORT NOISE, BIRD HAZARD AND PUBLIC SAFETY ZONES

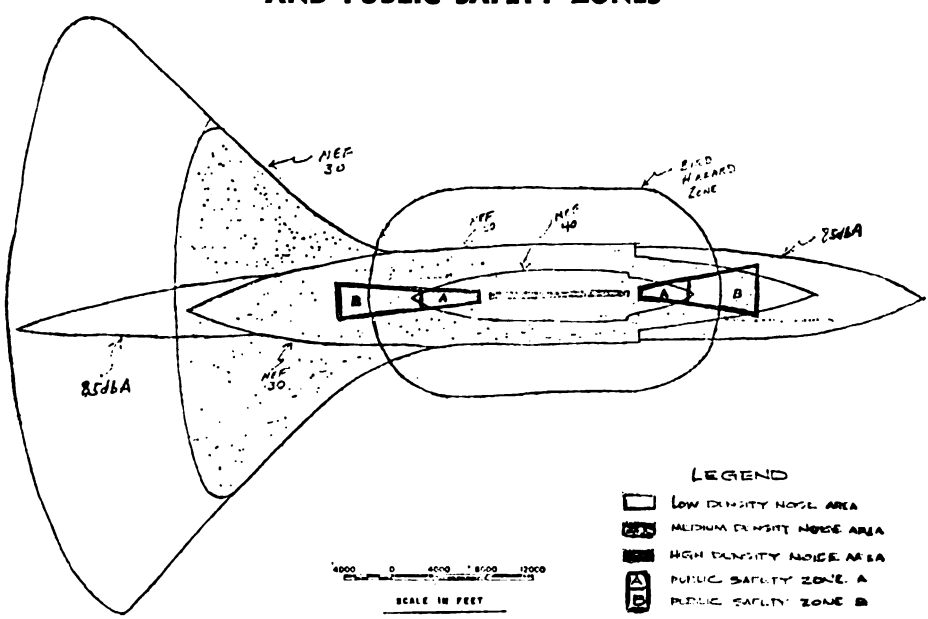

EXHIBIT 1

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from the runway to provide bird hazard avoidance.[12] The FAA criterion takes into account possible conflicts between the airport approach surfaces and the probable flight profiles of birds to and from nesting and/or feeding grounds.

PUBLIC SAFETY ZONES

The purpose of the public safety zones is to protect against disasters involving large concentrations of people on the ground resulting from aircraft crashes either by direct collision or by secondary explosions, fires and leakages of radiation and toxic liquids and gasses from land uses. The public safety zones consist of Zone A and Zone B.[13]

Public Safety Zone is trapezoidal and extends outward 5,000 feet from the runway end of the safety zone as depicted on Exhibit 1. The zone is equivalent to the area described as eligible for participation in the ADAP (Airport Development Aid) Program.[14] Zone B is trapezoidal and extends 8,200 feet outward from Zone A. Zone A represents an area of higher ground accident exposure than Zone B; the two zones, together with the airport primary surface, historically contain approximately 90 percent of all civil air carrier and military aircraft ground collision accidents.[15,16]

OBSTRUCTION HAZARD ZONES

The purpose of the obstruction hazard zones is to protect against aircraft accidents and reduced capacity of the airport to accommodate air traffic demand due to the establishment of objects which would constitute obstructions to aircraft operating to, from, and in the vicinity of the airport for which the zones are delineated. The four obstruction hazard zones, as shown on Exhibit 2, control maximum height rather than specific land uses. The zones, located beneath what are often referred to as imaginary surfaces, are based on Part 77 of the Federal Aviation Regulations.[17]

OTHER LAND-USE CONSIDERATIONS

Other considerations in airport siting and land-use control, listed below, can be determined to be hazards only on a case-by-case basis; when warranted, corrective action should be taken.

- SMOKE—Land uses which emit large volumes of smoke may create a restriction to air navigation and cause a reduction in the operational capacity of the airport.[18] Potential detrimental effects should be determined on the basis of aircraft flight patterns and prevailing winds.
- GLARE may create a hazard to air navigation by misleading or blinding pilots during the final stage of approaches to landings. The cause of the glare may be lights associated with a freeway, an illuminated sign, etc., which can be mistaken for the airport lighting system at night or may be sunlight reflected from a building or other structure. With respect to the latter problem, it is particularly useful to be alert to existing or planned large structures of unusual architecture, especially large glass-faced buildings whose walls are not perpendicular to the ground.
- ELECTRO-MAGNETIC INTERFERENCE with airport radar in critical directions and with instrument landing systems may constitute a hazard to precise air navigation and result in the unnecessary expenditure of public funds to alleviate the problem. Buildings, power lines and other structures can create a shadow effect on airport radar and may cause unsafe reflections in radio signals from glide-slopes, localizers, beacons and VORs. Industrial equipment may emit radio signals of a critical frequency causing false indications from aircraft instruments. Each airport site is unique in terms of inter-relationships of its physiography, navaid arrangement and flight patterns, the principal baseline factors against which the potential for electro-magnetic interference can be

OBSTRUCTION HAZARDS — ZONING PLAN

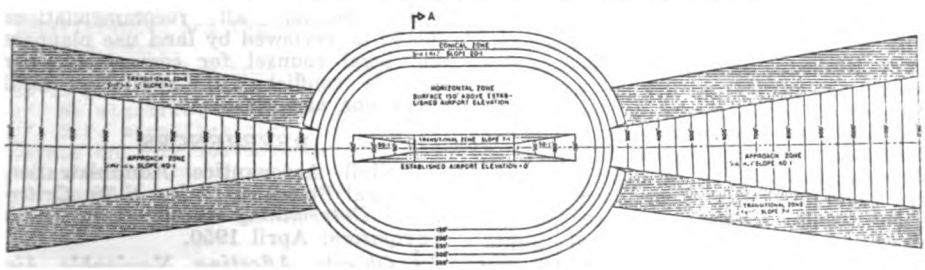

EXHIBIT 2

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determined. It is recommended that the Federal Aviation Administration be consulted to designate critical areas around a site for early review of land use proposals which could create electro-magnetic interference.

● FOG may constitute a hazard for aircraft landings, takeoffs, and ground operations and may reduce the operational capacity or force the closing of an airport. Fog potential may usually be determined when siting an airport. The site's exposure to areawide fog formation, primarily caused by advection, frontal, and uplift fog, is usually well known to meteorologists and local residents. Fog dispersal systems are available which may reduce the extent of fog.[19,20]

Local fog is usually radiation fog caused by faster cooling of the ground relative to the air around it. Radiation fog will form more easily where cold air drains into topographically low areas and where industrial smoke contributes to the condensation nuclei which are usually necessary for fog formation. Large areas of water or poor drainage near a runway will contribute additional water vapor to the air and aid in fog formation. These conditions should be anticipated during airport siting and the proper grading and drainage techniques should be employed to alleviate the problem.

Abatement action should be taken against nearby industries which emit large volumes of fog-producing particular matter and smog-producing gasses into the air; new heavy-pollution industries should be prohibited.

RECOMMENDED LAND USE RESTRICTIONS

Recommended land use restrictions for 74 land-use types were developed in the Model Airport Land Use Control System for all zones,[21,22,23] except obstruction hazard zones which contain height restrictions only, and are shown on Exhibit 3. A recommendation is made for each land use type, by zone, as to whether or not it should be permitted, prohibited or allowed by special permit. The special permit procedure is a common land-use zoning technique which allows the regulating agency to impose reasonable requirements to ensure that the land use is developed in a manner consistent with the intent of the zone. Acoustical insulation or planting barriers could be required to lower interior noise levels, special anti-pollution devices could be installed, and lights could be shielded, for example. On the other hand, the permit review procedure could conclude that the land use, as planned, is compatible with airport operations or could not be compatible regardless of the modifications required.

INSTRUCTIONS FOR USE

For a specific airport, prerequisite material must first be developed: the geometric configuration of runways and the runway lengths (with airport elevation point established for obstruction hazard zoning); and NEF 30 and 40 and ASDS 85dbA noise contours (for noise zones). The zones may then be delineated using the prerequisite material and based on the criteria previously discussed.

Where zones associated with one runway overlap similar zones for alternate runways, the most restrictive standard should apply. Where zones of different types overlap, a land use must meet all applicable zone requirements. The recommended land use restrictions for any point in any zone, or combination of zones, may then be determined from Exhibit 3. These land uses must not violate the height limitation outlined on Exhibit 2.

The end result of defining the six land-use zones and four height zones to a multiple runway configuration will resemble the schematic zones shown on Exhibits 4, 5 and 6. The zoning pattern in Exhibit 4 is representative of patterns for an airport which has no restrictions on the routing of inbound and outbound aircraft. In Exhibit 5, the zones are substantially reduced commensurate with the operational constraints imposed by existing land-use in the vicinity of the airport. The height zoning pattern in Exhibit 6 is dictated solely by the runway configuration.

In the event that the Model Airport Land Use Control System is used in preparing land use regulations, two points must be noted. First, the recommendations were developed for a typical large airport with precision instrument runways used primarily by civil air carrier aircraft. Any attempt to apply the regulations to other types of airports requires modification of the recommendations. Second, all recommendations should be reviewed by land use planners and legal counsel for compatibility or possible conflict with applicable local conditions and statutes.

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RECOMMENDED LAND USE CONTROLS[a]

Land Use Type	Noise Intensity Zones			Bird Hazard Zone	Public Safety Zones	
	Low	Medium	High		Zone A	Zone B
Residential						
High Density						
• Single Family	Yes [b]	No [c]	No	Yes	No	No
• Multi-Family	Yes	S.P.[d]	No	Yes	No	No
• Mobile Homes	Yes	No	No	Yes	No	No
Low Density						
• Single Family	Yes	No	No	Yes	No	Yes
• Mobile Homes	Yes	No	No	Yes	No	No
Motels - Hotels	Yes	S.P.	No	Yes	No	No
All Others	Yes	S.P.	No	Yes	No	No
Retail Trade and Services						
Commercial Offices	Yes	S.P.	No	Yes	No	S.P.
Marine Craft, Aircraft	Yes	Yes	Yes	Yes	Yes	Yes
Mobile Homes	Yes	Yes	No	Yes	Yes	Yes
Construction Contractors' Yards	Yes	Yes	Yes	Yes	Yes	Yes
Building Materials, Construction and Repair	Yes	Yes	Yes	Yes	Yes	Yes
Auto, Truck, Farm Equipment	Yes	Yes	No	Yes	Yes	Yes
Veterinary Hospital and Kennels	Yes	Yes	Yes	Yes	Yes	Yes
Medical and Health	Yes	S.P.	No	Yes	No	No
Aviation Schools	Yes	Yes	No	Yes	No	No
All Others [e]	Yes	Yes	No	Yes	No	S.P.
Manufacturing and Bulk Storage Wholesaling and Handling						
Food (Human and Animal)	Yes	Yes	Yes	S.P.	No	Yes
Chemicals	Yes	Yes	Yes	Yes	No	S.P.
Petroleum	Yes	Yes	Yes	Yes	No	S.P.
Rubber and Plastics	Yes	Yes	Yes	Yes	No	S.P.
Primary Metals	Yes	Yes	Yes	Yes	No	Yes
Salvage Yards	Yes	Yes	Yes	Yes	Yes	Yes
Communications, Manufacture and Research	Yes	S.P.	No	Yes	No	Yes
All Others [e]	Yes	Yes	Yes	Yes	No	S.P.
Transportation						
Railroads (other than yards)	Yes	Yes	Yes	Yes	Yes	Yes
Railroad Switching Yards	Yes	Yes	Yes	Yes	No	No
Cargo Terminals	Yes	Yes	Yes	Yes	S.P.	Yes
Passenger Terminals	Yes	Yes	Yes	Yes	No	No
Road Right-of-Way	Yes	Yes	Yes	Yes	Yes	Yes
Automobile Parking	Yes	Yes	Yes	Yes	Yes	Yes
Port Facilities and Berths	Yes	Yes	Yes	Yes	No	S.P.
All Others [e]	Yes	Yes	Yes	Yes	No	S.P.

[a] Other land use considerations including smoke, glare, electro-magnetic interference and fog are discussed under "Other Land Use Considerations" on this chart.
[b] Yes signifies that the land use type should be permitted provided that it is permitted in all other overlapping zones, if any.
[c] No signifies that the land use type should not be permitted.
[d] S.P. signifies that the land use type should be authorized by special permit only if suitable design measures are taken and assurances are given which ensure that the purposes of the zone are not violated.
[e] Local conditions may warrant further extraction and designation of specific land use types from this general group.

EXHIBIT 3

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Land Use Type	Noise Intensity Zones			Bird Hazard Zone	Public Safety Zones	
	Low	Medium	High		Zone A	Zone B
Communications						
TV, Radio and Microwave Towers	Yes	Yes	Yes	Yes	Yes	Yes
TV and Radio Studios	Yes	No	No	No	No	No
Institutional						
Governmental Offices	Yes	Yes	No	Yes	No	No
Correctional Institutions	Yes	S.P.	No	Yes	No	No
Military Installations	Yes	Yes	Yes	Yes	S.P.	S.P.
Schools and Libraries	S.P.	S.P.	No	Yes	No	No
Religious	Yes	S.P.	No	Yes	No	No
Cemeteries	Yes	S.P.	No	Yes	No	No
Medical and Health	S.P.	No	No	Yes	No	No
Cultural Entertainment and Recreation						
Performing Arts, Indoors	Yes	S.P.	No	Yes	No	No
Performing Arts, Outdoors	No	No	No	Yes	No	No
Movie Theaters, Indoors	Yes	S.P.	No	Yes	No	No
Movie Theaters, Outdoors	Yes	No	No	Yes	No	No
Nature Exhibits	Yes	Yes	No	S.P.	Yes	Yes
Parks	Yes	Yes	No	S.P.	No	S.P.
Wildlife Management Area	Yes	Yes	Yes	S.P.	Yes	Yes
Nature Preserves	Yes	Yes	Yes	S.P.	Yes	Yes
Resorts and Group Campgrounds	Yes	No	No	Yes	No	No
Playgrounds	Yes	Yes	No	Yes	No	No
Spectator Sports	Yes	Yes	No	Yes	No	No
Participant Sports, Indoors	Yes	Yes	No	Yes	No	No
Participant Sports, Outdoors	Yes	Yes	No	Yes	S.P.	Yes
Expositions, Fairs, Carnivals, Circuses	Yes	No	No	Yes	No	No
Resource Production and Extraction						
Livestock Farming	Yes	Yes	S.P.	S.P.	Yes	Yes
Orchards	Yes	Yes	Yes	S.P.	Yes	Yes
All Other Agriculture	Yes	Yes	Yes	Yes	Yes	Yes
Forestry, Including Sawmills	Yes	Yes	Yes	Yes	Yes	Yes
Commercial Fishing	Yes	Yes	Yes	No	Yes	Yes
Mining	Yes	Yes	Yes	Yes	Yes	Yes
Undeveloped Areas						
Unused Land	Yes	Yes	Yes	Yes	Yes	Yes
Sanitary Landfill	Yes	Yes	Yes	S.P.	Yes	Yes
Water Areas	Yes	Yes	Yes	S.P.	Yes	Yes
Utilities						
Water Storage and Treatment	Yes	Yes	Yes	S.P.	Yes	Yes
Water Lines	Yes	Yes	Yes	Yes	Yes	Yes
Gas Storage Facilities	Yes	Yes	Yes	Yes	No	No
Gas Lines	Yes	Yes	Yes	Yes	Yes	Yes
Electric Generation Station	Yes	Yes	Yes	Yes	No	No
Electric Sub-Stations	Yes	Yes	Yes	Yes	No	Yes
Electric Lines	Yes	Yes	Yes	Yes	Yes	Yes
Sewage Treatment	Yes	Yes	Yes	Yes	Yes	Yes
Sewage Lines	Yes	Yes	Yes	Yes	Yes	Yes

EXHIBIT 3 (continued)

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**ZONING SCHEMATIC
HYPOTHETICAL AIRPORT WITH
NO AIRCRAFT TURN RESTRICTIONS**

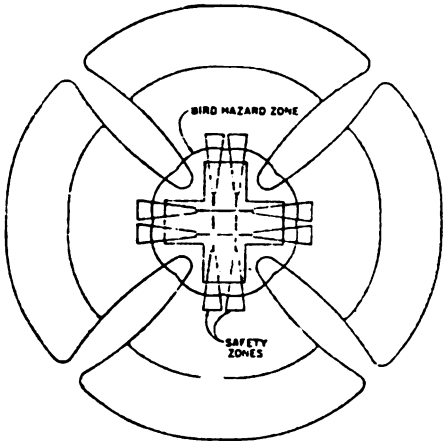
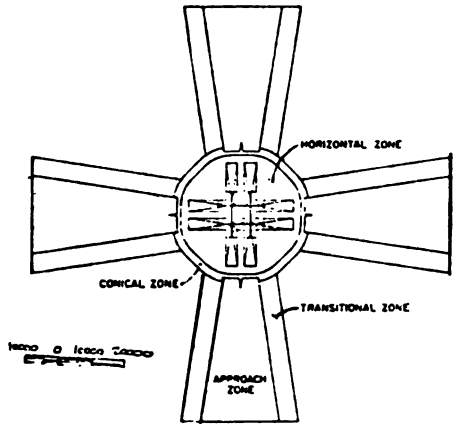


EXHIBIT 4

**SCHEMATIC VIEW
MULTIPLE RUNWAY CONFIGURATION
OBSTRUCTION ZONES**



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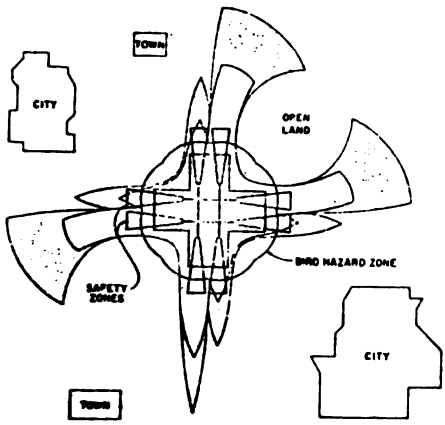
**ZONING SCHEMATIC
HYPOTHETICAL AIRPORT WITH
AIRCRAFT TURN RESTRICTIONS**



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