

Air Installation Compatible Use Zone (AICUZ) Study Westover Air Reserve Base, Massachusetts

United States Air Force
February 2013



FINAL

Volume II



VOLUME II APPENDICES

Westover Air Reserve Base, Massachusetts AICUZ
United States Air Force

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WESTOVER ARB AICUZ
VOLUME II
APPENDICES

This is the companion document to Volume I of the Air Installation Compatible Use Zone (AICUZ) Study prepared for Westover Air Reserve Base, Massachusetts, in February 2013. It contains supplemental AICUZ information.

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A. APPENDIX A

THE AICUZ CONCEPT, PROGRAM, METHODOLOGY, AND POLICIES

A.1 Concept

Federal legislation, national sentiment, and other external forces which directly affect the United States Air Force mission have served to greatly increase the Air Force's role in environmental and planning issues. Problems of airfield encroachment from incompatible land uses surrounding installations, as well as air and water pollution and socio-economic impact, require continued and intensified USAF involvement. The nature of these problems dictates direct USAF participation in comprehensive community and land use planning. Effective, coordinated planning that bridges the gap between the federal government and the community requires the establishment of good working relationships with local citizens, local planning officials, and state and federal officials. This planning depends upon creating an atmosphere of mutual trust and helpfulness. The Air Installation Compatible Use Zone (AICUZ) concept has been developed in an effort to:

- Protect local citizens from the noise exposure and accident potential associated with flying activities.
- Prevent degradation of the Air Force's capability to achieve its mission by promoting compatible land use planning.

The land use guidelines developed herein are a composite of a number of other land use compatibility studies that have been refined to fit the Westover ARB aviation environment.

A.2 Program

Base Commanders establish and maintain active programs to achieve the maximum feasible land use compatibility between air installations and neighboring communities. The program requires that all appropriate governmental bodies and citizens be fully informed whenever AICUZ or other planning matters affecting the installation are under consideration. This includes positive and continuous programs designed to:

- Provide information, criteria, and guidelines to federal, state, regional, and local planning bodies, civic associations, and similar groups.
- Inform such groups of the requirements of the flying activity, noise exposure, aircraft accident potential, and AICUZ plans.
- Describe the noise reduction measures that are being used.
- Ensure that all reasonable, economical, and practical measures are taken to reduce or control the impact of noise-producing activities. These measures include such considerations as proper location of engine test facilities, provision for sound

suppressers where necessary, and adjustment of flight patterns and/or techniques to minimize the noise impact on populated areas. This must be done without jeopardizing safety or operational effectiveness.

A.3 Methodology

The AICUZ consists of land areas upon which certain land uses may obstruct the airspace or otherwise be hazardous to aircraft operations; and land areas which are exposed to the health, safety, or welfare hazards of aircraft operations. The AICUZ includes:

- Accident Potential Zones (APZ) and clear zones (CZ) based on past Air Force aircraft accidents and installation operational data (Appendix B).
- Noise zones (NZs) produced by the computerized Day-Night Average A-Weighted Sound Level (DNL) metric (Appendix C).
- The area designated by the Federal Aviation Administration and the Air Force for purposes of height limitations in the approach and departure zones of the base (Appendix D).

The APZs, CZ, and NZs are the basic building blocks for land use planning with AICUZ data. Compatible land uses are specified for these zones, and recommendations on building materials and standards to reduce interior noise levels inside structures are provided in Appendix E.

As part of the Air Installation Compatible Use Zone program, the only real property acquisition for which the USAF has received congressional authorization and the base and Major Commands request appropriation are the areas designated as the CZ. Real property interests are acquired by fee or easement giving the base control over the use of the property. Fee land so acquired may be leased out for agricultural or grazing purposes. Compatible land use controls for the remaining airfield environs should be accomplished through the community land use planning processes.

A.4 AICUZ Land Use Development Policies

The basis for any effective land use control system is the development of, and subsequent adherence to, policies which serve as the standard by which all land use planning and control actions are evaluated. Westover ARB recommends the following policies be considered for incorporation into the comprehensive plans of agencies in the vicinity of the base environs:

A.4.1 Policy 1. In order to promote the public health, safety, peace, comfort, convenience, and general welfare of the inhabitants of airfield environs, it is necessary to:

- Guide, control, and regulate future growth and development.

- Promote orderly and appropriate use of land.
- Protect the character and stability of existing land uses.
- Prevent the destruction or impairment of the airfield and the public investment therein.
- Enhance the quality of living in the areas affected.
- Protect the general economic welfare by restricting incompatible land use.

A.4.2 Policy 2. In furtherance of Policy 1, it is appropriate to:

- Establish guidelines of land use compatibility.
- Restrict or prohibit incompatible land use.
- Prevent establishment of any land use which would unreasonably endanger aircraft operations and the continued use of the airfield.
- Incorporate the Air Installation Compatible Use Zone concept into community land use plans, modifying them when necessary.
- Adopt appropriate ordinances to implement airfield environs land use plans.

A.4.3 Policy 3. Within the boundaries of the Clear Zone (CZ), certain land uses are inherently incompatible. The following land uses are not in the public interest and must be restricted or prohibited:

- Uses that release into the air any substance, such as steam, dust, or smoke, which would impair visibility or otherwise interfere with the operation of aircraft.
- Uses that produce light emissions, either direct or indirect (reflective), which would interfere with pilot vision.
- Uses that produce electrical emissions which would interfere with aircraft communication systems or navigation equipment.
- Uses that attract birds or waterfowl, such as operation of sanitary landfills, maintenance or feeding stations, or growth of certain vegetation.
- Uses that provide for structures within ten feet of aircraft approach-departure and/or transitional surfaces.

A.4.4 Policy 4. Certain noise levels of varying duration and frequency create hazards to both physical and mental health. A limited, though definite, danger to life exists in certain

areas adjacent to airfields. Where these conditions are sufficiently severe, it is not consistent with public health, safety, and welfare to allow the following land uses:

- Residential.
- Retail business.
- Office buildings.
- Public buildings (schools, churches, etc.).
- Recreation buildings and structures.

A.4.5 Policy 5. Land areas below takeoff and final approach flight paths are exposed to significant danger of aircraft accidents. The density of development and intensity of use must be limited in such areas.

A.4.6 Policy 6. Different land uses have different sensitivities to noise. Standards of land use acceptability should be adopted, based on these noise sensitivities. In addition, a system of Noise Level Reduction guidelines (Appendix E) for new construction should be implemented to permit certain uses where they would otherwise be prohibited.

A.4.7 Policy 7. Land use planning and zoning in the airfield environs cannot be based solely on aircraft-generated effects. Allocation of land used within the AICUZ should be further refined by consideration of:

- Physiographic factors.
- Climate and hydrology.
- Vegetation.
- Surface geology.
- Soil characteristics.
- Intrinsic land use potential and constraints.
- Existing land use.
- Land ownership patterns and values.
- Economic and social demands.
- Cost and availability of public utilities, transportation, and community facilities.
- Other noise sources.

Each runway end at Westover ARB has a 3,000 foot by 3,000 foot CZ and two APZs (Appendix B). Accident potential on or adjacent to the runway or within the CZ is so high that the necessary land use restrictions would prohibit reasonable economic use of land. As stated previously, it is Air Force policy to request Congress to authorize and appropriate funds for the necessary real property interests in this area to prevent incompatible land uses. At Westover ARB, approximately 250 acres remain outside of base property.

APZ I is less critical than the CZ, but still possesses a significant risk factor. This 3,000 foot by 5,000 foot area has land use compatibility guidelines which are sufficiently flexible to allow reasonable economic use of the land, such as industrial/manufacturing, transportation, communication/utilities, wholesale trade, open space, recreation, and agriculture. However, uses that concentrate people in small areas are not acceptable.

APZ II is less critical than APZ I, but still possesses potential for accidents. APZ II, also 3,000 feet wide, is 7,000 feet long extending to 15,000 feet from the runway threshold. Acceptable uses include those of APZ I, as well as low density single family residential, and those personal and business services and commercial/retail trade uses of low intensity or scale of operation. High density functions such as multi-story buildings, places of assembly (theaters, churches, schools, restaurants, etc.), and high density office uses are not considered appropriate.

High people densities should be limited to the maximum extent possible. The optimum density recommended for residential usage (where it does not conflict with noise criteria) in APZ II is one dwelling per acre. For most non-residential usage, buildings should be limited to one story and the lot coverage should not exceed 20 percent.

A.5 Basic Land Use Compatibility

Research on aircraft accident potential, noise, and land use compatibility is ongoing at a number of federal and other agencies. These studies and all other compatibility guidelines must not be considered inflexible standards. They are the framework within which land use compatibility questions can be addressed and resolved. In each case, full consideration must be given to local conditions such as:

- Previous community experience with aircraft accidents and noise.
- Local building construction and development practices.
- Existing noise environment due to other urban or transportation noise sources.
- Time period of aircraft operations and land use activities.
- Specific site analysis.
- Noise buffers, including topography.

These basic guidelines cannot resolve all land use compatibility questions, but they do offer a reasonable framework within which to work.

A.6 Accident Potential

Land use guidelines for the two APZs are based on a hazard index system which compares the relationship of accident occurrence for five areas:

- On or adjacent to the runway.
- Within the CZ.
- In APZ I.
- In APZ II.
- In all other areas within a 10 nautical mile radius of the runway.

Accident potential on or adjacent to the runway or within the CZ is so high that few uses are acceptable. The risk outside APZ I and APZ II, but within the 10 nautical mile radius area, is significant, but is acceptable if sound engineering and planning practices are followed.

Land use guidelines for APZs I and II have been developed. The main objective has been to restrict all people-intensive uses because there is greater risk in these areas. The basic guidelines aim at prevention of uses that:

- Have high residential density characteristics.
- Have high labor intensity.
- Involve above-ground explosive, fire, toxic, corrosive, or other hazardous characteristics.
- Promote population concentrations.
- Involve utilities and services required for area-wide population, where disruption would have an adverse impact (telephone, gas, etc.).
- Concentrate people who are unable to respond to emergency situations, such as children, elderly, handicapped, etc.
- Pose hazards to aircraft operations.

There is no question that these guidelines are relative. Ideally, there should be no people-intensive uses in either of these APZs. The free market and private property systems prevent this where there is land development demand. To go beyond these guidelines, however, substantially increases risk by placing more people in areas where there may ultimately be an aircraft accident.

A.7 Noise

Nearly all studies on residential aircraft noise compatibility recommend no residential uses in noise zones above DNL 75 dB. Usually, no restrictions are recommended below noise zone DNL 65 dB. Between DNL 65-74 dB there is currently no consensus. These areas may not qualify for Federal mortgage insurance in residential categories according to the Department of Housing and Urban Development (HUD) Regulation 24 CFR 51B. In many cases, HUD approval requires noise attenuation measures, the Regional Administrator's concurrence, and an Environmental Impact Statement. The Department of Veterans Affairs also has airfield noise and accident restrictions which apply to their home loan guarantee program. Whenever possible, residential land use should be located below DNL 65 dB according to Air Force land use recommendations.

Most industrial/manufacturing uses are compatible in the airfield environs. Exceptions are uses such as research or scientific activities which require lower noise levels. Noise attenuation measures are recommended for portions of buildings devoted to office use, receiving the public, or where the normal background noise level is low.

The transportation, communications and utilities categories have a high noise level compatibility because they generally are not people-intensive. When people use land for these purposes, the use is generally very short in duration. Where buildings are required for these uses, additional evaluation is warranted.

The commercial/retail trade and personal and business services categories are compatible without restriction up to DNL 70 dB; however, they are generally incompatible above DNL 80 dB. Between DNLs 70-80 dB, noise level reduction measures should be included in the design and construction of buildings.

The nature of most uses in the public and quasi-public services category requires a quieter environment, and attempts should be made to locate these uses below DNL 65 dB (an Air Force land use recommendation), or else provide adequate noise level reduction.

Although recreational use has often been recommended as compatible with high noise levels, recent research has resulted in a more conservative view. Above DNL 75 dB, noise becomes a factor which limits the ability to enjoy such uses. Where the requirement to hear is a function of the use (i.e., music shell, etc.), compatibility is limited. Buildings associated with golf courses and similar uses should be noise attenuated.

With the exception of forestry activities and livestock farming, uses in the resources production, extraction, and open space category are compatible almost without restrictions.

B. APPENDIX B

ACCIDENT POTENTIAL ZONES

B.1 Guidelines for Accident Potential

Urban areas around airports are exposed to the possibility of aircraft accidents even with well-maintained aircraft and highly trained aircraft crews. Despite stringent maintenance requirements and countless hours of training, past history makes it clear that accidents are going to occur.

When the AICUZ program began, there were no current comprehensive studies on accident potential. In support of the program, the Air Force completed a study of Air Force accidents that occurred between 1968 and 1972 within 10 nautical miles of airfields. The study of 369 accidents revealed that 75 percent of aircraft accidents occurred on or adjacent to the runway (1,000 feet to each side of the runway centerline) and in a corridor 3,000 feet (1,500 feet either side of the runway centerline) wide, extending from the runway threshold along the extended runway centerline for a distance of 15,000 feet.

Three zones were established based on crash patterns: The CZ, APZ I, and APZ (APZ) II. The CZ starts at the end of the runway and extends outward 3,000 feet. It has the highest accident potential of the three zones. The Air Force has adopted a policy of acquiring property rights to areas designated as CZs because of the high accident potential. APZ I extends from the CZ an additional 5,000 feet. It includes an area of reduced accident potential. APZ II extends from APZ I an additional 7,000 feet in an area of further reduced accident potential.

The Air Force research work in accident potential was the first significant effort in this subject area since 1952 when the President's Airport Commission published "The Airport and Its Neighbors," better known as the "Doolittle Report." The recommendations of this earlier report were influential in the formulation of the APZ concept.

The risk to people on the ground of being killed or injured by aircraft accidents is small. However, an aircraft accident is a high consequence event and when a crash does occur, the result is often catastrophic. Because of this, the Air Force does not attempt to base its safety standards on accident probabilities. Instead the Air Force approaches this safety issue from a land use planning perspective.

B.2 Accident Potential Analysis

Military aircraft accidents differ from commercial air carrier and general aviation accidents because of the variety of aircraft used, the type of missions, and the number of training flights. In 1973, the U.S. Air Force (USAF) performed an aircraft accident hazard study in order to identify land near airfields with significant accident potential. Accidents studied occurred within ten nautical miles of airfields.

The study reviewed 369 major USAF accidents during 1968-1972, and found that 61 percent of the accidents were related to landing operations and 39 percent were takeoff related. It also found that 70 percent occurred in daylight, and that fighter and training aircraft accounted for 80 percent of the accidents.

Because the purpose of the study was to identify accident hazards, the study plotted each of the 369 accidents in relation to the airfield. This plotting found that the accidents clustered along the runway and its extended centerline. To further refine this clustering, a tabulation was prepared which described the cumulative frequency of accidents as a function of distance from the runway centerline along the extended centerline. This analysis was done for widths of 2,000, 3,000, and 4,000 total feet. The location analysis found the following, shown in **Table B.1**:

Table B.1

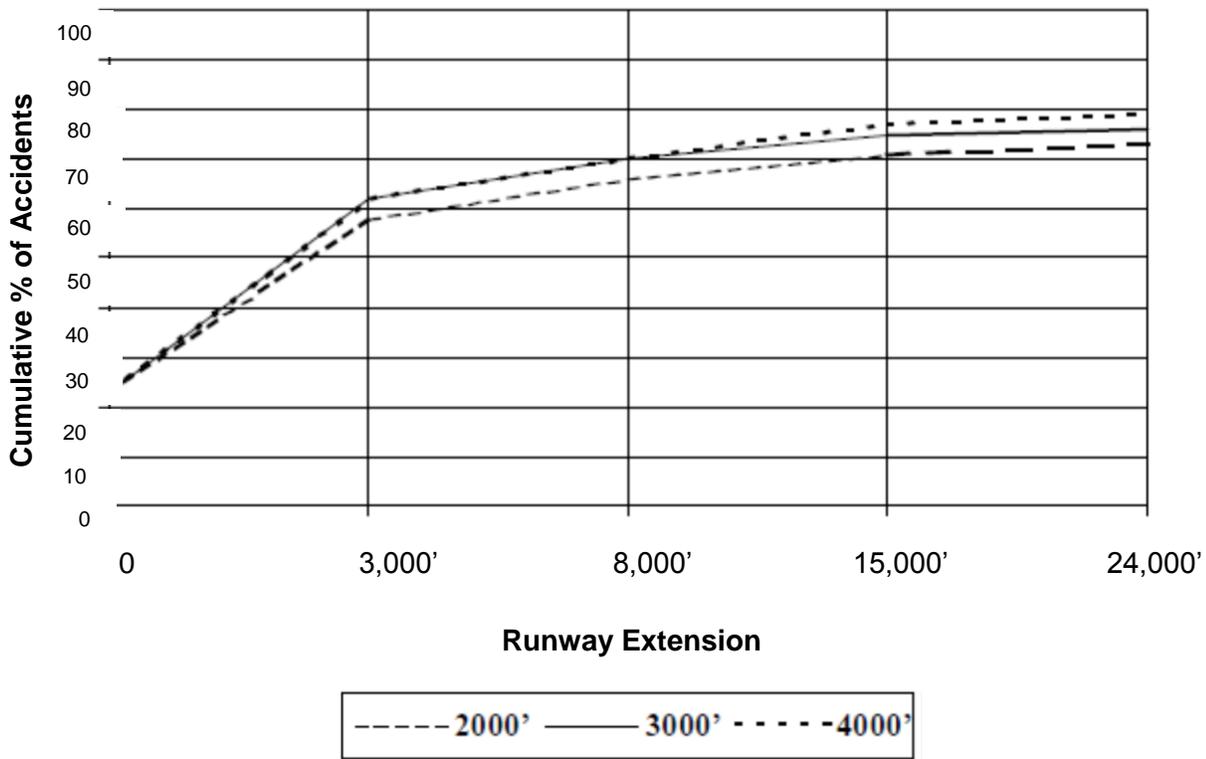
Location Analysis

| Width of Runway Extension (feet) | | | |
|-------------------------------------------------------------------------|--------------|--------------|--------------|
| Length from both Ends of Runway | 2,000 | 3,000 | 4,000 |
| Percent of Accidents | | | |
| On or adjacent to runway (1,000 feet to each side of runway centerline) | 23 | 23 | 23 |
| 0 to 3,000 | 35 | 39 | 39 |
| 3,000 to 8,000 | 8 | 8 | 8 |
| 8,000 to 15,000 | 5 | 5 | 7 |
| Cumulative Percent of Accidents | | | |
| On or adjacent to runway (1,000 feet to each side of runway centerline) | 23 | 23 | 23 |
| 0 to 3,000 | 58 | 62 | 62 |
| 3,000 to 8,000 | 66 | 70 | 70 |
| 8,000 to 15,000 | 71 | 75 | 77 |

Figure B-1 indicates that the cumulative number of accidents rises rapidly from the end of the runway to 3,000 feet, rises more gradually to 8,000 feet, then continues at about the same rate of increase to 15,000 feet, where it levels off rapidly. The location analysis also indicates that the optimum width of the runway extension, which would include the maximum percentage of accidents in the smallest area, is 3,000 feet.

Figure B-1

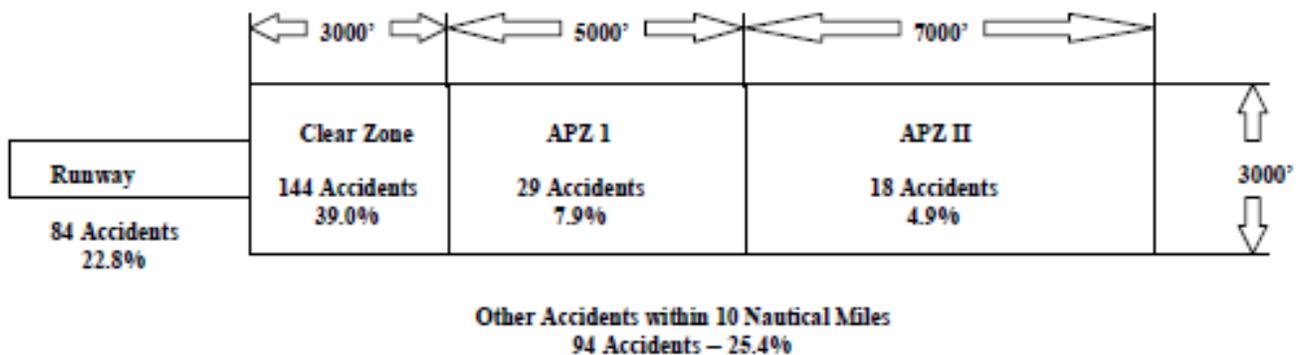
Distribution of Air Force Aircraft Accidents



Using the optimum runway extension width, 3,000 feet, and the cumulative distribution of accidents from the end of the runway, zones were established which minimized the land area included and maximized the percentage of accidents included. The zone dimensions and accident statistics for the 1968-1972 study are shown in **Figure B-2**.

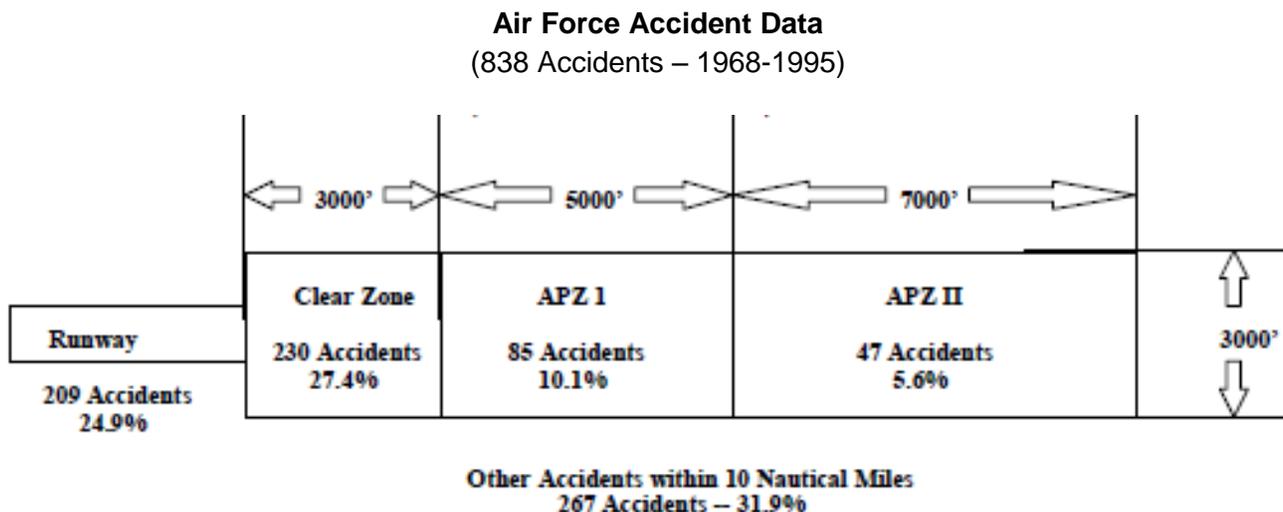
Figure B-2

Air Force Accident Data
(369 Accidents – 1968-1972)



The original study was updated to include accidents through September 1995. The updated study now includes 838 accidents during the 1968-1995 period. Using the optimum runway extension width of 3,000 feet, the accident statistics of the updated study are shown below in **Figure B-3**.

Figure B-3



Using the designated zones and accident data, it is possible to calculate a ratio of percentage of accidents to percentage of area size. As shown in **Table B.2**, these ratios indicate that the CZ, with the smallest area size and the highest number of accidents, has the highest ratio, followed by the runway and adjacent area, APZ I and then APZ II.

Table B.2

Accident to Area Ratio

| Ratio of Percentage of Accidents to Percentage of Area | | | | | | |
|--------------------------------------------------------|------------------------------|----------------------------------|----------------------|-----------------|---------------------|--------------------------------------------|
| (Air Force Accident Data 1968 - 1995) | | | | | | |
| | Area ¹ (acres) | Number ² Accidents | Accident per Acre | % Total Area | % Total Accident | Ratio: ³ Accident to Area |
| Runway Area ⁴ | 487 | 209 | 1 per 2.3 | 0.183 | 24.9 | 136 |
| CZ | 413 | 226 | 1 per 1.8 | 0.155 | 27.4 | 177 |
| APZ I | 689 | 85 | 1 per 8.1 | 0.258 | 10.1 | 39 |
| APZ II | 964 | 47 | 1 per 20.5 | 0.362 | 5.6 | 15 |
| Other | 264,053 | 267 | 1 per 989 | 99.0425 | 31.9 | 0.3 |

Notes:

1. Area includes land within 10 nautical miles of runway (Total of 266,606 acres).
2. Total number of accidents is 838 (through 1995).
3. Percent total accidents divided by percent total area.
4. Runway dimensions are 2,000' x 10,600'.

B.3 Definable Debris Impact Areas

The Air Force also determined which accidents had definable debris impact areas, and in what phase of flight the accident occurred. Overall, 75 percent of the accidents had definable debris impact areas, although they varied in size by type of accident. The Air Force used weighted averages of impact areas, for accidents occurring only in the approach and departure phase, to determine the following average impact areas:

Average Impact Areas for Approach and Departure Accidents

| | |
|-------------------------------------|------------|
| Overall Average Impact Area | 5.06 acres |
| Fighter, Trainer and Misc. Aircraft | 2.73 acres |
| Heavy Bomber and Tanker Aircraft | 8.73 acres |

B.4 Findings

Designation of safety zones around the airfield and restriction of incompatible land uses can reduce the public's exposure to safety hazards.

Air Force accident studies have found that aircraft accidents near Air Force installations occurred in the following patterns:

- 61% were related to landing operations.
- 39% were related to takeoff operations.
- 70% occurred in daylight.
- 80% were related to fighter and training aircraft operations.
- 25% occurred on the runway or within an area extending 1,000 feet out from each side of the runway.
- 27% occurred in an area extending from the end of the runway to 3,000 feet along the extended centerline and 3,000 feet wide, centered on the extended centerline.
- 15% occurred in an area between 3,000 and 15,000 feet along the extended runway centerline and 3,000 feet wide, centered on the extended centerline.

U.S. Air Force aircraft accident statistics found that 75% of aircraft accidents resulted in definable impact areas. The size of the impact areas were:

- 5.1 acres overall average.
- 2.7 acres for fighters and trainers.
- 8.7 acres for heavy bombers and tankers.

C. APPENDIX C

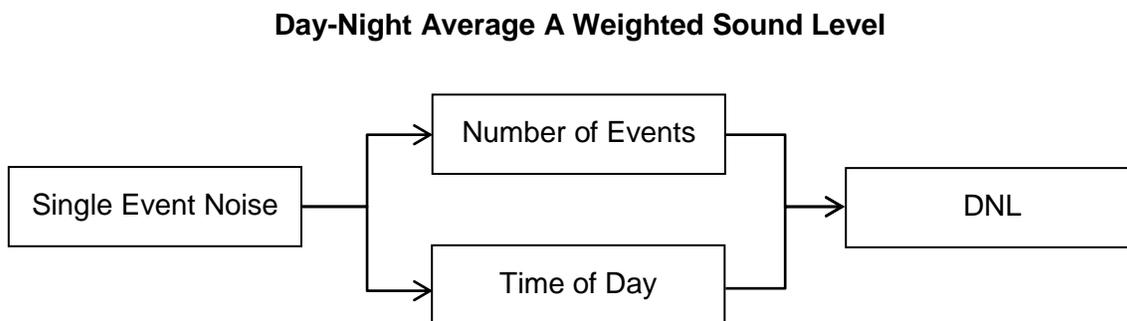
DESCRIPTION OF THE NOISE ENVIRONMENT

C.1 Noise Environment Descriptor

The noise contour methodology used herein is the Day-Night Average A-Weighted Sound Level (DNL) metric of describing the noise environment. Efforts to provide a national uniform standard for noise assessment have resulted in adoption by the Environmental Protection Agency of DNL as the standard noise descriptor. The Air Force uses the DNL descriptor in assessing the amount of aircraft noise exposure, and as a metric for community response to the various levels of exposure. The DNL values used for planning purposes are 65, 70, 75, and 80 dB. Land use guidelines are based on the compatibility of various land uses with these noise exposure levels.

It is generally recognized that a noise environment descriptor should consider, in addition to the annoyance of a single event, the effect of repetition of such events and the time of day in which these events occur. DNL begins with a single event descriptor and adds corrections for the number of events and the time of day. Since the primary development concern is residential, nighttime events are considered more annoying than daytime events and are weighted accordingly. DNL values are computed from the single event noise descriptor, plus corrections for number of flights and time of day (**Figure C-1**).

Figure C-1



As part of the extensive data collection process, detailed information is gathered on the type of aircraft, the number, and time of day of flying operations for each flight track during a typical day. This information is used in conjunction with the single event noise descriptor to produce DNL values. These values are combined on an energy summation basis to provide single DNL values for the mix of aircraft operations at the base. Equal value points are connected to form the contour lines.

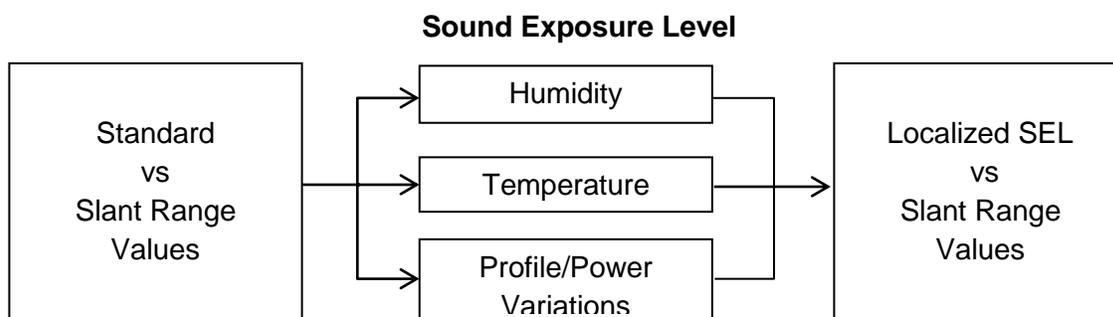
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C.2 Noise Event Descriptor

The single event noise descriptor used in the DNL system is the Sound Exposure Level (SEL). The SEL measure is an integration of an "A" weighted noise level over the period of a single event such as an aircraft flyover, in dB.

Frequency, magnitude, and duration vary according to aircraft type, engine type, and power setting. Therefore, individual aircraft noise data are collected for various types of aircraft/engines at different power settings and phases of flight. The following diagram shows the relationship of the single event noise descriptor (SEL) to the source sound energy.

Figure C-2



SEL vs. slant range values are derived from noise measurements made according to a source noise data acquisition plan developed by Bolt, Beranek, and Newman, Inc., in conjunction with the Air Force's Armstrong Laboratory (AL) and carried out by AL. These standard day, sea level values form the basis for the individual event noise descriptors at any location and are adjusted to the location by applying appropriate corrections for temperature, humidity, and variations from standard profiles and power settings.

Ground-to-ground sound propagation characteristics are used for altitudes up to 500 feet absolute with linear transition between 500 and 700 feet and air-to-ground propagation characteristics above 700 feet.

In addition to the assessment of aircraft flight operations, the DNL system also incorporates noise resulting from engine/aircraft maintenance checks on the ground. Data concerning the orientation of the noise source, type of aircraft or engine, number of test runs on a typical day, power settings used and their duration, and use of suppression devices are collected for each

ground run up or test position. This information is processed and the noise contribution added (on an energy summation basis) to the noise generated by flying operations to produce noise contours reflecting the overall noise environment with respect to aircraft air and ground operations.

C.3 Noise Contour Production

Data describing flight track distances and turns, altitudes, airspeeds, power settings, flight track operational utilization, maintenance locations, ground run-up engine power settings, and number and duration of runs by type of aircraft/engine is assembled by each individual AFB. The data is screened by the MAJCOM and HQ AFCEE/ECC. Trained personnel process the data for input into a central computer. Flight track maps are generated for verification and approval by the base/MAJCOM. After any required changes have been incorporated, DNL contours are generated by the computer using the supplied data and standard source noise data corrected to local weather conditions. These contours are plotted and prepared for photographic reproduction. A set of these contours is provided in the body of the report.

C.4 Technical Information

Additional technical information on the DNL procedures is available in the following publications:

Community Noise Exposure Resulting from Aircraft Operations: Applications Guide for Predictive Procedure, AMRLTR-73-105, November, 1974, from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22151.

Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with Adequate Margin of Safety, EPA Report 550/9-74-004, March, 1974, from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Adopted Noise Regulations for California Airports, Title 4, Register 70, No. 48-11-28-70, Subchapter 6, Noise Standards.

D. APPENDIX D

HEIGHT AND OBSTRUCTIONS CRITERIA

D.1 Height and Obstructions Criteria

D.1.1 General

This appendix establishes criteria for determining whether an object or structure is an obstruction to air navigation.

Obstructions to air navigation are considered to be:

- Natural objects or man-made structures that protrude above the planes or surfaces as defined in the following paragraphs, and/or;
- Man-made objects that extend more than 500 feet above the ground at the site of the structure.

D.1.2 Explanation of Terms

The following will apply (See Figure D-1):

Controlling Elevation. Whenever surfaces or planes within the obstructions criteria overlap, the controlling (or governing) elevation becomes that of the lowest surface or plane.

Runway Length. Westover ARB has two runways, and 18,679 feet of pavement designed and built for sustained aircraft landings and takeoffs. Runway 5/23 is 11,597 feet long. Runway 15/33 is 7,082 feet long.

Established Airfield Elevation. The elevation, in feet above mean sea level for Westover ARB is 241 feet.

Dimensions. All dimensions are measured horizontally unless otherwise noted.

D.1.3 Planes and Surfaces.

Definitions are as follows:

- **Primary Surface.** This surface defines the limits of the obstruction clearance requirements in the immediate vicinity of the landing area. The primary surface comprises surfaces of the runway, runway shoulders, and lateral safety zones and extends 200 feet beyond the runway end. The width of the primary surface for a single class "B" runway is 2,000 feet, or 1,000 feet on each side of the runway centerline.

- **Clear Zone Surface.** This surface defines the limits of the obstruction clearance requirements in the vicinity contiguous to the end of the primary surface. The length and width (for a single runway) of a CZ surface at Westover ARB is 3,000 feet by 3,000 feet.
- **Approach-Departure Clearance Surface.** This surface is symmetrical about the runway centerline extended, begins as an inclined plane (glide angle) 200 feet beyond each end of the primary surface of the centerline elevation of the runway end, and extends for 50,000 feet. The slope of the approach-departure clearance surface is 50:1 along the extended runway (glide angle) centerline until it reaches an elevation of 500 feet above the established airfield elevation. It then continues horizontally at this elevation to a point 50,000 feet from the start of the glide angle. The width of this surface at the runway end is 2,000 feet; it flares uniformly, and the width at 50,000 feet is 16,000 feet.
- **Inner Horizontal Surface.** This surface is a plane, oval in shape at a height of 150 feet above the established airfield elevation. It is constructed by scribing an arc with a radius of 7,500 feet above the centerline at the end of the runway and interconnecting these arcs with tangents.
- **Conical Surface.** This is an inclined surface extending outward and upward from the outer periphery of the inner horizontal surface for a horizontal distance of 7,000 feet to a height of 500 feet above the established airfield elevation. The slope of the conical surface is 20:1.
- **Outer Horizontal Surface.** This surface is a plane located 500 feet above the established airfield elevation. It extends for a horizontal distance of 30,000 feet from the outer periphery of the conical surface.
- **Transitional Surfaces.** These surfaces connect the primary surfaces, CZ surfaces, and approach-departure clearance surfaces to the outer horizontal surface, conical surface, other horizontal surface, or other transitional surfaces. The slope of the transitional surface is 7:1 outward and upward at right angles to the runway centerline. To determine the elevation for the beginning the transitional surface slope at any point along the lateral boundary of the primary surface, including the CZ, draw a line from this point to the runway centerline. This line will be at right angles to the runway axis. The elevation at the runway centerline is the elevation for the beginning of the 7:1 slope.

The land areas outlined by these criteria should be regulated to prevent uses which might otherwise be hazardous to aircraft operations. The following uses should be restricted and/or prohibited.

- Uses which release into the air any substance which would impair visibility or otherwise interfere with the operation of aircraft (i.e. steam, dust, or smoke).

- Uses which produce light emissions, either direct or indirect (reflective), which would interfere with pilot vision.
- Uses which produce electrical emissions which would interfere with aircraft communications systems or navigational equipment.
- Uses which would attract birds or waterfowl, including but not limited to, operation of sanitary landfills, maintenance of feeding stations, or the growing of certain vegetation.
- Uses that provide for structures within ten feet of aircraft approach-departure and/or transitional surfaces.

D.2 Height Restrictions

City, County and Township agencies involved with approvals of permits for construction should require developers to submit calculations which show that projects meet the height restriction criteria of FAA Part 77 as described, in part, by the information contained in this Appendix.

WESTOVER ARB, MASSACHUSETTS

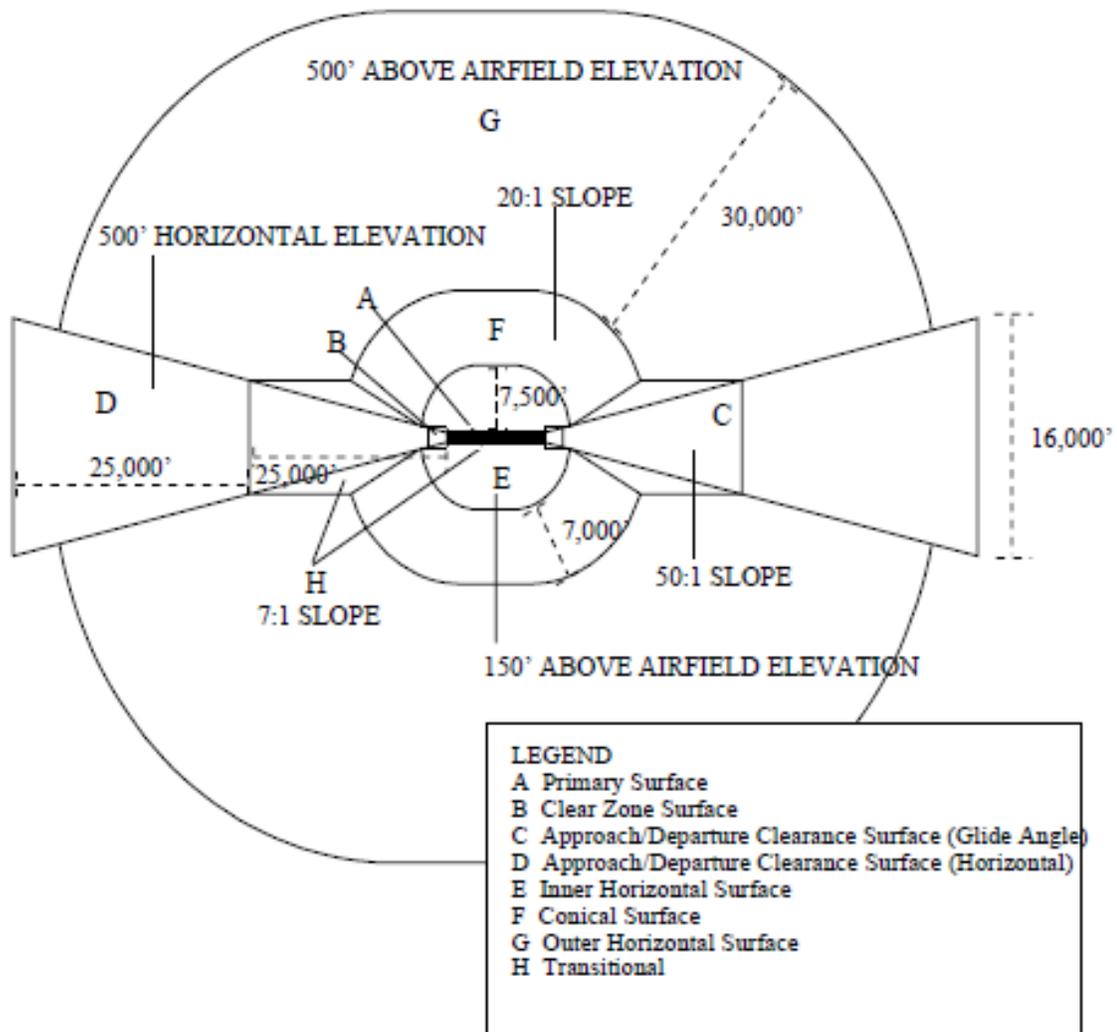
Coordinates and Elevations

| Runway | Elevation | Latitude | Longitude |
|------------------|------------------|-----------------|------------------|
| Runway 5 | 235 feet MSL | 42-10-38.87 | 72-32-52.82 |
| Runway 23 | 241 feet MSL | 42-12-13.62 | 72-31-26.24 |
| Runway 15 | 241 feet MSL | 42-12-22.32 | 72-32-31.56 |
| Runway 33 | 240 feet MSL | 42-11-33.72 | 72-31-24.57 |

Figure D-1

Airspace Control Surface Plan

For more complete description of airspace control surfaces, refer to FAR Part 77, Subpart C or AFR 86-14.



E. APPENDIX E

NOISE LEVEL REDUCTION GUIDELINES

A study which provides in-depth, state-of-the-art noise level reduction guidelines was completed for the Naval Facilities Engineering Command and the Federal Aviation Administration, by Wyle Laboratories in November 1989. The study title is *Guidelines for the Sound Insulation of Residences Exposed to Aircraft Operations*, Wyle Research Report WR 89-7. A revised edition was completed by Wyle Laboratories in April 2005 with the following:

- A revised organization wherein the main text serves as a concise overview of the material and much of the technical material is given in appendices,
- Recommendations are made on a room-by-room basis for existing homes and on a whole house basis for new construction,
- The inclusion of Sound Transmission Class rather than Exterior Wall Rating for specifying building products,
- The costs have been updated to reflect 2004 values, and
- Calculations performed using the specific frequency content of various types of aircraft.¹

Copies of this study are available online at: <http://www.wyle.com/PDFs/archive/WSI.pdf>.

¹ Wyle Laboratories, *Guidelines for Sound Insulation of Residences Exposed to Aircraft Operations*, April 2005. <http://www.wyle.com/PDFs/archive/WSI.pdf> (Accessed 12/11).