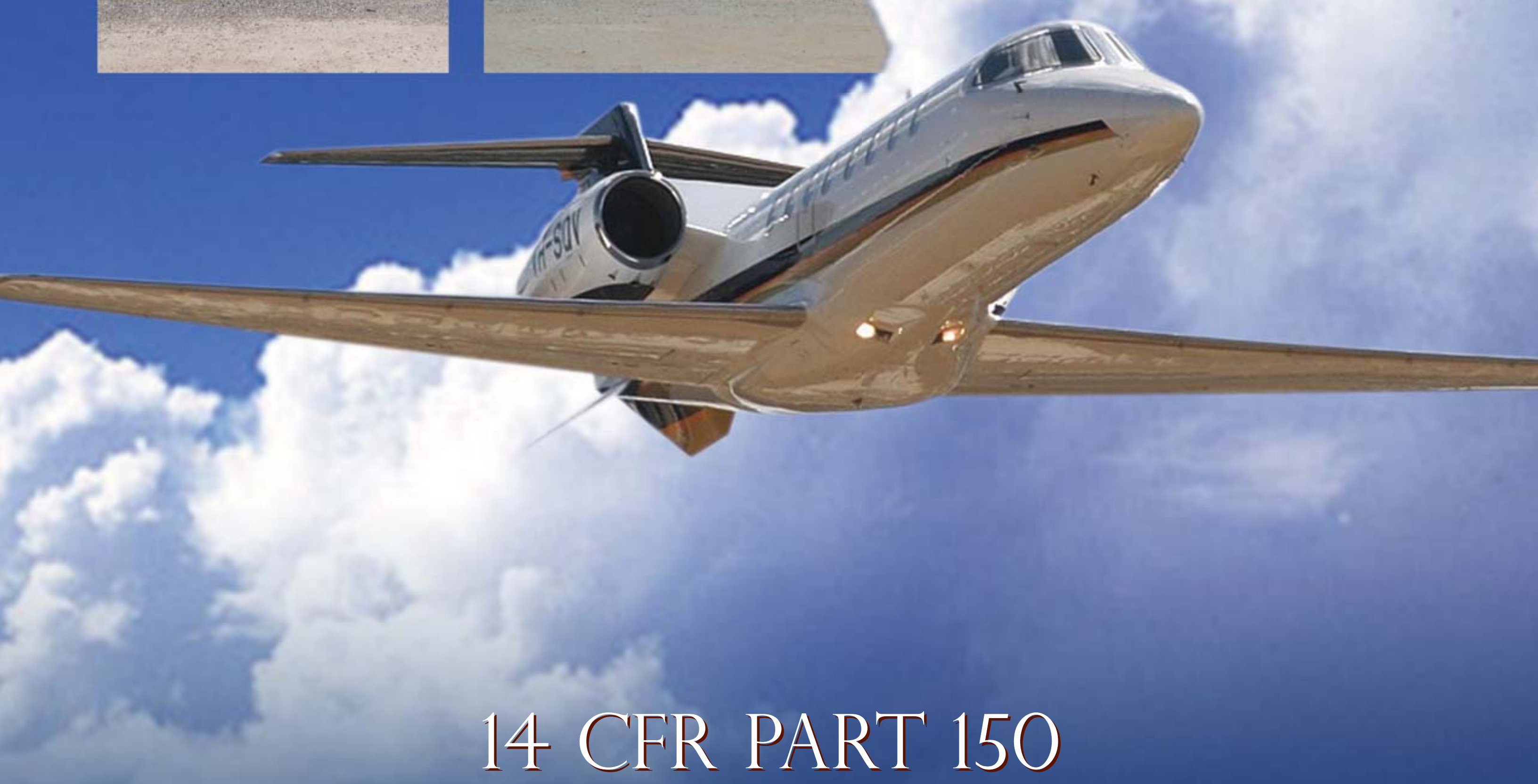
BUCKEYE
Municipal Airport



14 CFR PART 150
NOISE COMPATIBILITY STUDY
NOISE EXPOSURE MAPS

BUCKEYE MUNICIPAL AIRPORT

14 CFR Part 150
Noise Compatibility Study

NOISE EXPOSURE MAPS

Prepared For

The Town Of Buckeye, Arizona

By

Coffman Associates, Inc.

June 2008

The preparation of this document was financed in part through a planning grant from the Federal Aviation Administration (FAA) as approved under the Airport and Airway Improvement Act of 1982, as amended. The contents of this report do not necessarily reflect the official views or policy of the FAA. Acceptance of this report by the FAA does not in any way constitute a commitment on the part of the United States to participate in any development depicted therein, nor does it indicate that the proposed development is environmentally acceptable in accordance with applicable public laws.

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NOISE EXPOSURE MAPS

NOISE EXPOSURE MAPS

This document is the Noise Exposure Map document prepared for the Town of Buckeye, Arizona, owner and operator of Buckeye Municipal Airport. The Noise Exposure Maps documentation for Buckeye Municipal Airport presents current aircraft noise impacts and anticipated impacts in five years. The documentation contains sufficient information so that reviewers unfamiliar with local conditions and the local public unfamiliar with the technical aspects of aircraft noise can understand the findings.

This Noise Exposure Maps document includes the first four chapters of the complete Title 14, Code of Federal Regulations (CFR), Part 150 Noise Compatibility Study. Chapter One, Inventory, presents an overview of the airport, airspace, aviation facilities, existing land uses, and local land use policies and regulations.

Chapter Two, Aviation Forecasts, examines the existing and potential demand for aviation activity at the airport.

Chapter Three, Aviation Noise, explains the methodology used to develop aircraft noise contours. It also describes the key input assumptions used for noise modeling.

Chapter Four, Noise Impacts, presents existing and forecast aircraft noise exposure based on the assumption of no additional noise abatement efforts. This provides baseline data for evaluating potential noise abatement strategies in the second part of the study. It also analyzes the impact of the baseline aircraft noise on noise-sensitive land uses and the resident population.

Supplemental information is provided in appendices and Technical Information Papers. Appendix A lists the members of the Planning Advisory Committee (PAC) that were consulted throughout the planning process. It also includes an explanation of the role of the PAC in the process.

Appendix B, Coordination, Consultation, and Public Involvement, summarizes the planning process, local coordination, and the public involvement process.

Appendix C contains the INM Output Report. This report provides detailed tables which depict reported aircraft operations, runway use, and day/nighttime operation split by aircraft type.

Six Technical Information Papers (TIPs) are provided for reference and background. These papers include the Glossary of Noise Compatibility Terms, Federal Aviation Noise Regulations, The Measurement and Analysis of Sound, Effects of Noise Exposure, Measuring the Impact of Noise on People, and Noise and Land Use Compatibility Guidelines.

The official Noise Exposure Maps are presented in this section following page viii. For the convenience of FAA reviewers, the FAA's official Noise Exposure Map checklist is presented on pages iii through vii.

14 CFR PART 150
NOISE EXPOSURE MAP CHECKLIST

AIRPORT NAME: ***Buckeye Municipal Airport***
Buckeye, Arizona

REVIEWER: ________________________

	Yes/No/NA	Page No. Other Reference
I. **IDENTIFICATION AND SUBMISSION OF MAP DOCUMENTS:** A. Is this submittal appropriately identified as one of the following, 1. a NEM only? 2. a NEM and NCP? 3. a revision to NEMs which have previously been determined by FAA to be in compliance with Part 150?	 Yes No No	 Title Page, p. i
B. Is the airport name and the qualified airport operator identified?	Yes	Title Page, p. i
C. Is there a dated cover letter from the airport operator which indicates the documents are submitted under Part 150 for appropriate FAA determination?	Yes	p. viii
II. **CONSULTATION: [150.21(b), A150.105(a)]** A. Is there a narrative description of the consultation accomplished, including opportunities for public review and comment during map development?	Yes	Appendix B; and supplemental volume, "Supporting Information on Project Coordination and Local Consultation"
B. Identification: 1. Are the consulted parties identified	 Yes	 Appendices A and B; and supplemental volume, "Supporting Information on Project Coordination and Local Consultation"
2. Do they include all those required by 150.21(b) and A150.105(a)?	Yes	Appendices A and B, and supplemental volume, "Supporting Information on Project Coordination and Local Consultation"
C. Does the documentation include the airport operator's certification, and evidence to support it, that interested persons have been afforded adequate opportunity to submit their views, data, and comments during map development and in accordance with 150.21(b)?	Yes	p. viii; Appendix B, and supplemental volume, "Supporting Information on Project Coordination and Local Consultation"
D. Does the document indicate whether written comments were received during consultation and, if there were comments, that they are on file with the FAA region?	Yes	Appendix B and supplemental volume, "Supporting Information on Project Coordination and Local Consultation"

14 CFR PART 150
NOISE EXPOSURE MAP CHECKLIST

AIRPORT NAME: ***Buckeye Municipal Airport, Buckeye, Arizona*** ***REVIEWER:*** ______________________

	Yes/No/NA	Page No. Other Reference
III. **GENERAL REQUIREMENTS: [150.21]** A. Are there two maps, each clearly labeled on the face with year (existing condition year and 5-year)?	Yes	See NEM Exhibits 1 and 2, after p. viii
B. Map currency: 1. Does the existing condition map year match the year on the airport operator's submittal letter?	Yes	
2. Is the 5-year map based on reasonable forecasts and other planning assumptions and is it for the fifth calendar year after the year of submission?	Yes	
3. If the answer to 1 & 2 above is no, has the airport operator verified in writing that data in the documentation are representative of existing condition and 5-year forecast conditions as of the date of submission?	N/A	The FAA forecast approval letter is contained in Supplemental Volume "Supporting Information on Project Coordination and Local Consultation."
C. **If the NEM and NCP are submitted together:** 1. Has the airport operator indicated whether the 5-year map is based on 5-year contours without the program vs. contours if the program is implemented?	N/A	
2. If the 5-year map is based on program implementation: a. are the specific program measures which are reflected on the map identified?	N/A	
b. does the documentation specifically describe how these measures affect land use compatibilities depicted on the map?	N/A	
3. If the 5-year NEM does not incorporate program implementation, has the airport operator included an additional NEM for FAA determination after the program is approved which shows program implementation conditions and which is intended to replace the 5-year NEM as the new official 5-year map?	N/A	

14 CFR PART 150
NOISE EXPOSURE MAP CHECKLIST

AIRPORT NAME: ***Buckeye Municipal Airport***
Buckeye, Arizona

REVIEWER: ________________________

	Yes/No/NA	**Page No. Other Reference**
IV. **MAP SCALE, GRAPHICS, AND DATA REQUIREMENTS: [A150.101, A150.103, A150.105, 150.21(a)]** A. Are the maps sufficient scale to be clear and readable (they must not be less than 1" = 2,000'), and is the scale indicated on the maps?	Yes	See NEM Exhibits 1 and 2, after p. viii
B. Is the quality of the graphics such that required information is clear and readable?	Yes	See NEM Exhibits 1 and 2, after p. viii
C. Depiction of the airport and its environs. 1. Is the following graphically depicted to scale on both the existing conditions and 5-year maps: a. airport boundaries?	Yes	See NEM Exhibits 1 and 2, after p. viii
b. runway configurations with runway end numbers?	Yes	See NEM Exhibits 1 and 2, after p. viii
2. Does the depiction of the off-airport data include: a. a land use base map depicting streets and other identifiable geographic features?	Yes	See NEM Exhibits 1 and 2, after p. viii
b. the area within the 65 Ldn (**or beyond, at local discretion**)?	Yes	See NEM Exhibits 1 and 2, after p. viii
c. clear delineation of geographic boundaries and the names of all jurisdictions with planning and land use control authority within the 65 Ldn (or beyond, at local discretion)?	Yes	See NEM Exhibits 1 and 2, after p. viii
D. 1. Continuous contours for at least the 65, 70, and 75 Ldn?	Yes	See NEM Exhibits 1 and 2, after p. viii
2. Based on current airport and operational data for the existing condition year NEM, and forecast data for the 5-year NEM?	Yes	See NEM Exhibit 2 after p. viii; Chapter Two, pp. 2-16 – 2-18
E. Flight tracks for the existing condition and 5-year forecast time-frames (these may be on supplemental graphics which must use the same land use base map as the existing condition and 5-year NEM), which are numbered to correspond to accompanying narrative?	Yes	Chapter Three, Exhibits 3D, 3E, 3F, 3G, 3H, 3J after p. 3-8
F. Locations of any noise monitoring sites (these may be on supplemental graphics which must use the same land use base map as the official NEMs)	N/A	N/A
G. Noncompatible land use identification: 1. Are noncompatible land uses within at least the 65 Ldn depicted on the maps?	Yes	See NEM Exhibits 1 and 2 after p. viii
2. Are noise-sensitive public buildings identified?	Yes	See NEM Exhibits 1 and 2 after p. viii

14 CFR PART 150 ***NOISE EXPOSURE MAP CHECKLIST***		
AIRPORT NAME: ***Buckeye Municipal Airport*** ***Buckeye, Arizona***	***REVIEWER:*** ______________________	
	Yes/No/NA	**Page No. Other Reference**
3. Are the noncompatible uses and noise-sensitive public buildings readily identifiable and explained on the map legend?	Yes	See NEM Exhibits 1 and 2 after p. viii
4. Are compatible land uses, which would normally be considered noncompatible, explained in the accompanying narrative?	N/A	
V. **NARRATIVE SUPPORT OF MAP DATA: [150.21(a), A150.1, A150.101, A150.103]** A. 1. Are the technical data, including data sources, on which the NEMs are based adequately described in the narrative?	Yes	Chapter Three, pp. 3-2 – 3-11
2. Are the underlying technical data and planning assumptions reasonable?	Yes	Chapter Three, pp. 3-2 – 3-11
B. Calculation of Noise Contours: 1. Is the methodology indicated? a. is it FAA-approved?	 Yes Yes	 Chapter Three, p. 3-2 Chapter Three, p. 3-2
b. was the same model used for both maps?	Yes	Chapter Three, p. 3-2
c. has AEE approval been obtained for use of a model other than those which have previous blanket FAA approval?	N/A	
2. Correct use of noise models: a. does the documentation indicate the airport operator has adjusted or calibrated FAA-approved noise models or substituted one aircraft type for another?	Yes	Chapter Three, pp. 3-5. No calibration done. Some composite aircraft descriptors used.
b. if so, does this have written approval from AEE?	N/A	All aircraft INM designators used are on AEE's pre-approved list of substitutions.
3. If noise monitoring was used, does the narrative indicate that Part 150 guidelines were followed?	N/A	

14 CFR PART 150
NOISE EXPOSURE MAP CHECKLIST

AIRPORT NAME: ***Buckeye Municipal Airport***
Buckeye, Arizona

REVIEWER: ______________________

	Yes/No/NA	Page No. Other Reference
4. For noise contours below 65 Ldn, does the supporting documentation include explanation of local reasons? (Narrative explanation is highly desirable but not required by the Rule.)	Yes	Chapter Three, p. 3-9, Chapter Four, pp. 4-3 – 4-5, T.I.P., Aircraft Noise and Land Use Compatibility Guidelines
C. Noncompatible Land Use Information: 1. Does the narrative give estimates of the number of people residing in each of the contours (Ldn 65, 70, and 75 at a minimum) for both the existing condition and 5-year maps?	Yes	Chapter Four, pp. 4-5 – 4-12
2. Does the documentation indicate whether Table 1 of Part 150 was used by the airport operator? a. If a local variation to Table 1 was used; (1) does the narrative clearly indicate which adjustments were made and the local reasons for doing so?	Yes	Chapter Four, pp. 4-2 – 4-3, Exhibit 4A, Chapter Four, pp. 4-3 – 4-5, T.I.P. Aircraft Noise and Compatibility Guidelines
(2) does the narrative include the airport operators complete substitution for Table 1?	N/A	
3. Does the narrative include information on self-generated or ambient noise where compatible/noncompatible land use identification consider non-airport/aircraft sources?	No	
4. Where normally noncompatible land uses are not depicted as such on the NEMs, does the narrative satisfactorily explain why, with reference to the specific geographic areas?	N/A	
5. Does the narrative describe how forecasts will affect land use compatibility?	Yes	Chapter Four, pp. 4-7 – 4-12
VI. **MAP CERTIFICATIONS: [150.21(b), 150.21(e)]** A. Has the operator certified in writing that interested persons have been afforded adequate opportunity to submit views, data, and comments concerning the correctness and adequacy of the draft maps and forecasts?	Yes	Certification statements on NEM Exhibits 1 and 2 and p. viii

SPONSOR'S CERTIFICATION

The Noise Exposure Maps and accompanying documentation for Buckeye Municipal Airport, including the description of consultation and opportunity for public involvement, are submitted in accordance with 14 CFR Part 150, and hereby certified as true and complete to the best of my knowledge and belief. It is hereby certified that adequate opportunity has been afforded to interested persons to submit views, data, and comments on the Noise Exposure Maps and airport operations forecasts. It is further certified that the 2006 Noise Exposure Maps and supporting data are fair and reasonable representations of existing conditions at the airport.

______________________________	______________________________
Date of Signature	Mr. Jackie Meck Mayor, Town of Buckeye

05SP14-1-05/07/08

SPONSOR'S CERTIFICATION

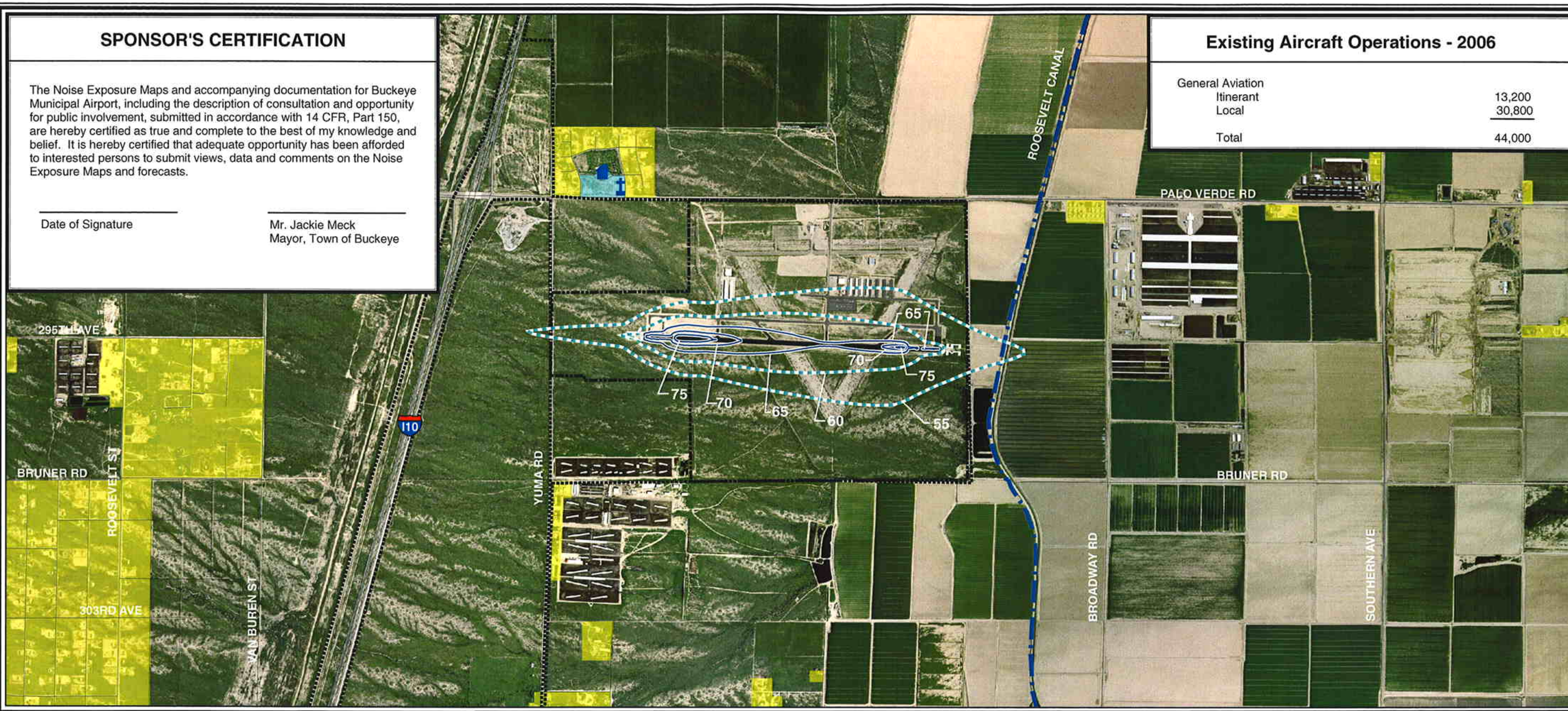
The Noise Exposure Maps and accompanying documentation for Buckeye Municipal Airport, including the description of consultation and opportunity for public involvement, submitted in accordance with 14 CFR, Part 150, are hereby certified as true and complete to the best of my knowledge and belief. It is hereby certified that adequate opportunity has been afforded to interested persons to submit views, data and comments on the Noise Exposure Maps and forecasts.

Date of Signature

Mr. Jackie Meck
Mayor, Town of Buckeye

Existing Aircraft Operations - 2006

General Aviation	
Itinerant	13,200
Local	30,800
Total	44,000



LEGEND

- Airport Property
- Municipal Boundary
- 2006 Contour, Marginal Effect
- 2006 Contour, Significant Effect
- Water
- Residential
- Noise-Sensitive Institutions
- Place of Worship
- Community Center

Runway 35 End

Source: Aerial Photography, March 2005.
Coffman Associates Analysis.

NORTH

0 2,000
Feet

Exhibit 1
2006 NOISE EXPOSURE MAP

05SP14-2-05/07/08

SPONSOR'S CERTIFICATION

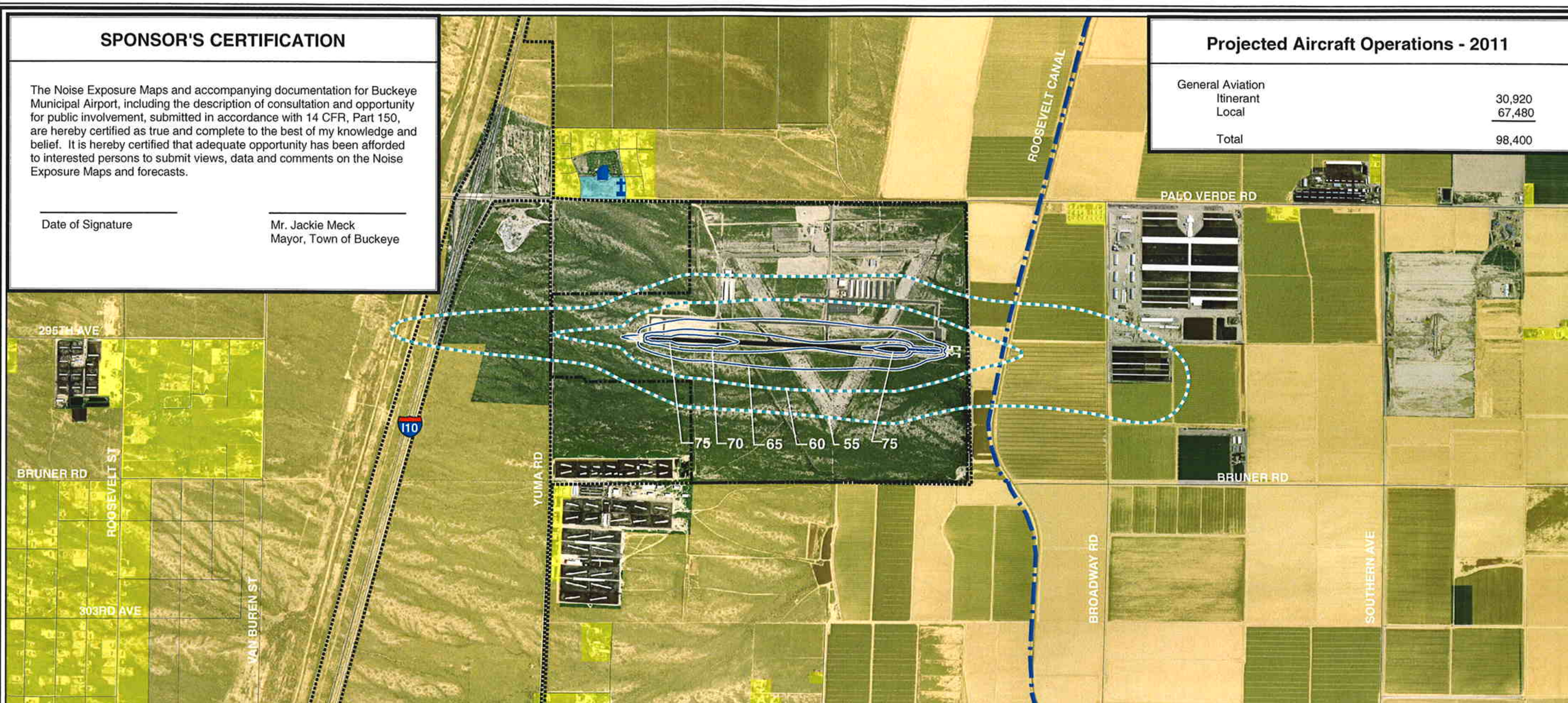
The Noise Exposure Maps and accompanying documentation for Buckeye Municipal Airport, including the description of consultation and opportunity for public involvement, submitted in accordance with 14 CFR, Part 150, are hereby certified as true and complete to the best of my knowledge and belief. It is hereby certified that adequate opportunity has been afforded to interested persons to submit views, data and comments on the Noise Exposure Maps and forecasts.

Date of Signature

Mr. Jackie Meck
Mayor, Town of Buckeye

Projected Aircraft Operations - 2011

General Aviation	
Itinerant	30,920
Local	67,480
Total	98,400



LEGEND

- Airport Property
- Municipal Boundary
- 2011 Contour, Marginal Effect
- 2011 Contour, Significant Effect
- Water
- Residential
- Noise-Sensitive Institutions
- Place of Worship
- Community Center
- Growth Risk

Source: Aerial Photography, March 2005.
Coffman Associates Analysis.

NORTH

0 2,000
Feet

Exhibit 2
2011 NOISE EXPOSURE MAP

Chapter One

INVENTORY

INVENTORY

The purpose of this chapter is to provide a foundation for the Noise Compatibility Study by examining the baseline conditions at Buckeye Municipal Airport (BXK) and the surrounding area. Ultimately, this information will be used to develop airport noise exposure contours and a detailed plan for mitigating or eliminating current and future noise impacts. Information presented within this chapter includes the following:

- A detailed definition of the purpose and procedures needed to undertake a Noise Compatibility Program as described under Title 14, Part 150 of the Code of Federal Regulations.
- A description of the airport setting, key airport facilities, and airspace.
- A discussion of the jurisdictions impacted by aircraft activity at Buckeye Municipal Airport and their respective responsibilities to the public.
- An overview of land use planning tools applicable within the study area.

WHAT IS A PART 150 STUDY?

Before presenting background information relating to the airport and surrounding communities, the definition and purpose of a Part 150 study is necessary. A Part 150 study is a federally funded, voluntary process which involves the preparation of two

official documents: the Noise Exposure Maps (NEM) and the Noise Compatibility Program (NCP). The NEM document is the baseline analysis for the noise conditions at the airport. The NCP document provides an analysis of various alternatives for reducing or eliminating airport noise impacts, concluding with a plan to effectively mitigate adverse noise impacts currently and in the future.

In addition to the materials provided in this section, the Technical Information Paper (TIP), *Federal Noise Regulations,* following the appendices of this report, provides additional information regarding the responsibility of the airport operator and federal, state, and local governments to reduce aircraft noise impacts.

NOISE EXPOSURE MAPS

The NEM document contains information regarding the existing and future noise conditions at the airport based on a number of variables discussed in Chapters Two and Three of this document. It defines the scope of the noise environment at the airport and includes maps of noise exposure for the current year, five-year forecast, and long range forecast. These noise contours are shown on a land use map to identify areas of non-compatible land use. Supporting information is provided to explain the methods used to develop the noise exposure contours.

Part 150 requires the use of federally prescribed methodologies and noise metrics to analyze and describe airport noise. It also establishes guidelines for the identification of land uses which are incompatible with airport noise of varying levels. Airport proprietors are required to update noise exposure maps when changes in airport operations create any new, substantial non-compatible use. The most widely used measure of this change is an increase in the yearly Day-Night Average Sound Level (DNL) of 1.5 decibels over non-compatible land uses.

DNL describes the 24-hour average sound level in A-weighted decibels, as averaged over a span of one year. More information regarding the measurement of sound can be found in Chapter Three and the TIP entitled, *The Measurement and Analysis of Sound*.

A limited degree of legal protection can be afforded to the airport proprietor through preparation of noise exposure maps. Section 107(a) of the Aviation Safety and Noise Abatement Act of 1979 (ANSA) provides that:

A person acquiring an interest in property...in an area surrounding an airport for which a noise exposure map has been submitted...and having actual or constructive knowledge of the existence of the map may recover damages for noise attributable to the airport only if, in addition to any other elements for recovery of damages, the person shows that (1) after acquiring the interest, there was a significant (A) change in the type or frequency of aircraft operations at the airport; (B) change in the airport layout; (C) change in flight patterns; or (D) increase in nighttime operations; and (2) the damages resulted from the change or increase.

ANSA provides that "constructive knowledge" shall be attributed to any person if a copy of the noise exposure map was provided to him or her at the time of property acquisition, or if notice of the existence of the noise exposure map was published three times in a newspaper of general circulation in the area. Additionally, Part 150 defines "significant increase" as an increase of 1.5 DNL. For purposes of this provision, Federal Aviation Administration (FAA) officials consider the term "area surrounding an airport" to mean an area within the 65 DNL noise exposure contour. For additional information on this subject, see Part 150, Section 150.21 [d], [f] and [g].

Acceptance of the noise exposure maps by the FAA is required before a noise compatibility program for the airport can be approved.

Noise Compatibility Program

Part 150 establishes procedures and criteria for FAA evaluation of noise compatibility programs. Among these, two criteria are of particular importance: the airport proprietor may take no action that imposes an undue burden on interstate or foreign commerce; nor may the proprietor unjustly discriminate between different categories of airport users.

A noise compatibility program includes recommendations for the abatement of aircraft noise through aircraft operating procedures, air traffic control procedures, airport regulations, or airport facility modifications. It also includes recommendations for land use compatibility planning and may include actions to mitigate the impact of noise on non-compatible land uses. Additionally, the program should contain provisions for updates and periodic revision.

With an approved noise compatibility program, an airport proprietor becomes eligible for funding through the federal Airport Improvement Program (AIP) to implement the qualified components of the program.

FAA established a new policy in 1998 for Part 150 approval and funding of noise mitigation measures which increased the incentives for airport operators to discourage development of new non-compatible land uses within the airport environs. Under the revised policy, the FAA will not approve measures in Noise Compatibility Programs proposing corrective noise mitigation actions for non-compatible development that was allowed to occur in the vicinity of airports after October 1, 1998, the effective date of the policy. Therefore, corrective noise mitigation measures for new non-compatible development that occurs after October 1, 1998, will not be eligible for AIP funding under the noise set-aside fund, regardless of previous approvals under Part 150.

A Noise Compatibility Program is intended to promote aircraft noise control and land use compatibility. Three things make such a study unique: (1) it is the only comprehensive approach to reduce airport and community land use conflicts; (2) it identifies items eligible for AIP funding; and (3) it is the only federally funded airport study that balances community land use desires and aviation requirements.

The principal objectives of a Noise Compatibility Program are to:

- Identify the current and projected aircraft noise levels and their impact on the airport area.
- Propose strategies to reduce the impacts of aircraft noise through changes in aircraft operations or airport facilities.
- In undeveloped areas where aircraft noise is projected to remain, encourage future land use zoning determined to be compatible with the noise and operation of an airport, such as agriculture, commercial, or industrial, etc.
- In existing residential areas that are expected to remain impacted by noise, determine ways of reducing the adverse impacts of noise.
- Establish procedures for implementing, reviewing, and updating the plan.

Why Conduct a Part 150 Study?

A Noise Compatibility Study is necessary to prevent the encroachment of non-compatible land uses on Buckeye Municipal Airport. The airport is an integral part of the local and regional economy. It provides jobs, recreational opportunities, and transportation access to people in western Maricopa County. As growth continues to occur in this area, residential development could start to occur near the airport. Frequently, communities wait until airport noise becomes problematic before initiating a Part 150 study. The Town of Buckeye has demonstrated the foresight necessary to protect future development from airport noise exposure and the airport from encroachment by engaging in the Part 150 process.

Buckeye Municipal Airport is taking the first step to ensuring airport land use compatibility by initiating a Part 150 Noise Compatibility Study. This study will allow the airport to establish itself as a good neighbor to future development while maintaining the needed aviation services within the community.

JURISDICTION AND RESPONSIBILITIES

The reduction or limitation of aviation noise impacts is a complex issue with several parties sharing the responsibility. The following sections describe the roles of each stakeholder.

FEDERAL GOVERNMENT

The federal government, primarily through the FAA, has the authority and responsibility to control aircraft noise sources through the following methods:

- Implement and Enforce Aircraft Operational Procedures – These include pilot responsibilities, compliance with Air Traffic Control instructions, flight restrictions, and monitoring careless and reckless operation of aircraft. Where and how aircraft are operated is under the complete jurisdiction of the FAA.

- Manage the Air Traffic Control System – The FAA is responsible for the control of navigable airspace and reviews any proposed alterations in flight procedures for noise abatement on the basis of safety of flight operations, safe and efficient use of navigable airspace, management and control of the national airspace and air traffic control systems, effects on security and national defense, and compliance with applicable laws and regulations.

- Certification of Aircraft – The FAA has required the reduction of aircraft noise through certification, modification of engines, or aircraft replacement as defined in the Code of Federal Regulations Title 14, Part 36.

Currently, FAA noise reduction regulations do not apply to military aircraft or aircraft below 75,000 pounds.

- Pilot Licensing – Individuals licensed as pilots are trained under strict guidelines concentrating on safe and courteous aircraft operating procedures, many of which are designed to lessen the effects of aircraft noise.

- Noise Compatibility Studies – Part 150 establishes procedures and criteria for the evaluation of Noise Compatibility Studies.

14 CFR Parts 36 and 91
Federal Aircraft
Noise Regulations

The FAA has required reduction of aircraft noise at the source through certification, modification of engines, or replacement of aircraft. 14 CFR Part 36 prohibits the further escalation of noise levels of subsonic civil turbojet and transport category aircraft. It also requires new airplane types to be markedly quieter than earlier models. Subsequent amendments have extended the noise standards to include small, propeller-driven airplanes and supersonic transport aircraft.

14 CFR Part 36 has four stages of certification. Stage 4 is the most rigorous and applies to aircraft certificated after January 1, 2006. FAA's final ruling on this change was published in the Federal Register on July 5, 2005, and is effective January 1, 2006. Stage 3 applies to aircraft certificated between November 5, 1975, and January 1, 2006; Stage 2 applies to aircraft certificated between December 1, 1969, and November 5, 1975; and Stage 1 includes all previously certificated aircraft.

14 CFR Part 91, Subpart I, known as the "Fleet Noise Rule," mandated a compliance schedule under which Stage 1 aircraft were to be retired or refitted with hush kits or quieter engines by January 1, 1988. A very limited number of exemptions have been granted by the U.S. Department of Transportation for foreign aircraft operating into specified international airports.

Pursuant to the Congressional mandate in the *Airport Noise and Capacity Act of 1990* (ANCA), the FAA has established amendments to 14 CFR Part 91 by setting December 31, 1999, as the date for discontinuing use of all Stage 2 aircraft exceeding 75,000 pounds. Stage 2 aircraft operating non-revenue flights can operate beyond the December 31, 1999, deadline for the following purposes:

- To sell, lease, or scrap the aircraft;
- To obtain modifications to meet Stage 3 standards;
- To obtain scheduled heavy maintenance or significant modifications;
- To deliver the aircraft to a lessee or return it to a lessor;
- To park or store the aircraft;
- To prepare the aircraft for any of these events; or
- To operate under an experimental airworthiness certificate.

Neither 14 CFR Part 36 nor Part 91 applies to military aircraft. Nevertheless, many of the advances in quiet engine technology are being used by the military as they upgrade aircraft to improve performance and fuel efficiency.

14 CFR Part 161
Regulation Of Airport Noise And Access Restrictions

14 CFR Part 161 sets forth requirements for notice and approval of local restrictions on aircraft noise levels and airport access. Part 161 was developed in response to ANCA. It applies to local airport restrictions that would have the effect of limiting operations of Stage 2 or 3 aircraft. These include direct limits on maximum noise levels, nighttime curfews, and special fees intended to encourage changes in airport operations to lessen noise.

In order to implement noise or access restrictions on Stage 2 aircraft, the airport proprietor must provide public notice of the proposal and provide at least a 45-day comment period. This includes notification of the FAA and publication of the proposed restriction in the *Federal Register*. An analysis must be prepared describing the proposal, alternatives to the proposal, and the costs and benefits of each. FAA will either accept the analysis of the restriction on Stage 2 aircraft as complete or return it with a request for additional study.

Noise or access restrictions on Stage 3 aircraft can be implemented only after receiving FAA approval. Before granting approval, the FAA must find that the following six conditions specified in the statute are met:

(1) The restriction is reasonable, nonarbitrary, and nondiscriminatory.

(2) The restriction does not create an undue burden on interstate or foreign commerce.

(3) The proposed restriction maintains safe and efficient use of the navigable airspace.

(4) The proposed restriction does not conflict with any existing federal statute or regulation.

(5) The applicant has provided adequate opportunity for public comment on the proposed restriction.

(6) The proposed restriction does not create an undue burden on the national aviation system.

In its application for FAA review and approval of the restriction, the airport operator must include an environmental assessment of the proposal and a complete analysis addressing the six conditions. Within 30 days of receipt of the application, the FAA must determine whether the application is complete. After a complete application has been filed, the FAA publishes a notice of the proposal in the *Federal Register*. FAA must approve or disapprove the restriction within 180 days of receipt of the completed application. Very few Part 161 studies have been undertaken since the enactment of ANCA. **Table 1A** summarizes the studies that have been done to date.

Airport operators that implement noise and access restrictions in violation of 14 CFR Part 161 are subject to termination of eligibility for airport grant funds and authority to impose and collect passenger facility charges.

STATE AND LOCAL

Control of land use in noise-impacted areas around airports is a key tool in limiting the number of residents exposed to aircraft noise. The FAA encourages land use compatibility within the vicinity of airports, and Part 150 has guidelines relating to land use compatibility based on varying levels of noise exposure. Nevertheless, the federal government has no direct legal authority to regulate land use. That responsibility rests exclusively with state and local governments.

State

The State of Arizona, through enabling legislation, has given the power to administer land use regulations to counties, cities, and towns. *Arizona Revised Statutes* do not require the establishment of planning commissions, agencies, or departments in municipalities; however, where such appointments are made, the municipality is required to prepare and adopt a long-range general plan and may regulate zoning, subdivision of land, and land development, consistent with the plan.

The State of Arizona provides for the disclosure of aviation activities to prospective buyers of real estate. In 1997, the state adopted legislation allowing airport sponsors to identify Airport Influence Areas (AIA) around public and commercial use airports. The establishment of an AIA is voluntary and requires a public hearing. The boundary of the AIA must be recorded with the county in which the airport resides.

TABLE 1A
Summary of 14 CFR Part 161 Studies

Airport	Year Started	Year Ended	Cost	Proposal, Status
Aspen-Pitkin County Airport Aspen, Colorado	N/A	N/A	N/A	The study has not yet been submitted to FAA.
Kahului Airport Kahului, Maui, Hawaii	1991	1994	$50,000 (est.)	Proposed nighttime prohibition of Stage 2 aircraft pursuant to court stipulation. Cost-benefit and statewide impact analysis found to be deficient by FAA. Airport never submitted a complete Part 161 Study. Suspended consideration of restriction.
Minneapolis-St. Paul International Airport Minneapolis, Minnesota	1992	1992	N/A	Proposed nighttime prohibition of Stage 2 aircraft. Cost-benefit analysis was deficient. Never submitted complete Part 161 study. Suspended consideration of restriction and entered into negotiations with carriers for voluntary cooperation.
Pease International Tradeport Portsmouth, New Hampshire	1995	N/A	N/A	Have not yet submitted Part 161 study for FAA review.
San Francisco International Airport San Francisco, California	1998	1999	$200,000	Proposing extension of nighttime curfew on Stage 2 aircraft over 75,000 pounds. Started study in May 1998. Submitted to FAA in early 1999 and subsequently withdrawn.
San Jose International Airport San Jose, California	1994	1997	Phase 1 - $400,000 Phase 2 - $5 to $10 million (est.)	Study undertaken as part of a legal settlement agreement. Studied a Stage 2 restriction. Suspended study after Phase 1 report showed costs to airlines at San Jose greater than benefits in San Jose. Never undertook Phase 2, systemwide analysis. Never submitted study for FAA review.
Burbank-Glendale-Pasadena Airport (Bob Hope Airport) Burbank, California	2000	Ongoing	Estimated cost is between $2 and $4 million.	Proposed curfew restricting all aircraft operations from 10:00 p.m. to 7 a.m. FAA issued comments on the preliminary Part 161 analysis and the study was stopped.
Naples Municipal Airport Naples, Florida	1999	2003	Estimated cost of $1.0 to $1.5 million for consulting and legal fees due to litigation.	Enactment of a total ban on Stage 2 general aviation jet aircraft under 75,000 pounds. The airport began enforcing the restriction on March 1, 2002. FAA has deemed the Part 161 study complete; however, FAA has ruled that the restriction violates federal grant assurances. Appeals process found that Naples can implement the access restriction and FAA can still withhold federal funding due to violation of grant assurances.
Van Nuys Airport Van Nuys, California	2004	Ongoing	$3 to $3.5 million	Proposing to prohibit Stage 2 aircraft from the airport and establish a curfew for Stage 3 aircraft.
Los Angeles International Airport Los Angeles, California	2005	Ongoing	N/A	The purpose of the study will be to prohibit east departures from 12:00 a.m. to 6:30 a.m.

N/A - Not available.
Sources: Telephone interviews with Federal Aviation Administration officials and staff of various airports.

In addition, the 1999 Arizona State Legislature adopted legislation requiring the state real estate department to prepare and maintain a series of maps depicting the traffic pattern airspace of each public airport in the state. These maps are to be provided to the public on request. The intent of the maps is to provide disclosure of the location of the airport as well as the potential influence the airport may have on the surrounding property.

The Public Disclosure Map for Buckeye Municipal Airport was adopted on October 18, 2005, and is depicted on **Exhibit 1A.** The boundary of this area is based on the traffic pattern airspace for the airport. The issuance of avigation easements and fair disclosure notices is required for development within the public disclosure area.

Council of Governments

The Maricopa Association of Governments (MAG) provides regional planning and policy decisions in areas of transportation, air quality, water quality, regional development, and human services. It also serves as the Metropolitan Planning Organization for the region and is responsible for securing federal funds for transportation projects. MAG is governed by a Regional Council comprised of elected officials from the member jurisdictions and a representative from the State Transportation Board.

City and County

In the vicinity of Buckeye Municipal Airport, the Town of Buckeye and Maricopa County each have land use regulation responsibilities. The Town of Buckeye operates under a mayor/council form of government under the direction of the Town Manager. The Buckeye Town Council is composed of six members, plus the mayor. Additionally, the Town of Buckeye has a development board which makes recommendations on land use issues to the Town Council. This body is made up of seven appointed members.

The unincorporated portions of Maricopa County are governed by the Board of Supervisors, which is made up from representatives from the five county districts. Maricopa County also has a Planning and Zoning Commission.

In addition to regulating land use, local governments may also acquire property to mitigate or prevent airport noise impacts, or may sponsor sound insulation programs for this purpose.

Airport Proprietor

Buckeye Municipal Airport is owned and operated by the Town of Buckeye. As airport proprietor, the Town has restricted power to control what type of civil aircraft use its airport or to impose curfews or other use restrictions. This power is limited by 14 CFR Part 161, which is discussed in depth in the TIP titled *Federal Noise Regulations* which can be found at the end of this document.

Within the limits of the law and financial feasibility, airport proprietors may mitigate aviation noise or acquire land or partial interests in land, such as air rights, easements, and development

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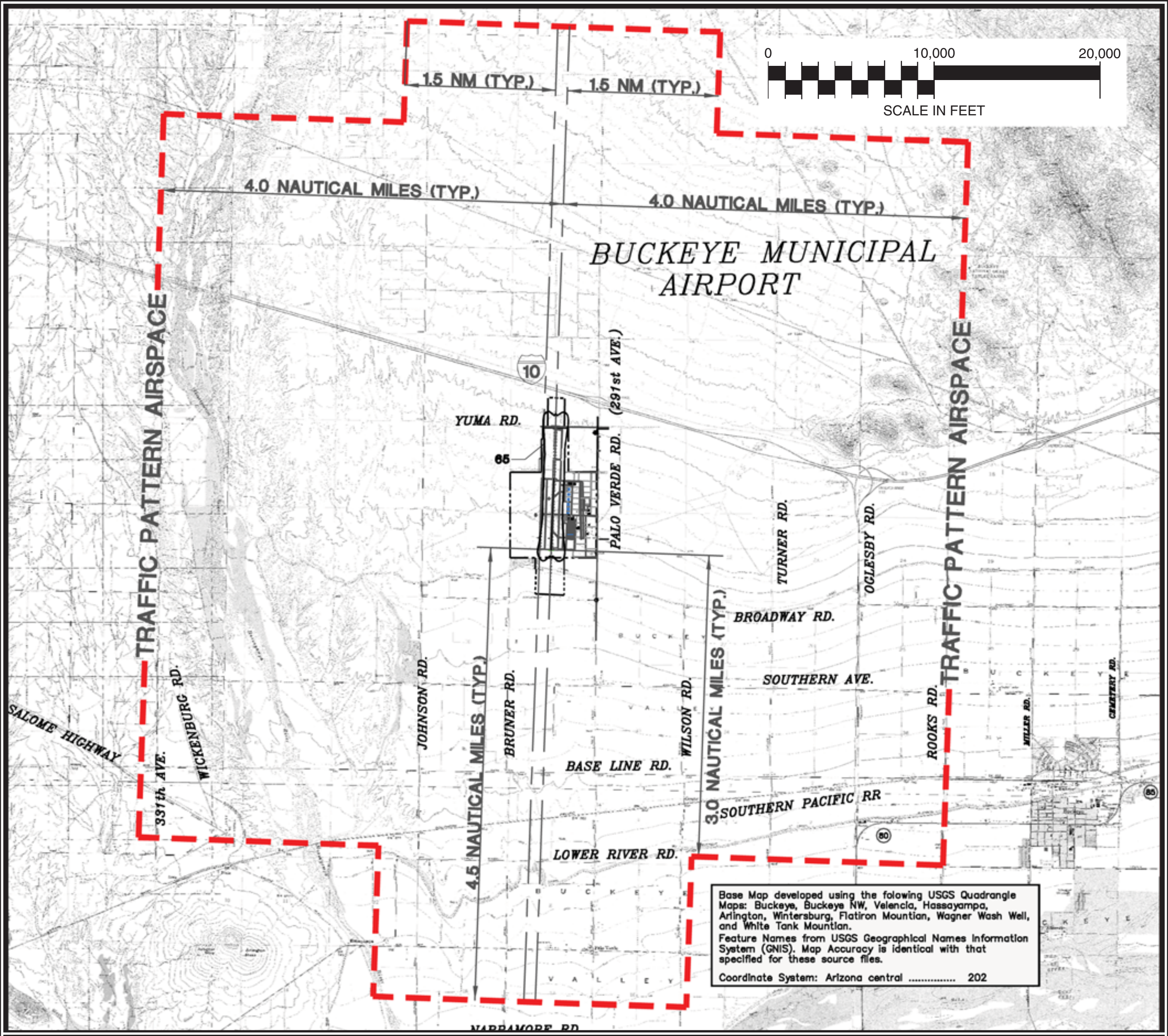

NOTES:

1. This map has been prepared in accordance with A.R.S., Section 28-8486, relating to public airport disclosure.
2. The Traffic Pattern Boundaries have been established in accordance with the guidelines provided in FAA Order 7400.2D.
3. 1 Nautical mile = 6,080 feet or 1.1515 statute miles.

LEGEND:

- Traffic Pattern Airspace
- Existing Airport Property Line
- Extended Runway Centerline
- DNL Noise Contours

NORTH

Exhibit 1A
PUBLIC AIRPORT DISCLOSURE MAP

rights, to assure the use of property for purposes which are compatible with airport operations.

AIRPORT SETTING

Buckeye Municipal Airport is located in the west-central portion of the Town of Buckeye planning area as shown on **Exhibit 1B**. The Town of Buckeye is situated in the southwestern portion of the Phoenix Metropolitan Area in Maricopa County, Arizona. The Town of Buckeye is located south of Interstate Highway 10. The Palo Verde Road interchange on Interstate Highway 10 provides access to the Buckeye Municipal Airport, which is located less than one mile south of the Interstate Highway. Arizona State Route 85 extends through downtown Buckeye. Route 85 links the Town of Buckeye with Interstate Highway 8 to the south.

CLIMATE

Weather plays an important role in the operational capabilities of an airport. The region experiences very little precipitation annually, with the greatest amounts occurring in the months of July and August. August is the warmest month, while January is the coolest. **Table 1B** summarizes typical temperature and precipitation data for the Town of Buckeye.

TABLE 1B
Temperature and Precipitation Data

	Temperature (Fahrenheit)		
	Mean Maximum	Mean Minimum	Precipitation (inches)
January	67.8	34.6	0.82
February	72.5	38.4	0.78
March	78.4	42.4	0.75
April	86.6	48.4	0.28
May	95.0	55.8	0.10
June	104.2	64.0	0.07
July	107.1	74.4	0.87
August	105.2	73.6	1.13
September	100.8	65.3	0.77
October	89.9	52.0	0.50
November	76.9	40.9	0.62
December	68.1	35.0	0.90
Annual Average	87.7	52.1	0.63

Source: Western Regional Climate Center

AIRPORT HISTORY

Originally constructed during World War II by Luke Air Force Base, Buckeye Municipal Airport was utilized by the Air Force as an auxiliary base for military training purposes. In 1949, the airfield was decommissioned and transferred to the State of Arizona by Quit Claim Deed under the Surplus Property Act of 1944. The Town of Buckeye subsequently acquired the airport from the state on March 11, 1960, also by Quit Claim Deed.

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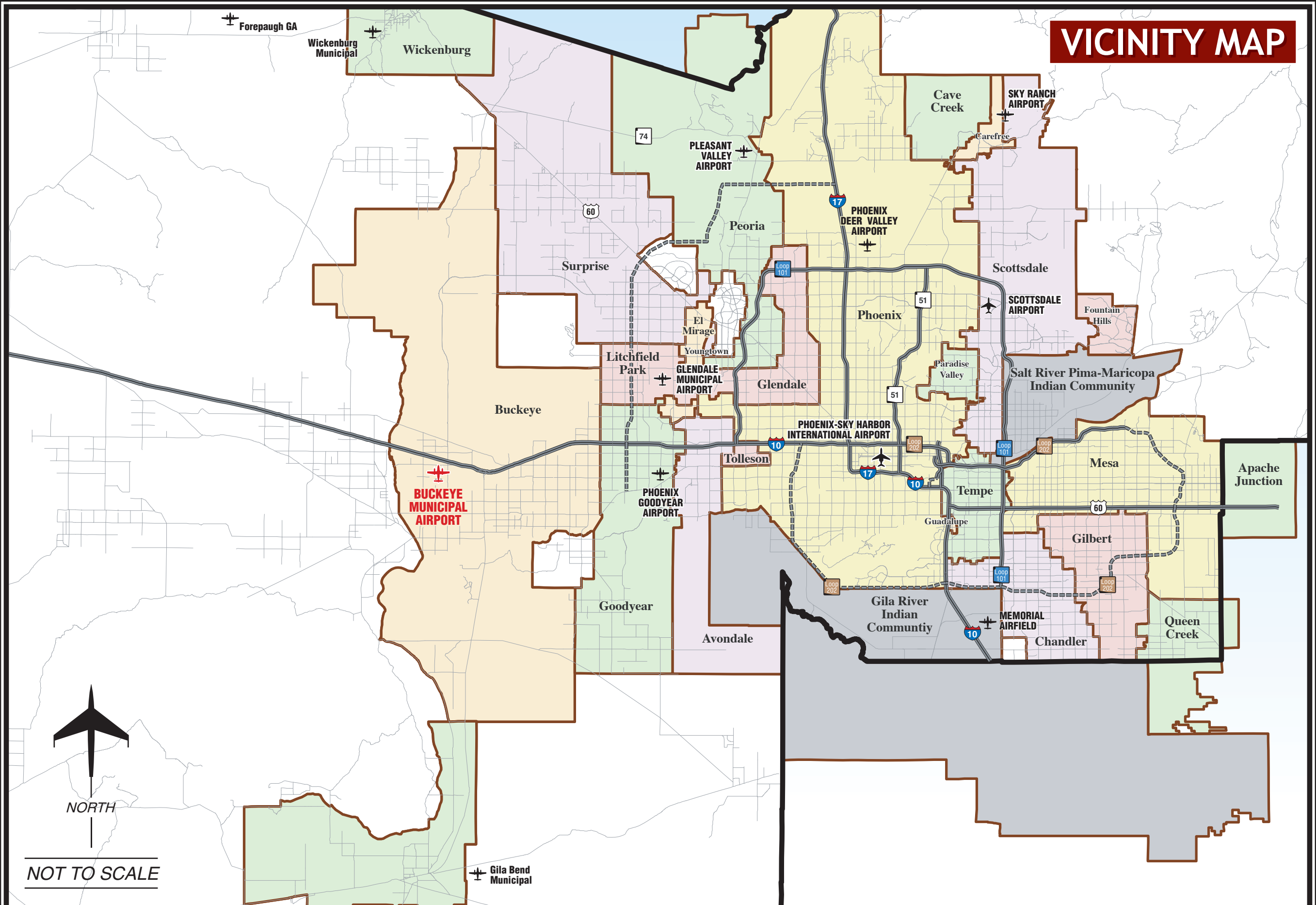

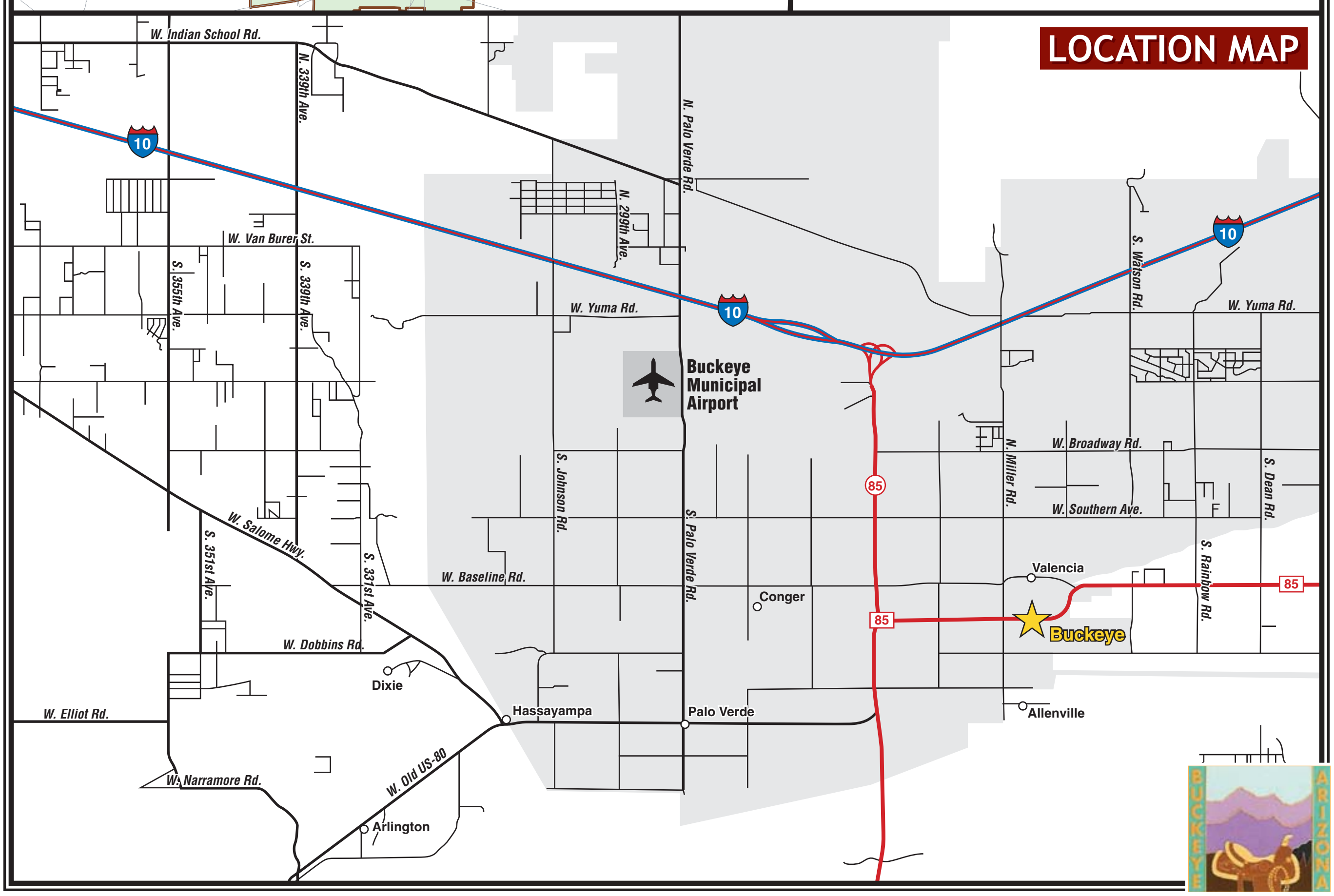

Exhibit 1B
LOCATION MAP

The original airport site included three runways, of which only Runway 16-34 was maintained by the Town of Buckeye. In the early 1980s, Runway 16-34 was closed and Runway 17-35 constructed to serve as the primary runway. The remaining portions of Runway 16-34 now serve as Taxiway J. The original construction of Runway 17-35 was completed in 1987.

In 1985 the Town of Buckeye delegated airport management, maintenance, and development responsibilities to a single lessee. The Lauridsen Industrial Corporation was selected as the sole lessee and signed a 25-year master lease with the Town. The lease was approved by the FAA and was structured in a manner which prevents exclusive rights. The master lease provided the Lauridsen Industrial Corporation the opportunity to operate and develop the airport. This lease agreement was terminated in 2003 when the Town took over control if the airport and received ownership of all structures and equipment. The Town of Buckeye now manages and develops the airport.

The airport is the responsibility of a full-time airport manager who reports directly to the Town Manager. There are no other airport employees. The Town is establishing an airport advisory board to advise the Town Council on the operation and development of the airport. In 2004, the Town Council approved both minimum standards for aeronautical operators at the airport and rules and regulations that govern the use of the airport.

AIRPORT FACILITIES

Airport facilities can be functionally classified into two broad categories: airside and landside. The airside category includes those facilities directly associated with aircraft operations. The landside category includes those facilities necessary to provide a safe transition from surface to air transportation and support aircraft servicing, storage, maintenance, and operational safety.

AIRSIDE FACILITIES

Airside facilities include runways, taxiways, airfield lighting, and navigational aids. Airside facilities are identified on **Exhibit 1C**. **Table 1C** summarizes airside facility data.

Runways

A single runway is available at Buckeye Municipal Airport. Runway 17-35 is 5,500 feet long and 75 feet wide and oriented in a north-south direction. Originally constructed in 1984 at 4,300 feet, Runway 17-35 was extended 1,200 feet to the north in 2003 and 2004. Based upon FAA pavement strength testing and documents, the load bearing strength of Runway 17-35 has been calculated at 30,000 pounds single wheel loading (SWL). SWL refers to the design of certain aircraft landing gear which has a single wheel on each main landing gear strut. This varies from the FAA Form 5010-1 and Airport/Facility Directory which lists a 12,500 pound SWL strength rating for Runway 17-35.

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Exhibit 1C
EXISTING FACILITIES

TABLE 1C **Airside Facility Data** **Buckeye Municipal Airport**	**Runway 17-35**
Runway Length (feet) Runway Width (feet)	5,500 75
Runway Surface Material Condition	Asphalt Good
Runway Pavement Markings Condition	Basic Good
Runway Load Bearing Strengths (lbs.)	30,000 SWL
Runway Lighting	Medium Intensity
Taxiway Lighting	Medium Intensity
Taxiway Pavement Markings Condition	Centerline, Holdlines Good
Approach Lighting	PAPI-2L (Runway 17) PAPI-4L (Runway 35)
Navigational Aids	VORTAC GPS Loran-C
Instrument Approach Procedures	None
Other Aids	Segmented Circle Lighted Wind Cone Rotating Beacon Lighted & Unlighted Directional Signs Runway Threshold Lights

Source: *Airport/Facility Directory, Southwest U.S*; FAA Form 5010-1, Airport Master Record

GPS – Global Positioning System
PAPI – Precision Approach Path Indicator
SWL – Single Wheel Loading
VORTAC – Very High Frequency Omnidirectional Range Facility with Military Tactical Navigational Aid

Runway gradient describes the upward or downward slope of a runway. The gradient is determined by dividing the difference in runway end elevations by the runway length. Runway 17-35 slopes upward to the north. There is a 38-foot elevation difference between each end of the runway, which equates to a 0.7 percent gradient.

LANDSIDE FACILITIES

Landside facilities are the facilities that support the aircraft and pilot/passenger handling functions. These facilities typically include the terminal building, aircraft storage/ maintenance hangars, aircraft parking aprons, and support facilities such as fuel storage, automobile parking, roadway access, and aircraft rescue and firefighting. Landside facilities are identified on **Exhibit 1C**. All buildings and structures at Buckeye Municipal Airport are owned by the Town of Buckeye.

Terminal Building

The passenger terminal building is located at the terminus of Butler Drive, near the center of the aircraft parking apron. The terminal building includes space for aircraft management, restrooms, a pilot's lounge, and a meeting/greeting area. The terminal building encompasses approximately 1,200 square feet.

Aircraft Hangar Facilities

There are eight separate enclosed hangar facilities totaling approximately 116,600 square feet at the airport; these are used for aircraft storage and/or maintenance. The large shade structures along Taxiway E are not included as they are not used for aircraft storage.

Hangar space at Buckeye Municipal Airport is comprised of conventional hangars and T-hangars. Conventional hangars provide a large enclosed space, typically accommodating more than one aircraft. T-hangars provide for separate, single aircraft storage areas, typically in one large building where as many as 10 T-hangars are located next to each other.

Conventional hangar space at the airport totals approximately 41,000 square feet, in three separate structures. There are four 10-unit T-hangar structures totaling approximately 38,600 square feet.

ENROUTE NAVIGATION AND AIRSPACE

Navigational aids are electronic devices that transmit radio frequencies, which pilots of properly equipped aircraft translate into point-to-point guidance and position information. The types of electronic navigational aids available for aircraft flying to or from Buckeye Municipal Airport include the very high frequency omnidirectional range (VOR) facility, Loran-C, and global positioning system (GPS).

The VOR, in general, provides azimuth readings to pilots of properly equipped aircraft by transmitting a radio signal at every degree to provide 360 individual navigational courses. Frequently, distance measuring equipment (DME) is combined with a VOR facility (VOR/DME) to provide distance as well as direction information to the pilot. In addition, the military Tactical Air Navigational Systems (TACANS) and civil VORs are commonly combined to form a VORTAC. A VORTAC provides distance and direction information to civil and military pilots. Pilots flying to or from the airport can utilize the Buckeye VORTAC located approximately seven nautical miles northwest of the airport. **Exhibit 1D**, a map of the regional airspace system, depicts the location of the Buckeye VORTAC.

GPS is an additional navigational aid. GPS was initially developed by the United States Department of Defense for military navigation around the world. Increasingly, GPS has been utilized more in civilian aircraft. GPS uses satellites placed in orbit around the globe to transmit electronic signals, which properly equipped aircraft use to determine altitude, speed, and position information. GPS allows pilots to navigate directly to any airport in the country. In contrast with the

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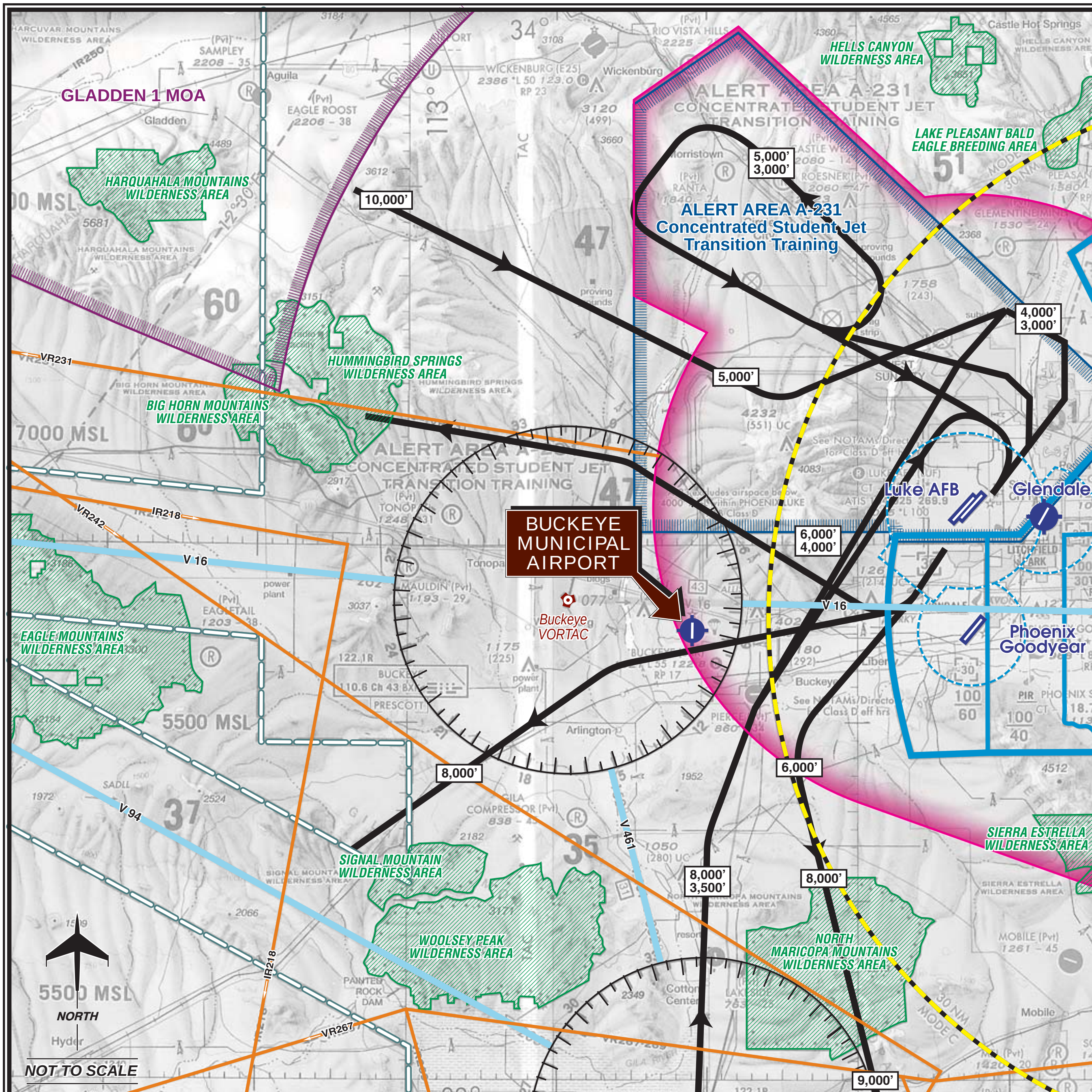

LEGEND

- Airport with other than hard-surfaced runways
- Airport with hard-surfaced runways 1,500' to 8,069' in length
- Airports with hard-surfaced runways greater than 8,069' or some multiple runways less than 8,069'
- Non-Directional Radiobeacon (NDB)
- VORTAC
- VHF Omni Range (VOR)
- VOR-DME
- Compass Rose
- Class D Airspace
- Class E Airspace
- Class E Airspace with floor 700 ft. above surface
- Mode C
- Victor Airways
- Wilderness Area
- Military Training Routes
- Differentiates floors of Class E Airspace greater than 700 ft. above surface
- Luke F-16 Traffic Flow
- Military Operations Area - MOA
- Prohibited, Restricted, Warning, and Alert Areas

Source: Phoenix Sectional Chart, US Department of Commerce, National Oceanic and Atmospheric Administration Oct. 27, 2005

Exhibit 1D
AIRSPACE MAP

VOR, pilots are not required to navigate from one specific navigational aid to the next. Loran-C uses a system of ground-based transmitters. Similar to GPS, pilots can navigate directly to their destination.

A GPS modernization effort is underway by the FAA and focuses on augmenting the GPS signal to satisfy requirements for accuracy, coverage, availability, and integrity. For civil aviation use, this includes the development of the Wide Area Augmentation System (WAAS), which was launched on July 10, 2003. The WAAS uses a system of reference stations to correct signals from the GPS satellites for improved navigation and approach capabilities. The present GPS provides for enroute navigation and instrument approaches with both course and vertical navigation. The WAAS upgrades are expected to allow for the development of approaches to most airports with cloud ceilings as low as 250 feet above the ground and visibilities restricted to three-quarters mile, after 2015.

Airspace Structure

To ensure a safe and efficient airspace environment for all aspects of aviation, the FAA has established an airspace structure that regulates and establishes procedures for aircraft using the National Airspace System. The U.S. airspace structure provides two basic categories of airspace, controlled and uncontrolled, and identifies them as Classes A, B, C, D, E, and G. These airspace classifications are depicted on **Exhibit 1E**.

Class A airspace is controlled airspace that includes all airspace from 18,000 feet mean sea level (MSL) to Flight Level 600 (approximately 60,000 feet MSL). Class B airspace is controlled airspace surrounding high-capacity commercial service airports (i.e., Phoenix Sky Harbor International Airport). Class C airspace is controlled airspace surrounding lower activity commercial service airports and some military airports (i.e., Tucson International Airport). Class D airspace is controlled airspace surrounding airports with an airport traffic control tower (i.e., Phoenix Goodyear Airport). All aircraft operating within Classes A, B, C, and D airspace must be in contact with the air traffic control facility responsible for that particular airspace. Class E airspace is controlled airspace that encompasses all instrument approach procedures and low-altitude federal airways. Only aircraft conducting instrument flights are required to be in contact with air traffic control when operating in Class E airspace. Aircraft conducting visual flights in Class E airspace are not required to be in radio communications with air traffic control facilities. Visual flight can only be conducted if minimum visibility and cloud ceilings exist. Class G airspace is uncontrolled airspace that does not require contact with an air traffic control facility.

Airspace in the vicinity of Buckeye Municipal Airport is depicted on **Exhibit 1D**. Buckeye Municipal Airport is located in Class E airspace, beginning at 700 feet above the surface and

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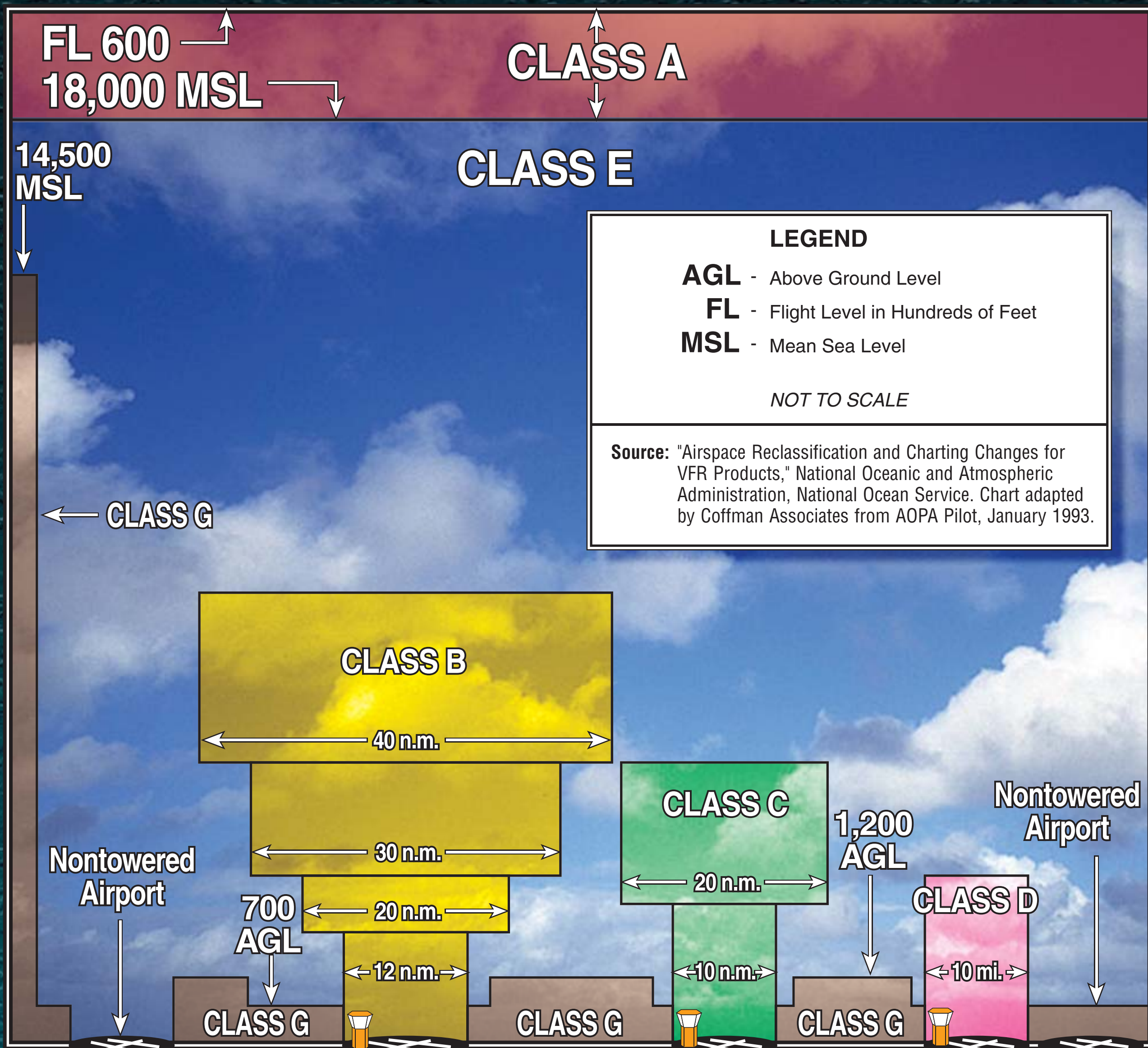

CLASSIFICATION	DEFINITION
CLASS A	Generally airspace above 18,000 feet MSL up to and including FL 600 .
CLASS B	Generally multi-layered airspace from the surface up to 10,000 feet MSL surrounding the nation's busiest airports.
CLASS C	Generally airspace from the surface to 4,000 feet AGL surrounding towered airports with service by radar approach control.
CLASS D	Generally airspace from the surface to 2,500 feet AGL surrounding towered airports.
CLASS E	Generally controlled airspace that is not Class A, Class B, Class C, or Class D.
CLASS G	Generally uncontrolled airspace that is not Class A, Class B, Class C, Class D, or Class E.

Exhibit 1E
AIRSPACE CLASSIFICATION

extending to 18,000 feet MSL. Class E airspace also encompasses the low-altitude Victor Airways in the vicinity of the airport. Victor Airways are corridors of airspace eight miles wide that extend upward from 1,200 feet above ground level (AGL) to 18,000 feet MSL and extend between VOR navigational facilities. Victor Airways in the area emanate from the Buckeye VORTAC.

SPECIAL USE AIRSPACE

Airspace may be reserved for use by a specific agency, primarily the military, within which operations of other aircraft are restricted or prohibited. The special use airspace in the vicinity of Buckeye Municipal Airport is defined in the following paragraphs and is identified on **Exhibit 1D**.

Alert Area A-231 is located immediately north of the airport. This area encompasses a primary training area for student pilots from Luke Air Force Base (AFB). This area is in operation continuously from 500 feet AGL to 6,500 feet MSL. While civilian operations are not limited within Alert Area A-231, pilots are requested to contact approach control at the radar approach control (RAPCON) based at Luke AFB for advisories.

While military aircraft from Luke AFB do not use Buckeye Municipal Airport, several approach and departure paths for Luke AFB extend to the north and south of Buckeye Municipal Airport. Altitudes on these routes extend from 3,500 feet MSL to 8,000 feet MSL. Typical routes near Buckeye Municipal Airport are shown on **Exhibit 1D**.

While not located immediately adjacent to the Buckeye Municipal Airport, several military operations areas (MOAs) are located in the regional area as shown on **Exhibit 1D**. MOAs define areas of high level military activity and are intended to segregate military and civilian aircraft. While civilian operations are not restricted within the MOA, civilian aircraft are cautioned to be alert for military aircraft when operating in the MOA. These MOAs are under control of the Albuquerque Air Route Traffic Control Center (ARTCC). The Gladden 1 MOA is located to the north of the airport. Aircraft operate above 7,000 feet MSL or 5,000 feet AGL, whichever is higher. It is in use between 6:00 a.m. and 7:00 p.m. each weekday.

A number of military training routes (MTRs) are located near Buckeye Municipal Airport. These routes are used by military training aircraft which commonly operate at speeds in excess of 250 knots and at altitudes to 10,000 feet MSL. While general aviation flights are not restricted within this area, pilots are strongly cautioned to be alert for high-speed military jet training aircraft.

As shown on **Exhibit 1D**, several areas in the vicinity of Buckeye Municipal Airport are designated as National Recreation and Wilderness Areas. Aircraft in and over these designated areas are requested to remain above 2,000 feet AGL.

Airspace Control

Buckeye Municipal Airport does not currently have an airport traffic control tower (ATCT) to regulate flight operations. Instead, pilots follow general flight procedures for arriving and departing the airport. Pilots announce their position and intentions on the Unicom frequency 122.8.

Enroute air traffic control service to Buckeye Municipal Airport is provided by the ARTCC. ARTCC controls aircraft in a large multi-state area. All aircraft in radio communication with the ARTCC are provided with altitude, aircraft separation, and route guidance to and from the airport.

The Phoenix Terminal Radar Approach Control (TRACON) facility, based at Phoenix Sky Harbor International Airport, controls aircraft operating within the Class B airspace surrounding Phoenix Sky Harbor International Airport. The TRACON uses direct radio communications and the Automated Radar Terminal tracking system (ARTS) to control air traffic within its jurisdiction. Air traffic control services provided by Phoenix TRACON include radar vectoring, sequencing and separation of IFR aircraft, and traffic advisories.

Instrument Approach Procedures

Instrument approach procedures are a series of predetermined maneuvers established by the FAA, using electronic navigational aids that assist pilots in locating and landing at an airport, especially during instrument flight conditions. Buckeye Municipal Airport currently does not have any published instrument approach procedures.

Visual Flight Procedures

Flights at Buckeye Municipal Airport are conducted under visual flight rules (VFR). Under VFR, the pilot is responsible for collision avoidance. Typically, the pilot will make radio calls announcing the position of the aircraft relative to the airport and the intentions of the pilot.

In most situations under VFR and basic radar services, the pilot is responsible for navigation and choosing the arrival and departure flight paths to and from the airport. The results of individual pilot navigation for sequencing and collision avoidance are that aircraft do not fly a precise flight path to and from the airport. Therefore, aircraft can be found flying over a wide area around the airport for sequencing and safety reasons.

While aircraft can be expected to operate over most areas of the airport, the density of aircraft operations is higher near the airport. This is the result of aircraft following the established traffic patterns for the airport. The traffic pattern is the traffic flow that is prescribed for aircraft landing or taking off from an airport. The components of a typical traffic pattern are as follows:

- Upwind Leg - A flight path parallel to the landing runway in the direction of landing.

- Crosswind Leg - A flight path at right angles to the landing runway off its upwind end.

- Downwind Leg - A flight path parallel to the landing runway in the direction opposite to landing. The downwind leg normally extends between the crosswind leg and the base leg.

- Base Leg - A flight path at right angles to the landing runway off its approach end. The base leg normally extends from the downwind leg to the intersection of the extended runway centerline.

- Final Approach - A flight path in the direction of landing along the extended runway centerline. The final approach normally extends from the base leg to the runway.

Essentially, the traffic pattern defines which side of the runway aircraft will operate. A right-hand traffic pattern has been established for Runway 17. Aircraft approaching this runway make a right turn from base leg to final approach for landing. Therefore, aircraft operating to Runway 17 remain west of the runway. For Runway 35, aircraft also remain west of the runway and approach the runway end following a series of left-hand turns.

While the traffic pattern defines the direction of turns that an aircraft will follow on landing or departure, it does not define how far from the runway an aircraft will operate. The distance laterally from the runway centerline an aircraft operates or the distance from the end of the runway is at the discretion of the pilot, based on the operating characteristics of the aircraft, number of aircraft in the traffic pattern, and metrological conditions. The actual ground location of each leg of the traffic pattern varies from aircraft operation to aircraft operation for the reasons of safety, navigation, and sequencing described above. The distance that the downwind leg is located laterally from the runway will vary based mostly on the speed of the aircraft. Slower aircraft can operate closer to the runway as their turn radius is smaller.

The FAA has established that piston-powered aircraft operating in the traffic pattern fly at 1,000 feet above the ground (or 2,000 feet MSL) when on the downwind leg. The traffic pattern altitude is established so that aircraft have a predictable descent profile on base leg to final approach for landing.

Regional Airports

A review of airports within 30 nautical miles of Buckeye Municipal Airport has been made to identify and distinguish the type of air service provided in the area surrounding the airport. Public-use airports within 30 nautical miles of the airport are illustrated on **Exhibit 1D**. Information pertaining to each airport was obtained from FAA master airport records.

Glendale Municipal Airport is located approximately 21 nautical miles northeast of Buckeye Municipal Airport. Glendale Municipal Airport is owned and operated by the City of

Glendale. A single runway is available for use. Runway 1-19 is 7,150 feet long and 100 feet wide. The ATCT at Glendale Municipal Airport is operated from 6:00 a.m. to 8:30 p.m., Monday through Friday, and 7:00 a.m. to 7:00 p.m. on the weekends. There is one published GPS instrument approach into Glendale Municipal Airport. There are approximately 269 based aircraft at Glendale. A full range of general aviation services are available at the airport.

Phoenix Goodyear Airport is located approximately 15.5 nautical miles east of Buckeye Municipal Airport. Phoenix Goodyear Airport is owned and operated by the City of Phoenix. A single runway, 8,500 feet long by 150 feet wide, is available for use. Phoenix Goodyear Airport has an operating ATCT, which is operated from 6:00 a.m. to 9:00 p.m. daily. There are approximately 227 based aircraft and a limited range of general aviation services are available at Phoenix Goodyear Airport.

Luke Air Force Base is located approximately 16.7 miles northeast of Buckeye Municipal Airport. Luke AFB is a military base with two runways. The largest runway has a length of 10,012 feet and a width of 150 feet. There is an operating ATCT at the air base. Luke AFB serves as the primary F-16 training base for the U.S. Air Force.

Gila Bend Municipal Airport is located approximately 27.7 nautical miles south of Buckeye Municipal Airport. Gila Bend Municipal Airport provides a single runway 5,200 feet long by 75 feet wide. The airport is uncontrolled and there are two based aircraft. There are no instrument approach procedures. Limited general aviation services are available at the airport.

FIXED BASE OPERATOR (FBO) AND SPECIALTY OPERATORS

The following businesses and organizations on located on airport property:

- Trademark Group – Aircraft Fueling
- Groen Brothers – Gyrocopter construction, maintenance, and training.
- Desert Skydiving Center – Skydiving

Additionally, Arizona Public Service (APS) leases a portion of the conventional hangar east of the terminal building and 15 acres of land for emergency preparedness in the event of an emergency at the Palo Verde nuclear power plant, located west of the Town of Buckeye.

LAND USE PLANNING POLICIES AND REGULATIONS

In most cities and counties, land use planning occurs through both regulatory and non-regulatory means. Regulatory tools for directing land use include the zoning ordinance, which limits the types, size, and density of uses allowed in various locations; subdivision regulations, which regulate the platting and division of land; and building codes which establish requirements for building. Non-regulatory means include the comprehensive plan, which is also referred to as a general or master plan, and specific area plan. The comprehensive plan provides the basis for the zoning ordinance and sets guidelines for future development. Specific area plans provide further guidance for particular portions of a community.

It is important to note the distinction between the primary land use concepts used in evaluating development within the airport environs: existing land use, existing zoning, and general plan land use. Existing land use refers to property improvements as they exist today according to city or county records. Examples of land use types include residential, commercial, industrial, and agricultural. Existing zoning identifies the type of land use permitted on a given piece of property according to the city or county zoning ordinance and map. In some cases, this may differ from the existing land use. Finally, the general plan land use identifies the projected or future land use according to the city or county's general plan. This document guides future development within the community planning area.

The following sections provide descriptions of the various land use planning tools currently in place within the study area. From these descriptions, an understanding of the regulations can be developed.

REGULATORY FRAMEWORK

Arizona state law allows cities and counties to prepare a comprehensive, generalized land use plan for the development of land within their jurisdiction. The city or county also provide for zoning and the delineation of zoning districts. Additionally, the county is responsible for regulating the subdivision of all lands within its jurisdiction, except subdivisions which are regulated by municipalities. Maricopa County regulates the unincorporated areas within the study area.

Municipalities are permitted to prepare, adopt, and implement comprehensive, long-range, generalized land use plans for land both under their current jurisdiction and for unincorporated (extraterritorial) sections of the county which are likely to be annexed by the city or town. General land use plans include plans and policies outlining the community's goals, objectives, principles, and standards for overall growth and development.

Local governments are required to regulate the subdivision of all lands within their corporate limits and may also prepare and adopt zoning ordinances and building codes. Zoning ordinances must be consistent with the general plan, where one has been prepared.

In the vicinity of Buckeye Municipal Airport, the Town of Buckeye and Maricopa County share responsibility for land use planning. Each jurisdiction administers zoning ordinances, subdivision regulations, and building codes. Much of the land near the airport is within the Buckeye Town Limits. **Exhibit 1F** shows the current jurisdictional boundaries. The applicable planning and development tools are described in the following sections.

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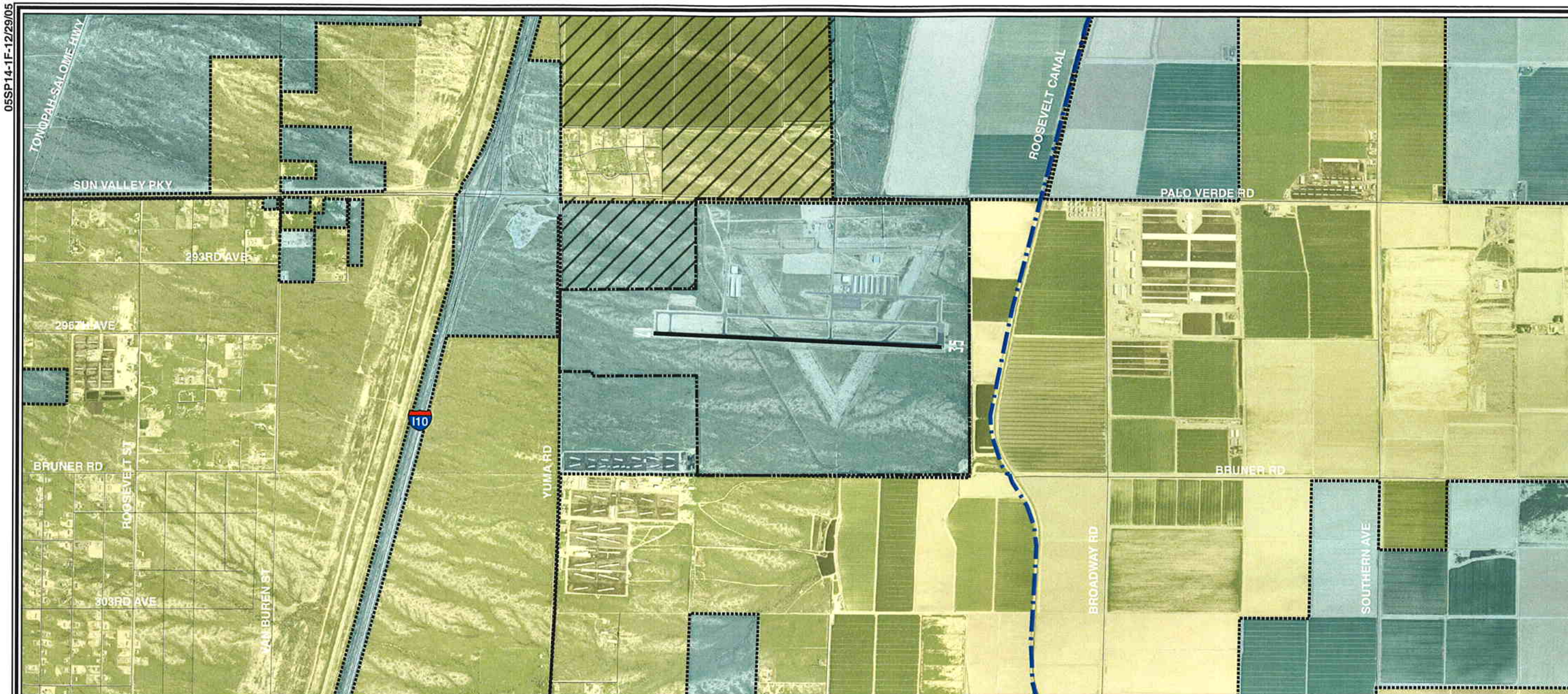

LEGEND

- Airport Property
- Municipal Boundary
- State of Arizona Land
- Maricopa County
- Town Of Buckeye
- Water

Source: Aerial Photography, March 2005.
Maricopa County Planning & Development, Annexation Map, August 2005.

NORTH

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Feet

Exhibit 1F
JURISDICTIONAL BOUNDARIES

STATE OWNED LAND

The Arizona State Land Department owns parcels located near the airport. These lands are identified on **Exhibit 1F**. The purpose of the State Land Department is to manage land to enhance its value and optimize its economic return for its beneficiaries, which include public schools, public hospitals, and other state institutions. Land can be sold or leased from State Land Department. Lands that are to be used for residential purposes are generally sold, while commercial development land is leased. State Trust lands may be leased for a variety of commercial purposes including retail, industrial, office, and other uses. Short (0-10 years) and long term (10-99) leases are also available for state-owned lands through a public auction process.

EXISTING LAND USE

Exhibit 1G depicts the existing land uses surrounding the airport. The map was developed using information from the Town of Buckeye and Maricopa County Assessor's office, and verified by the consultant through field investigations in August 2005 and a review of aerial photography dated March 2005. Much of the land surrounding the airport is undeveloped and primarily used for dairy farming. There are two dairy farms located near the airport, one to the south and one to the west. These farms have associated employee's quarters located on the premises. Additionally, there is a small cluster of single-family residences located northeast of the airport. This area is within unincorporated Maricopa County. Additional rural residential homes are located within the vicinity of the airport, including several to the north of Interstate 10 and several scattered residences to the east, south, and west.

GENERAL PLAN

A community's general plan sets the standards and guidelines for future development and provides the legal basis for the zoning ordinance. The plan represents a generalized guideline, as opposed to a precise blueprint, for locating future development. During the preparation of a plan, existing land uses are evaluated. Based on the evaluation, future land uses and facilities are determined. By illustrating preferred land use patterns, a general plan can be used by community decision-makers, staff, developers, investors, and residents to assist in evaluating future development opportunities.

BUCKEYE GENERAL PLAN

The Buckeye General Plan, adopted September 2001, provides the foundation for planning decisions within the Town of Buckeye. The General Plan map adopted by the Town is illustrated in **Exhibit 1H**. The plan is divided into several elements that address growth issues for the Town. Although there is no direct reference to airport noise, the following recommendation from the Environmental Element addresses general noise as it relates to future development.

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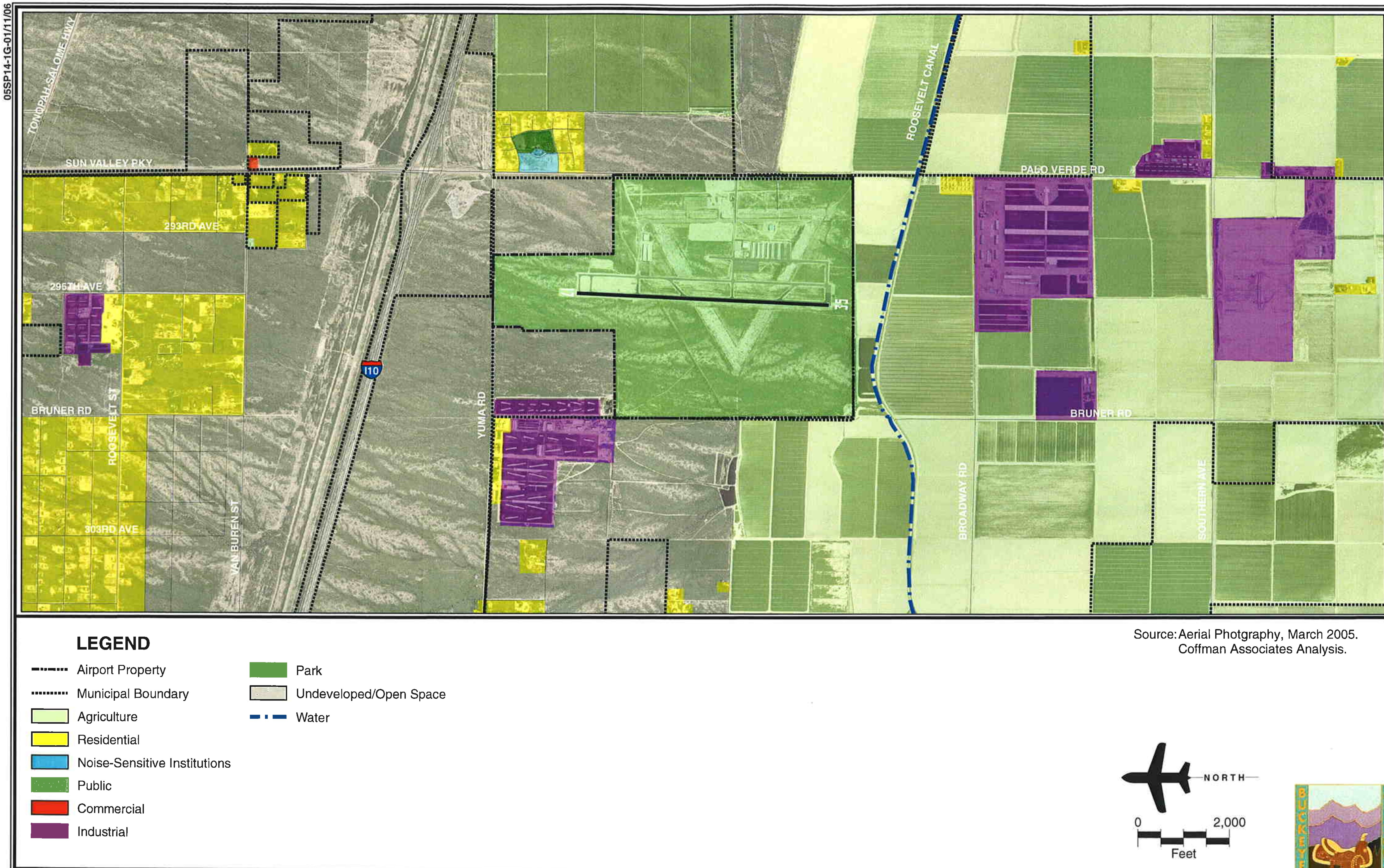

Exhibit 1G
EXISTING LAND USE

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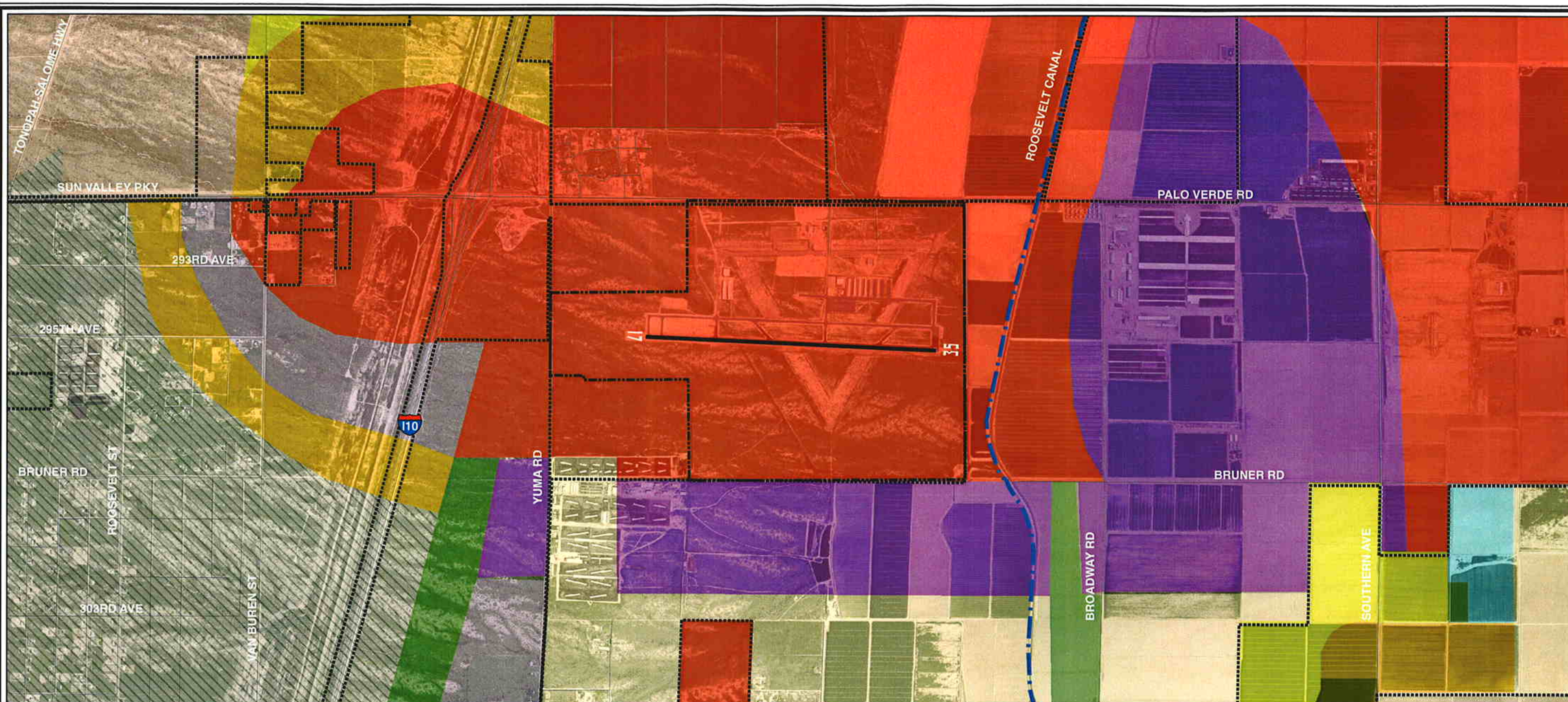

LEGEND

- Airport Property
- Municipal Boundary
- Rural-Density Residential
- Low-Density Residential
- Medium-Density Residential
- High-Density Residential
- Noise-Sensitive Institutions
- Planned Communities
- Park & Open Space
- Mixed Economic Use
- Commercial
- Industrial
- No Designated Land Use
- Water

Source: Aerial Photography, March 2005.
Buckeye General Plan Map, July 2005.
Cipriani, Community Master Plan, May 2005.

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Feet

BUCKEYE ARIZONA

Exhibit 1H
GENERAL PLAN LAND USE

a. Goal: Maintain clean, unpolluted, water and air

Action Recommendation: Enforce against all types of environmental pollution, including measures to reduce noise and the glare of artificial lighting.

The action statement is intended to provide support for reducing overall noise impacts within the Town.

Additionally, within the Growth Areas Element of the General Plan there is a reference to the type of development that should occur near the airport. As stated in the plan, "The Buckeye Airport, south of I-10 on Palo Verde Road, is an ideal location for economic development to occur." It is assumed that this type of development includes industrial or commercial development rather than residential.

MARICOPA COUNTY COMPREHENSIVE PLAN

Maricopa County adopted its most recent county comprehensive plan in 1997 and amended it in 2002. The plan is comprised of seven elements that address various components of growth within the entire county. The Land Use element specifically comments on noise as it relates to development. It proposes "to protect, preserve, and promote the health, safety and welfare of Maricopa County's citizens through the reduction, control, and prevention of noise." To achieve this goal, the plan states the following objective and policy:

Objective L4: Provide for the coexistence of urban and rural land uses.

Policy L4.3: Encourage development patterns and standards compatible with the continuing operation of military and civilian airports and other unincorporated county areas.

This objective and policy addresses airport land use compatibility issues outside of the incorporated portions of the Town of Buckeye.

ZONING

While land use plans are intended to establish policies and goals to guide future development and land use, municipalities and counties actually control land use through zoning ordinances and development codes.

The purpose of this section is to summarize the various land use controls that apply within the airport vicinity. The following summarized information will be used in the Part 150 study process to identify zoning districts which provide a compatible land use buffer and those that could allow encroachment of noise-sensitive land uses. Efforts will be made in the final recommendations of this study to change circumstances in which non-compatible development could be allowed.

Town of Buckeye Development Code

The Town of Buckeye Development Code establishes the regulations for development within the incorporated portions of the town. It identifies the land use districts applicable to these lands and outlines the permissible uses for each category. **Table 1D** outlines the Town of Buckeye Land Use Districts and the noise-sensitive sensitive uses permitted in each category.

TABLE 1D
Town of Buckeye Land Use Districts

District	Permitted Uses	Conditional Uses	Minimum Lot Size
Rural Residential	Guest room, quarters for caretaker, residential facility, residential ranch, single-family dwelling	Bed and breakfast, boarding house, campgrounds, cemetery, manufactured home subdivision, recreational vehicle park, zoo	10 acres, unless part of an approved subdivision, in which case the minimum lot size shall be one acre per dwelling unit
Planned Residential	Golf course/resort, places of worship, residential facility, residential ranch, single-family dwelling	Manufactured home subdivision	10 acres, unless part of an approved subdivision, in which case there is no minimum size
Mixed Residential	Golf course/resort, group home, multiple family dwelling, places of worship, residential facility, schools, public and private, single-family dwelling	Bed and breakfast, boarding house, day care center, manufactured home park, nursing home	10,000 square feet for single-family dwellings or 2,000 square feet per multiple-family dwelling
Planned Community	Master Planned Community, residential facility, single-family dwelling	None	10 acres, unless part of an approved subdivision, in which case there is no minimum size
Commercial Center	Clinic/health care facility, group home, guest room, hotel/motel, multiple family dwelling, museum, places of public assembly, places of worship, quarters for caretaker, residential facility, schools, veterinary clinic, veterinary hospital	Day care center, funeral home, hospital, manufactured home park, nursing home, recreational vehicle park	3,000 square feet per dwelling unit
General Commerce	Clinic/health care facility, golf course/resort, hotel/motel, museum, places of public assembly, quarters for caretaker, rodeo arena, veterinary clinic, veterinary hospital	Day care center, funeral home, hospital, zoo	1 acre, unless part of an approved subdivision, in which case there is no minimum size
Special Use	Golf course/resort, museum, places of public assembly, quarters for caretaker, rodeo arena, schools	Campgrounds, recreational vehicle park, zoo	Ten acres

Maricopa County Zoning Ordinance

The Maricopa County Zoning Ordinance was last amended in April 2005. **Table 1E** summarizes Maricopa County's zoning districts and the noise-sensitive uses allowed in each district.

TABLE 1E
Maricopa County Zoning Districts

District	Permitted Uses	Conditional Uses	Minimum Lot Size
Rural – 190	Single-family residential, multi-sectional manufactured home, church, columbarium, group home, elementary and high schools, private and charter schools, golf course, libraries, museums, parks	Caretaker's quarters	190,000 Square Feet/DU
Rural – 70	Same as Rural – 190	Caretaker's quarters	70,000 Square Feet
Rural – 43	Same as Rural – 190	Caretaker's quarters	1 acre (43,560 Square Feet)/DU
R1 – 35, Single-family	Single-family residential, multi-sectional manufactured home, church, columbarium, group home, elementary and high schools, private and charter schools, golf course, libraries, museums, parks	None	35,000 Square Feet/DU
R1 – 18, Single-family	Same as R1 – 35	None	18,000 Square Feet/DU
R1 – 10, Single-family	Same as R1 – 35	None	10,000 Square Feet/DU
R1 – 8, Single-family	Same as R1 – 35	None	8,000 Square Feet/DU
R1 – 7, Single-family	Same as R1 – 35	None	7,000 Square Feet/DU
R1 – 6, Single-family	Same as R1 – 35	None	6,000 Square Feet/DU
R-2, Two-Family	Single-family residential, multi-sectional manufactured home, church, columbarium, group home, elementary and high schools, private and charter schools, golf course, libraries, museums, parks, two-family and limited multiple-family dwellings	None	4,000 Square Feet/DU
R-3, Multiple Family	Same as R-2	None	3,000 Square Feet/DU
R-4, Multiple Family	Same as R-2	None	2,000 Square Feet/DU
R-5, Multiple Family	Same as R-2	None	1,000 Square Feet/DU
C-S, Planned Shopping Center	Rural or residential zoning regulations in effect prior to the establishment of the C-S district	None	None
C – O, Commercial Office	Physician's office	None	12,000 Square Feet

TABLE 1E (Continued)
Maricopa County Zoning Districts

District	Permitted Uses	Conditional Uses	Minimum Lot Size
C-1, Neighborhood Commercial	Churches, day nurseries and nursery schools, private schools, libraries, museums, parks, elementary and high schools, colleges	None	6,000 Square Feet
C-2, Intermediate Commercial	Churches, day nurseries and nursery schools, private schools, libraries, museums, parks, elementary and high schools, colleges, funeral homes, mortuaries, chapels, hotels, motels, radio and television broadcasting stations and studios, theatres, trade schools, veterinary hospitals	None	6,000 Square Feet
C-3, General Commercial	Churches, day nurseries and nursery schools, private schools, libraries, museums, parks, elementary and high schools, colleges, funeral homes, mortuaries, chapels, hotels, motels, radio and television broadcasting stations and studios, theatres, trade schools, veterinary hospitals, drive-in theatres	None	6,000 Square Feet
IND-1, Planned Industrial	None	None	35,000 Square Feet
IND-2, Light Industrial	Caretaker's residence	None	6,000 Square Feet
IND-3, Heavy Industrial	None	None	6,000 Square Feet
OVERLAY DISTRICTS			
PAD, Planned Area Development	Limited to those within the base district	None	None
RUPD, Residential Unit Plan	Limited to those within the base district	None	None
CUPD, Commercial Plan	Limited to those within the base district	None	None
IUPD, Industrial Plan	Limited to those within the base district	None	None
PD, Planned Development	Limited to those within the base district	None	None
SC, Senior Citizen	None	None	None

Summary of Zoning Classifications

The various zoning districts of the Town of Buckeye and Maricopa County have been combined into generalized zoning categories. The generalized zoning designations are summarized in **Table 1F**. **Exhibit 1J** depicts the zoning classifications for the land surrounding Buckeye Municipal Airport.

TABLE 1F
Classification of Zoning Districts

Generalized Zoning Category	Town of Buckeye	Maricopa County
Rural-Density Residential (0-1.0 du/ac)	Rural Residential, Planned Residential, Planned Community	Rural-190, Rural-70, Rural-43
Low-Density Residential (1.1-5.0 du/ac)	Mixed Residential	R1-18, R-1-10
Medium-Density Residential (5.1-10.0 du/ac)	N/A	R1-8, R1-7, R1-6
High-Density Residential (> 10.0 du/ac)	Commercial Center	R-2, R-3, R-4, R-5
Specific Area Plan	Special Use	N/A
Commercial	General Commerce	C-S, C-1, C-2, C-3
Industrial	N/A	IND-1, IND-2, IND-3

Residential Categories

Rural-density Residential properties are those that have densities ranging between 0 and 1.0 dwelling units per acre. The Low-density Residential category includes parcels with densities between 1.1 and 5.0 dwelling units per acre. Medium-density Residential properties are those with densities between 5.1 and 10.0 dwelling units per acre. The High-density Residential category refers to those areas with greater than 10 dwelling units per acre.

Non-residential Categories

The Commercial and Industrial categories are areas zoned for manufacturing, office space and retail services.

SUBDIVISION REGULATIONS

Subdivision regulations apply in cases where a parcel of land is proposed to be divided into lots or tracts. They are established to ensure the proper arrangement of streets, adequate and convenient public spaces, efficient movement of traffic, adequate and properly located utilities, access for firefighting apparatus, and the orderly and efficient layout and use of land.

Subdivision regulations can be used to specify requirements for airport-compatible land development by requiring developers to plat and develop land so as to minimize noise impacts or reduce the noise sensitivity of new development. The regulations can also be used to protect the airport proprietor from litigation for noise im-

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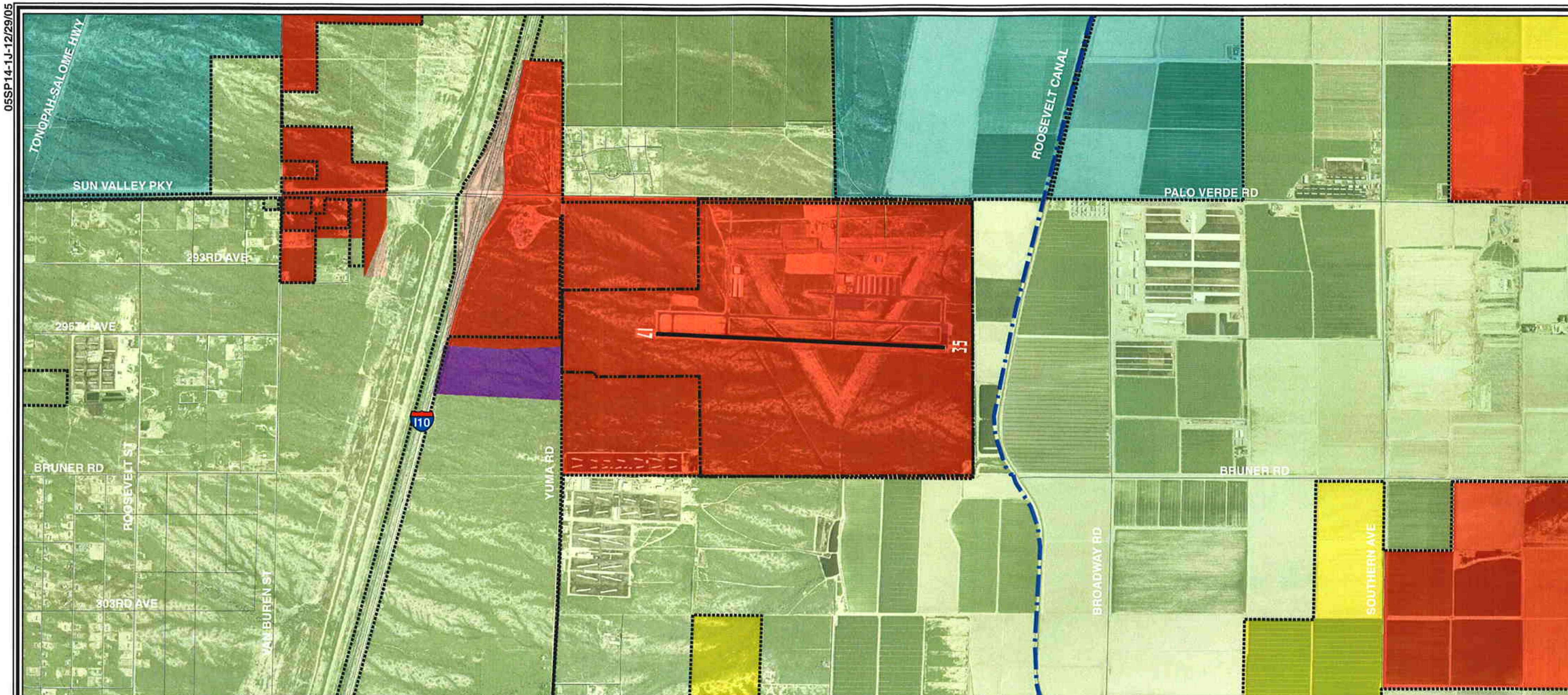

LEGEND

- Airport Property
- Municipal Boundary
- Agriculture
- Planned Residential
- Commercial
- Industrial
- Special Use Area
- Planned Community
- Water

Source: Aerial Photography, March 2005.
Maricopa County Planning & Development, Zoning Map, September 2005.
Town of Buckeye Zoning Map, Revised September 2005.

NORTH

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Feet

BUCKEYE ARIZONA

Exhibit 1J
GENERALIZED ZONING

pacts at a later date. The most common requirement is the dedication of a noise or avigation easement to the airport proprietor by the land developer as a condition of development approval. Easements typically authorize overflights of property, with noise levels attendant to such operations. They can also require developers to incorporate noise insulation during construction.

Both the Town of Buckeye and Maricopa County have adopted subdivision regulations. A description of the various regulations is presented in the following sections.

Town of Buckeye

The Town of Buckeye's subdivision codes are contained within Title 6 of the *Town of Buckeye Land Development Code*. Within the regulations, there are no specific references to airport-compatible development. The stated purpose, however, is to provide for orderly and harmonious development in accordance with the goals stated in the Town of Buckeye General Plan and other adopted ordinances.

Maricopa County

Maricopa County's subdivision ordinance is contained within Chapter 18 of the Maricopa County Code. The existing regulations suggest that the developer consult with the Federal Aviation Administration if the proposed development is in "close proximity" to an airport.

BUILDING CODE

Building codes regulate the construction of buildings and ensure that they are constructed to safe standards. Building codes may be used to require sound insulation in new residential, office, and institutional buildings when warranted by existing or potential high aircraft noise levels. The Town of Buckeye and Maricopa County have both adopted standard building codes. The Town of Buckeye uses the 2000 International Building Code and Maricopa County uses the 2003 International Building Code. These codes do not include additional regulations related to airport noise in the vicinity of Buckeye Municipal Airport.

CAPITAL IMPROVEMENT PROGRAM

Capital improvement programs (CIPs) are multi-year plans, typically covering five or six years, which outline major capital improvements planned to be undertaken by a particular jurisdiction. The CIP does not include facility improvements that are proposed to be funded entirely by developers.

Most capital improvements have no direct bearing on noise compatibility as few municipal developments are noise-sensitive. The obvious exceptions are schools, and in certain circumstances, libraries, medical facilities, and cultural/recreational facilities. The Part 150 noise compatibility planning process includes an evaluation of these types of planned facilities.

Some capital improvements, however, may have an indirect, but more profound, relationship to airport noise compatibility. For instance, sewer and water facilities may open up large vacant areas for private development of noise-sensitive residential uses. In contrast, the same types of facilities with the capacity to accommodate industrial users could permit industrial development in the same area that might otherwise be attractive for residential development on septic tanks.

Capital improvement projects in the vicinity of Buckeye Municipal Airport are outlined within the Town of Buckeye Capital Improvement Plan. The current list of projects includes road improvements as well as infrastructure improvements. A key infrastructure project that could spur development in the airport area is the construction of a sanitary sewer line west of the airport.

SUMMARY

The information presented in this chapter is intended to familiarize the reader with Buckeye Municipal Airport and its environs. This information will be used throughout the Part 150 Noise Compatibility Study to analyze existing and future noise conditions at the airport and to ultimately develop a strategy to mitigate or eliminate noise impacts. Both airside and landside alternatives will be considered to develop a multi-faceted approach for airport land use compatibility.

CHAPTER TWO

FORECASTS

FORECASTS

To evaluate the noise conditions at Buckeye Municipal Airport, a thorough evaluation of the existing operations at the airport as well as forecasts of future operations is necessary. Forecasts of based aircraft, the based aircraft fleet mix, and annual aircraft operations will serve as the basis for noise compatibility planning.

The primary objective of this planning effort is to define the magnitude of change in aviation demand that can be expected over time. Because of the cyclical nature of the economy, it is virtually impossible to predict, with certainty, year-to-year fluctuations in activity when looking more than 20 years into the future. However, a trend can be established which delineates long-term growth potential. While a single line is often used to express the anticipated growth, it is important to remember that actual growth may fluctuate above and below this line. This is because aviation activity is affected by many external influences, as well as by the types of aircraft used and the nature of available facilities.

In order to fully assess current and future aviation demand for the Buckeye Municipal Airport, an examination of several key factors is needed. These include national and regional aviation trends, historical and forecast socioeconomic and demographic information of the area, and historical trends at Buckeye Municipal Airport.

NATIONAL AVIATION TRENDS

In the 11 years since the passage of the *General Aviation Revitalization Act* of 1994 (federal legislation which limits the liability on general aviation aircraft to 18 years from the date of manufacture), it is clear that the Act has successfully infused new life into the general aviation industry. This legislation sparked an interest to renew the manufacturing of general aviation aircraft due to the reduction in product liability, as well as renewed optimism for the industry.

After the passage of this legislation, annual shipments of new aircraft rose every year between 1994 and 2000. According to the General Aviation Manufacturers Association (GAMA), between 1994 and 2000 general aviation aircraft shipments increased at an average annual rate of more than 20 percent, increasing from 928 shipments in 1994, to 3,140 shipments in 2000. As shown in **Table 2A,** the growth in the general aviation industry slowed considerably after 2000, negatively impacted by the national economic recession and the events surrounding 9/11. In 2003, there were over 450 fewer aircraft shipments than in 2000, a decline of 14 percent.

Most notable about 2003 shipments was that single-engine piston deliveries were the only category to increase. Single-engine piston deliveries increased to 1,825 from 1,601 or 14.0 percent. This is most likely the result of new product offerings and the age of the single-engine piston aircraft fleet. Turboprop and turbojet deliveries declined. Business jets were down 23.4 percent, the second year of decline. This is the result of slowing demand by fractional jet companies and a large used market for turboprop and turbojet aircraft.

In 2004, the general aviation production showed a significant increase, returning near pre-9/11 levels for most indicators. With the exception of multi-engine piston aircraft deliveries, deliveries of new aircraft in all categories increased.

TABLE 2A
Annual General Aviation Airplane Shipments
Manufactured Worldwide and Factory Net Billings

Year	Total	SEP	MEP	TP	J	Net Billings ($ millions)
2000	3,140	1,862	103	415	760	13,497.0
2001	2,994	1,644	147	421	782	13,866.6
2002	2,687	1,601	130	280	676	11,823.1
2003	2,686	1,825	71	272	518	9,994.8
2004	2,963	1,999	52	321	591	11,903.8

Source: GAMA
SEP – Single-Engine Piston; MEP – Multi-Engine Piston; TP – Turboprop; J – Turbofan/Turbojet

On July 21, 2004, the FAA published the final rule for light-sport aircraft (LSA). The *Certification of Aircraft and Airmen for the Operation of Light-*

Sport Aircraft rules went into effect September 1, 2004. This final rule establishes new light-sport aircraft categories and allows aircraft manufacturers to build and sell completed aircraft without obtaining type and production certificates. Instead, aircraft manufacturers will build to industry consensus standards. This reduces development costs and subsequent aircraft acquisition costs. This new category places specific conditions on the design of the aircraft, to limit them to "slow (less than 120 knots maximum) and simple" performance aircraft. New pilot training times are reduced and offer more flexibility in the type of aircraft which the pilot would be allowed to operate.

Viewed by many within the general aviation industry as a revolutionary change in the regulation of recreational aircraft, this new rule is anticipated to significantly increase access to general aviation by reducing the time required to earn a pilot's license and the cost of owning and operating an aircraft. These regulations are aimed primarily at the recreational aircraft owner/operator. By 2016, there is expected to be 15,410 of these aircraft in the national fleet.

While impacting aircraft production and delivery, the events of 9/11 and economic downturn have not had the same negative impact on the business/corporate side of general aviation. The increased security measures placed on commercial flights have increased interest in fractional and corporate aircraft ownership, as well as on-demand charter flights. According to GAMA, the total number of corporate operators increased by 471 in 2003 (the latest year of available data). Corporate operators are defined as those companies that have their own flight departments and utilize general aviation airplanes to enhance productivity. **Table 2B** summarizes the number of U.S. companies operating fixed-wing turbine aircraft since 1991.

TABLE 2B
U.S. Companies Operating Fixed-Wing Turbine Business Aircraft and Number of Aircraft, 1991-2003

Year	Number of Operators	Number of Aircraft
1991	6,584	9,504
1992	6,492	9,504
1993	6,747	9,594
1994	6,869	10,044
1995	7,126	10,321
1996	7,406	11,285
1997	7,805	11,774
1998	8,236	12,425
1999	8,778	13,148
2000	9,317	14,079
2001	9,709	14,837
2002	10,191	15,569
2003	10,661	15,870

Source: GAMA/NBAA

The growth in corporate operators comes at a time when fractional aircraft programs are experiencing significant growth. Fractional ownership programs sell 1/8 or greater shares in an aircraft at a fixed cost. This cost, plus monthly maintenance fees, allows the shareholder a set number of hours of use per year and provides for the management and pilot services associated with the aircraft's operation. These programs guarantee the aircraft is available at any time, with short notice. Fractional ownership programs offer the shareholder a more efficient use of time (when compared with commercial air service) by providing faster point-to-point travel times and the ability to conduct business confidentially while flying. The lower initial startup costs (when compared with acquiring and establishing a flight department) and easier exiting options are also positive benefits.

Since beginning in 1986, fractional jet programs have flourished. **Table 2C** summarizes the growth in fractional shares since 1986. The number of aircraft in fractional jet programs has grown rapidly. In 2001, there were 696 aircraft in fractional jet programs. This grew to 776 aircraft in fractional jet programs at the end of 2002 and 823 in 2003.

TABLE 2C
Fractional Shares
1986-2003

Year	Number of Shares
1986	3
1987	5
1988	26
1989	51
1990	57
1991	71
1992	84
1993	110
1994	158
1995	285
1996	548
1997	957
1998	1,551
1999	2,607
2000	3,834
2001	4,071
2002	4,232
2003	4,515

Source: GAMA/NBAA

Two business aviation forecasts, Honeywell Aerospace's *12th Annual Business Aviation Outlook* and Rolls-Royce's *The Market for Business Jets 2003-2022*, project continuing demand for new business aircraft. The Honeywell forecast predicts 7,724 new aircraft deliveries between 2003 and 2013. The Rolls-Royce forecast predicts 13,948 new aircraft between 2003 and 2022.

Each year, the FAA updates and publishes a national aviation forecast. Included in this publication are forecasts for the large air carriers, regional/commuter air carriers, general aviation, and FAA workload measures. The forecasts are prepared to meet budget and planning needs of the constituent units of the FAA and to provide information that can be used by state and local authorities, the aviation industry, and the general public. The current edition when this chapter was prepared was FAA *Aerospace Forecasts-Fiscal Years 2005-2016*, published in March 2005. The forecasts use the economic performance of the United States as an indicator of future aviation industry growth. Similar economic analyses are applied to the outlook for aviation growth in international markets.

In the seven years prior to the events of 9/11, the U.S. civil aviation industry experienced unprecedented growth in demand and profits. The impacts to the economy and aviation industry from the events of 9/11 were immediate and significant. However, the economic climate and aviation industry have been recovering in the past year. The FAA expects the U.S. economy to recover rapidly over the next two years, growing moderately thereafter. This will positively influence the aviation industry, leading to passenger, air cargo, and general aviation growth throughout the forecast period (assuming that there will not be any new successful terrorists incidents against either U.S. or world aviation). The FAA forecast assumes that the regulatory environment affecting general aviation will not change dramatically. The forecast also assumes that the fractional ownership market will continue to expand and bring new operators and shareholders into business aviation.

The FAA projects the active general aviation aircraft fleet to increase at an average annual rate of 1.1 percent over the 12-year forecast period, increasing from 210,600 in 2003, to 240,070 in 2016. This growth includes the addition of a new aircraft category, light-sport aircraft, which is expected to enter the active fleet in 2005 and account for 15,410 aircraft in 2016. Light-sport aircraft include small fixed-wing airplanes, powered-parachutes, gyro-planes, ultra-lights, and others.

FAA forecasts identify two general aviation economies that follow different market patterns. The turbojet fleet is expected to increase at an average annual rate of 5.4 percent, increasing from 8,153 in 2003, to 15,900 in 2016. Factors leading to this substantial growth include expected strong U.S. and global economic growth; the continued success of fractional-ownership programs; and a continuation of the shift from commercial air travel to corporate/business air travel by business travelers and corporations. In addition, new microjets will begin to enter the fleet in 2006, and grow to 4,500 aircraft by 2016. These aircraft are expected to stimulate the market for on-demand air taxis.

Exhibit 2A depicts the FAA forecast for active general aviation aircraft in the United States. The number of single-engine piston aircraft is projected to reach 148,000 in 2015, which represents an average annual growth rate of 0.2 percent. During this same time, the number of active multi-engine piston aircraft in the fleet is expected to decline by 0.2 percent, resulting in a total of 17,235 aircraft in 2016. The number of turboprop aircraft is expected to increase at an average annual rate of 3.7 percent over the 12-year forecast period to 8,400 active aircraft. The rotorcraft fleet is forecast to grow 1.2 percent annually through 2016, while the number of experimental aircraft is projected to increase from 20,603 in 2003, to 21,380 in 2010. Thereafter, the growth in experimental aircraft is expected to flatten, primarily due to the growth in sport aircraft.

The declines in the aircraft utilization rates experienced in 2000 (down 3.2 percent) and 2001 (down 7.2 percent) were due, in part, to higher fuel prices and the 2001 U.S. economic recession. However, the restrictions placed on general aviation in the aftermath of the 9/11 events contributed heavily to the decline in utilization in 2001. A strong recovery in the U.S. economy in 2004 and 2005 has led to increased utilization rates for most categories of general aviation aircraft.

The total pilot population is projected to increase from an estimated 618,633

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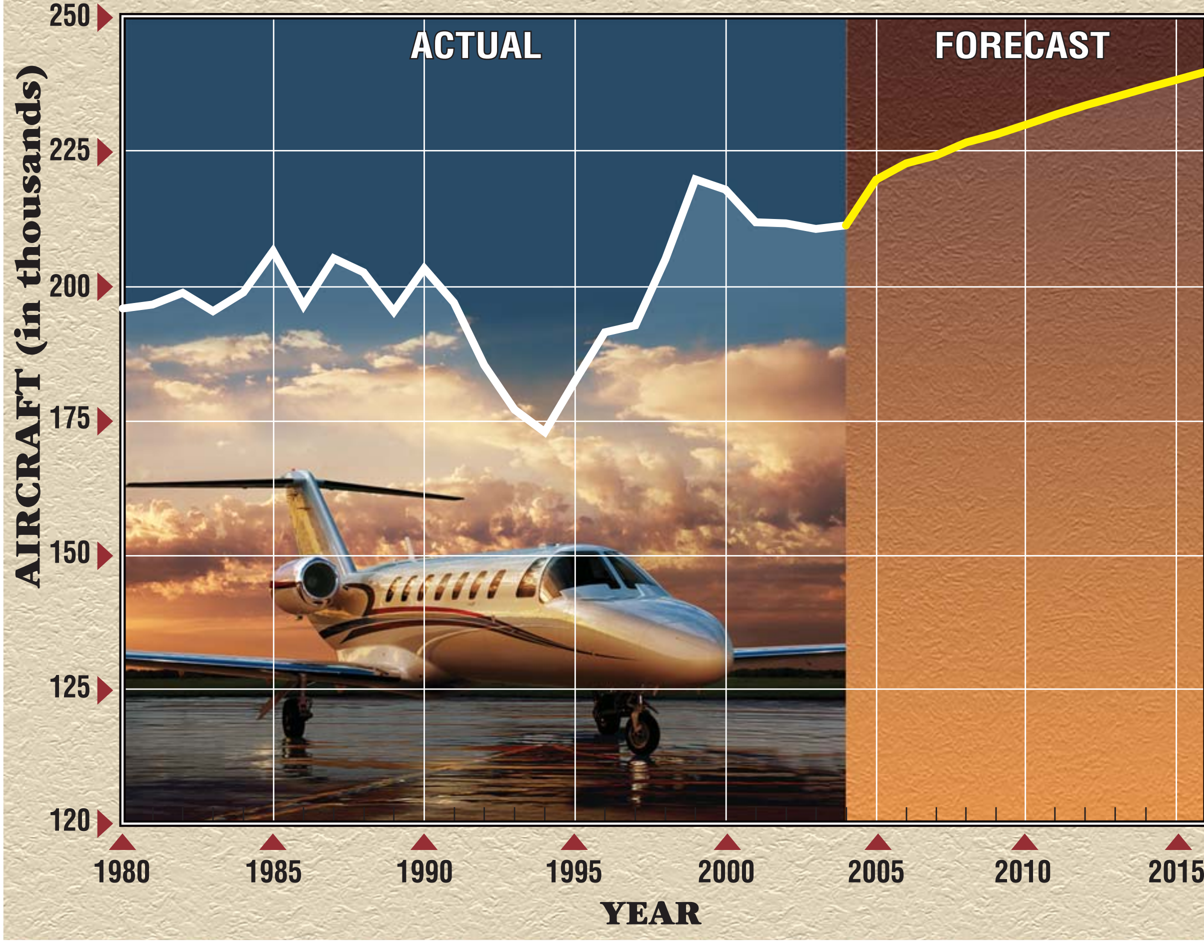
U.S. ACTIVE GENERAL AVIATION AIRCRAFT



U.S. ACTIVE GENERAL AVIATION AIRCRAFT (in thousands)

	FIXED WING									
	PISTON		TURBINE		ROTORCRAFT					
Year	Single Engine	Multi-Engine	Turboprop	Turbojet	Piston	Turbine	Experimental	Sport Aircraft	Other	Total
2004 (Est.)	144.0	17.7	7.3	8.4	2.2	4.7	20.8	N/A	6.2	211.3
2008	145.5	17.5	7.7	10.5	2.4	4.9	21.3	10.8	6.1	227.7
2012	147.0	17.4	8.1	13.3	2.5	5.1.	21.4	13.2	5.9	233.9
2016	148.0	17.2	8.4	15.9	2.6	5.3	21.4	15.4	5..8	240.1

Source: FAA Aerospace Forecasts, Fiscal Years 2005-2016.

Notes: An active aircraft is one that has a current registration and was flown at least one hour during the calendar year.

Exhibit 2A
U.S. ACTIVE GENERAL AVIATION
AIRCRAFT FORECASTS

in 2004, to 750,260 by 2016, which represents an average annual growth rate of 1.6 percent. The student pilot population increased 0.7 percent in 2004, and is forecast to increase at an annual rate of 1.8 percent over the 12-year forecast period, reaching a total of 108,800 in 2016. Growth rates for the other pilot categories over the forecast period are as follows: airline transport pilots, up 1.7 percent; recreational pilots, up 1.6 percent; rotorcraft only, up 1.2 percent; and glider only, up 0.2 percent.

Over the past several years, the general aviation industry has launched a series of programs and initiatives whose main goals are to promote and assure future growth within the industry. "No Plane, No Gain" is an advocacy program created in 1992 by the General Aviation Manufacturers Association (GAMA) and the National Business Aircraft Association (NBAA) to promote acceptance and increased use of general aviation as an essential, cost-effective tool for businesses. Other programs are intended to promote growth in new pilot starts and introduce people to general aviation. "Project Pilot," sponsored by the Aircraft Owners and Pilots Association (AOPA), promotes the training of new pilots in order to increase and maintain the size of the pilot population. The "Be a Pilot" program is jointly sponsored and supported by more than 100 industry organizations. The NBAA sponsors "AvKids," a program designed to educate elementary school students about the benefits of business aviation to the community and career opportunities available to them in business aviation. Over the years, programs such as these have played an important role in the success of general aviation and will continue to be vital to its growth in the future.

POPULATION PROJECTIONS

Population growth provides an indication of the potential for sustaining growth in aviation activity over the planning period. **Table 2D** summarizes forecast population numbers for the Town of Buckeye. The Town of Buckeye projects the Town's population growing at an average annual rate of 16.3 percent through 2025. These local population forecasts assume implementation and phased development programs of the many master-planned residential developments now approved in the Town of Buckeye.

TABLE 2D
Historical and Forecast Population
Town of Buckeye

Year	Town of Buckeye
Historical	
1990	5,040
1995	5,130
2000	8,497
2004	14,505
Avg. Annual Growth Rate	7.8%
Forecasts	
2010	100,000
2015	182,500
2020	265,000
2025	345,000
Avg. Annual Growth Rate	16.3%

Source for historical data:
Arizona Department of Economic Security
Source for forecast population:
Town of Buckeye

The Town of Buckeye projections vary from those prepared by the Maricopa Association of Governments (MAG). In the July 2003 *Interim Projections of Population, Housing, and Employment by Municipal Planning Area and Regional Analysis Zone* publication prepared by MAG, the Town of Buckeye was projected to reach 275,500 residents by 2025, nearly 70,000 less than the Town's own projections. In the MAG projections, the Town of Buckeye would not surpass 345,000 residents until closer to 2030. A similar variance is shown in 2010, where MAG projects 58,600 residents, while the Town of Buckeye projects 100,000 residents.

For this noise compatibility study, the higher forecast prepared by the Town will be assumed since it accounts differently for the planned residential communities than does MAG. By utilizing the Town's projections, the noise compatibility study will be consistent with local Town planning. The Town does not maintain separate housing or employment projections. Therefore, while projections of housing and employment may be available from MAG, for consistency, the MAG projections were not utilized in this study as they have a different growth rate than the Town based on different population assumptions.

STATE AND REGIONAL TRENDS

The Arizona Department of Transportation (ADOT) Aeronautics Division assists airports in the state in identifying infrastructure needs, with a state aviation needs study and other special aviation studies. The most recent study on a statewide basis is the *State Aviation Needs Study* (SANS) - *2000*. The SANS 2000 includes forecasts of aviation activity in the state. MAG is charged with preparing and updating a *Regional Airport System Plan* (RASP) for the Phoenix metropolitan area. The most recent aviation forecasts for the MAG-RASP were prepared in late 2001, after the events of September 11. They were adopted by MAG in 2003.

Table 2E depicts the based aircraft forecasts prepared from the SANS 2000 for the state and Maricopa County. The base year for these forecasts was 1998. The SANS 2000 forecast that based aircraft in the state would grow at an annual average rate of 1.3 percent through 2020. This is well above the 0.7 percent that the FAA projects for active aircraft nationwide.

TABLE 2E
Maricopa County Based Aircraft Forecasts

	Base Year*	2005	2010	2015	2020	2025
SANS 2000						
Arizona	6,700	7,156	7,674	8,247	8,896	NA
Maricopa County	3,857	4,065	4,303	4,568	4,877	NA
MAG-RASP						
Maricopa County	4,317	4,820	5,517	6,215	6,913	7,612

Sources: *State Aviation Needs Study – 2000*; ADOT, 1999.
Regional Airport System Plan; Maricopa Council of Governments, 2001.
* Base Year: SANS – 1998; MAG-RASP – 2000.

The percentage of Arizona-based aircraft in Maricopa County was actually forecast to decline over the years, from 57.6 percent in 1998 to 54.8 percent in 2020. Thus, the average growth rate for based aircraft in Maricopa County was projected to be slightly lower, at 1.2 percent.

Table 2E also presents the more recent forecast of Maricopa County based aircraft prepared for the MAG-RASP. The base year for this forecast was 2000. As evident from the table, based aircraft in Maricopa County increased by 12 percent between 1998 and 2000. In fact, the actual based aircraft in 2000 were more than the SANS 2000 forecast for 2010.

As could be expected, the MAG-RASP forecast of based aircraft is higher. This forecast projects total based aircraft in the region to reach 7,612 by 2025. This would be an annual average increase of 2.1 percent, significantly stronger than the national or statewide growth rates projected by FAA and ADOT, respectively.

Keeping in line, the MAG-RASP projects fixed-wing turbine aircraft based in the county to grow from 170 in 2000, to 427 by 2025. This would be an increase of 151 percent (3.75 percent annually). Turbine aircraft would also grow as a percentage of all based aircraft, from 3.9 percent in 2000, to 9.3 percent in 2025.

SERVICE AREA

The generalized service area of an airport is defined by its proximity to other airports providing similar service. Buckeye Municipal Airport is one of several airports serving the general aviation needs of the Phoenix metropolitan area.

Exhibit 2B depicts Buckeye Municipal Airport in relationship to other airports that serve the West Valley. These airports include: Phoenix Goodyear Airport to the east, Glendale Municipal Airport to the northeast, Pleasant Valley Airport to the northeast, and Gila Bend Municipal Airport to the south. **Table 2F** compares the runway lengths and based aircraft of these airports to Buckeye Municipal Airport.

TABLE 2F
Public Airports
West Valley

Name	Distance from Buckeye	Longest Runway (ft.)	Approach Minimums (feet-miles)	Based Aircraft	2004 Annual Operations*
Buckeye Municipal	NA	5,500	NA	58	35,027
Phoenix Goodyear	15.5	8,500	NA	209	105,471
Pleasant Valley	31.5	4,200 (Dirt)	NA	61	76,000
Glendale Municipal	20.6	7,150	500 – 1 ¼	269	118,140
Gila Bend Municipal	27.7	5,200	NA	2	11,000

* Tower counts, except for Buckeye, Gila Bend, and Pleasant Valley, which are an estimate taken from FAA Form 5010.

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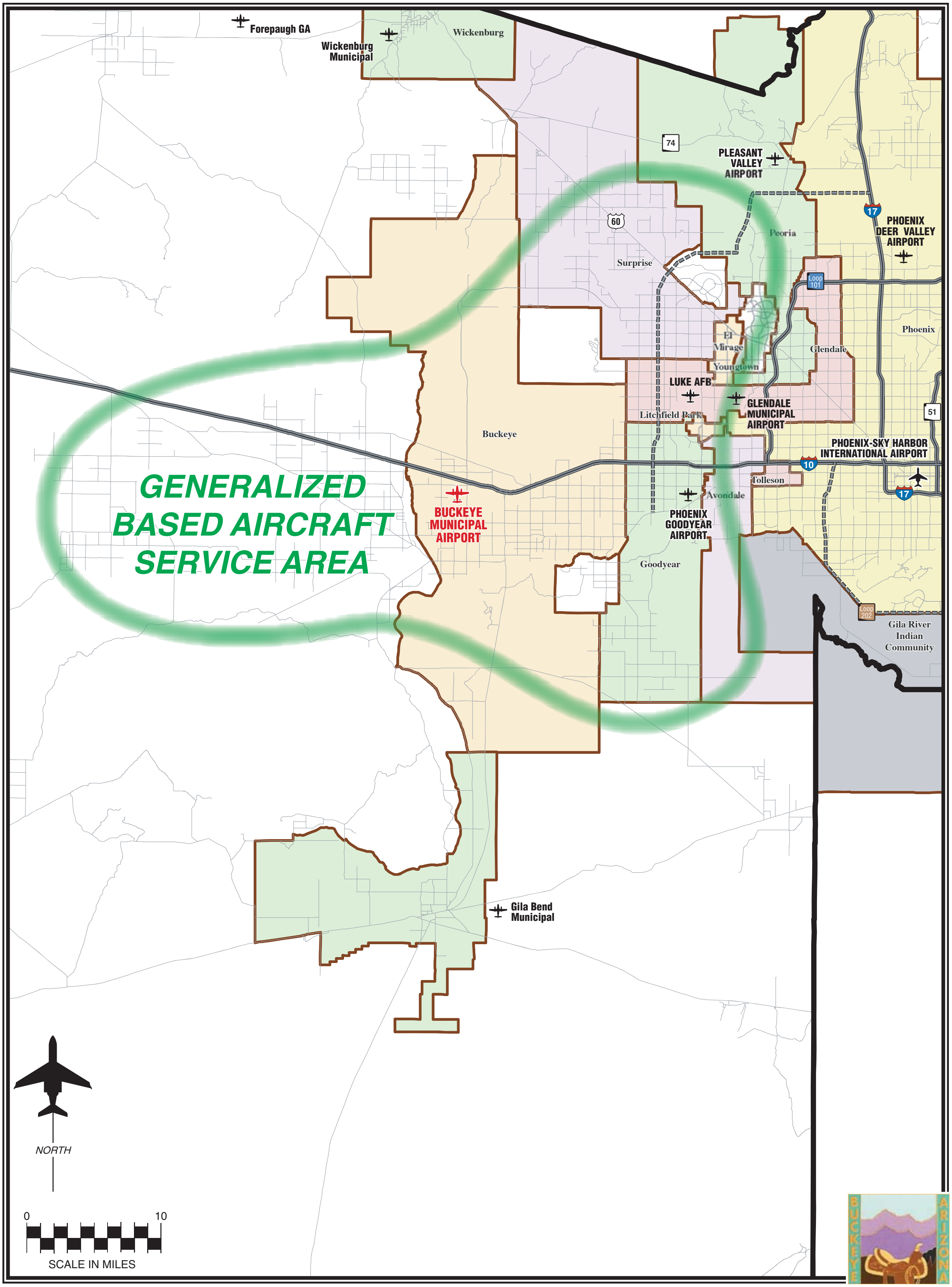

Exhibit 2B
BASED AIRCRAFT SERVICE AREA

These five airports base a total of 595 aircraft. Glendale Municipal Airport has the most with 269 based aircraft. Phoenix Goodyear Airport and Glendale Municipal Airport are similar in traffic volume with over 100,000 annual operations each. Buckeye Municipal Airport and Pleasant Valley Airport are currently on the western fringes of the growing metropolitan area and have not experienced the same activity levels as Glendale Airport or Phoenix Goodyear Airport yet. Pleasant Valley Airport, in particular, is a recreational-only airport due to the airport not having any paved runways. Gila Bend Municipal Airport and the Gila Bend community are more rural from the Phoenix metropolitan area. The based aircraft and operational levels are consistent with this distance from the metropolitan area.

The MAG-RASP has considered alternatives for developing new airports in the south valley. There are no specific sites, but the MAG-RASP includes a potential new general aviation airport located in Pinal County, and is likely to be contained within the Gila River Indian Community. A location west of Interstate 10 is viewed as having the least potential impact on military airspace in the area.

Based upon the proximities of the other four public airports listed above, the primary general aviation service area for Buckeye Municipal Airport is limited to the Town of Buckeye and areas to the west as Glendale Municipal Airport and Phoenix Goodyear Airport provide higher levels of service than Buckeye Municipal Airport. Since both Glendale Municipal Airport and Phoenix Goodyear Airport have longer runways and provide a greater level of maintenance and other services to general aviation, these airports most likely serve some of the transient activity that may be destined for Buckeye Municipal Airport. Therefore, in some respects, Buckeye Municipal Airport is most likely not capturing all the transient activity it possibly could. Should Buckeye Municipal Airport increase its service levels (maintenance, fueling, customer service) and physical facilities (runway length, instrument approaches) comparable to these airports, it could begin to draw transient activity back from these airports.

A review of based aircraft owners' addresses was used to determine the based aircraft service area. As shown on **Exhibit 2B**, aircraft owners base at Buckeye Municipal Airport from a large portion of the western metropolitan area. Some based aircraft owners actually choose to base at Buckeye Municipal Airport over airports located in closer proximity to their home or business. As shown on the exhibit, Buckeye Municipal Airport draws based aircraft from Glendale, Avondale, Litchfield Park, Goodyear, Surprise, Peoria, Avondale, and unincorporated portions of Maricopa County to the west. Over 50 aircraft owners are currently on a waiting list for hangars at Buckeye Municipal Airport. Some factors which may lead to the airport having such a large service area include: cost factors (hangar rentals are more inexpensive at Buckeye), lower activity levels which tend to attract recreational and sport aircraft owners, condition of facilities (paved runway at Buckeye versus the dirt runways in Pleasant Valley), and airspace factors. While Buckeye is located in close proximity to Luke Air Force Base (AFB), it is located outside the Alert Area associated with Luke AFB. Buckeye Municipal Airport is located 17 miles from Luke AFB, while Glendale Municipal Airport is only 4.4 miles, and Phoenix Goodyear Airport is only 6.7 miles. This allows general aviation aircraft using Buckeye Municipal Airport more area to maneuver around the military airspace. Buckeye Municipal Airport is also located outside the Phoenix Class B airspace, whereas Glendale and Goodyear are both located under the Phoenix Class B airspace.

AVIATION ACTIVITY FORECASTS

General aviation is defined as that portion of civil aviation which encompasses all portions of aviation, except scheduled commercial operations. To determine the types and sizes of facilities that should be planned to accommodate general aviation activity, certain elements of this activity must be forecast. These indicators of general aviation demand include based aircraft, aircraft fleet mix, and annual operations.

The following forecast analysis examines each of the aviation demand categories expected at Buckeye Municipal Airport through 2025. Each segment will be examined individually, and then collectively, to provide an understanding of the overall aviation activity at the airport.

The remainder of this chapter presents the forecasts for aviation demand, which includes the following:

- Based Aircraft
- Based Aircraft Fleet Mix
- Local and Itinerant Operations
- Airport Capacity

Based Aircraft

The number of based aircraft is the most basic indicator of general aviation demand. By first developing a forecast of based aircraft, the growth of aviation activities at the airport can be projected.

As shown in **Table 2G,** total based aircraft have fluctuated at the airport in the past 10 years, but have increased since 1980 when there were 22 aircraft based at Buckeye Municipal Airport. In 2004, there were 54 aircraft based at the airport. This is 16 less than in 1994 when 70 aircraft were based at the airport. The declines in the early 1990s are the result of the relocation of a large flight training operation to Phoenix Goodyear Airport. Since 2000, based aircraft levels have remained relatively static. This is most likely the result of changes in the management of the airport, changes in the availability and types of services, and the lack of new hangar construction in more than 10 years. Since 2000, the management of the airport has been transferred back to the Town from a private management company. Only limited fueling services have been available. A new service and flight training operation for gyro-copters has been added at the airport.

TABLE 2G
Historical Based Aircraft
Buckeye Municipal Airport

Year	Based Aircraft
1980	22
1994	70
1997	46
2000	55
2004	54
Avg. Ann. Growth Rate	3.8%

Source: MAG-RASP, Airport Records, 5010-1

Because actual based aircraft levels were not available on an annual basis, statistical methods of projected based aircraft (such as time-series and regression analyses) were not performed. Furthermore, past based aircraft trends are most likely not indicative of future growth potential at Buckeye Municipal Airport. Statistical measures such as time-series analysis and regressions analyses rely on past performance, in part, for establishing indicators of future demand. As indicated earlier in the presentation of population projections and discussions of land use development in the Town of Buckeye, summarized in Chapter One, the Town of Buckeye is poised for explosive growth. The Town's population is expected to grow nearly 600 percent in the next five years and nearly 2,300 percent over the next 20 years. This population growth will undoubtedly have an impact on future based aircraft growth that is much different from the factors affecting based aircraft levels at the airport in the past.

Table 2H examines the ratio of population at other general aviation airports in the Phoenix metropolitan area since 1980. This data is used to derive an understanding of how aviation demand is affected by rapidly growing communities. For example, since 1980 the population in the Chandler Airport service area (assumed to be the City of Gilbert and the City of Chandler) has expanded by more than 330,000 residents at annual rate of 10.6 percent. This is very similar to that forecast for the Town of Buckeye over the next 20 years. Based aircraft at Chandler Municipal Airport also grew during the same period, increasing at an annual rate of 7.0 percent and 367 aircraft.

Of the other general aviation airports examined in the metropolitan area, only Scottsdale Airport experienced a decline in based aircraft while the population increased. This may be the result of limited land area at Scottsdale Airport, and Deer Valley Airport serving a large portion of the small aircraft demand as Scottsdale Airport matured as a business aviation airport. In general, the trend is for increasing based aircraft levels as the population grows and for a declining ratio of based aircraft to population. This declining ratio is the result of the population growing faster than based aircraft.

Table 2J presents two forecast scenarios for future based aircraft at Buckeye Municipal Airport based upon assumptions of the ratio of based aircraft to forecast population in the Town of Buckeye. Both scenarios assume a declining ratio of based aircraft per 1,000 residents through the planning period when compared to the existing ratio. Forecast Scenario I projects the ratio of based aircraft to 1,000 residents declining to less than one aircraft per 1,000 residents by the end of the planning period. This has occurred at various points in the past for Glendale Municipal Airport. Forecast Scenario I projects based aircraft growing at 8.1 percent annually and by 223 aircraft over the planning period.

TABLE 2H
Ratio of Residents to Based Aircraft
Selected Communities in the Phoenix Metropolitan Area

	Glendale Airport			Chandler Airport		
	Based AC	**Population**	**Ratio**	**Based AC**	**Population**	**Ratio**
1980	219	93,640	2.34	90	35,905	2.51
1991	167	151,635	1.10	238	128,955	1.85
1994	178	164,890	1.08	247	163,575	1.51
1997	184	191,105	0.96	300	230,680	1.30
2000	208	218,812	0.95	392	286,278	1.37
2004	269	233,330	1.15	457	371,995	1.23
Average	0.9%	3.9%	1.26	7.0%	10.2%	1.63
	Scottsdale Airport			**Phoenix Deer Valley Airport**		
	Based AC	**Population**	**Ratio**	**Based AC**	**Population**	**Ratio**
1980	517	88,945	5.81	472	796,745	0.59
1991	405	135,275	2.99	778	1,004,695	0.77
1994	393	154,145	2.55	803	1,051,515	0.76
1997	400	186,610	2.14	908	1,250,285	0.73
2000	425	202,705	2.10	1,206	1,321,045	0.91
2004	460	221,130	2.08	1,262	1,416,055	0.89
Average	-0.5%	3.9%	2.95	4.2%	2.4%	0.78
	Phoenix Goodyear Airport			**Mesa Airport**		
	Based AC	**Population**	**Ratio**	**Based AC**	**Population**	**Ratio**
1980	140	15,440	9.07	601	155,465	3.87
1991	142	34,720	4.09	580	295,680	1.96
1994	153	39,295	3.89	559	318,885	1.75
1997	198	46,530	4.26	878	350,555	2.50
2000	198	63,578	3.11	923	396,375	2.33
2004	209	105,430	1.98	985	447,130	2.20
Average	1.7%	8.3%	4.40	2.1%	4.5%	2.44

Source for Historical Population: Arizona Department of Economic Security
Source for Historical Based Aircraft: MAG-RASP, Airport Records
Notes: Goodyear population includes Avondale, Tolleson, and Litchfield Park; Chandler population includes Gilbert

Forecast Scenario II is a more aggressive forecast that assumes a similar growth in the number of based aircraft as has occurred at Chandler Airport in the past 25 years. This scenario assumes the addition of over 400 aircraft at Buckeye Municipal Airport by 2025.

TABLE 2J
Based Aircraft Per 1,000 Residents Forecasts

Year	Buckeye Airport Based Aircraft	Town of Buckeye Population	Ratio
1994	70	5,065	13.8
1997	46	4,960	9.3
2000	55	8,497	6.5
2004	54	14,505	3.7
Avg. Ann. Growth Rate	-2.6%	11.1%	
Scenario I			
2010	110	100,000	1.10
2015	183	182,500	1.00
2020	239	265,000	0.90
2025	276	345,000	0.80
Avg. Ann. Growth Rate	8.1%	16.3%	
Scenario II			
2010	100	100,000	1.00
2015	201	182,500	1.10
2020	318	265,000	1.20
2025	449	345,000	1.30
Avg. Ann. Growth Rate	10.6%	16.3%	

Source for Historical Population: Arizona Department of Economic Security
Source for Forecast Population: Town of Buckeye, 2015 Extrapolated
Source for Historical Based Aircraft: MAG-RASP, Airport Records
Based Aircraft Forecasts: Coffman Associates

The FAA, ADOT Aeronautics, and MAG have all examined future based aircraft demand at Buckeye Municipal Airport. The 2005 FAA *Terminal Area Forecast* (TAF) used a base year total of 74 based aircraft remaining constant through 2020. The *2000 State Aviation Needs Study* (SANS) projected based aircraft growing from 74 in 1998 to 200 by 2020. The 2001 MAG *Regional Aviation System Plan* (RASP) projected based aircraft growing from 55 in 2000 to 132 by 2020.

The 1998 Master Plan projected based aircraft reaching 130 by 2015. Actual based aircraft growth at Buckeye Municipal Airport has been slower than forecast in the previous Master Plan. Many of the reasons for slower growth were listed above. This included changes in the management of the airport and services, and the fact that no new hangars have been developed at the airport in more than 10 years.

TABLE 2K
Based Aircraft Forecast Summary

Forecast	2004	2010	2015	2020	2025
Ratio of Residents to Based Aircraft (Scenario I)	N/A	110	183	239	276
Ratio of Residents to Based Aircraft (Scenario II)	N/A	100	201	318	449
1998 Buckeye Municipal Airport Master Plan	N/A	105	130	N/A	N/A
2001 MAG-RASP	N/A	70	101	132	N/A
2005 FAA Terminal Area Forecast (TAF)	N/A	74	74	74	N/A
2000 State Aviation Needs Study (SANS)	N/A	122	156	200	N/A
Preferred Planning Forecast	**54**	**110**	**175**	**225**	**275**

Source: Coffman Associates analysis
MAG-RASP: Maricopa Association of Governments Regional Aviation System Plan

Table 2K and **Exhibit 2B** provide a summary of all general aviation based aircraft forecasts for Buckeye Municipal Airport. The combination of the forecasts defines the planning envelope, or the area within which future demand should be found. Due to variances in how each forecast has accounted for effects of the projected population growth on future aviation demand at Buckeye Municipal Airport, the planning envelope range is broad. The lower portion of the planning envelope is defined by the FAA TAF, which projects static growth at the airport through the planning period. The FAA TAF more than likely does not account for the projected population growth patterns. The upper reaches of the planning envelope are defined by Forecast Scenario II. This planning forecast assumed that ratio of aircraft to residents in the Town of Buckeye would be comparable to that experienced at Chandler Airport in the past, as the City of Chandler and Town of Gilbert have grown and expanded.

In evaluating these forecasts, several conclusions can be made. First, the FAA TAF which projects static growth at the airport through the planning period does not adequately consider the expected growth in the community. While the Town's population growth may impact aviation demand at different rates, a positive impact is inevitable. As shown earlier in **Table 2G**, nearly every airport in the Phoenix metropolitan area has experienced based aircraft growth as the population has grown.

The 2001 MAG RASP forecast and 1998 Master Plan forecast are most likely not indicative of future growth. The 1998 Master Plan was based on the community growing to 51,000 residents by 2015. Current growth projections have the Town exceeding 50,000 residents before 2010. The 2001 MAG RASP projects based aircraft growing slower than the previous Master Plan.

Forecast Scenario II of the ratio of based aircraft to residents may overstate future based aircraft demand. This forecast is much higher than the 2000 SANS and Forecast Scenario I of the ratio of based aircraft to residents, which fall closely together. An extrapolation of the 2000 SANS forecast to 2025 would yield 250 aircraft. This is within 12 percent of the Forecast Scenario I, which forecasts 279 based aircraft in 2025. The tight range of these two forecasts indicates a higher degree of reliability for estimating future based aircraft demand. The planning forecast was developed to lie slightly above the 2000 SANS projections and slightly below Forecast Scenario I of the ratio of based aircraft to residents forecast.

This planning forecast projects 222 new based aircraft by 2025. Based aircraft are projected to grow at 8.2 percent annually. This is less than half the annual population growth rate projected for the Town of Buckeye.

Based Aircraft Fleet Mix

Knowing the aircraft fleet mix expected to utilize the airport is necessary to properly plan facilities that will best serve the level of activity and the type of activities occurring at the airport. **Table 2L** indicates that the 2005 based aircraft fleet mix is comprised mainly of single-engine piston aircraft. The based aircraft fleet mix has been examined as a share of total based aircraft and is depicted on **Exhibit 2C**.

TABLE 2L
Based Aircraft Fleet Mix

Year	Total	Single Engine Piston	Multi-Engine Piston	Turboprop	Turbojet	Helicopter	Other*
1995	38	36	2	0	0	0	0
2004	54	35	2	1	0	0	16
Percentage Share							
1995	100.0%	94.7%	5.3%	0.0%	0.0%	0.0%	0.0%
2003	100.0%	64.8%	3.7%	1.9%	0.0%	0.0%	29.6%
Forecast							
2010	110	81	4	2	1	1	21
2015	175	132	8	4	3	2	26
2020	225	170	11	5	5	2	32
2025	275	205	15	8	9	3	35
Percentage Share							
2010	100.0%	73.0%	4.0%	2.0%	1.0%	1.0%	19.0%
2015	100.0%	75.8%	4.5%	2.2%	1.5%	1.0%	15.0%
2020	100.0%	75.6%	5.0%	2.4%	2.0%	1.0%	14.0%
2025	100.0%	74.4%	5.6%	2.9%	3.3%	1.0%	12.8%
Change	221	170	13	7	9	3	19

Source: Coffman Associates analysis
* Gyroplanes and ultralights

The single-engine piston category as a percentage of total based aircraft is expected to increase through the planning period. Local economic and population growth will add new private aircraft ownership. The new regulations for sport aircraft should increase single-engine based aircraft levels as

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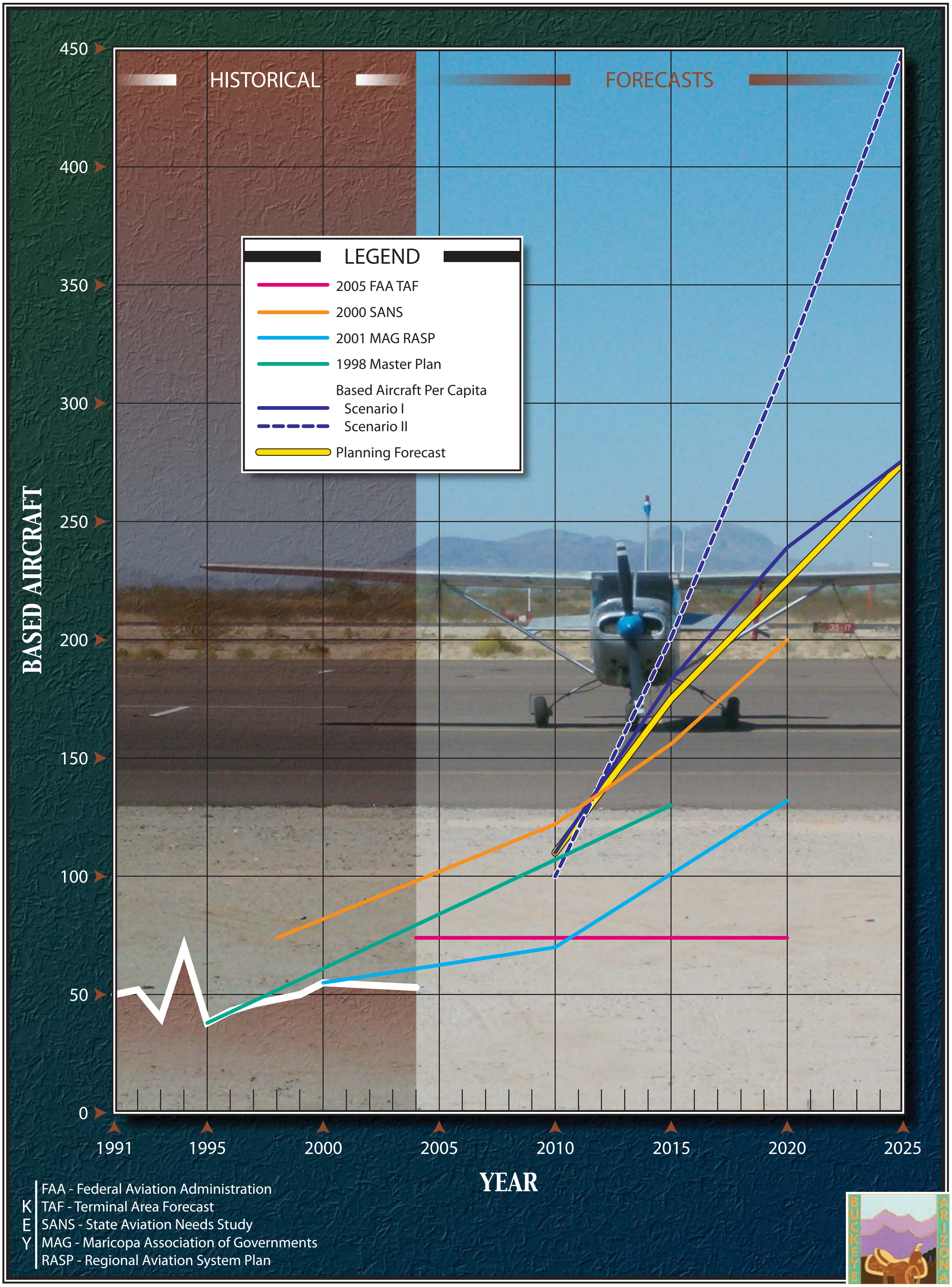

Exhibit 2C
BASED AIRCRAFT FORECASTS

well. This new rule-making is expected to result in 300 to 500 new aircraft nationally each year, beginning in 2006. By 2015, this results in between 2,700 and 4,500 new single-engine piston aircraft. The traditional single-engine piston fleet is expected to grow in the next 12 years as well.

Thirteen new multi-engine piston aircraft are added through the planning period. Nationally, the number of multi-engine piston aircraft is expected to decline; however, multi-engine piston aircraft are an integral component of flight training programs and for some private ownership.

The number of helicopters grows by three through the planning period. Helicopters are projected for a slow, yet steady, growth rate nationally through the planning period. With an increase in population could also come an increase in the need for medivac services and other types of services that rely on helicopters.

Up to 16 new turbine-powered aircraft are projected through the planning period. The introduction of the new microjets and expanded single-engine turbine-powered aircraft should not be disregarded as potential aircraft which may base at the airport. Business and corporate aviation continues to grow. The MAG RASP envisions strong growth in this segment of aviation for the metropolitan area. The FAA expects turbine-powered aircraft growth to outpace all other segments of aircraft growth over the next 12 years. The expanding commercial and residential base could lead to more business and corporate aviation aircraft ownership at Buckeye Municipal Airport.

ANNUAL OPERATIONS

There are two types of operations at an airport: local and itinerant. A local operation is a takeoff or landing performed by an aircraft that operates within sight of an airport, or which executes simulated approaches or touch-and-go operations at the airport. Itinerant operations are those performed by aircraft with a specific origin or destination away from the airport. Generally, local operations are characterized by training operations. Typically, itinerant operations increase with business and commercial use since business aircraft are used primarily to carry people from one location to another.

Due to an absence of an airport traffic control tower (ATCT), actual operation counts are not available for Buckeye Municipal Airport. Instead, only estimates of operations are available. Since early 2004, a record of aircraft landings has been kept for the airport on weekdays and during normal business hours. These records indicate that, on average, there are 80 operations per day at the airport. To account for the periods when the operations are not observed, it is estimated that over 120 operations are conducted at the airport each day. This equates to an annual total of 43,800 annual operations. **Table 2M** summarizes historical operational estimates for Buckeye Municipal Airport. The 2004 total was developed based upon the activity observations. The method for estimating annual operations prior to 2004 is not readily known.

TABLE 2M
Historical Operations

Year	Annual Operations
1995	25,400
2000	35,027
2004	39,000
2005	44,000

Source: Airport Records, FAA Form 5010-1, 1998 Master Plan

Typically, the operations per based aircraft range from 200 operations per based aircraft at airports with small amounts of flight training, to near 1,000 operations per based aircraft at airports with significant levels of flight training. It appears that there is a significant level of training operations at the airport since the ratio of operations to based aircraft currently exceeds 800, as shown in **Table 2N**.

Projections of annual operations are examined by the number of operations per based aircraft. Two forecasts of operations per based aircraft have been developed. Forecast Scenario I, shown in **Table 2N**, assumes a declining number of operations per based aircraft through the planning period. This forecast would be consistent with a transition to more transient activity and lower levels of training activity at the airport. As shown in the table, this forecast yields 137,500 annual operations at Buckeye Municipal Airport by 2025. A second forecast assumes a static or constant share of operations per based aircraft through the planning period. This forecast is consistent with the high levels of training activity already occurring at the airport and would remain through the planning period. Forecast Scenario II yields 220,000 annual operations in 2025.

TABLE 2N
Annual Operations Forecasts

Year	Based Aircraft	Annual Operations	Operations Per Based Aircraft
Historical			
1995	38	25,400	668
2000	55	35,027	637
2004	54	39,000	722
2005	54	44,000	815
Scenario I			
2010	110	77,000	700
2015	175	105,000	600
2020	225	123,800	550
2025	275	137,500	500
Avg. Annual Growth Rate	8.5%	5.9%	
Scenario II			
2010	110	88,000	800
2015	175	140,000	800
2020	225	180,000	800
2025	275	220,000	800
Avg. Annual Growth Rate	8.5%	8.4%	

The FAA, ADOT Aeronautics, and MAG have all projected annual operations for Buckeye Municipal Airport. The 2005 FAA *Terminal Area Forecast* (TAF) used a base year total of 17,020 annual operations remaining constant through 2020. The *2000 State Aviation Needs Study* (SANS) projected annual operations growing from 16,020 in 1998 to 47,900 by 2020. The 2001 MAG *Regional Aviation System Plan* (RASP) projected annual operations growing from 90,000 in 2000 to 180,000 by 2020.

The 1998 Master Plan projected annual operations reaching 140,600 by 2015. Similar to actual based aircraft growth at Buckeye Municipal Airport, annual operations growth has been slower than forecast in the previous Master Plan. Many of the reasons for slower activity have been detailed earlier in this chapter. Activity levels in 2005 were less than half of what was projected in the last Master Plan.

A summary of annual operations forecasts for Buckeye Municipal Airport is shown in **Table 2P**. The FAA projects an increase in aircraft utilization and the number of general aviation hours flown nationally. This trend, along with projected growth in based aircraft, supports future growth in annual operations at Buckeye Municipal Airport. The Phoenix region is home to significant levels of flight training, due to the favorable climate conditions which support flight training. This is a trend that could be expected to continue at the airport. Considering these factors, Forecast Scenario II has been selected for the annual operations planning forecast for the airport. This forecast projects annual operations growing at an average annual growth rate of 8.4 percent through the planning period, consistent with based aircraft growth.

TABLE 2P
Annual Operations Forecast Summary

Forecast	2004	2010	2015	2020	2025
Operations Per Based Aircraft (Scenario I)	N/A	77,000	105,000	123,800	137,500
Operations Per Based Aircraft (Scenario II)	N/A	88,000	140,000	180,000	220,000
1998 Buckeye Municipal Airport Master Plan	N/A	111,200	140,600	N/A	N/A
2001 MAG-RASP	N/A	140,080	165,120	190,190	N/A
2005 FAA Terminal Area Forecast (TAF)	N/A	17,020	17,020	17,020	N/A
2000 State Aviation Needs Study (SANS)	N/A	21,000	27,700	36,400	N/A
Preferred Planning Forecast	**44,000**	**88,000**	**140,000**	**180,000**	**220,000**

Source: Coffman Associates analysis
MAG-RASP: Maricopa Association of Governments Regional Aviation System Plan

Due to the high number of operations per based aircraft at Buckeye Municipal Airport, local operations are expected to account for 70 percent of annual operations at the airport. For planning purposes, local operations are projected to account for the majority of operations through the planning period, although declining slightly to 55 percent by 2025. **Exhibit 2C** depicts the general aviation operations forecast. **Table 2Q** summarizes the local and itinerant operations forecasts through 2025.

TABLE 2Q Local and Itinerant Operations Forecast					
Year	**Local Operations**	**% of Total**	**Itinerant Operations**	**% of Total**	**Total Operations**
Historical					
2005	30,800	70%	13,200	30%	44,000
Forecasts					
2010	61,600	70%	26,400	30%	88,000
2015	91,000	65%	49,000	35%	140,000
2020	108,000	60%	72,000	40%	180,000
2025	121,000	55%	99,000	45%	220,000

AIRPORT CAPACITY

For land use planning purposes, it is beneficial to determine the maximum capacity of the airport based on the ultimate configuration of runways. The maximum capacity of an airport refers to the maximum amount of activity that can safely occur at an airport. These numbers are not connected to a specific time period. Guidance for this exercise is provided by the FAA *Advisory Circular 150/5060-5 Airport Capacity and Demand*. The assumptions for this forecast include the construction of a parallel runway and the extension of the primary runway. These changes to the runway configuration will be discussed in detail as part of Chapter Three. **Table 2R** provides a summary of the operations forecasts to be used in modeling the noise exposure contours.

TABLE 2R Operations Summary Buckeye Regional Airport		Forecast	
	Existing 2006[1,2,3]	**2011[3]**	**Long Range Capacity[3]**
General Aviation			
Local	30,800	67,480	188,710
Itinerant	13,200	30,920	160,290
TOTAL OPERATIONS	44,000	98,400	349,000

[1] – Existing operations based on daily aircraft observations.
[2] – Baseline condition from 2005 Buckeye Municipal Airport Master Plan.
[3] – FAA *Advisory Circular 150/5060-5, Airport Capacity and Delay*

SUMMARY

This chapter has provided forecasts for each sector of aviation demand anticipated through the planning period. The airport is expected to experience an increase in total based aircraft and annual operations throughout the planning period. These forecasts will be used in the following chapters to assess the noise conditions at Buckeye Municipal Airport and their impact on the surrounding land uses.

CHAPTER THREE

AVIATION NOISE

AVIATION NOISE

The purpose of this chapter is to describe the input variables and methodology for preparing the Noise Exposure Map (NEM) contours for Buckeye Municipal Airport. The analysis for this study includes the preparation of noise contours for three study years: 2006 (existing condition), 2011 (short-term forecast), and a long range capacity condition. The 2006 noise contour map illustrates the current noise exposure at Buckeye Municipal Airport based on data from 2004 and 2005. The 2011 noise contours are based on levels from the operation forecast outlined in Chapter Two, Aviation Forecasts. The long range capacity contour is based on the ultimate runway configuration as outlined in the 2006 Airport Master Plan. The assumptions for these contours simulate the maximum number of operations, based on FAA methodology, which the airport could safely accommodate. This noise contour has been developed primarily for future land use planning purposes. The 2006 and 2011 noise exposure contours are the basis for the airport's official Noise Exposure Maps required as part of this study under Volume 14, Part 150 of the Code of Federal Regulations.

The noise exposure contours (2006, 2011, long range capacity) are considered as a baseline analysis for this study. They assume operations based on the existing flight procedures at Buckeye Municipal Airport. No additional noise abatement procedures have been assumed in the development of the contours. The noise contours will serve as the condition against which potential noise abatement procedures and land use man-

agement techniques will be compared later in this study.

The noise analyses presented in this chapter rely on complex analytical methods and use numerous technical terms. To aid in understanding this process and terms used, a Technical Information Paper (TIP), titled *The Measurement and Analysis of Sound* has been included in the final section of this document. It presents helpful background information on noise measurement and analysis.

AIRCRAFT NOISE ANALYSIS METHODOLOGY

Part 150 guidelines mandate that the prevailing noise conditions at an airport must be analyzed using a computer simulation model. The Federal Aviation Administration (FAA) has approved the use of the Integrated Noise Model (INM) for analysis in noise compatibility studies. The most recent version of the INM is quite sophisticated in predicting noise conditions at a given geographic location and accounts for variables such as airfield elevation, temperature, headwinds, and local topography. Version 6.2 of the INM was used to prepare noise exposure contours for Buckeye Municipal Airport.

The purpose of the noise model is to graphically represent noise conditions at the airport and to identify areas that are exposed to aircraft noise. To achieve an accurate representation, data regarding various airport operation characteristics must be gathered.

Input categories for the INM include runway configuration, flight track locations, aircraft fleet mix, terrain, and numbers of daytime and nighttime operations by aircraft type. **Exhibit 3A** depicts the various INM input categories for developing the noise exposure contours.

The INM includes information regarding the noise characteristics for aircraft that commonly operate at Buckeye Municipal Airport. For each aircraft, the INM computes typical profiles for aircraft operating at the specified airport location based on its field elevation, temperature, and flight procedure data provided by aircraft manufacturers. The INM will also accept user-provided input, although the FAA reserves the right to accept or deny the use of such data depending on its statistical validity.

To develop the noise exposure contours, the INM calculates aircraft noise levels at a set of grid points surrounding the airport. The numbers and locations of the grid points are established by the user during the noise modeling process to assess noise levels in areas where operations are concentrated, depending on tolerance and level of refinement specified. The noise level values at the grid points are used to prepare noise contours which connect points of equal noise exposure.

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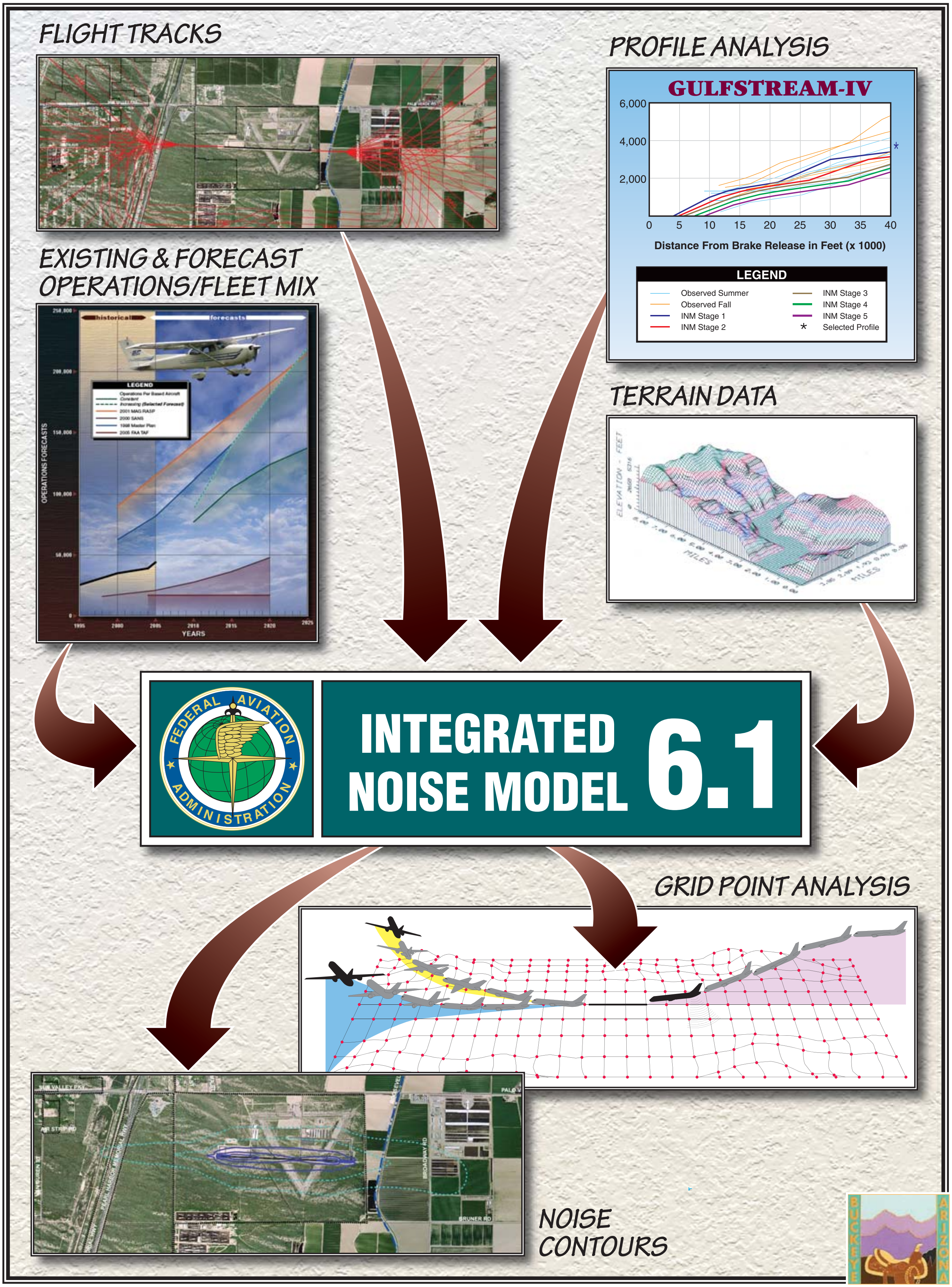

Exhibit 3A
INM PROCESS

INM INPUT

AIRPORT INFORMATION

Runway position information for Buckeye Municipal Airport was input into the INM according to the longitude, latitude, and elevation of the runway ends. As previously mentioned, the INM computes typical flight profiles for aircraft operating at the airport location. The airport's field elevation is 1,021 feet above mean sea level (MSL), and its average annual temperature is 71.2 degrees Fahrenheit (F). The INM also allows the user to incorporate topographic data to account for changes in elevation in the surrounding terrain, which can alter the way noise is experienced. Incorporating this information allows the INM to recreate, as realistically as possible, the existing conditions surrounding the airport. Topographic data from the United States Geological Survey was used to develop the noise contours for Buckeye Municipal Airport.

AIRCRAFT ACTIVITY DATA

An evaluation of the existing noise condition is based upon observations of daily aircraft operations. The five-year (2011) operation counts are based on the short term forecasts from Chapter Two, Aviation Forecasts. The long term capacity operations are based on methodology described in FAA Advisory Circular 150/5060-5 *Airport Capacity and Demand*. These numbers were derived using the ultimate runway configuration, which includes a 4,300-foot parallel runway, for the airport. Therefore, the long range operations are derived from the capacity of the future runway system and not a specific year in the future. Existing and annual operations are summarized in **Table 3A.**

TABLE 3A
Operations Summary
Buckeye Municipal Airport

		Forecast	
	Existing 2006[1,2,3]	2011[3]	Long Range Capacity[4]
General Aviation			
Local	30,800	67,480	188,710
Itinerant	13,200	30,920	160,290
TOTAL OPERATIONS	44,000	98,400	349,000

[1] – Existing operations based on daily aircraft observations.
[2] – Baseline condition from 2005 Buckeye Municipal Airport Master Plan.
[3] – 2005 Buckeye Municipal Airport Master Plan and summarized in this document in Chapter Two, Table 2R
[4] – Based upon the ultimate future airfield capacity as described in FAA *Advisory Circular 150/5060-5, Airport Capacity and Delay*

OPERATIONS AND FLEET MIX

For the Buckeye Municipal Airport noise analysis, current operations data to calculate noise contours. Average daily operations were calculated by dividing the total annual operations by 365 days. **Table 3B** lists the annual and forecast operations for Buck-(takeoffs and landings), forecasts of future activity (2011), and long range capacity estimates were used. INM requires daily operation numbers eye Municipal Airport. As discussed in Chapter Two, Aviation Forecasts, daily operations are estimated at 80 per day based on daily landing reports maintained by the airport.

TABLE 3B
Operational Fleet Mix
Buckeye Municipal Airport

Aircraft	INM Designator	2006	2011	Long Range
ITINERANT				
BUSINESS JET				
Lear 35	LEAR35	50	258	625
Citation 500	CNA500	50	515	1,250
Challenger 600	CL600	-	258	625
Subtotal		100	1,031	2,500
HELICOPTER				
Bell 205	B206L	100	1,031	3,490
GENERAL AVIATION				
Single Engine Piston-Variable Pitch	GASEPV	2,335	5,111	28,640
Single Engine Piston-Fixed Pitch	GASEPF	9,341	20,445	114,561
Multi-Engine Piston	BEC58P	488	1,241	5,864
Turboprop	CNA441	836	2,061	5,235
Subtotal		13,000	28,858	154,300
TOTAL ITINERANT		13,200	30,920	160,290
GENERAL AVIATION – LOCAL				
Single Engine Piston-Variable Pitch	GASEPV	2,966	6,478	17,503
Single Engine Piston-Fixed Pitch	GASEPF	26,694	58,307	157,527
Multi-Engine Piston	BEC58P	1,140	2,695	13,680
Subtotal		**30,800**	**67,480**	**188,710**
GRAND TOTAL		**44,000**	**98,400**	**349,000**

Source: Coffman Associates analysis

Within the INM, representative aircraft are selected to simulate noise conditions at Buckeye Municipal Airport. Each aircraft type emits a different amount of noise resulting in a unique noise footprint. A noise footprint illustrates the noise conditions for an aircraft during a landing and takeoff sequence. This concept is depicted on **Exhibits 3B** and **3C.** The illustrated aircraft are those which commonly operate at Buckeye Municipal Airport. The aircraft fleet mix refers to the specific types or defined categories of aircraft operating at an airport. The fleet mix for any airport depends on, among other factors, the type and dimensions of the runways, availability of commercial service, presence of military installations, and the demand for private aircraft storage. The operations mix for the busi-

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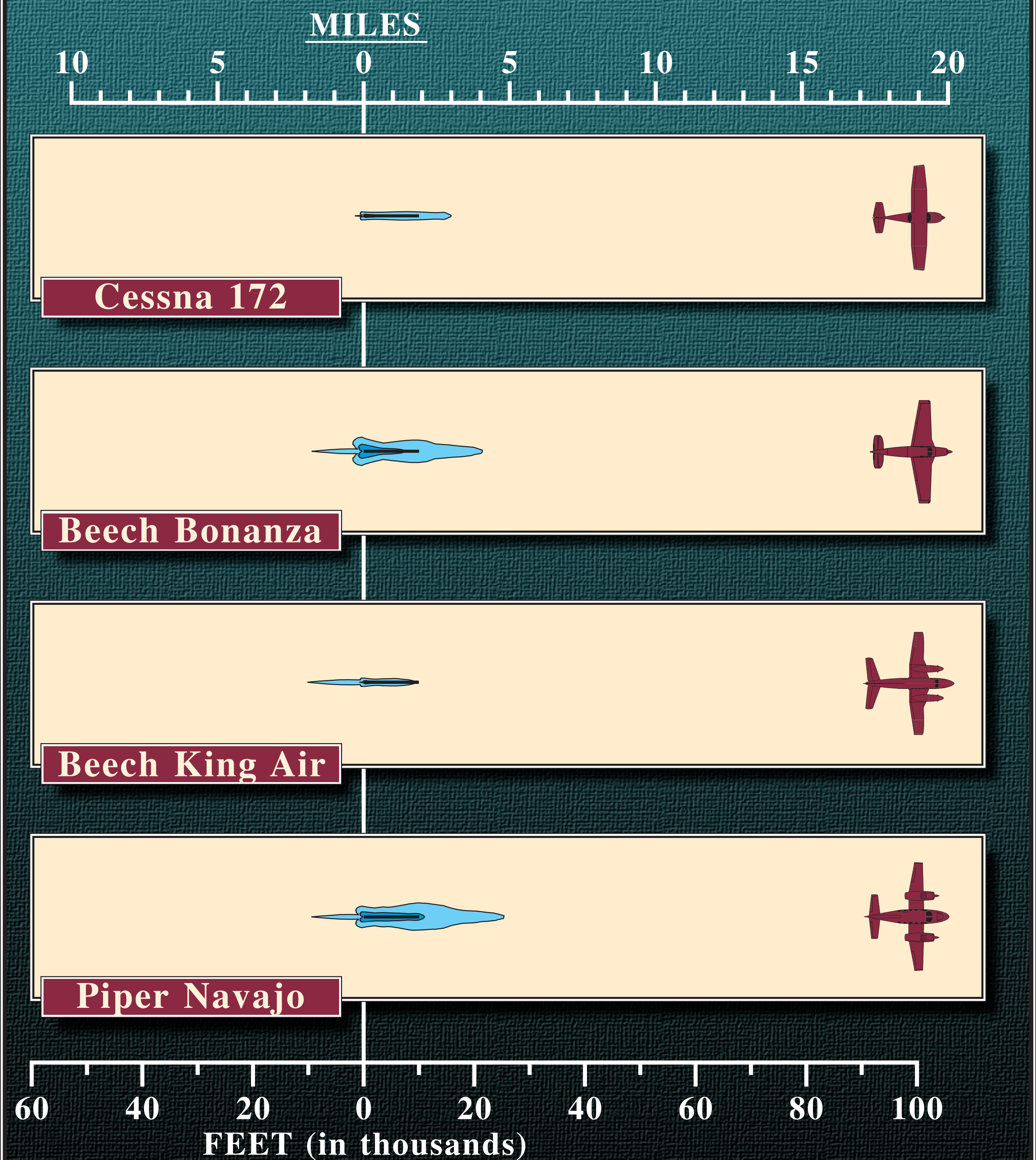


The contours represent sound exposure levels (SEL) of 80 and 90 dB for one arrival and one departure of each aircraft type. The outer contour represents 80 dB SEL. The inner contour represents 90 dB SEL.

Source: Coffman Associates 1999

Exhibit 3B
PROPELLER AIRCRAFT NOISE
FOOTPRINT COMPARISON

05SP14-3C-1/4/06

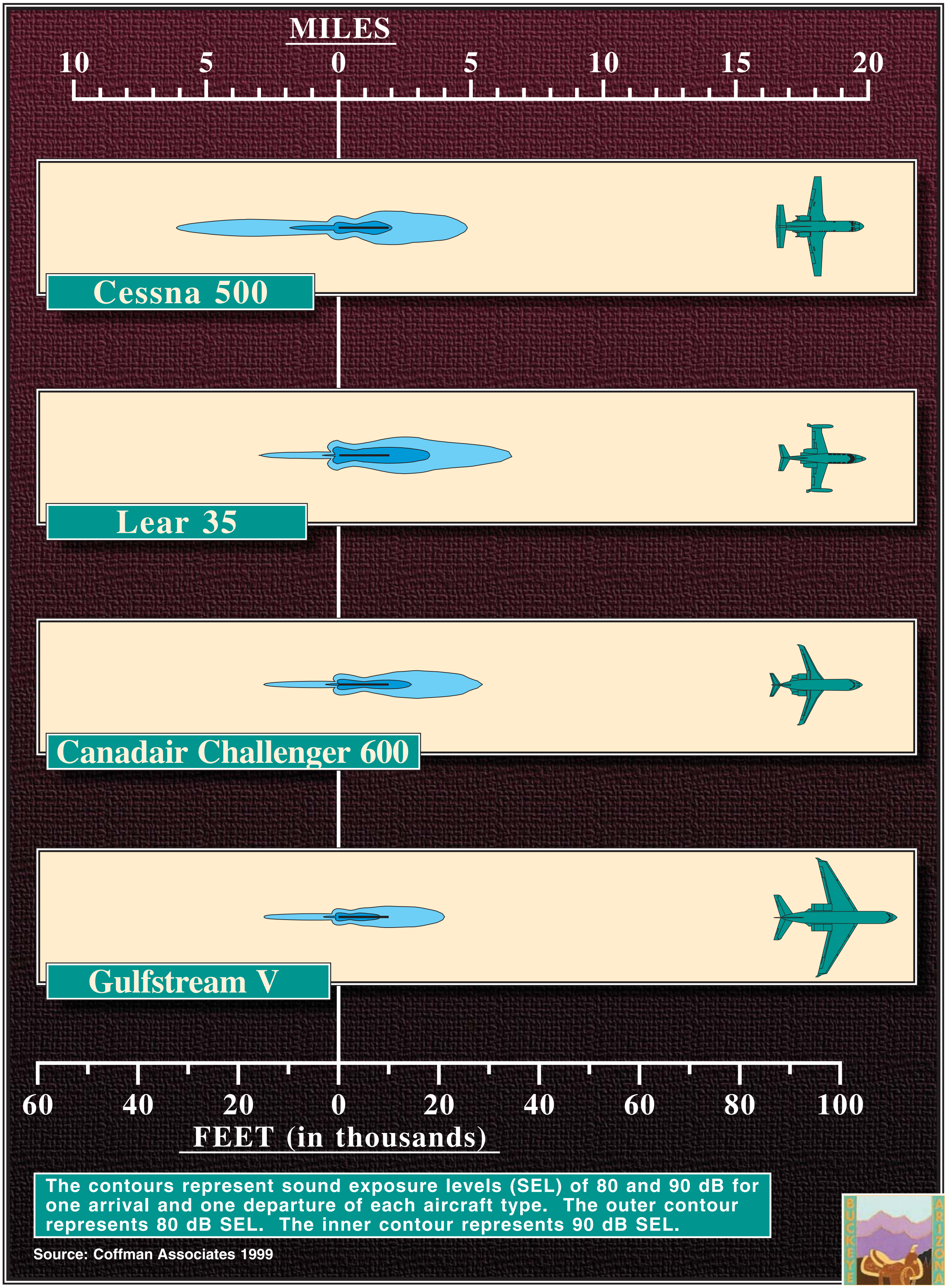


Exhibit 3C
TURBOJET AIRCRAFT NOISE
FOOTPRINT COMPARISON

ness jet, turboprop, and multi-engine piston aircraft are based on discussions with the airport manager, landing reports, fixed base operators, and an evaluation of the based aircraft at Buckeye Municipal Airport. **Table 3B** presents the assumed fleet mix for the existing and future noise contours.

According to the airport's Master Record filed with the FAA, the current based aircraft fleet mix consists of 50 single-engine piston aircraft, six rotorcraft, and six ultra-light aircraft.

Nationally, the general aviation fleet mix is approximately 80 percent single-engine aircraft. The national trend is toward a larger percentage of sophisticated aircraft and helicopters in the fleet mix. Growth within each category at the airport has been determined by comparison with national projections which reflect current aircraft in production.

DATABASE SELECTION

The INM includes aircraft noise data for most of the aircraft operating at Buckeye Municipal Airport. In cases where an aircraft is not included, the FAA provides an aircraft substitution list that identifies aircraft with comparable noise characteristics.

The FAA aircraft substitution list indicates that the general aviation single-engine variable pitch propeller model, identified as GASEPV in the INM, can be used to model noise for several general aviation aircraft. These include the Cessna 182, 185, and 206 and the Piper PA-28, among others. Additionally, a variety of general aviation single-engine fixed propeller aircraft are modeled with the GASEPF aircraft. Included among these are the Cessna 150, 152, and 172; the Piper PA-22; and the SparrowHawk Gyro-plane (AEE coordination on the SparrowHawk Gyro-plane can be found in Appendix C. Turboprop aircraft are represented by the Cessna 441, identified as CAN441.

The INM provides data for most of the business jet aircraft in the national fleet. The following INM designators were selected to represent business jet operations at Buckeye Municipal Airport. Lear 35 operations were modeled using LEAR35. The CNA500 was used to model operations for the Cessna 500, and Challenger 600 operations were represented by the CL600 profile. All INM business jet aircraft are from FAA's pre-approved list.

Helicopter operations were modeled using helicopter noise and profile information exported from the Helicopter Noise Model (HNM) and imported to the INM. The Bell 206 (B206L) was used to model general aviation helicopter operations.

TIME OF DAY

The time of day which aircraft operations occur is an important component of the INM model and depends on the noise metric used to represent noise conditions. The average day-night noise level (DNL), which is the FAA approved metric for Part 150 studies, adds additional weight to operations that occur during nighttime hours

(10:00 p.m. to 7:00 a.m.) During this time, an additional 10 dB is added to all aircraft operations to represent the increased sensitivity that residents might have during nighttime hours. When calculating aircraft noise exposure, one nighttime operation is equal to ten daytime operations resulting from the penalty.

Because Buckeye Municipal Airport does not have the means to track flights at the airport, time of day information was gathered from conversations with the airport manager and fixed base operators. **Table 3C** summarizes the time-of-day percentages assumed in the model. As shown in the table, a majority of operations occur during the daytime hours.

TABLE 3C
Time of Day Activity
Buckeye Municipal Airport

	Arrivals		Departures	
Aircraft Category	**Day (7:00 a.m. to 10:00 p.m.)**	**Nighttime (10:00 p.m. to 7:00 a.m.)**	**Day (7:00 a.m. to 10:00 p.m.)**	**Nighttime (10:00 p.m. to 7:00 a.m.)**
Business Jet	85%	15%	85%	15%
Turboprop	85%	15%	85%	15%
General Aviation Local	80%	20%	80%	20%
General Aviation Itinerant	80%	20%	80%	20%
Helicopter	80%	20%	80%	20%

Source: Time of day information was established through discussions with the airport manager, fixed based operators, and Coffman Associates analysis.

RUNWAY USE

Runway usage data is another essential component for developing noise exposure contours in the INM. Continuous runway use records are not maintained by the airport. Runway usage estimates were established through discussions with the airport manager. **Table 3D** summarizes the runway use percentages for the existing and future conditions.

TABLE 3D
Runway Use Percentages
Buckeye Municipal Airport

Runway	Business Jet	Turboprop	General Aviation Itinerant	General Aviation Local	Helicopter
Departures					
17	70%	70%	70%	70%	70%
35	30%	30%	30%	30%	30%
Arrivals					
17	70%	70%	70%	70%	70%
35	30%	30%	30%	30%	30%

Source: Runway usage was established through discussions with the airport manager and fixed based operators, at Buckeye Municipal Airport.

The ultimate configuration of runways at Buckeye Municipal Airport will change the long term runway use because of the additional parallel runway. It is anticipated that some of the general aviation activity will shift from the current primary runway to Runway 17R-35L, while business jet and turboprop activity will remain on the primary runway. **Table 3E** presents the runway use distribution for the long range capacity scenario.

TABLE 3E
Future Runway Use Percentages
Buckeye Municipal Airport

Runway	Business Jet	Turboprop	General Aviation	Helicopter
DEPARTURES				
17L	70%	70%	65%	7%
35R	30%	30%	25%	3%
17R	0%	0%	7%	65%
35L	0%	0%	3%	25%
ARRIVALS				
17L	70%	70%	65%	7%
35R	30%	30%	25%	3%
17R	0%	0%	7%	65%
35L	0%	0%	3%	25%

Source: Runway usage was established through discussions with the airport manager and evaluation of the wind conditions at Buckeye Municipal Airport.

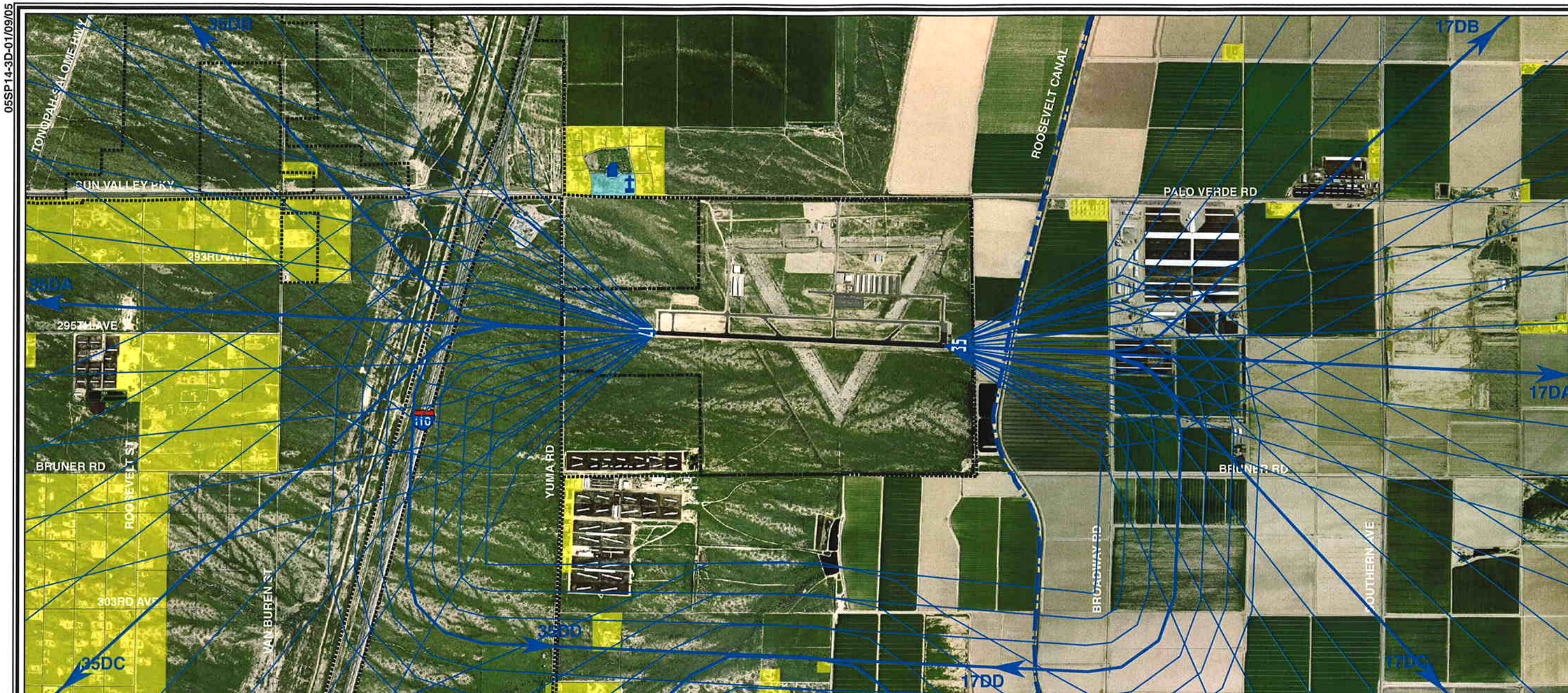
EXISTING FLIGHT TRACKS

Local and standard air traffic procedures and input from the airport manager and fixed base operators were used to develop consolidated flight tracks for use in the INM. The result is consolidated flight tracks describing the average corridors that lead to and from Buckeye Municipal Airport. At a general aviation airport such as Buckeye Municipal Airport, air traffic is expected over most areas around the airport. The density of air traffic generally increases closer to the airport. The flight tracks were developed to reflect these common patterns and to account for the dispersion of flight paths near the airport.

Exhibit 3D illustrates the flight tracks used to model departing operations at Buckeye Municipal Airport. For the current runway configuration, departures occur off both runway ends and diverge to account for various flight paths and turns following departure. Specified runway departure procedures or preferential runway use programs have not been established.

Additionally, the consolidated arrival flight tracks for Buckeye Municipal Airport are presented in **Exhibit 3E**. Arrival patterns are generally straight-in close to the airport. Arrivals from the direction opposite the runway flow typically enter the traffic pattern at approximately a 45-degree angle and follow the airport traffic pattern until a suitable approach can be made.

Touch-and-go operations are illustrated on **Exhibit 3F**. The series of concentric oval-shaped flight tracks represent the variance in the size of the training pattern at Buckeye Municipal Airport. Presently, these operations occur to the west of the airport.



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LEGEND

- Airport Property
- Municipal Boundary
- Departure Tracks
- Departure Sub-Tracks
- Water
- Residential
- Noise-Sensitive Institutions
- Place of Worship
- Community Center

Source: Aerial Photography, March 2005.
Coffman Associates Analysis.

NORTH

0 2,000
Feet

BUCKEYE ARIZONA

Exhibit 3D
CONSOLIDATED DEPARTURE FLIGHT TRACKS

05SP14-3E-01/09/05

LEGEND

- Airport Property
- Municipal Boundary
- Arrival Tracks
- Arrival Sub-Tracks
- Water
- Residential
- Noise-Sensitive Institutions
- Place of Worship
- Community Center

Source: Aerial Photography, March 2005.
Coffman Associates Analysis.

NORTH

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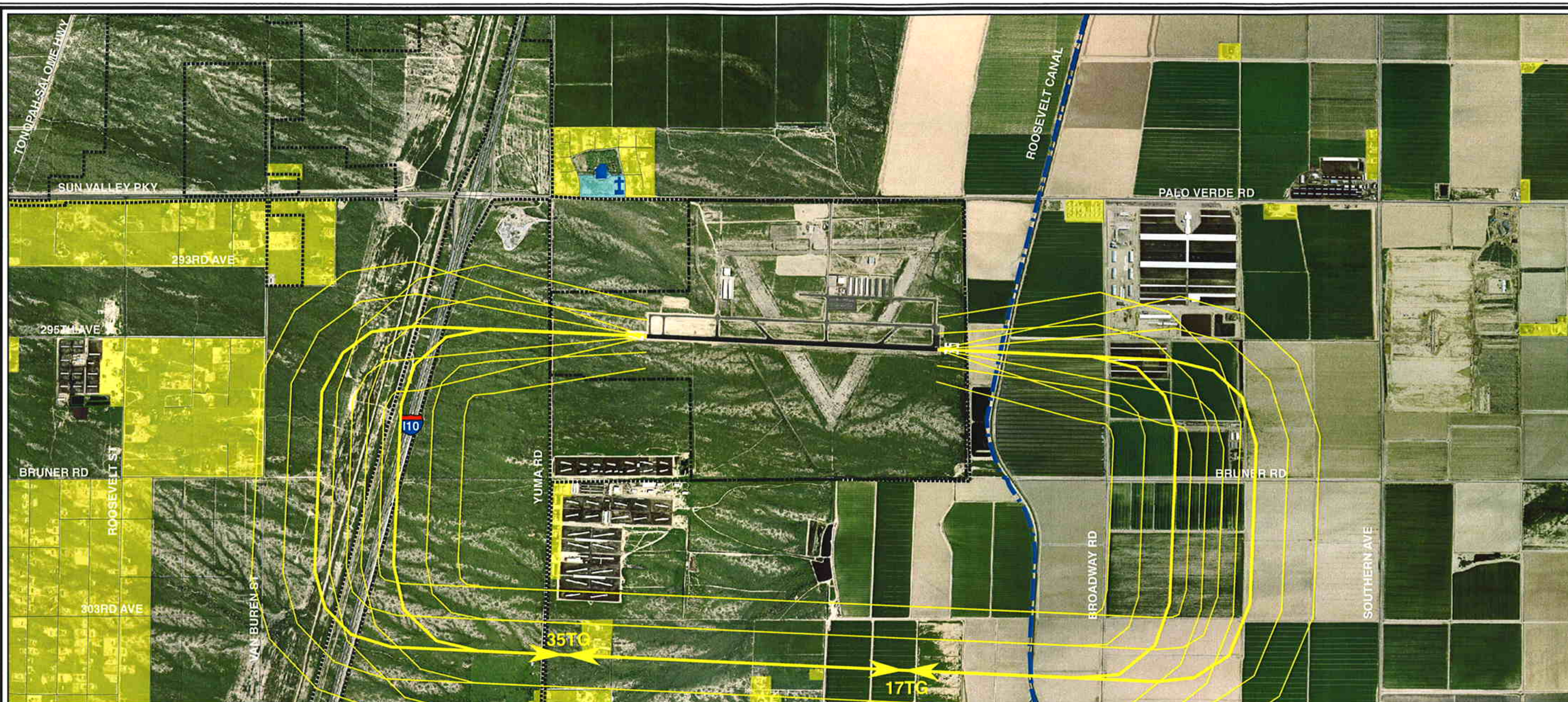
Feet

Exhibit 3E
CONSOLIDATED ARRIVAL FLIGHT TRACKS

05SP14-3F-01/09/05



LEGEND

- Airport Property
- Municipal Boundary
- Touch-and-Go Tracks
- Touch-and-Go Sub-Tracks
- Water
- Residential
- Noise-Sensitive Institutions
- Place of Worship
- Community Center

Source: Aerial Photography, March 2005.
Coffman Associates Analysis.

NORTH

0 2,000
Feet

BUCKEYE ARIZONA

Exhibit 3F
CONSOLIDATED TOUCH-AND-GO FLIGHT TRACKS

LONG RANGE FLIGHT TRACKS

The construction of the parallel runway identified in the master plan will alter the arrival and departure paths taken by aircraft operating at Buckeye Municipal Airport. As previously stated, the airport traffic pattern is to the west of the airport. When the new runway is constructed, the traffic pattern for the new runway will continue to be on the west side of the airport while the primary runway traffic pattern will be shifted to the east of the airport.

Exhibit 3G illustrates the departure flight tracks for the ultimate runway configuration. Departures will occur off both ends of both runways and were modeled to disperse traffic over several flight paths. As with the existing configuration, there are no established departure procedures or preferential runway use programs assumed in this analysis.

The arrival flight tracks for the ultimate runway configuration are depicted on **Exhibit 3H**. As with the existing condition, the arrival patterns are generally straight-in close to the airport. Additionally, arrivals from the direction opposite of the runway flow will enter the traffic pattern at approximately a 45-degree angle and follow the airport traffic pattern until a suitable approach can be made.

Touch-and-go operations will change the existing traffic pattern. As depicted in **Exhibit 3J**, the touch-and-go operations will occur to the east of the airport for the primary runway and to the west of the airport for the parallel runway. A touch-and-go flight track was modeled for each runway end to account for operations in both directions on each runway.

ASSIGNMENT OF FLIGHT TRACKS

The final step in developing input assumptions for the INM is the assignment of aircraft to specific flight tracks. Prior to this step, specific flight tracks, runway utilization, and operations statistics for the various aircraft models using Buckeye Municipal Airport were evaluated.

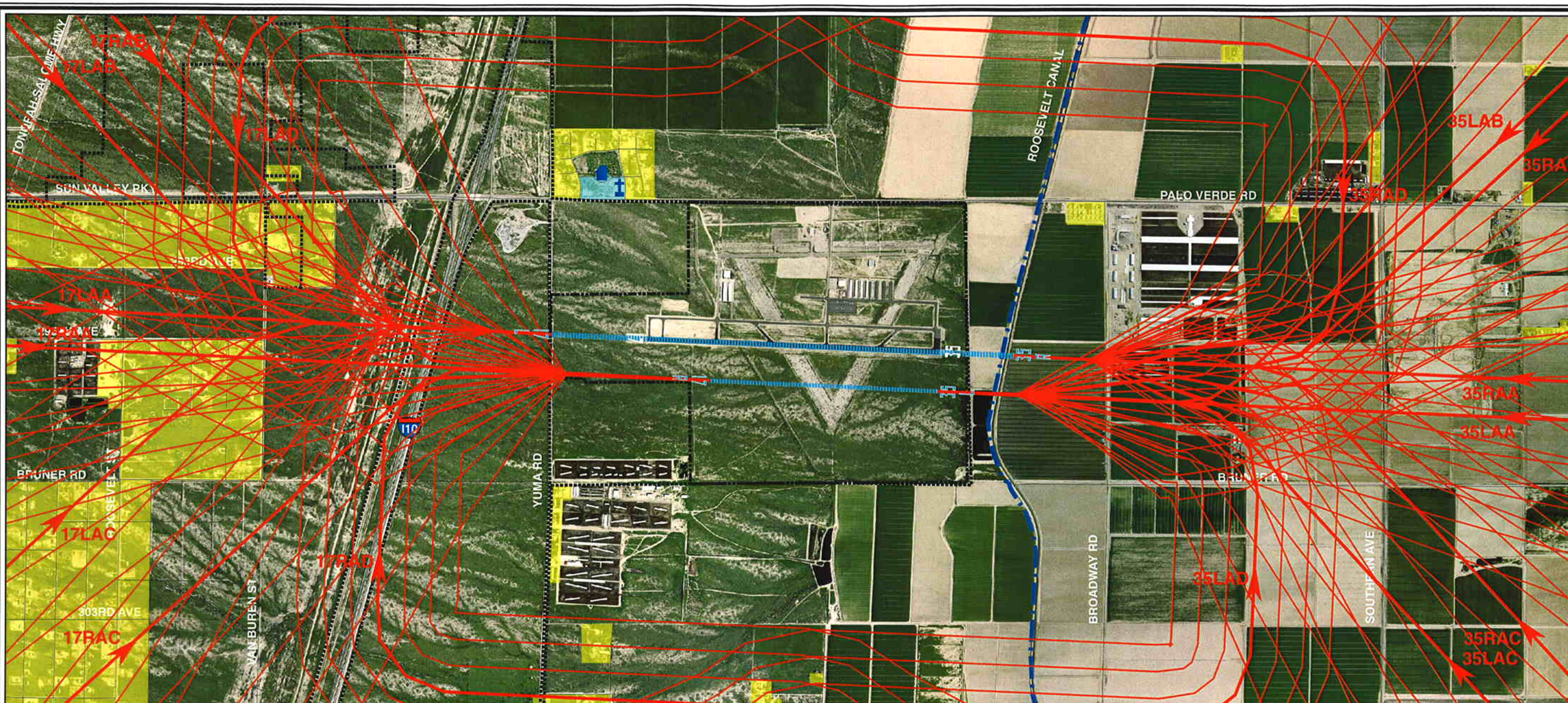
The flight tracks were developed with the help of the airport manager and local operators to identify the proportion of traffic using each consolidated flight track. This analysis resulted in a percentage of use for each flight track. These percentages were then used to assign operations of the various aircraft categories to the flight tracks. To determine the specific number of aircraft assigned to any one flight track, a series of calculations was performed. The number of specific aircraft of one group was factored by runway utilization and flight track percentage.

In the long term situation, a majority of the operations will continue to occur on the primary runway, while some of the general aviation training activity will be conducted on the parallel runway. Helicopter traffic and touch-and-go traffic was also assigned to tracks based on airport manager and local operator recommendations. A detailed breakdown of flight track assignments

05SP14-3D-07/11/06

Exhibit 3G
CONSOLIDATED LONG RANGE DEPARTURE FLIGHT TRACKS

05SP14-3H-07/11/06



LEGEND

- Airport Property
- Municipal Boundary
- Arrival Tracks
- Arrival Sub-Tracks
- Ultimate Runway
- Water
- Residential
- Noise-Sensitive Institutions
- Place of Worship
- Community Center

Source: Aerial Photography, March 2005.
Coffman Associates Analysis.

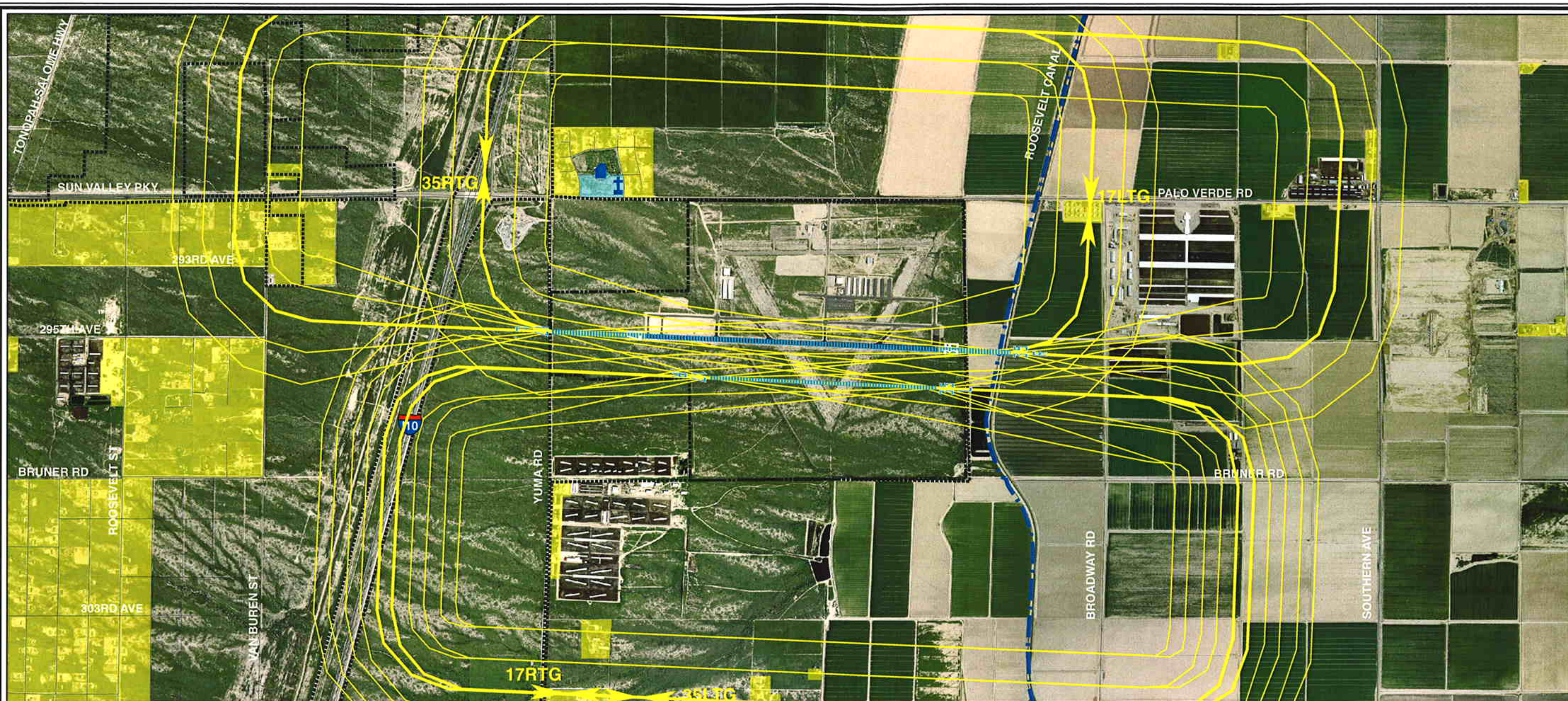
NORTH

0 2,000
Feet

BUCKEYE ARIZONA

Exhibit 3H
CONSOLIDATED LONG RANGE ARRIVAL FLIGHT TRACKS

05SP14-3J-07/11/06



LEGEND

- Airport Property
- Municipal Boundary
- Touch-and-Go Tracks
- Touch-and-Go Sub-Tracks
- Ultimate Runway
- Water
- Residential
- Noise-Sensitive Institutions
- Place of Worship
- Community Center

Source: Aerial Photography, March 2005.
Coffman Associates Analysis.

NORTH

0 2,000
Feet

BUCKEYE ARIZONA

Exhibit 3J
CONSOLIDATED LONG RANGE TOUCH-AND-GO FLIGHT TRACKS

can be found in **Appendix C** of this document.

INM OUTPUT

The INM has a variety of user-defined output options. As stated in the Part 150 guidelines, the noise metric used for this study must be DNL. Additional requirements state that 65, 70, and 75 DNL noise contours are presented in the airport's official Noise Exposure Maps.

While the 65 DNL noise contour is considered the threshold of significance by the FAA, the 55 and 60 DNL noise contours are also mapped as part of this study for future noise abatement and land use compatibility planning. For the purposes of this Part 150 study, Buckeye Municipal Airport considers noise in areas between 55 and 65 DNL to have a marginal effect. The following sections present the results of the INM noise contour development process for the current, future, and long range capacity conditions at Buckeye Municipal Airport.

Noise contours need to be examined relative to the existing conditions in the area surrounding the airport. To achieve an understanding of the extent of the noise exposure contours relative to the airport, the noise contours are overlaid on a map representing the airport surroundings. The land area covered by each of the contours is presented in **Table 3F**. The shape and coverage of the noise contours reflect the underlying flight track assumptions.

TABLE 3F
Comparative Areas of Noise Exposure
Buckeye Municipal Airport

	Area in Square Miles		
DNL Contour	**2006**	**2011**	**Long Range**
55	0.494	1.164	3.233
60	0.207	0.430	1.469
65	0.065	0.186	0.653
70	0.014	0.064	0.300
75	0.003	0.014	0.091

Source: Coffman Associates analysis

2006 NOISE EXPOSURE CONTOURS

Exhibit 3K illustrates the 2006 noise exposure contours for Buckeye Municipal Airport. As shown in **Table 3D**, a majority of departures occurs on Runway 17. The resulting significant effect noise contours are wider at this end due to the departure spool-up noise generated during take-off. Departures to the north, on Runway 35, contribute to the smaller bulge in the significant effect contours at the southern end of the runway. This is also due to departure spool-up noise.

The 2006 significant effect (75, 70, and 65 DNL) noise contours remain entirely on airport property.

The 60 DNL noise contour is cigar-shaped and situated close to the runway. The bulges at the Runway 35 end of the 55 DNL noise contour are due to departure turns and the established traffic pattern at the airport, which routes aircraft over the areas west of the airport.

The marginal effect noise contours (60 and 55 DNL) stay primarily on airport

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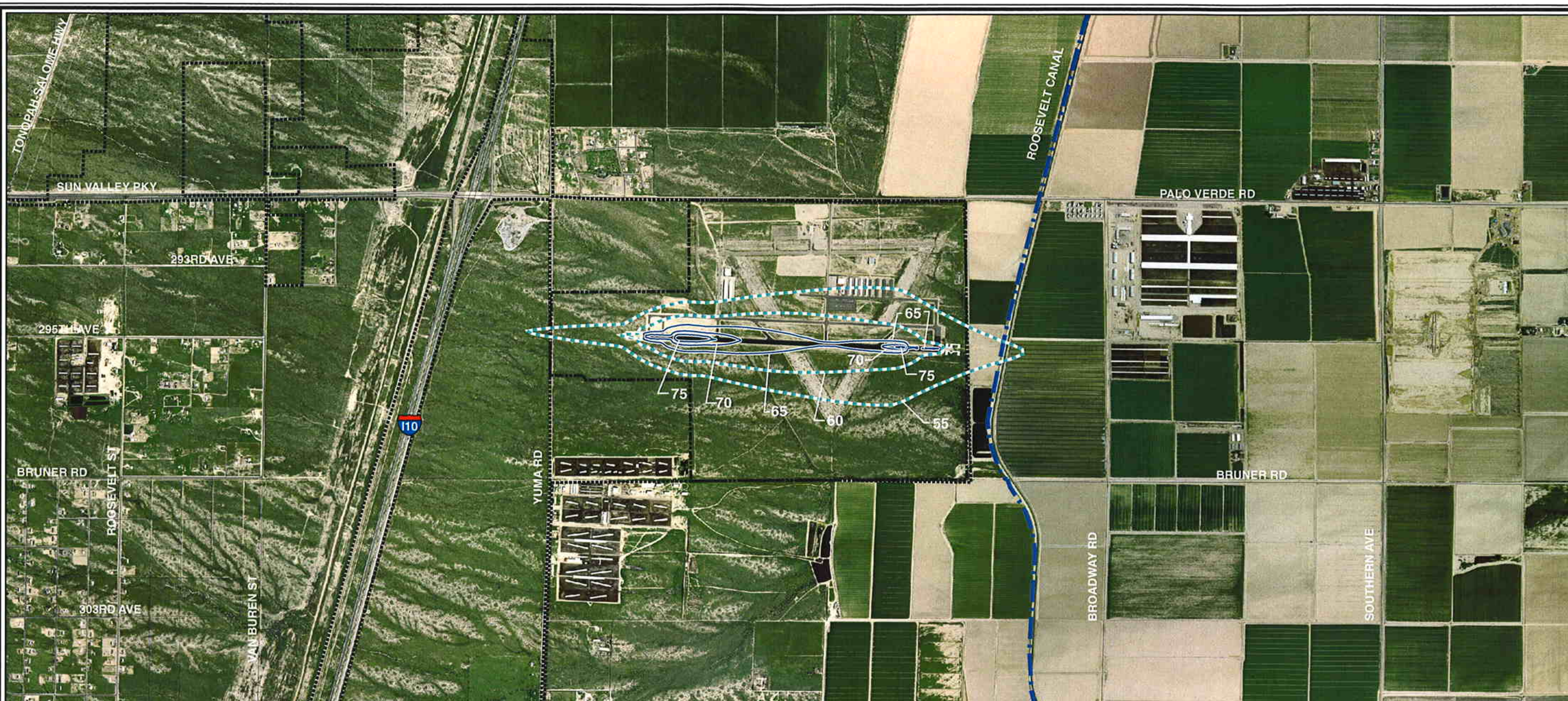

LEGEND

- Airport Property
- Municipal Boundary
- 2006 Contour, Marginal Effect
- 2006 Contour, Significant Effect
- Water

Runway 35 End

Source: Aerial Photography, March 2005.
Coffman Associates Analysis.

NORTH

0 2,000
Feet

BUCKEYE ARIZONA

Exhibit 3K
2006 NOISE EXPOSURE CONTOURS

property with the exception of the northern and southern reaches of the 55 DNL noise contour. The 55 DNL noise contour extends 400 feet to the north and 1,000 feet to the south of airport property.

2011 NOISE EXPOSURE CONTOURS

Operations at Buckeye Municipal Airport are anticipated to increase significantly by 2011. As a result, the size of the noise contours will change. As shown in **Exhibit 3L**, the 65 DNL noise contour exhibits a cigar shape and is comparatively wider than the existing condition. The 2011 significant effect noise contours remain entirely on airport property.

The 60 DNL noise contour is cigar-shaped with a slight bulge to the east and west at the Runway 35 end. This results from departure turns and aircraft entering the airport traffic pattern. This contour reaches the airport property line to the north and extends beyond the boundary approximately 1,100 feet to the south.

The 55 DNL noise exposure contour is considerably larger than the 60 DNL and extends well beyond the property line. At the southern end, the noise exposure contours curve to the west due to aircraft entering the traffic pattern. Additionally, the noise contour extends approximately 3,000 feet north of the airport and 4,100 feet to the south of the airport boundary.

LONG RANGE CAPACITY CONTOUR

As stated previously, the long range capacity noise contour is intended for land use planning purposes. The assumptions used for creating this contour include the maximum number of operations possible at the airport according to the ultimate configuration detailed in the 2006 Airport Master Plan. The Master Plan development concept includes an additional 4,300-foot parallel runway located west of the primary runway and an 1,800-foot extension to the north on the primary runway and a 1,400-foot extension to the south end of the primary runway.

The total operations number is based on FAA published guidance on airport capacity. Because of the increased operations resulting from the maximum capacity calculation, the noise contours are larger, as indicated in **Table 3F** and depicted on **Exhibit 3M**.

The shape of the significant effect noise contours is influenced by the change in the traffic pattern for the airport. The new traffic pattern would require aircraft using Runway 17L-35R to use the area east of the airport and aircraft using Runway 17R-35L to use the area west of the airport. The shape of the noise contours south of the airport curve to the west. This is due to the traffic pattern and departure turns to the west of the airport. The significant effect noise exposure contours in the long rage condition extend beyond the airport property line.

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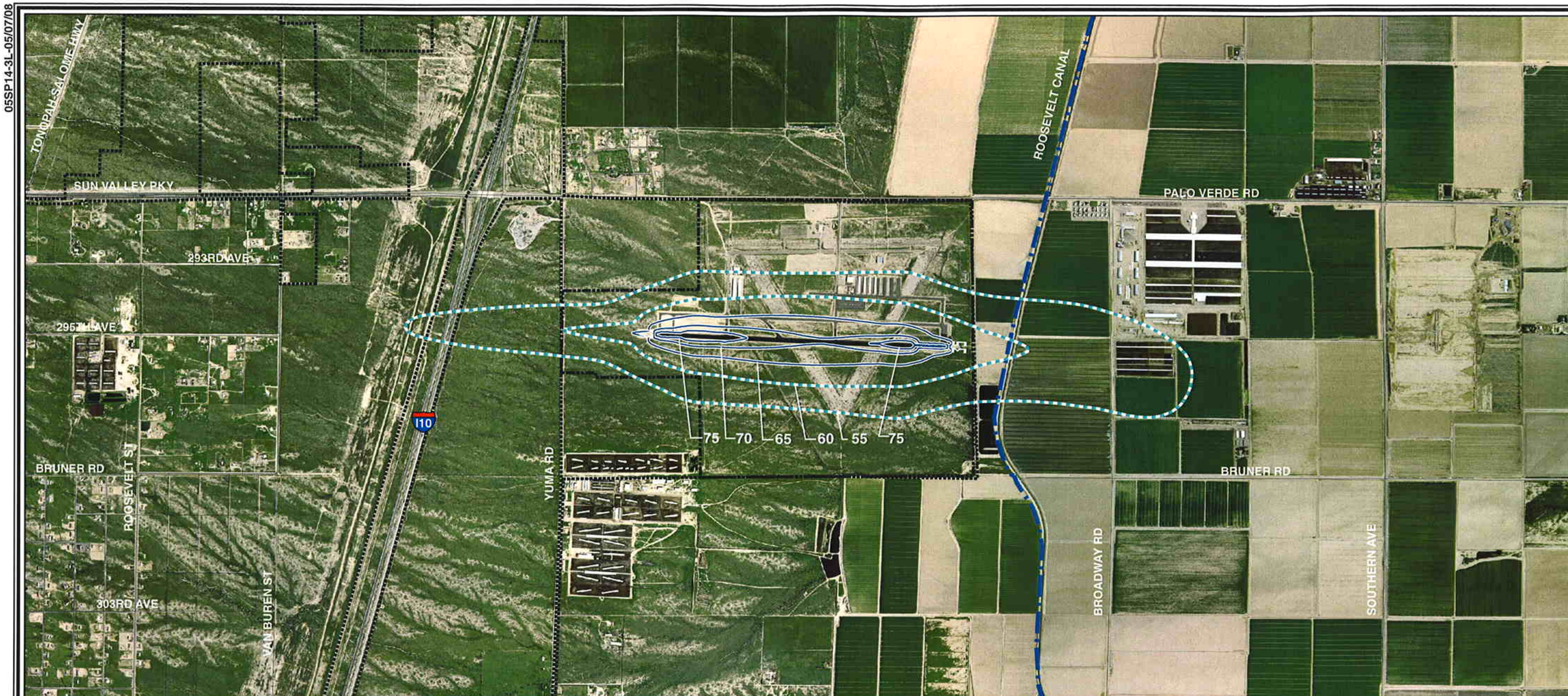

LEGEND

- Airport Property
- Municipal Boundary
- 2011 Contour, Marginal Effect
- 2011 Contour, Significant Effect
- Water

Source: Aerial Photography, March 2005.
Coffman Associates Analysis.

NORTH

0 2,000
Feet

BUCKEYE ARIZONA

Exhibit 3L
2011 NOISE EXPOSURE CONTOURS

05SP14-3M-12/29/05

LEGEND

- Airport Property
- Municipal Boundary
- Long Range Capacity Contour, Marginal Effect
- Long Range Capacity Contour, Significant Effect
- Ultimate Runway
- Water

Source: Aerial Photography, March 2005.
Coffman Associates Analysis.

NORTH

0 2,000
Feet

Exhibit 3M
LONG RANGE NOISE EXPOSURE CONTOURS

The 70 DNL noise contour extends approximately 400 feet to the north of the property line and extends approximately 900 feet beyond the existing property line to the south. The 65 DNL noise contour extends 1,600 feet beyond the property line to the north and 1,900 feet to the south.

The shape of the marginal effect noise contours is also influenced by the traffic pattern. To the north and south, these contours have bulges resulting from traffic pattern activity. The 60 DNL noise contour extends 3,600 feet north of the existing airport property line and approximately 5,200 feet to the south of the property line.

The 55 DNL noise contour extends 6,400 feet to the north of the airport property line and 7,300 feet to the south at its greatest point.

SUMMARY

This chapter has provided a detailed discussion of the methodology used to develop the noise exposure contours for Buckeye Municipal Airport. This information will be used in subsequent chapters to determine the extent of the noise impacts created by airport operations and to formulate strategies to limit future impacts.

CHAPTER FOUR

NOISE IMPACTS

NOISE IMPACTS

The impact of noise on existing and future land uses and population within the Buckeye Municipal Airport environs are discussed in this chapter. The most common impact resulting from airport noise is annoyance. Annoyance results from sleep disruption, interference with the enjoyment of radio and television programs, interruption of conversations, and disturbance of quiet relaxation. Individual responses to noise are highly variable, thus making it difficult to predict how any one person is likely to react to environmental noise. However, the response of a large group of people to environmental noise is much less variable and has been found to correlate well with cumulative noise metrics such as Leq, DNL, and CNEL.

The development of aircraft noise impact analysis techniques has been based on the relationship between average community response and cumulative noise exposure. For more detailed information on the effects of noise exposure, refer to the Technical Information Paper (TIP), *Effects of Noise Exposure*, located at the end of this document.

LAND USE COMPATIBILITY

The concept of "airport land use compatibility" has developed from the observation of the systematic variation of human tolerance to aviation noise. Numerous studies by governmental and academic researchers have defined the compatibility of different land uses exposed to varying noise levels. A review of these studies and resulting guidelines is presented in the TIP, *Aircraft Noise and Land Use*

Compatibility Guidelines, found in the final section of this document.

The degree of annoyance which people experience from aircraft noise varies depending on their activities during the time of exposure. Studies regarding airport noise revealed that people rarely are as disturbed by aircraft noise when they are working, shopping, or driving as when they are at home. In one's residence there is an expectation of a quiet environment; therefore, any unwanted noise can be particularly disturbing. Occupants of hotels and motels seldom express as much concern with aircraft noise as do permanent residents of an area. To standardize the assessment of airport land use compatibility, the Federal Aviation Administration (FAA) has established guidelines, codified within 14 CFR Part 150, that identify suitable land uses for development near airport facilities.

14 CFR PART 150 GUIDELINES

In the early 1980s, the FAA promulgated the Code of Federal Regulations (CFR) Title 14, Part 150 to guide airport land use compatibility studies. These guidelines were based on earlier studies and guidelines by federal agencies (Federal Interagency Committee on Urban Noise, 1980). These land use compatibility guidelines are advisory in nature, rather than regulatory. Part 150 explicitly states that determinations of land use compatibility are purely local responsibilities. (See Section A150.101(a) and (d) and explanatory note in Table 1 of 14 CFR Part 150.) **Exhibit 4A** summarizes the FAA airport noise land use compatibility guidelines.

The FAA uses Part 150 guidelines as the basis for defining areas within which noise mitigation projects, such as sound insulation or property acquisition, may be eligible for federal funding. Federal grants are available through the noise set-aside funds from the Airport Improvement Program (AIP). In general, noise compatibility projects must be within the 65 DNL noise contour to be eligible for federal funding. According to the AIP handbook, "Noise compatibility projects usually are located in areas where aircraft noise is significant, as measured in day-night average sound level (DNL) or 65 decibels (dB) or greater." (See FAA Order 5100.38Bm, Chapter 8, paragraph 810.b.)

However, projects may also be approved and made eligible in areas of less noise exposure. In these cases, the following criterion apply: the airport operator must adopt a designation of non-compatibility different from federal guidelines; the NEM and NCP must identify areas as non-compatible; and measures proposed for mitigation within the area must meet Part 150 criteria.

The FAA guidelines outlined in **Exhibit 4A** state that residential development, including standard construction (residential construction without acoustic treatment), mobile homes, and transient lodging are all incompatible with noise above 65 DNL. Homes of standard construction and transient lodging may be considered compatible where local communities

05SP14-4A-1/10/06

LAND USE	Yearly Day-Night Average Sound Level (DNL) 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	Y	N[1]	N[1]	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Government 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, hardware 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, parks, resorts, and camps	Y	Y	Y	N	N	N
Golf courses, riding stables, and water recreation	Y	Y	25	30	N	N

The designations contained in this table do not constitute a federal determination that any use of land covered by the program is acceptable under federal, state, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests 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.

See other side for notes and key to table.

Exhibit 4A

LAND USE COMPATIBILITY GUIDELINES

KEY

Y (Yes)	Land Use and related structures compatible without restrictions.
N (No)	Land Use and related structures are not compatible and should be prohibited.
NLR	Noise Level Reduction (outdoor-to-indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
25, 30, 35	Land Use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structure.

NOTES

1 Where the community determines that residential or school uses must be allowed, measures to achieve outdoor-to-indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB, respectively, should be incorporated into building codes and be considered in individual approvals. Normal residential 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 round. However, the use of NLR criteria will not eliminate outdoor noise problems.

2 Measures to achieve NLR of 25 dB 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 the normal noise level is low.

3 Measures to achieve NLR of 30 dB 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 the normal noise level is low.

4 Measures to achieve NLR of 35 dB 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 the 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 a NLR of 30.

8 Residential buildings not permitted.

Source: ***14 CFR Part 150***, Appendix A, Table 1.

Exhibit 4A (Continued)
LAND USE COMPATIBILITY GUIDELINES

have determined these uses are permissible; however, sound insulation methods are recommended. Schools and other public use facilities are also generally considered to be incompatible with noise exposure above 65 DNL. As with residential development, communities can permit these uses to be acceptable with appropriate sound insulation measures.

Examples of incompatible land uses at various noise levels include outdoor music venues and amphitheatres at levels exceeding 65 DNL; zoos and nature exhibits above 70 DNL; and hospitals, nursing homes, places of worship, auditoriums, concert halls, livestock breeding, amusement parks, resorts, and camps above 75 DNL.

Historic properties, such as those listed on the National Register of Historic Places, have been deemed to be in compliance with Part 150, Section 4(f) of the *Department of Transportation Act* (DOT Act), and the *National Historic Preservation Act of 1966*, as amended. In general, these properties are not any more sensitive to noise than are other properties of similar uses; however, federal regulations require that noise effects on these uses be considered when evaluating the effects of an action, such as a noise abatement or land use management procedure.

The strictest of these requirements is the Department of Transportation (DOT) Act. Section 4(f) of the DOT Act provides that the U.S. Secretary of Transportation shall not approve any program (such as a Noise Compatibility Program) or project which requires the use of any historic site of national, state, or local significance unless there is no feasible and prudent alternative to the use of such land. The FAA is required to consider the direct physical taking of eligible property (such as acquisition and demolition of historic structures) and the indirect use of, or adverse impact to, eligible property (such as noise exposure within the 65 DNL noise contour). When evaluating effects of the noise abatement and land use management alternatives later in this report, it will be necessary to also identify whether the proposed action conflicts with or is compatible with the normal activity or aesthetic value of any historic properties not already significantly affected by noise. The Noise Exposure Map (NEM) contours are not evaluated under Section 4(f).

Land Use Guidelines At Buckeye Municipal Airport

For purposes of the Part 150 Noise Compatibility Study at Buckeye Municipal Airport, the FAA's land use compatibility guidelines will be used as the starting point for making determinations about land use compatibility in the airport area.

While the FAA considers 65 DNL as the threshold of significant impact on noise-sensitive uses, the noise analysis for this Part 150 Study extends to the 55 DNL level. Enacting land use regulations beyond the federal threshold helps to ensure future noise impacts are limited. The following points provide an overview of the rationale for regulating land use beyond the 65 DNL noise contour.

- Federal funding is not available for mitigation of noise-sensitive development constructed within the 65 DNL noise contour after October 1, 1998.

- The cost of mitigating or purchasing land use incompatibilities is usually far greater than avoiding them initially.

- Federal Interagency Council on Noise (FICON) recognizes the potential for noise impacts down to 60 DNL for the following reasons:

  - Schultz curve recognizes that some individuals would be "highly annoyed" at these levels (see *Aircraft Noise and Land Use Compatibility Guidelines* Technical Information Paper in the back of this document for an explanation of the Schultz curve).

  - Large changes in noise levels (on the order of 3 dB or more below 65 dB) can be perceived by people as a degradation of their noise environment.

  - Improved techniques for assessing noise impacts below 65 DNL are now in existence.

- Aviation industry professionals are beginning to understand the limitations of the DNL metric for use in local regulations. Its limitations result from a decreasing accuracy at lower noise levels and its inability to incorporate varying perceptions of noise in a community. As a result, noise regulation and mitigation for airports are being applied to areas with less prolonged noise exposure such as the 55 and 60 DNL noise contours.

- EPA Guidelines published in 1974 state that interference with outdoor activities may become a problem when noise levels exceed 55 DNL.

- FAA established the Center of Excellence for Aircraft Noise Mitigation in 2003. This research center is a partnership between academia, industry, and government. Part of the center's focus will be on what level of noise is significant, as well as alternate noise metrics that can be used to assess the impact of aircraft noise on individuals.

- While research has shown that significantly fewer people are affected as noise decreases below 65 DNL, aircraft noise continues to be a problem for at least some people at extremely low DNL exposure. This is indicated in the two graphs illustrated on **Exhibit 4B** relating to annoyance with DNL levels.

Additionally, the area around Buckeye Municipal Airport is undeveloped and this study can be used to establish justification for regulating the development of non-compatible land uses within the immediate vicinity of the airport.

For purposes of this Part 150 Study, Buckeye Municipal Airport considers

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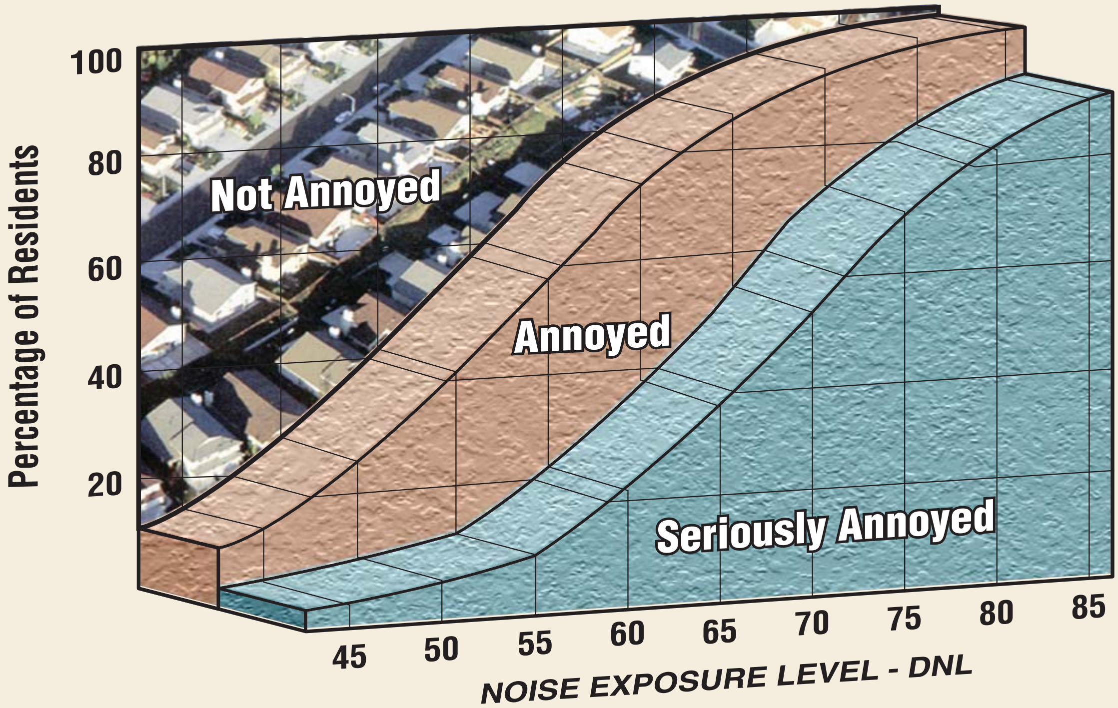
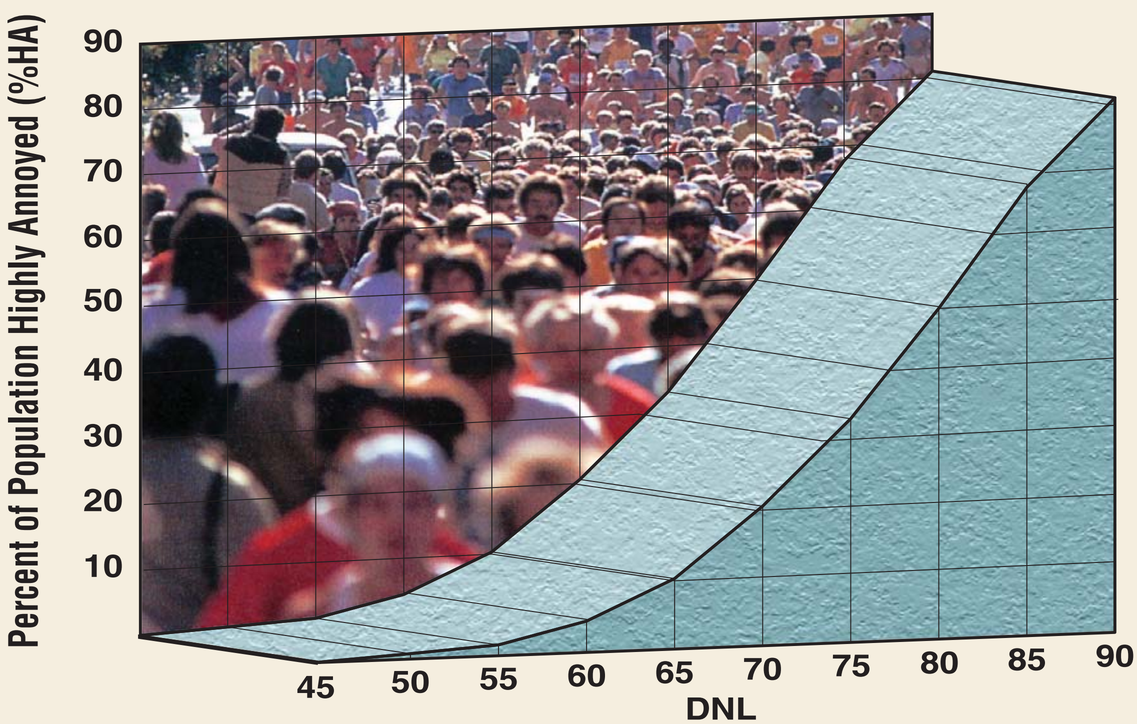


Source: Richards and Ollerhead 1973, p.31

UPDATED SCHULTZ CURVE



Equation for Curve: $\% HA = \frac{100}{1 + e\,(11.13 - .14\,Ldn)}$

Source: Finegold et al. 1992 and 1994.

Exhibit 4B
ANNOYANCE CAUSED BY AIRCRAFT
NOISE IN RESIDENTIAL AREAS

noise between 55 and 65 DNL to have a marginal effect on the following noise-sensitive land uses:

- Residential
- Schools
- Hospitals and nursing care facilities
- Places of worship, auditoriums, and concert halls
- Outdoor music shells and amphitheatres

For additional information, refer to the TIP, *Aircraft Noise and Land Use Compatibility Guidelines*, found in the last section of this document.

CURRENT NOISE EXPOUSURE

This section describes the exposure of existing land uses and population as they relate to noise exposure contours. For purposes of this study, noise in excess of 55 DNL will be discussed for purposes of evaluating future land use alternatives. It should be noted that only noise-sensitive land uses within the 65 DNL noise contour are eligible for federal funding assistance for any proposed mitigation.

Land Use Exposed To 2006 Noise

The location of noise-sensitive land uses in relation to the 2006 noise exposure contours for Buckeye Municipal Airport is illustrated on **Exhibit 4C**. A description of the size and extent of the noise contours can be found in Chapter Three, Aviation Noise. Noise-sensitive land uses shown on the exhibit are based on guidance from Part 150 land use compatibility guidelines and include land uses considered incompatible with noise exposure above 65 DNL and marginally compatible above 55 DNL.

The number of dwelling units within each noise exposure contour is determined by analyzing electronic mapping provided by the Maricopa County Assessor's Office, aerial photography, and field surveys conducted by the consultant. For purposes of this study, dwelling units are considered to be single-family residences, apartment buildings, and condominium units. The number of impacted dwelling units was derived from aerial photography and was verified by field surveys conducted in September 2005.

The land use impacts resulting from the 2006 noise exposure contours are summarized in **Table 4A** and described in the following sections.

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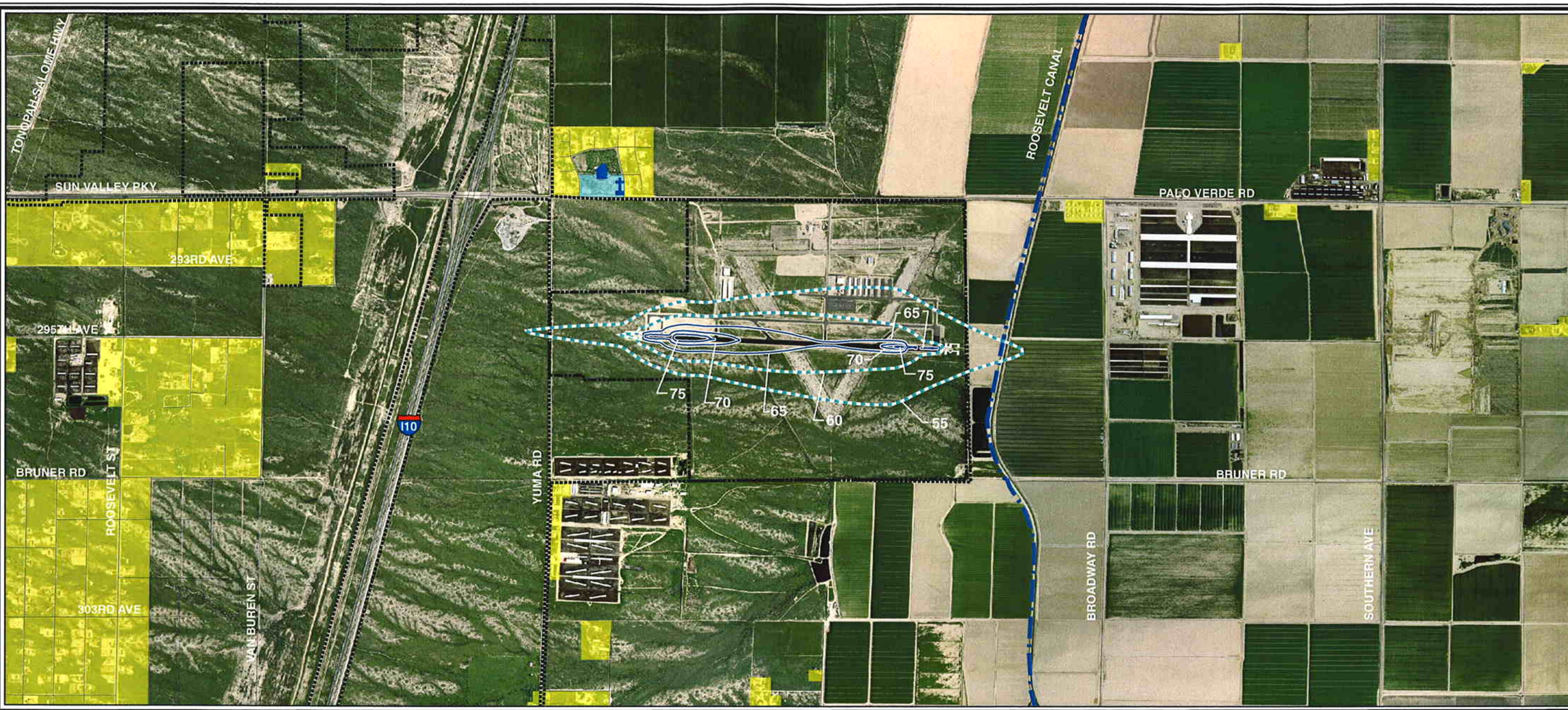

LEGEND

- Airport Property
- Municipal Boundary
- 2006 Contour, Marginal Effect
- 2006 Contour, Significant Effect
- Water
- Residential
- Noise-Sensitive Institutions
- Place of Worship
- Community Center

Runway 35 End

Source: Aerial Photography, March 2005.
Coffman Associates Analysis.

NORTH
0 2,000
Feet

Exhibit 4C
2006 NOISE EXPOSURE CONTOURS WITH LAND USE

TABLE 4A **Land Uses Exposed to 2006 Aircraft Noise** **Buckeye Municipal Airport**						
	Noise Contour (DNL)					
Land Use	**55-60**	**60-65**	**65-70**	**70-75**	**75+**	**Total**
Existing Dwelling Units	0	0	0	0	0	0
Noise-Sensitive Institutions						
Places of Worship	0	0	0	0	0	0
Medical Facilities	0	0	0	0	0	0
Schools	0	0	0	0	0	0
Day-care facilities	0	0	0	0	0	0
Historic Resources	0	0	0	0	0	0
Total Noise-Sensitive Institutions	0	0	0	0	0	0

Source: Coffman Associates analysis

As indicated in the table, there are no dwelling units within the 2006 noise exposure contours.

Table 4B presents the population and level-weighted population (LWP) within the noise contours impacted by the marginal and significant noise exposure contours. Impacted population is derived by multiplying the number of dwelling units within each contour range by the average household size (3.03 persons) for the Town of Buckeye, according to the United States Census Bureau. LWP is an estimate of the number of people actually annoyed by aircraft noise. It is derived by multiplying the population within each noise contour range by the appropriate LWP response factor. This method of estimating noise annoyance was developed as part of a study analyzing the impact of airport noise exposure. More information about this analysis technique can be found in the TIP, *Effects of Noise Exposure,* found at the end of this document.

TABLE 4B **Population Exposed to 2006 Aircraft Noise** **Buckeye Municipal Airport**						
	Noise Contour (DNL)					
	55-60	**60-65**	**65-70**	**70-75**	**75+**	**Total**
Existing Population	0	0	0	0	0	0
Existing LWP	0	0	0	0	0	0

Notes: Level weighted population (LWP) is an estimation of the number of people actually annoyed by aircraft noise. It is derived by multiplying the population in each noise exposure contour range by the LWP response factor. The factors are as follows: 0.107 for 55-60 DNL, 0.205 for 60-65 DNL, 0.376 for 65-70 DNL, 0.644 for 70-75 DNL, and 1.000 for 75+ DNL.
Source: Coffman Associates analysis

As stated in **Table 4B,** the estimated number of people living within the 55-60 and 60-65 DNL noise contours is zero. Additionally, there are no persons living beyond the FAA compatibility threshold.

POTENTIAL GROWTH RISK

Before evaluating the impact of future aircraft noise, the likelihood of noise-sensitive development in the area must be understood. This is of particular importance for Buckeye Municipal Airport as much of the area surrounding the airport is undeveloped. Calculating the number of potential residents near the airport should emphasize the importance of airport noise compatibility planning.

Understanding development trends in the vicinity of Buckeye Municipal Airport is also critical to compatibility planning as future noise-sensitive growth can constrain airport operations if it occurs beneath aircraft flight tracks and within areas subject to increased noise levels. The following sections describe population growth and potential residential development within the airport environs. The focus of this discussion includes population projections, residential development projections, and a discussion of other potential noise-sensitive development.

As presented in **Table 4C** and discussed in Chapter Two, population within the Town of Buckeye has grown over the past fifteen years by an average rate of 7.8 percent per year. Since the year 2000, the average annual population growth rate has been over 14 percent. As shown in **Table 4D**, the forecast population for the Town of Buckeye is expected to exceed 100,000 by the year 2010 and nearly 350,000 by the year 2025. The anticipated average annual growth during that time is over 16 percent.

TABLE 4C
Historical Population
Town of Buckeye and Maricopa County

Year	Town of Buckeye	Maricopa County
Historical		
1990	5,040	2,130,400
1991	5,305	2,179,975
1992	5,360	2,233,700
1993	5,060	2,291,200
1994	5,065	2,355,900
1995	5,130	2,454,525
1996	4,905	2,634,625
1997	4,960	2,720,575
1998	5,035	2,806,100
1999	5,865	2,913,475
2000	8,497	3,072,149
2001	10,650	3,192,125
2002	11,955	3,296,250
2003	13,030	3,396,875
2004	14,505	3,524,175
Avg. Annual Growth Rate	7.8%	3.7%

Source: Arizona Department of Economic Security

To accommodate this growth in population, several master planned communities have gained preliminary approval for construction within the Town of Buckeye. Currently, there are over 200,000 new dwelling units planned as part of several master-planned communities for construction within the Town. It is anticipated that these communities will be constructed over the next 50 years. An increase in population and dwelling units in the Town of Buckeye will likely create demand for noise-sensitive institutions such as schools, places of worship, and daycare facilities. According to the Town of Buckeye, it is estimated that 135 schools will be constructed to provide service to this new development. Estimates were not available for other noise sensitive institutions such as day care facilities, churches, or medical facilities.

TABLE 4D
Historical and Forecast Population
Town of Buckeye

Year	Town of Buckeye
Historical	
1990	5,040
1995	5,130
2000	8,497
2004	14,505
Avg. Annual Growth Rate	7.8%
Forecasts	
2010	100,000
2015	182,500
2020	265,000
2025	345,000
Avg. Annual Growth Rate	16.3%

Source for historical data: Arizona Department of Economic Security
Source for forecast population: Town of Buckeye

Growth Risk Analysis

The growth risk analysis for Buckeye Municipal Airport focuses on the undeveloped land which is planned or zoned for residential or noise-sensitive land uses. In order to identify areas of potential future development, existing land use (Exhibit 1G), community general plans (Exhibit 1H), and zoning designations (Exhibit 1J) were evaluated. Future residential development will be influenced by zoning on undeveloped parcels, the physical constraints of individual sites, the availability of sewer and water infrastructure, and the market for residential development in the area. Areas identified as growth risk are illustrated on **Exhibit 4D**.

The determination of the number of dwelling units per acre is calculated using the highest density allowed in the zoning district or land use plan designation, minus 33 percent for infrastructure such as roads, sidewalks, and utilities.

Growth risk population is calculated by multiplying the number of dwelling units by the average number of people per household from the U.S. Census Bureau. As previously stated, the average household size for the Town of Buckeye is 3.03 persons.

Land Use Exposed To 2011 Noise

This section describes the exposure of existing and potential land uses and population to the estimated 2011 aircraft noise for Buckeye Municipal Air-

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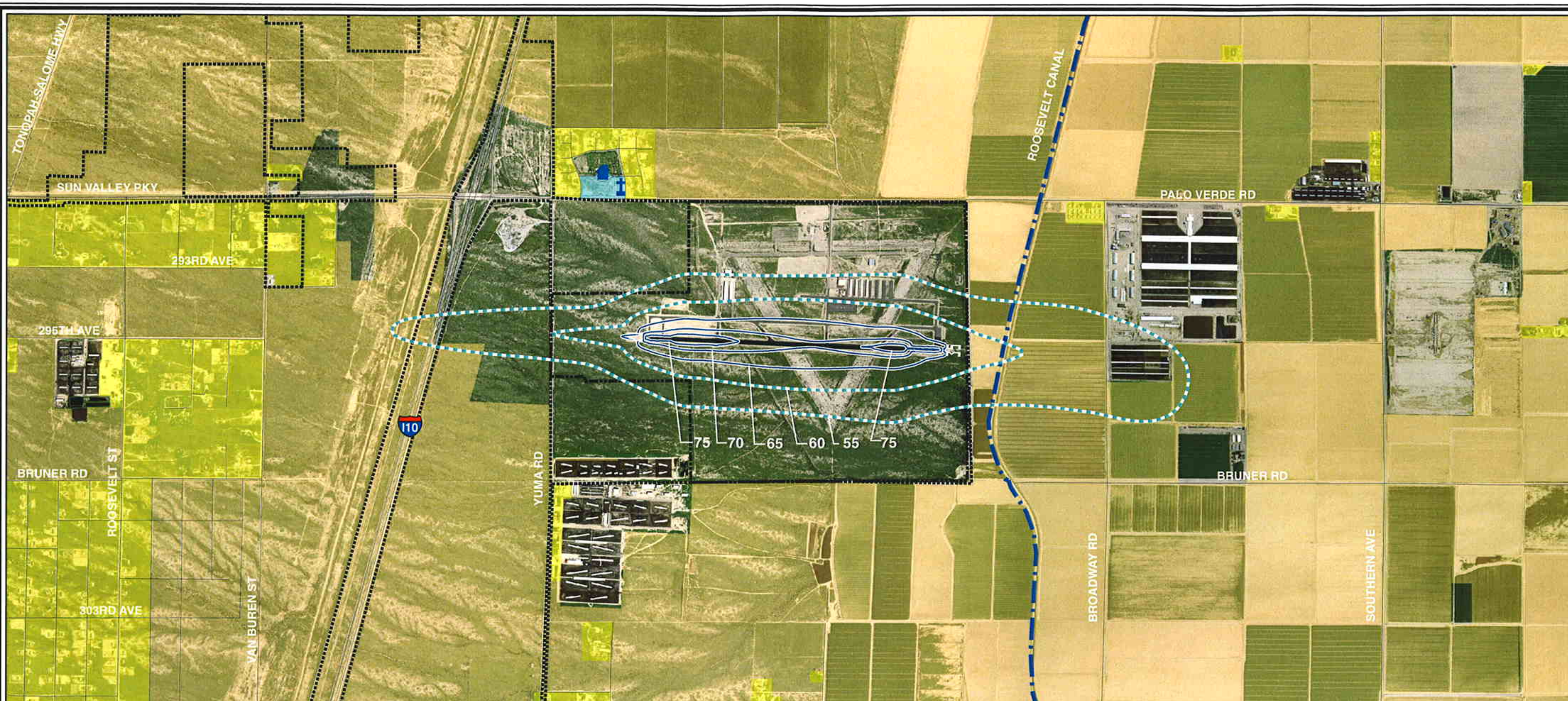


LEGEND

- Airport Property
- Municipal Boundary
- 2011 Contour, Marginal Effect
- 2011 Contour, Significant Effect
- Water
- Residential
- Noise-Sensitive Institutions
- Place of Worship
- Community Center
- Growth Risk

Source: Aerial Photography, March 2005.
Coffman Associates Analysis.

NORTH

0 2,000
Feet

BUCKEYE ARIZONA

Exhibit 4D
2011 NOISE EXPOSURE CONTOURS WITH LAND USE

port. The location of noise-sensitive land uses in relation to the 2011 noise exposure contours is illustrated on **Exhibit 4D**. A discussion of the size and shape of the noise contours can be found in Chapter Three, Aviation Noise. As indicated in **Table 4E,** there are zero existing dwelling units above the 55 DNL contour.

TABLE 4E
Noise-Sensitive Land Uses Exposed to 2011 Aircraft Noise
Buckeye Municipal Airport

	Noise Contour (DNL)					
Land Use	**55-60**	**60-65**	**65-70**	**70-75**	**75+**	**Total**
Existing Dwelling Units	0	0	0	0	0	0
Growth Risk	129	6	0	0	0	135
Residential Total	129	6	0	0	0	135
Noise-Sensitive Institutions						
Places of Worship	0	0	0	0	0	0
Medical Facilities	0	0	0	0	0	0
Schools	0	0	0	0	0	0
Day-care facilities	0	0	0	0	0	0
Historic Resources	0	0	0	0	0	0
Total Noise-Sensitive Institutions	0	0	0	0	0	0

Source: Coffman Associates analysis

Using the previously described methodology, there is potential for 135 dwelling units to be constructed in areas of marginal noise exposure, 129 of which are located within the 55-60 DNL contour range and 6 located within the 60-65 DNL contour range. These developments could occur in areas that are planned for Mixed Economic Use or zoned as Rural-43. A factor of one dwelling unit per 2,000 square feet was assumed for the Mixed Economic Use planned areas. This is based on density requirements outlined for the Mixed Residential classification in the Town of Buckeye Development Code. Also, one acre per dwelling unit was assumed for the Rural-43 zoned areas, based on the Maricopa County Zoning Ordinance.

For the 2011 noise exposure contours, there is no risk for noise-sensitive growth above the 65 DNL noise contour.

Table 4F presents the estimated population impacts based on 2011 airport noise exposure. There are no existing residences within the marginal or significant noise contours.

The potential population based on the growth risk analysis indicates that a total of 409 could reside within the marginal effect (55-65 DNL) contour ranges. This includes 391 within the 55-60 DNL contour range and 18 in the 60-65 DNL contour range. There are no impacts above the 65 DNL noise exposure contour.

The potential LWP for the marginal effect noise contours is 42 for the 55-60 DNL noise contour range and 4 for the 60-65 DNL noise contour range. The LWP above 65 DNL is zero.

TABLE 4F Population Exposed to 2011 Aircraft Noise Buckeye Municipal Airport	Noise Contour (DNL)					
	55-60	60-65	65-70	70-75	75+	Total
Population						
Existing Population	0	0	0	0	0	0
Potential Population	391	18	0	0	0	409
Total Population	391	18	0	0	0	409
LWP						
Existing LWP	0	0	0	0	0	0
Potential LWP	42	4	0	0	0	46
Total LWP	42	4	0	0	0	46

Notes: Level weighted population (LWP) is an estimation of the number of people actually annoyed by aircraft noise. It is derived by multiplying the population in each noise exposure contour range by the LWP response factor. The factors are as follows: 0.107 for 55-60 DNL, 0.205 for 60-65 DNL, 0.376 for 65-70 DNL, 0.644 for 70-75 DNL, and 1.000 for 75+ DNL.
Source: Coffman Associates analysis

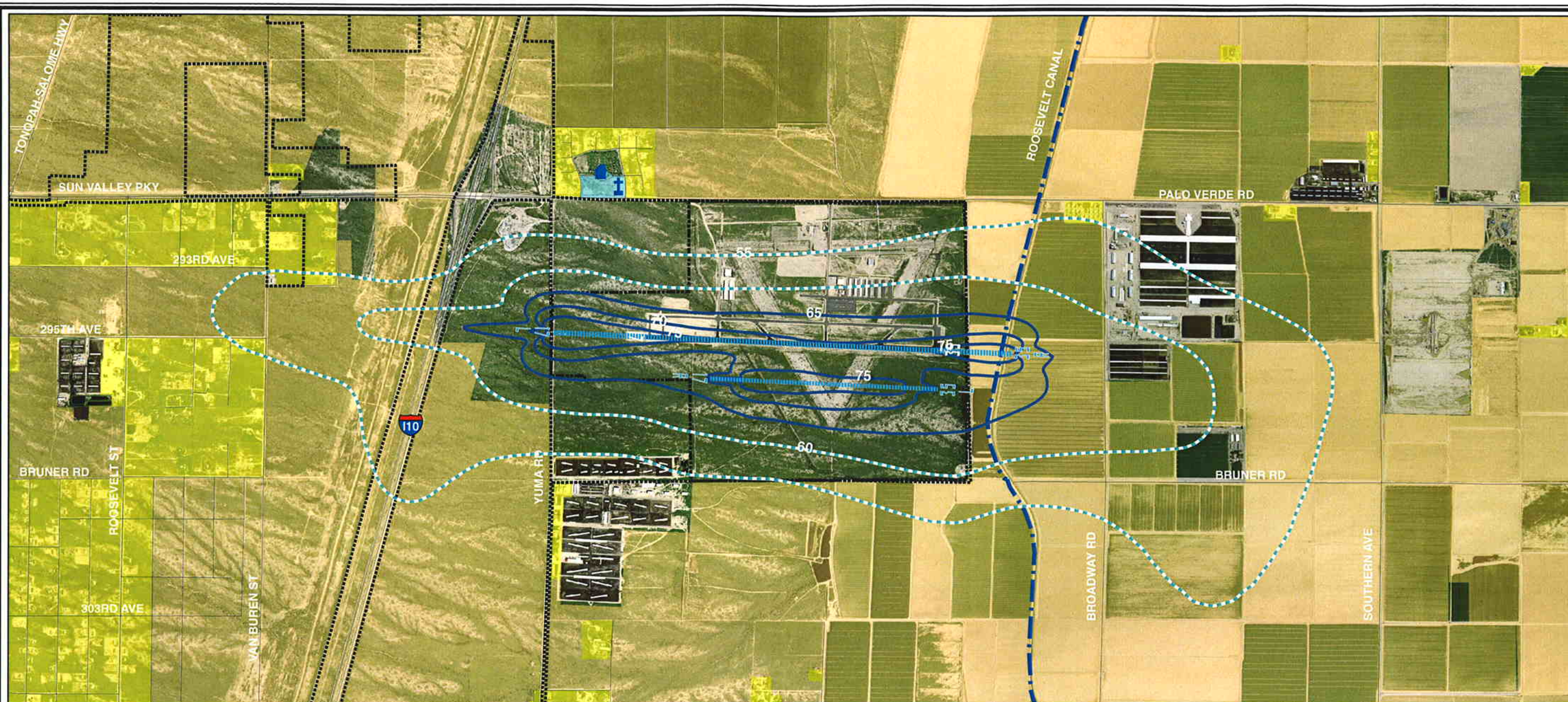
Land Uses Exposed To Long Range Noise

This section describes the exposure of existing and potential land uses and population to the estimated long range aircraft noise for Buckeye Municipal Airport.

The long range noise contours, depicted on **Exhibit 4E**, are intended for land use planning purposes. The contours illustrate the noise impacts resulting from Buckeye Municipal Airport operating at full capacity with the ultimate runway configuration described in the 2006 Airport Master Plan. A description of the size and extent of the noise contours can be found in Chapter Three, Aviation Noise.

Within the long range marginal effect noise contours (55 to 60 DNL), it is estimated that seven existing dwelling units would be impacted, as stated in **Table 4G**. Above 60 DNL, there are zero dwelling units.

An analysis of the growth risk areas within the long range noise contours reveals that the potential exists for 3,078 dwelling units to be built within the 55-60 DNL contour range. These dwelling units would occur in areas planned for Mixed Economic Use (2,000 square feet per dwelling unit) or zoned for Multi-family (2,000 square feet per dwelling unit) and Rural-43 (1 dwelling unit per acre) development. Within the 60-65 DNL contour range, there is a potential for 146 dwelling units, these would be located in areas planned for Mixed Economic Use or zoned Rural-43. The potential number of dwelling units within the 65-70 DNL contour range is 28, all of which could occur in areas zoned as Rural-43. Between 70-75 DNL, there is the potential for seven dwelling units to be built. Above 75 DNL, there is a potential for four houses to be



LEGEND

- Airport Property
- Municipal Boundary
- Long Range Capacity Contour, Marginal Effect
- Long Range Capacity Contour, Significant Effect
- Ultimate Runway
- Water
- Residential
- Noise-Sensitive Institutions
- Place of Worship
- Community Center
- Growth Risk

Source: Aerial Photography, March 2005.
Coffman Associates Analysis.

NORTH

0 2,000
Feet

BUCKEYE ARIZONA

Exhibit 4E
LONG RANGE NOISE EXPOSURE CONTOURS WITH LAND USE

built. There are no noise-sensitive institutions impacted by the forecast long range noise at Buckeye Municipal Airport.

TABLE 4G
Noise-Sensitive Land Uses Exposed to Long Range Aircraft Noise
Buckeye Municipal Airport

	Noise Contour (DNL)					
Land Use	**55-60**	**60-65**	**65-70**	**70-75**	**75+**	**Total**
Existing Dwelling Units	7	0	0	0	0	7
Growth Risk	3,078	146	28	7	4	3,263
Residential Total	3,085	146	28	7	4	3,270
Noise-Sensitive Institutions						
Places of Worship	0	0	0	0	0	0
Medical Facilities	0	0	0	0	0	0
Schools	0	0	0	0	0	0
Day-care facilities	0	0	0	0	0	0
Historic Resources	0	0	0	0	0	0
Total Noise-Sensitive Institutions	0	0	0	0	0	0

Source: Coffman Associates analysis

Table 4H presents the population and LWP exposed to the forecast long range noise at Buckeye Municipal Airport. The existing population for the 55 to 65 DNL noise contours is 21, with zero impacted above 65 DNL.

TABLE 4H
Population Exposed to Long Range Aircraft Noise
Buckeye Municipal Airport

	Noise Contour (DNL)					
	55-60	**60-65**	**65-70**	**70-75**	**75+**	**Total**
Population						
Existing Population	21	0	0	0	0	21
Potential Population	9,327	442	85	21	12	9,887
Total Population	9,348	442	85	21	12	9,908
LWP						
Existing LWP	2	0	0	0	0	2
Potential LWP	998	91	32	14	12	1,147
Total LWP	1,000	91	32	14	12	1,149

Notes: Level weighted population (LWP) is an estimation of the number of people actually annoyed by aircraft noise. It is derived by multiplying the population in each noise exposure contour range by the LWP response factor. The factors are as follows: 0.107 for 55-60 DNL, 0.205 for 60-65 DNL, 0.376 for 65-70 DNL, 0.644 for 70-75 DNL, and 1.000 for 75+ DNL.
Source: Coffman Associates analysis

The potential population increases with the increased size of the contours. It is estimated that 9,327 people could reside within the 55-60 DNL contour range and 442 could reside within the 60-65 DNL contour range. It is also estimated that a total of 85 people could reside within the 65-70 DNL noise contour range. The potential population between 70-75 DNL is 21, and 12 above 75 DNL. There are no projected population impacts above 70 DNL.

The total existing LWP for the long range noise contours is two people within the 55-60 DNL contour range. The potential LWP for marginal effect noise contours is 998 for the 55-60 DNL contour range and 91 for the 60-65 DNL contour range. Between 65-70 DNL, the LWP is 32. Between 70-75 DNL, the LWP is 14, and above 75 DNL, the LWP is 12.

SUMMARY

This chapter has provided an analysis of the current and potential noise impacts based on the 2006, 2011, and long range capacity noise exposure contours for Buckeye Municipal Airport. **Table 4J** summarizes the land use and population impacts for the area surrounding the airport.

TABLE 4J
Summary of Significant Noise Impacts
Buckeye Municipal Airport

	Noise Contour (DNL)					
	55-60	60-65	65-70	70-75	75+	Total
Dwelling Units						
2006 Existing	0	0	0	0	0	**0**
2011 Existing	0	0	0	0	0	0
2011 Potential	129	6	0	0	0	135
Total	**129**	**6**	**0**	**0**	**0**	**135**
Long Range Existing	7	0	0	0	0	7
Long Range Potential	3,078	146	28	7	4	3,263
Total	**3,085**	**146**	**28**	**7**	**4**	**3,270**
Noise-Sensitive Institutions						
2006 Existing	0	0	0	0	0	0
2011 Existing	0	0	0	0	0	0
Long Range Existing	0	0	0	0	0	0
Population						
2006 Existing	**0**	**0**	**0**	**0**	**0**	**0**
2011 Existing	0	0	0	0	0	0
2011 Potential	391	18	0	0	0	409
Total	**391**	**18**	**0**	**0**	**0**	**409**
Long Range Existing	21	0	0	0	0	21
Long Range Potential	9,326	442	85	21	12	9,887
Total	**9,348**	**442**	**85**	**21**	**12**	**9,908**

Source: Coffman Associates analysis

Appendix A

WELCOME TO THE PLANNING ADVISORY COMMITTEE

WELCOME TO THE PLANNING ADVISORY COMMITTEE

The Town of Buckeye and its consultant, Coffman Associates, Inc., are pleased to welcome you to the Planning Advisory Committee (PAC) for the 14 CFR Part 150 Noise Compatibility Study for Buckeye Municipal Airport. We appreciate your interest in this Study. Over the next several months you will be able to make an important contribution to the project. We believe that you will find your committee participation to be an interesting and rewarding experience. We would like to take this time in advance to thank you for your participation in this Study.

WHAT IS A NOISE COMPATIBILITY STUDY?

The impact of aircraft noise on development around airports has been a major environmental issue in the United States for decades. After years of study and demonstration programs, Congress authorized fullscale Federal support for airport noise compatibility programs through the Aviation Safety and Noise Abatement Act of 1979. In response to that Act, the Federal Aviation Administration (FAA) adopted a regulation establishing minimum standards for the preparation of such studies. That regulation is Title 14, Part 150 of the Code of Federal Regulations.

A Noise Compatibility Program is intended to promote aircraft noise control and land use compatibility. Three things make such a study unique: (1) it is the only federal comprehensive approach to preventing and reducing airport noise and community land use conflicts; (2) eligible items in the approved plan may be funded from a special account in the federal Airport Improvement Program; (3) it is the only kind of airport study sponsored by the FAA primarily for the benefit of airport neighbors.

The principal objectives of any Noise Compatibility Program are to:

- Identify the current and projected aircraft noise levels and their impact on the airport environs.
- Propose ways to reduce the impact of aircraft noise through changes in aircraft operations or airport facilities.
- In undeveloped areas where aircraft noise is projected to remain, encourage future land use which is compatible with the noise, such as agriculture, commercial or industrial land uses.
- In existing residential areas which are expected to remain impacted by noise, determine ways of reducing the adverse impacts of noise.
- Establish procedures for implementing, reviewing, and updating the plan.

WHAT IS THE ROLE OF THE COMMITTEE?

The PAC will play an important role in the Noise Compatibility Study. We want to benefit from your unique viewpoints, to have access to the people and resources you represent, to work with you in a creative atmosphere, and to gain your support in achieving results. Specifically, your role in the PAC is as follows:

- Sounding Board - The consultants need a forum in which to present information, findings, ideas, and recommendations during the course of the study. Everyone involved with the study will benefit from this forum because it allows an exchange of stakeholders' viewpoints, ideas, and concerns.
- Linkage to the Aviation Community - Each of you represents one or more constituent interests. As a committee member, you bring together the consultant and the people you represent, you can inform your constituents about the study as it progresses, and you can bring into the committee the views of others.
- Resource - An airport noise compatibility study is very complex; and it has an almost unlimited demand for information. Many of you have access to specialized information and can ensure that it is used in the study to its fullest potential.
- Think Tank - "Too many cooks spoil the broth" reflects the diffi-

culty committees have in writing a report. On the other hand, "two heads are better than one" tells us that creative thinking is best accomplished by a group of concerned people who represent a diversity of backgrounds and views on a subject. We need all of the creative input we can get. PAC member ideas have literally "made the difference" on other studies of this type across the country.

- Critical Review - The study team needs their work scrutinized closely for accuracy, completeness of detail, clarity of thought, and intellectual honesty. We want you to point out any shortcomings in our work and to help us improve on it.

- Implementation - A Part 150 Noise Compatibility Plan depends on the actions of many different agencies and organizations for implementation. Each of you has a unique role to play in implementing the plan and demonstrating leadership among your constituent interests. Inform and educate them about the importance of your effort on their behalf and work with them to see that the final plan is carried out.

HOW WAS THE COMMITTE SELECTED?

Many organizations have been contacted and invited to designate representatives to serve on the PAC. The attached list of invited officials and organizations shows a broad range of interests to be represented – county and city representatives, airport officials, Federal Aviation Administration, pilot organizations, and state and regional representatives. Each of the committee members was selected based upon their area of expertise.

HOW WILL THE PAC OPERATE?

The PAC will operate as informally as possible -- no compulsory attendance, and no voting. The meetings will be conducted by the consultant and will be called at milestone points in the study (a total of three (3) when committee input is especially needed. Ordinarily, meetings will be scheduled with sufficient advance notice to permit you to arrange your schedule.

To keep you informed of the proceedings at the PAC meetings, we will prepare summary minutes and will distribute them after each meeting. These will be particularly helpful if you are unable to attend a meeting.

We will hold three (3) public information workshops during the preparation of the study so that we may report to the community at large and elicit their views and input. We strongly urge you to represent the PAC at the evening workshops. The workshops will be organized to maximize the opportunity for two-way communication. At these important meetings, you will have the chance to hear from local citizens and share your views and expertise with them.

Prior to each PAC meeting, the consultant will distribute working papers to you. These are draft chapters of the Noise Compatibility Study, and they will be a focus for discussion at the meetings. In addition, we will provide an outline of the subjects to be covered in the next phase of the project so that you may interject your ideas and concerns and have them addressed in the next working paper.

To help you keep your materials organized, we will give you a study workbook (a three-ring binder with a special cover and tab dividers) to hold working papers, technical information papers, PAC membership lists, meeting notes, and other resource material.

WHERE CAN YOU GET MORE INFORMATION?

For specific policy questions about the study, please contact:

Anne Quigley
Airport Manager
Buckeye Municipal Airport
3000 S. Palo Verde Rd.
Buckeye, AZ 85326
(623) 386-9482

For specific technical questions about the study, please contact:

James M. Harris, P.E.
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(602) 993-6999
jmharris@coffmanassociates.com

-or-

David Fitz, AICP
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237 N.W. Blue Parkway, Suite 100
Lee's Summit, MO 64063
(816) 524-3500
dfitz@coffmanassociates.com

BUCKEYE AIRPORT MASTER PLAN & PART 150 NOISE COMPATIBILITY STUDY PLANNING ADVISORY COMMITTEE (PAC)			
Name and Title	**Representing**	**Address**	**Phone/Fax Number**
Ms. Anne Quigley Airport Manager	**Town of Buckeye Municipal Airport**	508 E. Monroe Buckeye, AZ 85326	Ph: 623-386-9482 Fax: 623-386-9463 Email: jhardi-son@buckeyeaz.gov
Ms. Jeanine Guy Town Manager	**Town of Buckeye**	100 N Apache Rd Buckeye, AZ 85326	Ph: 623-386-4691 Fax: 623-386-7832 Email: crey-nolds@buckeyeaz.gov
Mr. Bob Bushfield Community Development Director	**Town of Buckeye Community Development Department**	110 E Irwin Ave Buckeye, AZ 85326	Ph: 623-386-8299 Fax: 623-386-8314 Email: bbush-field@buckeyeaz.gov
Ms. Lori Gary Economic Development Director	**Town of Buckeye Economic Development Department**	508 E. Monroe Avenue Buckeye, AZ 85326	Ph: 623-327-1812 Fax: 623-327-1814 Email: rchap-man@buckeyeaz.gov
Ms. Margie Drilling Airport Planner	**Federal Aviation Administration AWP-621.3 Western-Pacific Region Airports Division**	15000 Aviation Blvd. Lawndale, CA 90261	Ph: 310-725-3628 Fax: 310-725-6849 Email: margie.drilling@faa.gov
Ms. Michelle Simmons Environmental Specialist	**Federal Aviation Administration AWP-611.4 Western-Pacific Region Airports Division**	15000 Aviation Blvd. Lawndale, CA 90261	Ph: 310-725-3614 Fax: 310-725-6847 Email: mi-chelle.simmons@faa.gov
Mr. Barclay Dick Director	**ADOT Aeronautics Division - 426M**	P.O. Box 13588 Phoenix, AZ 85002-3588	Ph: 602-294-9144 Fax: 602-294-9141 Email: bdick@azdot.gov
Mr. Harry Wolfe Aviation Coordina-tor	**Maricopa Associa-tion of Govern-ments**	301 North 1st Ave-nue, Suite 300 Phoenix, Arizona 85003	Ph: 602-254-6300 Fax: 602-254-6490 Email: hwolfeaz@cox.net
Mr. Bill Gillies Chairman	**Arizona Military Airspace Working Group**	7224 N. 139th Dr. Luke AFB, AZ 85309-1934	Ph: 623-856-5855 Fax: 623-856-7096 Email: Wil-liam.Gillies@LUKE.AF.MIL

BUCKEYE AIRPORT MASTER PLAN & PART 150 NOISE COMPATIBILITY STUDY PLANNING ADVISORY COMMITTEE (PAC)			
Name and Title	**Representing**	**Address**	**Phone/Fax Number**
Mr. Dan Burkhart Regional Representative Environmental Services	**National Business Aircraft Association**	10164 Meadow Glen Way, E. Escondido, CA 92026	Ph: 760-749-6303 Fax: 760-749-6313
Ms. Stacy Howard Regional Representative	**AOPA**	41695 N. Coyote Road Queen Creek, AZ 85242	Ph: 480-987-9165 Fax: 480-987-0352 Email: sta-cy.howard@aopa.org
Mr. James Timm Executive Director	**Arizona Pilots Association (APA)**	220 E. Ellis Drive Tempe, AZ 85282	Ph: 480-839-9187 Email: jtimm@amug.org
Mr. John Hawley	**Development Board Member**	803 Lincoln Buckeye, AZ 85326	
Mr. Terry Brandt Master Flight Instructor	**American Autogyro**	3000 S. Palo Verde Rd. Buckeye, AZ 85326	Ph: 623-393-9451
Mr. Todd Narramore	**Aircraft Owner**	26302 W. Baseline Rd. Buckeye, AZ 85326	Ph: 623-386-0644
Mr. Al Wilcox	**Aircraft Owner**	26225 N. 158th Drive Surprise, AZ 85387	Ph: 623-556-9299

Appendix B

COORDINATION, CONSULTATION, AND PUBLIC INVOLVEMENT

Appendix B COORDINATION, CONSULTATION, AND PUBLIC INVOLVEMENT

INTRODUCTION

As part of the planning process, the public, airport users, and local, state, and federal agencies were given the opportunity to review and comment on the Noise Exposure Maps (NEM) and supporting documentation. Materials prepared by the consultant were submitted for local review, discussion, and revision at several points during the process.

Much of the local coordination was handled through a special study committee formed specifically to provide advice and feedback on the Part 150 Noise Compatibility Study. Known as the Planning Advisory Committee (PAC), it included representatives of all affected groups, including local residents, airport users, officials from the Town of Buckeye, local businesses, aviation organizations, fixed base operators, the Arizona Department of Transportation, and the Federal Aviation Administration (FAA). (A list of the PAC members is presented in **Appendix A**.)

The PAC reviewed and commented on the working papers prepared by the consultant and provided guidance for the next phase of the study. Most comments were made orally during the meetings, and some were followed by written confirmation. All comments were appropriately incorporated into this document or otherwise addressed.

The PAC met one time during the preparation of the NEM. The meeting was held on January 24, 2006, to introduce the participants, describe the study process, discuss goals and objectives, and hear comments and views pertaining to conditions at the airport. Chapter One – Inventory, Chapter Two – Aviation Forecasts, Chapter Three – Aviation Noise, and Chapter Four – Noise Impacts were presented at this meeting.

Following the PAC meeting, the general public was invited to a Public Information Workshop. This workshop was structured as an informal open-house, with display boards and information posted throughout the meeting room. The meeting allowed interested participants to acquire information about the 14 Code of Federal Regulations (CFR) Part 150 Study process, aircraft operations, baseline noise analysis, and noise impacts; participants could also ask questions and express concerns. The meeting was also intended to encourage two-way communication between the airport staff, consultants, and local residents.

In addition to the formal meeting, written and verbal contacts were also made between project management staff and officials of local, state, and federal agencies; representatives of various aviation user groups; and local residents. These were related to the day-to-day management of the project, as well as the resolution of specific questions and concerns arising from the working papers.

A supplemental volume entitled "Supporting Information on Project Coordination and Local Consultation" contains detailed information in support of the Noise Exposure Maps document. It includes copies of meeting announcements, summary notes from the meeting, sign-in sheets, and all written comments received on the Noise Exposure Maps study.

Appendix C

INM INPUT ASSUMPTIONS

Part 150

Appendix C
INM INPUT ASSUMPTIONS

Noise Compatibility Study

Buckeye Municipal Airport

This appendix provides FAA integrated noise model substitution coordination and detailed information depicting reported aircraft operations, runway use, flight track assignment, and day/nighttime operation split by aircraft type used to develop the 2006 and Long Range noise exposure map contours for Buckeye Municipal Airport. The 2011 noise exposure contour operation file has not been included in this appendix because it uses the same runway use, flight track assignment, and day/nighttime operation split by aircraft type used to develop the 2006 noise exposure contours.

2006 NOISE EXPOSURE MAPS FLIGHT OPERATIONS

Acft	Op	Profile	Stg	Rwy	Track	Sub	Group	Day	Evening	Night
B206L	APP	USER	1	17	A	0	HEL	0.0210	0.0000	0.0052
B206L	APP	USER	1	17	A	1	HEL	0.0168	0.0000	0.0042
B206L	APP	USER	1	17	A	2	HEL	0.0168	0.0000	0.0042
B206L	APP	USER	1	17	A	3	HEL	0.0084	0.0000	0.0021
B206L	APP	USER	1	17	A	4	HEL	0.0084	0.0000	0.0021
B206L	APP	USER	1	17	A	5	HEL	0.0024	0.0000	0.0006
B206L	APP	USER	1	17	A	6	HEL	0.0024	0.0000	0.0006
B206L	APP	USER	1	17	A	7	HEL	0.0003	0.0000	0.0001
B206L	APP	USER	1	17	A	8	HEL	0.0003	0.0000	0.0001
B206L	APP	USER	1	35	A	0	HEL	0.0090	0.0000	0.0022
B206L	APP	USER	1	35	A	1	HEL	0.0072	0.0000	0.0018
B206L	APP	USER	1	35	A	2	HEL	0.0072	0.0000	0.0018
B206L	APP	USER	1	35	A	3	HEL	0.0036	0.0000	0.0009

B206L	APP	USER	1	35	A	4	HEL	0.0036	0.0000	0.0009
B206L	APP	USER	1	35	A	5	HEL	0.0010	0.0000	0.0003
B206L	APP	USER	1	35	A	6	HEL	0.0010	0.0000	0.0003
B206L	APP	USER	1	35	A	7	HEL	0.0001	0.0000	0.0000
B206L	APP	USER	1	35	A	8	HEL	0.0001	0.0000	0.0000
BEC58P	APP	STANDARD	1	17	A	0	GA	0.0409	0.0000	0.0102
BEC58P	APP	STANDARD	1	17	A	1	GA	0.0328	0.0000	0.0082
BEC58P	APP	STANDARD	1	17	A	2	GA	0.0328	0.0000	0.0082
BEC58P	APP	STANDARD	1	17	A	3	GA	0.0164	0.0000	0.0041
BEC58P	APP	STANDARD	1	17	A	4	GA	0.0164	0.0000	0.0041
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BEC58P	APP	STANDARD	1	17	A	7	GA	0.0006	0.0000	0.0001
BEC58P	APP	STANDARD	1	17	A	8	GA	0.0006	0.0000	0.0001
BEC58P	APP	STANDARD	1	17	B	0	GA	0.0205	0.0000	0.0051
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BEC58P	APP	STANDARD	1	17	B	3	GA	0.0082	0.0000	0.0020
BEC58P	APP	STANDARD	1	17	B	4	GA	0.0082	0.0000	0.0020
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BEC58P	APP	STANDARD	1	17	B	6	GA	0.0023	0.0000	0.0006
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BEC58P	APP	STANDARD	1	17	B	8	GA	0.0003	0.0000	0.0001
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BEC58P	APP	STANDARD	1	17	C	1	GA	0.0164	0.0000	0.0041
BEC58P	APP	STANDARD	1	17	C	2	GA	0.0164	0.0000	0.0041
BEC58P	APP	STANDARD	1	17	C	3	GA	0.0082	0.0000	0.0020
BEC58P	APP	STANDARD	1	17	C	4	GA	0.0082	0.0000	0.0020
BEC58P	APP	STANDARD	1	17	C	5	GA	0.0023	0.0000	0.0006
BEC58P	APP	STANDARD	1	17	C	6	GA	0.0023	0.0000	0.0006
BEC58P	APP	STANDARD	1	17	C	7	GA	0.0003	0.0000	0.0001
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BEC58P	APP	STANDARD	1	17	D	6	GA	0.0012	0.0000	0.0003
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BEC58P	APP	STANDARD	1	35	A	2	GA	0.0140	0.0000	0.0035
BEC58P	APP	STANDARD	1	35	A	3	GA	0.0070	0.0000	0.0018
BEC58P	APP	STANDARD	1	35	A	4	GA	0.0070	0.0000	0.0018
BEC58P	APP	STANDARD	1	35	A	5	GA	0.0020	0.0000	0.0005
BEC58P	APP	STANDARD	1	35	A	6	GA	0.0020	0.0000	0.0005
BEC58P	APP	STANDARD	1	35	A	7	GA	0.0003	0.0000	0.0001
BEC58P	APP	STANDARD	1	35	A	8	GA	0.0003	0.0000	0.0001
BEC58P	APP	STANDARD	1	35	B	0	GA	0.0088	0.0000	0.0022
BEC58P	APP	STANDARD	1	35	B	1	GA	0.0070	0.0000	0.0018
BEC58P	APP	STANDARD	1	35	B	2	GA	0.0070	0.0000	0.0018
BEC58P	APP	STANDARD	1	35	B	3	GA	0.0035	0.0000	0.0009
BEC58P	APP	STANDARD	1	35	B	4	GA	0.0035	0.0000	0.0009
BEC58P	APP	STANDARD	1	35	B	5	GA	0.0010	0.0000	0.0003
BEC58P	APP	STANDARD	1	35	B	6	GA	0.0010	0.0000	0.0003
BEC58P	APP	STANDARD	1	35	B	7	GA	0.0001	0.0000	0.0000
BEC58P	APP	STANDARD	1	35	B	8	GA	0.0001	0.0000	0.0000
BEC58P	APP	STANDARD	1	35	C	0	GA	0.0088	0.0000	0.0022

BEC58P	APP	STANDARD	1	35	C	1	GA	0.0070	0.0000	0.0018
BEC58P	APP	STANDARD	1	35	C	2	GA	0.0070	0.0000	0.0018
BEC58P	APP	STANDARD	1	35	C	3	GA	0.0035	0.0000	0.0009
BEC58P	APP	STANDARD	1	35	C	4	GA	0.0035	0.0000	0.0009
BEC58P	APP	STANDARD	1	35	C	5	GA	0.0010	0.0000	0.0003
BEC58P	APP	STANDARD	1	35	C	6	GA	0.0010	0.0000	0.0003
BEC58P	APP	STANDARD	1	35	C	7	GA	0.0001	0.0000	0.0000
BEC58P	APP	STANDARD	1	35	C	8	GA	0.0001	0.0000	0.0000
BEC58P	APP	STANDARD	1	35	D	0	GA	0.0100	0.0000	0.0025
BEC58P	APP	STANDARD	1	35	D	1	GA	0.0075	0.0000	0.0019
BEC58P	APP	STANDARD	1	35	D	2	GA	0.0075	0.0000	0.0019
BEC58P	APP	STANDARD	1	35	D	3	GA	0.0030	0.0000	0.0008
BEC58P	APP	STANDARD	1	35	D	4	GA	0.0030	0.0000	0.0008
BEC58P	APP	STANDARD	1	35	D	5	GA	0.0005	0.0000	0.0001
BEC58P	APP	STANDARD	1	35	D	6	GA	0.0005	0.0000	0.0001
BEC58P	TGO	STANDARD	1	17	A	0	GA	0.3900	0.0000	0.0000
BEC58P	TGO	STANDARD	1	17	A	1	GA	0.2400	0.0000	0.0000
BEC58P	TGO	STANDARD	1	17	A	2	GA	0.2400	0.0000	0.0000
BEC58P	TGO	STANDARD	1	17	A	3	GA	0.0650	0.0000	0.0000
BEC58P	TGO	STANDARD	1	17	A	4	GA	0.0650	0.0000	0.0000
CNA441	APP	STANDARD	1	17	A	0	COM	0.0745	0.0000	0.0131
CNA441	APP	STANDARD	1	17	A	1	COM	0.0596	0.0000	0.0105
CNA441	APP	STANDARD	1	17	A	2	COM	0.0596	0.0000	0.0105
CNA441	APP	STANDARD	1	17	A	3	COM	0.0298	0.0000	0.0053
CNA441	APP	STANDARD	1	17	A	4	COM	0.0298	0.0000	0.0053
CNA441	APP	STANDARD	1	17	A	5	COM	0.0085	0.0000	0.0015
CNA441	APP	STANDARD	1	17	A	6	COM	0.0085	0.0000	0.0015
CNA441	APP	STANDARD	1	17	A	7	COM	0.0011	0.0000	0.0002
CNA441	APP	STANDARD	1	17	A	8	COM	0.0011	0.0000	0.0002
CNA441	APP	STANDARD	1	17	B	0	COM	0.0372	0.0000	0.0066
CNA441	APP	STANDARD	1	17	B	1	COM	0.0298	0.0000	0.0053
CNA441	APP	STANDARD	1	17	B	2	COM	0.0298	0.0000	0.0053
CNA441	APP	STANDARD	1	17	B	3	COM	0.0149	0.0000	0.0026
CNA441	APP	STANDARD	1	17	B	4	COM	0.0149	0.0000	0.0026
CNA441	APP	STANDARD	1	17	B	5	COM	0.0043	0.0000	0.0008
CNA441	APP	STANDARD	1	17	B	6	COM	0.0043	0.0000	0.0008
CNA441	APP	STANDARD	1	17	B	7	COM	0.0005	0.0000	0.0001
CNA441	APP	STANDARD	1	17	B	8	COM	0.0005	0.0000	0.0001
CNA441	APP	STANDARD	1	17	C	0	COM	0.0372	0.0000	0.0066
CNA441	APP	STANDARD	1	17	C	1	COM	0.0298	0.0000	0.0053
CNA441	APP	STANDARD	1	17	C	2	COM	0.0298	0.0000	0.0053
CNA441	APP	STANDARD	1	17	C	3	COM	0.0149	0.0000	0.0026
CNA441	APP	STANDARD	1	17	C	4	COM	0.0149	0.0000	0.0026
CNA441	APP	STANDARD	1	17	C	5	COM	0.0043	0.0000	0.0008
CNA441	APP	STANDARD	1	17	C	6	COM	0.0043	0.0000	0.0008
CNA441	APP	STANDARD	1	17	C	7	COM	0.0005	0.0000	0.0001
CNA441	APP	STANDARD	1	17	C	8	COM	0.0005	0.0000	0.0001
CNA441	APP	STANDARD	1	17	D	0	COM	0.0426	0.0000	0.0075
CNA441	APP	STANDARD	1	17	D	1	COM	0.0319	0.0000	0.0056
CNA441	APP	STANDARD	1	17	D	2	COM	0.0319	0.0000	0.0056
CNA441	APP	STANDARD	1	17	D	3	COM	0.0128	0.0000	0.0023
CNA441	APP	STANDARD	1	17	D	4	COM	0.0128	0.0000	0.0023
CNA441	APP	STANDARD	1	17	D	5	COM	0.0021	0.0000	0.0004
CNA441	APP	STANDARD	1	17	D	6	COM	0.0021	0.0000	0.0004
CNA441	APP	STANDARD	1	35	A	0	COM	0.0319	0.0000	0.0056
CNA441	APP	STANDARD	1	35	A	1	COM	0.0256	0.0000	0.0045
CNA441	APP	STANDARD	1	35	A	2	COM	0.0256	0.0000	0.0045
CNA441	APP	STANDARD	1	35	A	3	COM	0.0128	0.0000	0.0023

CNA441	APP	STANDARD	1	35	A	4	COM	0.0128	0.0000	0.0023
CNA441	APP	STANDARD	1	35	A	5	COM	0.0037	0.0000	0.0006
CNA441	APP	STANDARD	1	35	A	6	COM	0.0037	0.0000	0.0006
CNA441	APP	STANDARD	1	35	A	7	COM	0.0005	0.0000	0.0001
CNA441	APP	STANDARD	1	35	A	8	COM	0.0005	0.0000	0.0001
CNA441	APP	STANDARD	1	35	B	0	COM	0.0160	0.0000	0.0028
CNA441	APP	STANDARD	1	35	B	1	COM	0.0128	0.0000	0.0023
CNA441	APP	STANDARD	1	35	B	2	COM	0.0128	0.0000	0.0023
CNA441	APP	STANDARD	1	35	B	3	COM	0.0064	0.0000	0.0011
CNA441	APP	STANDARD	1	35	B	4	COM	0.0064	0.0000	0.0011
CNA441	APP	STANDARD	1	35	B	5	COM	0.0018	0.0000	0.0003
CNA441	APP	STANDARD	1	35	B	6	COM	0.0018	0.0000	0.0003
CNA441	APP	STANDARD	1	35	B	7	COM	0.0002	0.0000	0.0000
CNA441	APP	STANDARD	1	35	B	8	COM	0.0002	0.0000	0.0000
CNA441	APP	STANDARD	1	35	C	0	COM	0.0160	0.0000	0.0028
CNA441	APP	STANDARD	1	35	C	1	COM	0.0128	0.0000	0.0023
CNA441	APP	STANDARD	1	35	C	2	COM	0.0128	0.0000	0.0023
CNA441	APP	STANDARD	1	35	C	3	COM	0.0064	0.0000	0.0011
CNA441	APP	STANDARD	1	35	C	4	COM	0.0064	0.0000	0.0011
CNA441	APP	STANDARD	1	35	C	5	COM	0.0018	0.0000	0.0003
CNA441	APP	STANDARD	1	35	C	6	COM	0.0018	0.0000	0.0003
CNA441	APP	STANDARD	1	35	C	7	COM	0.0002	0.0000	0.0000
CNA441	APP	STANDARD	1	35	C	8	COM	0.0002	0.0000	0.0000
CNA441	APP	STANDARD	1	35	D	0	COM	0.0182	0.0000	0.0032
CNA441	APP	STANDARD	1	35	D	1	COM	0.0137	0.0000	0.0024
CNA441	APP	STANDARD	1	35	D	2	COM	0.0137	0.0000	0.0024
CNA441	APP	STANDARD	1	35	D	3	COM	0.0055	0.0000	0.0010
CNA441	APP	STANDARD	1	35	D	4	COM	0.0055	0.0000	0.0010
CNA441	APP	STANDARD	1	35	D	5	COM	0.0009	0.0000	0.0002
CNA441	APP	STANDARD	1	35	D	6	COM	0.0009	0.0000	0.0002
CNA500	APP	STANDARD	1	17	A	0	GA	0.0111	0.0000	0.0020
CNA500	APP	STANDARD	1	17	A	1	GA	0.0089	0.0000	0.0016
CNA500	APP	STANDARD	1	17	A	2	GA	0.0089	0.0000	0.0016
CNA500	APP	STANDARD	1	17	A	3	GA	0.0045	0.0000	0.0008
CNA500	APP	STANDARD	1	17	A	4	GA	0.0045	0.0000	0.0008
CNA500	APP	STANDARD	1	17	A	5	GA	0.0013	0.0000	0.0002
CNA500	APP	STANDARD	1	17	A	6	GA	0.0013	0.0000	0.0002
CNA500	APP	STANDARD	1	17	A	7	GA	0.0002	0.0000	0.0000
CNA500	APP	STANDARD	1	17	A	8	GA	0.0002	0.0000	0.0000
CNA500	APP	STANDARD	1	35	A	0	GA	0.0048	0.0000	0.0008
CNA500	APP	STANDARD	1	35	A	1	GA	0.0038	0.0000	0.0007
CNA500	APP	STANDARD	1	35	A	2	GA	0.0038	0.0000	0.0007
CNA500	APP	STANDARD	1	35	A	3	GA	0.0019	0.0000	0.0003
CNA500	APP	STANDARD	1	35	A	4	GA	0.0019	0.0000	0.0003
CNA500	APP	STANDARD	1	35	A	5	GA	0.0005	0.0000	0.0001
CNA500	APP	STANDARD	1	35	A	6	GA	0.0005	0.0000	0.0001
CNA500	APP	STANDARD	1	35	A	7	GA	0.0001	0.0000	0.0000
CNA500	APP	STANDARD	1	35	A	8	GA	0.0001	0.0000	0.0000
GASEPF	APP	STANDARD	1	17	A	0	GA	0.7831	0.0000	0.1958
GASEPF	APP	STANDARD	1	17	A	1	GA	0.6271	0.0000	0.1568
GASEPF	APP	STANDARD	1	17	A	2	GA	0.6271	0.0000	0.1568
GASEPF	APP	STANDARD	1	17	A	3	GA	0.3136	0.0000	0.0784
GASEPF	APP	STANDARD	1	17	A	4	GA	0.3136	0.0000	0.0784
GASEPF	APP	STANDARD	1	17	A	5	GA	0.0897	0.0000	0.0224
GASEPF	APP	STANDARD	1	17	A	6	GA	0.0897	0.0000	0.0224
GASEPF	APP	STANDARD	1	17	A	7	GA	0.0112	0.0000	0.0028
GASEPF	APP	STANDARD	1	17	A	8	GA	0.0112	0.0000	0.0028
GASEPF	APP	STANDARD	1	17	B	0	GA	0.3915	0.0000	0.0979

GASEPF	APP	STANDARD 1	17	B	1	GA	0.3136	0.0000	0.0784
GASEPF	APP	STANDARD 1	17	B	2	GA	0.3136	0.0000	0.0784
GASEPF	APP	STANDARD 1	17	B	3	GA	0.1568	0.0000	0.0392
GASEPF	APP	STANDARD 1	17	B	4	GA	0.1568	0.0000	0.0392
GASEPF	APP	STANDARD 1	17	B	5	GA	0.0449	0.0000	0.0112
GASEPF	APP	STANDARD 1	17	B	6	GA	0.0449	0.0000	0.0112
GASEPF	APP	STANDARD 1	17	B	7	GA	0.0056	0.0000	0.0014
GASEPF	APP	STANDARD 1	17	B	8	GA	0.0056	0.0000	0.0014
GASEPF	APP	STANDARD 1	17	C	0	GA	0.3915	0.0000	0.0979
GASEPF	APP	STANDARD 1	17	C	1	GA	0.3136	0.0000	0.0784
GASEPF	APP	STANDARD 1	17	C	2	GA	0.3136	0.0000	0.0784
GASEPF	APP	STANDARD 1	17	C	3	GA	0.1568	0.0000	0.0392
GASEPF	APP	STANDARD 1	17	C	4	GA	0.1568	0.0000	0.0392
GASEPF	APP	STANDARD 1	17	C	5	GA	0.0449	0.0000	0.0112
GASEPF	APP	STANDARD 1	17	C	6	GA	0.0449	0.0000	0.0112
GASEPF	APP	STANDARD 1	17	C	7	GA	0.0056	0.0000	0.0014
GASEPF	APP	STANDARD 1	17	C	8	GA	0.0056	0.0000	0.0014
GASEPF	APP	STANDARD 1	17	D	0	GA	0.4477	0.0000	0.1119
GASEPF	APP	STANDARD 1	17	D	1	GA	0.3359	0.0000	0.0840
GASEPF	APP	STANDARD 1	17	D	2	GA	0.3359	0.0000	0.0840
GASEPF	APP	STANDARD 1	17	D	3	GA	0.1344	0.0000	0.0336
GASEPF	APP	STANDARD 1	17	D	4	GA	0.1344	0.0000	0.0336
GASEPF	APP	STANDARD 1	17	D	5	GA	0.0224	0.0000	0.0056
GASEPF	APP	STANDARD 1	17	D	6	GA	0.0224	0.0000	0.0056
GASEPF	APP	STANDARD 1	35	A	0	GA	0.3356	0.0000	0.0839
GASEPF	APP	STANDARD 1	35	A	1	GA	0.2688	0.0000	0.0672
GASEPF	APP	STANDARD 1	35	A	2	GA	0.2688	0.0000	0.0672
GASEPF	APP	STANDARD 1	35	A	3	GA	0.1344	0.0000	0.0336
GASEPF	APP	STANDARD 1	35	A	4	GA	0.1344	0.0000	0.0336
GASEPF	APP	STANDARD 1	35	A	5	GA	0.0384	0.0000	0.0096
GASEPF	APP	STANDARD 1	35	A	6	GA	0.0384	0.0000	0.0096
GASEPF	APP	STANDARD 1	35	A	7	GA	0.0048	0.0000	0.0012
GASEPF	APP	STANDARD 1	35	A	8	GA	0.0048	0.0000	0.0012
GASEPF	APP	STANDARD 1	35	B	0	GA	0.1678	0.0000	0.0420
GASEPF	APP	STANDARD 1	35	B	1	GA	0.1344	0.0000	0.0336
GASEPF	APP	STANDARD 1	35	B	2	GA	0.1344	0.0000	0.0336
GASEPF	APP	STANDARD 1	35	B	3	GA	0.0672	0.0000	0.0168
GASEPF	APP	STANDARD 1	35	B	4	GA	0.0672	0.0000	0.0168
GASEPF	APP	STANDARD 1	35	B	5	GA	0.0192	0.0000	0.0048
GASEPF	APP	STANDARD 1	35	B	6	GA	0.0192	0.0000	0.0048
GASEPF	APP	STANDARD 1	35	B	7	GA	0.0024	0.0000	0.0006
GASEPF	APP	STANDARD 1	35	B	8	GA	0.0024	0.0000	0.0006
GASEPF	APP	STANDARD 1	35	C	0	GA	0.1678	0.0000	0.0420
GASEPF	APP	STANDARD 1	35	C	1	GA	0.1344	0.0000	0.0336
GASEPF	APP	STANDARD 1	35	C	2	GA	0.1344	0.0000	0.0336
GASEPF	APP	STANDARD 1	35	C	3	GA	0.0672	0.0000	0.0168
GASEPF	APP	STANDARD 1	35	C	4	GA	0.0672	0.0000	0.0168
GASEPF	APP	STANDARD 1	35	C	5	GA	0.0192	0.0000	0.0048
GASEPF	APP	STANDARD 1	35	C	6	GA	0.0192	0.0000	0.0048
GASEPF	APP	STANDARD 1	35	C	7	GA	0.0024	0.0000	0.0006
GASEPF	APP	STANDARD 1	35	C	8	GA	0.0024	0.0000	0.0006
GASEPF	APP	STANDARD 1	35	D	0	GA	0.1919	0.0000	0.0480
GASEPF	APP	STANDARD 1	35	D	1	GA	0.1440	0.0000	0.0360
GASEPF	APP	STANDARD 1	35	D	2	GA	0.1440	0.0000	0.0360
GASEPF	APP	STANDARD 1	35	D	3	GA	0.0576	0.0000	0.0144
GASEPF	APP	STANDARD 1	35	D	4	GA	0.0576	0.0000	0.0144
GASEPF	APP	STANDARD 1	35	D	5	GA	0.0096	0.0000	0.0024
GASEPF	APP	STANDARD 1	35	D	6	GA	0.0096	0.0000	0.0024

GASEPF	DEP	STANDARD	1	17	A	0	GA	0.8196	0.0000	0.2732
GASEPF	DEP	STANDARD	1	17	A	1	GA	0.6564	0.0000	0.2188
GASEPF	DEP	STANDARD	1	17	A	2	GA	0.6564	0.0000	0.2188
GASEPF	DEP	STANDARD	1	17	A	3	GA	0.3282	0.0000	0.1094
GASEPF	DEP	STANDARD	1	17	A	4	GA	0.3282	0.0000	0.1094
GASEPF	DEP	STANDARD	1	17	A	5	GA	0.0939	0.0000	0.0313
GASEPF	DEP	STANDARD	1	17	A	6	GA	0.0939	0.0000	0.0313
GASEPF	DEP	STANDARD	1	17	A	7	GA	0.0117	0.0000	0.0039
GASEPF	DEP	STANDARD	1	17	A	8	GA	0.0117	0.0000	0.0039
GASEPF	DEP	STANDARD	1	17	B	0	GA	0.2732	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	B	1	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	B	2	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	B	3	GA	0.1094	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	B	4	GA	0.1094	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	B	5	GA	0.0313	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	B	6	GA	0.0313	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	B	7	GA	0.0039	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	B	8	GA	0.0039	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	C	0	GA	0.2732	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	C	1	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	C	2	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	C	3	GA	0.1094	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	C	4	GA	0.1094	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	C	5	GA	0.0313	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	C	6	GA	0.0313	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	C	7	GA	0.0039	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	C	8	GA	0.0039	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	D	0	GA	0.3124	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	D	1	GA	0.2344	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	D	2	GA	0.2344	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	D	3	GA	0.0938	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	D	4	GA	0.0938	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	D	5	GA	0.0156	0.0000	0.0000
GASEPF	DEP	STANDARD	1	17	D	6	GA	0.0156	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	A	0	GA	0.2732	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	A	1	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	A	2	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	A	3	GA	0.1094	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	A	4	GA	0.1094	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	A	5	GA	0.0313	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	A	6	GA	0.0313	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	A	7	GA	0.0039	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	A	8	GA	0.0039	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	B	0	GA	0.2732	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	B	1	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	B	2	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	B	3	GA	0.1094	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	B	4	GA	0.1094	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	B	5	GA	0.0313	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	B	6	GA	0.0313	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	B	7	GA	0.0039	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	B	8	GA	0.0039	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	C	0	GA	0.2732	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	C	1	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	C	2	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	C	3	GA	0.1094	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	C	4	GA	0.1094	0.0000	0.0000
GASEPF	DEP	STANDARD	1	35	C	5	GA	0.0313	0.0000	0.0000

GASEPF	DEP	STANDARD 1	35	C	6	GA	0.0313	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35	C	7	GA	0.0039	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35	C	8	GA	0.0039	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35	D	0	GA	0.3124	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35	D	1	GA	0.2344	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35	D	2	GA	0.2344	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35	D	3	GA	0.0938	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35	D	4	GA	0.0938	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35	D	5	GA	0.0156	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35	D	6	GA	0.0156	0.0000	0.0000
GASEPF	TGO	STANDARD 1	17	A	0	GA	7.8000	0.0000	1.9500
GASEPF	TGO	STANDARD 1	17	A	1	GA	4.8000	0.0000	1.2000
GASEPF	TGO	STANDARD 1	17	A	2	GA	4.8000	0.0000	1.2000
GASEPF	TGO	STANDARD 1	17	A	3	GA	1.3000	0.0000	0.3250
GASEPF	TGO	STANDARD 1	17	A	4	GA	1.3000	0.0000	0.3250
GASEPF	TGO	STANDARD 1	35	A	0	GA	3.5100	0.0000	0.7800
GASEPF	TGO	STANDARD 1	35	A	1	GA	2.1600	0.0000	0.4800
GASEPF	TGO	STANDARD 1	35	A	2	GA	2.1600	0.0000	0.4800
GASEPF	TGO	STANDARD 1	35	A	3	GA	0.5850	0.0000	0.1300
GASEPF	TGO	STANDARD 1	35	A	4	GA	0.5850	0.0000	0.1300
GASEPV	APP	STANDARD 1	17	A	0	GA	0.1957	0.0000	0.0489
GASEPV	APP	STANDARD 1	17	A	1	GA	0.1568	0.0000	0.0392
GASEPV	APP	STANDARD 1	17	A	2	GA	0.1568	0.0000	0.0392
GASEPV	APP	STANDARD 1	17	A	3	GA	0.0784	0.0000	0.0196
GASEPV	APP	STANDARD 1	17	A	4	GA	0.0784	0.0000	0.0196
GASEPV	APP	STANDARD 1	17	A	5	GA	0.0224	0.0000	0.0056
GASEPV	APP	STANDARD 1	17	A	6	GA	0.0224	0.0000	0.0056
GASEPV	APP	STANDARD 1	17	A	7	GA	0.0028	0.0000	0.0007
GASEPV	APP	STANDARD 1	17	A	8	GA	0.0028	0.0000	0.0007
GASEPV	APP	STANDARD 1	17	B	0	GA	0.0979	0.0000	0.0245
GASEPV	APP	STANDARD 1	17	B	1	GA	0.0784	0.0000	0.0196
GASEPV	APP	STANDARD 1	17	B	2	GA	0.0784	0.0000	0.0196
GASEPV	APP	STANDARD 1	17	B	3	GA	0.0392	0.0000	0.0098
GASEPV	APP	STANDARD 1	17	B	4	GA	0.0392	0.0000	0.0098
GASEPV	APP	STANDARD 1	17	B	5	GA	0.0112	0.0000	0.0028
GASEPV	APP	STANDARD 1	17	B	6	GA	0.0112	0.0000	0.0028
GASEPV	APP	STANDARD 1	17	B	7	GA	0.0014	0.0000	0.0003
GASEPV	APP	STANDARD 1	17	B	8	GA	0.0014	0.0000	0.0003
GASEPV	APP	STANDARD 1	17	C	0	GA	0.0979	0.0000	0.0245
GASEPV	APP	STANDARD 1	17	C	1	GA	0.0784	0.0000	0.0196
GASEPV	APP	STANDARD 1	17	C	2	GA	0.0784	0.0000	0.0196
GASEPV	APP	STANDARD 1	17	C	3	GA	0.0392	0.0000	0.0098
GASEPV	APP	STANDARD 1	17	C	4	GA	0.0392	0.0000	0.0098
GASEPV	APP	STANDARD 1	17	C	5	GA	0.0112	0.0000	0.0028
GASEPV	APP	STANDARD 1	17	C	6	GA	0.0112	0.0000	0.0028
GASEPV	APP	STANDARD 1	17	C	7	GA	0.0014	0.0000	0.0003
GASEPV	APP	STANDARD 1	17	C	8	GA	0.0014	0.0000	0.0003
GASEPV	APP	STANDARD 1	17	D	0	GA	0.1119	0.0000	0.0280
GASEPV	APP	STANDARD 1	17	D	1	GA	0.0840	0.0000	0.0210
GASEPV	APP	STANDARD 1	17	D	2	GA	0.0840	0.0000	0.0210
GASEPV	APP	STANDARD 1	17	D	3	GA	0.0336	0.0000	0.0084
GASEPV	APP	STANDARD 1	17	D	4	GA	0.0336	0.0000	0.0084
GASEPV	APP	STANDARD 1	17	D	5	GA	0.0056	0.0000	0.0014
GASEPV	APP	STANDARD 1	17	D	6	GA	0.0056	0.0000	0.0014
GASEPV	APP	STANDARD 1	35	A	0	GA	0.0839	0.0000	0.0210
GASEPV	APP	STANDARD 1	35	A	1	GA	0.0672	0.0000	0.0168
GASEPV	APP	STANDARD 1	35	A	2	GA	0.0672	0.0000	0.0168
GASEPV	APP	STANDARD 1	35	A	3	GA	0.0336	0.0000	0.0084

GASEPV	APP	STANDARD	1	35	A	4	GA	0.0336	0.0000	0.0084
GASEPV	APP	STANDARD	1	35	A	5	GA	0.0096	0.0000	0.0024
GASEPV	APP	STANDARD	1	35	A	6	GA	0.0096	0.0000	0.0024
GASEPV	APP	STANDARD	1	35	A	7	GA	0.0012	0.0000	0.0003
GASEPV	APP	STANDARD	1	35	A	8	GA	0.0012	0.0000	0.0003
GASEPV	APP	STANDARD	1	35	B	0	GA	0.0419	0.0000	0.0105
GASEPV	APP	STANDARD	1	35	B	1	GA	0.0336	0.0000	0.0084
GASEPV	APP	STANDARD	1	35	B	2	GA	0.0336	0.0000	0.0084
GASEPV	APP	STANDARD	1	35	B	3	GA	0.0168	0.0000	0.0042
GASEPV	APP	STANDARD	1	35	B	4	GA	0.0168	0.0000	0.0042
GASEPV	APP	STANDARD	1	35	B	5	GA	0.0048	0.0000	0.0012
GASEPV	APP	STANDARD	1	35	B	6	GA	0.0048	0.0000	0.0012
GASEPV	APP	STANDARD	1	35	B	7	GA	0.0006	0.0000	0.0001
GASEPV	APP	STANDARD	1	35	B	8	GA	0.0006	0.0000	0.0001
GASEPV	APP	STANDARD	1	35	C	0	GA	0.0419	0.0000	0.0105
GASEPV	APP	STANDARD	1	35	C	1	GA	0.0336	0.0000	0.0084
GASEPV	APP	STANDARD	1	35	C	2	GA	0.0336	0.0000	0.0084
GASEPV	APP	STANDARD	1	35	C	3	GA	0.0168	0.0000	0.0042
GASEPV	APP	STANDARD	1	35	C	4	GA	0.0168	0.0000	0.0042
GASEPV	APP	STANDARD	1	35	C	5	GA	0.0048	0.0000	0.0012
GASEPV	APP	STANDARD	1	35	C	6	GA	0.0048	0.0000	0.0012
GASEPV	APP	STANDARD	1	35	C	7	GA	0.0006	0.0000	0.0001
GASEPV	APP	STANDARD	1	35	C	8	GA	0.0006	0.0000	0.0001
GASEPV	APP	STANDARD	1	35	D	0	GA	0.0480	0.0000	0.0120
GASEPV	APP	STANDARD	1	35	D	1	GA	0.0360	0.0000	0.0090
GASEPV	APP	STANDARD	1	35	D	2	GA	0.0360	0.0000	0.0090
GASEPV	APP	STANDARD	1	35	D	3	GA	0.0144	0.0000	0.0036
GASEPV	APP	STANDARD	1	35	D	4	GA	0.0144	0.0000	0.0036
GASEPV	APP	STANDARD	1	35	D	5	GA	0.0024	0.0000	0.0006
GASEPV	APP	STANDARD	1	35	D	6	GA	0.0024	0.0000	0.0006
GASEPV	DEP	STANDARD	1	17	A	0	GA	0.2732	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17	A	1	GA	0.2188	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17	A	2	GA	0.2188	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17	A	3	GA	0.1094	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17	A	4	GA	0.1094	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17	A	5	GA	0.0313	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17	A	6	GA	0.0313	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17	A	7	GA	0.0039	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17	A	8	GA	0.0039	0.0000	0.0000
GASEPV	TGO	STANDARD	1	17	A	0	GA	0.7800	0.0000	0.3900
GASEPV	TGO	STANDARD	1	17	A	1	GA	0.4800	0.0000	0.2400
GASEPV	TGO	STANDARD	1	17	A	2	GA	0.4800	0.0000	0.2400
GASEPV	TGO	STANDARD	1	17	A	3	GA	0.1300	0.0000	0.0650
GASEPV	TGO	STANDARD	1	17	A	4	GA	0.1300	0.0000	0.0650
GASEPV	TGO	STANDARD	1	35	A	0	GA	0.3900	0.0000	0.0000
GASEPV	TGO	STANDARD	1	35	A	1	GA	0.2400	0.0000	0.0000
GASEPV	TGO	STANDARD	1	35	A	2	GA	0.2400	0.0000	0.0000
GASEPV	TGO	STANDARD	1	35	A	3	GA	0.0650	0.0000	0.0000
GASEPV	TGO	STANDARD	1	35	A	4	GA	0.0650	0.0000	0.0000
LEAR35	APP	STANDARD	1	17	A	0	GA	0.0111	0.0000	0.0020
LEAR35	APP	STANDARD	1	17	A	1	GA	0.0089	0.0000	0.0016
LEAR35	APP	STANDARD	1	17	A	2	GA	0.0089	0.0000	0.0016
LEAR35	APP	STANDARD	1	17	A	3	GA	0.0045	0.0000	0.0008
LEAR35	APP	STANDARD	1	17	A	4	GA	0.0045	0.0000	0.0008
LEAR35	APP	STANDARD	1	17	A	5	GA	0.0013	0.0000	0.0002
LEAR35	APP	STANDARD	1	17	A	6	GA	0.0013	0.0000	0.0002
LEAR35	APP	STANDARD	1	17	A	7	GA	0.0002	0.0000	0.0000
LEAR35	APP	STANDARD	1	17	A	8	GA	0.0002	0.0000	0.0000

LEAR35	APP	STANDARD	1	35	A	0	GA	0.0048	0.0000	0.0008
LEAR35	APP	STANDARD	1	35	A	1	GA	0.0038	0.0000	0.0007
LEAR35	APP	STANDARD	1	35	A	2	GA	0.0038	0.0000	0.0007
LEAR35	APP	STANDARD	1	35	A	3	GA	0.0019	0.0000	0.0003
LEAR35	APP	STANDARD	1	35	A	4	GA	0.0019	0.0000	0.0003
LEAR35	APP	STANDARD	1	35	A	5	GA	0.0005	0.0000	0.0001
LEAR35	APP	STANDARD	1	35	A	6	GA	0.0005	0.0000	0.0001
LEAR35	APP	STANDARD	1	35	A	7	GA	0.0001	0.0000	0.0000
LEAR35	APP	STANDARD	1	35	A	8	GA	0.0001	0.0000	0.0000

LONG RANGE NOISE EXPOSURE MAPS FLIGHT OPERATIONS

Acft	Op	Profile	Stg	Rwy	Track	Sub	Group	Day	Evening	Night
B206L	APP	USER	1	17A	A	0	HEL	0.7314	0.0000	0.1829
B206L	APP	USER	1	17A	A	1	HEL	0.5858	0.0000	0.1464
B206L	APP	USER	1	17A	A	2	HEL	0.5858	0.0000	0.1464
B206L	APP	USER	1	17A	A	3	HEL	0.2929	0.0000	0.0732
B206L	APP	USER	1	17A	A	4	HEL	0.2929	0.0000	0.0732
B206L	APP	USER	1	17A	A	5	HEL	0.0838	0.0000	0.0209
B206L	APP	USER	1	17A	A	6	HEL	0.0838	0.0000	0.0209
B206L	APP	USER	1	17A	A	7	HEL	0.0104	0.0000	0.0026
B206L	APP	USER	1	17A	A	8	HEL	0.0104	0.0000	0.0026
B206L	APP	USER	1	35A	A	0	HEL	0.3135	0.0000	0.0784
B206L	APP	USER	1	35A	A	1	HEL	0.2511	0.0000	0.0628
B206L	APP	USER	1	35A	A	2	HEL	0.2511	0.0000	0.0628
B206L	APP	USER	1	35A	A	3	HEL	0.1255	0.0000	0.0314
B206L	APP	USER	1	35A	A	4	HEL	0.1255	0.0000	0.0314
B206L	APP	USER	1	35A	A	5	HEL	0.0359	0.0000	0.0090
B206L	APP	USER	1	35A	A	6	HEL	0.0359	0.0000	0.0090
B206L	APP	USER	1	35A	A	7	HEL	0.0045	0.0000	0.0011
B206L	APP	USER	1	35A	A	8	HEL	0.0045	0.0000	0.0011
B206L	DEP	USER	1	17A	A	0	HEL	0.8196	0.0000	0.2732
B206L	DEP	USER	1	17A	A	1	HEL	0.6564	0.0000	0.2188
B206L	DEP	USER	1	17A	A	2	HEL	0.6564	0.0000	0.2188
B206L	DEP	USER	1	17A	A	3	HEL	0.3282	0.0000	0.1094
B206L	DEP	USER	1	17A	A	4	HEL	0.3282	0.0000	0.1094
B206L	DEP	USER	1	17A	A	5	HEL	0.0939	0.0000	0.0313
B206L	DEP	USER	1	17A	A	6	HEL	0.0939	0.0000	0.0313
B206L	DEP	USER	1	17A	A	7	HEL	0.0117	0.0000	0.0039
B206L	DEP	USER	1	17A	A	8	HEL	0.0117	0.0000	0.0039
B206L	DEP	USER	1	35A	A	0	HEL	0.2732	0.0000	0.0000
B206L	DEP	USER	1	35A	A	1	HEL	0.2188	0.0000	0.0000
B206L	DEP	USER	1	35A	A	2	HEL	0.2188	0.0000	0.0000
B206L	DEP	USER	1	35A	A	3	HEL	0.1094	0.0000	0.0000
B206L	DEP	USER	1	35A	A	4	HEL	0.1094	0.0000	0.0000
B206L	DEP	USER	1	35A	A	5	HEL	0.0313	0.0000	0.0000
B206L	DEP	USER	1	35A	A	6	HEL	0.0313	0.0000	0.0000
B206L	DEP	USER	1	35A	A	7	HEL	0.0039	0.0000	0.0000
B206L	DEP	USER	1	35A	A	8	HEL	0.0039	0.0000	0.0000
BEC58P	APP	STANDARD	1	17A	A	0	GA	0.4565	0.0000	0.1141
BEC58P	APP	STANDARD	1	17A	A	1	GA	0.3656	0.0000	0.0914
BEC58P	APP	STANDARD	1	17A	A	2	GA	0.3656	0.0000	0.0914
BEC58P	APP	STANDARD	1	17A	A	3	GA	0.1828	0.0000	0.0457
BEC58P	APP	STANDARD	1	17A	A	4	GA	0.1828	0.0000	0.0457
BEC58P	APP	STANDARD	1	17A	A	5	GA	0.0523	0.0000	0.0131
BEC58P	APP	STANDARD	1	17A	A	6	GA	0.0523	0.0000	0.0131
BEC58P	APP	STANDARD	1	17A	A	7	GA	0.0065	0.0000	0.0016

BEC58P	APP	STANDARD	1	17A	A	8	GA	0.0065	0.0000	0.0016
BEC58P	APP	STANDARD	1	17A	B	0	GA	0.2282	0.0000	0.0571
BEC58P	APP	STANDARD	1	17A	B	1	GA	0.1828	0.0000	0.0457
BEC58P	APP	STANDARD	1	17A	B	2	GA	0.1828	0.0000	0.0457
BEC58P	APP	STANDARD	1	17A	B	3	GA	0.0914	0.0000	0.0229
BEC58P	APP	STANDARD	1	17A	B	4	GA	0.0914	0.0000	0.0229
BEC58P	APP	STANDARD	1	17A	B	5	GA	0.0261	0.0000	0.0065
BEC58P	APP	STANDARD	1	17A	B	6	GA	0.0261	0.0000	0.0065
BEC58P	APP	STANDARD	1	17A	B	7	GA	0.0033	0.0000	0.0008
BEC58P	APP	STANDARD	1	17A	B	8	GA	0.0033	0.0000	0.0008
BEC58P	APP	STANDARD	1	17A	C	0	GA	0.2282	0.0000	0.0571
BEC58P	APP	STANDARD	1	17A	C	1	GA	0.1828	0.0000	0.0457
BEC58P	APP	STANDARD	1	17A	C	2	GA	0.1828	0.0000	0.0457
BEC58P	APP	STANDARD	1	17A	C	3	GA	0.0914	0.0000	0.0229
BEC58P	APP	STANDARD	1	17A	C	4	GA	0.0914	0.0000	0.0229
BEC58P	APP	STANDARD	1	17A	C	5	GA	0.0261	0.0000	0.0065
BEC58P	APP	STANDARD	1	17A	C	6	GA	0.0261	0.0000	0.0065
BEC58P	APP	STANDARD	1	17A	C	7	GA	0.0033	0.0000	0.0008
BEC58P	APP	STANDARD	1	17A	C	8	GA	0.0033	0.0000	0.0008
BEC58P	APP	STANDARD	1	17A	D	0	GA	0.2610	0.0000	0.0653
BEC58P	APP	STANDARD	1	17A	D	1	GA	0.1958	0.0000	0.0490
BEC58P	APP	STANDARD	1	17A	D	2	GA	0.1958	0.0000	0.0490
BEC58P	APP	STANDARD	1	17A	D	3	GA	0.0784	0.0000	0.0196
BEC58P	APP	STANDARD	1	17A	D	4	GA	0.0784	0.0000	0.0196
BEC58P	APP	STANDARD	1	17A	D	5	GA	0.0130	0.0000	0.0033
BEC58P	APP	STANDARD	1	17A	D	6	GA	0.0130	0.0000	0.0033
BEC58P	APP	STANDARD	1	17R	A	0	GA	0.0491	0.0000	0.0123
BEC58P	APP	STANDARD	1	17R	A	1	GA	0.0394	0.0000	0.0098
BEC58P	APP	STANDARD	1	17R	A	2	GA	0.0394	0.0000	0.0098
BEC58P	APP	STANDARD	1	17R	A	3	GA	0.0197	0.0000	0.0049
BEC58P	APP	STANDARD	1	17R	A	4	GA	0.0197	0.0000	0.0049
BEC58P	APP	STANDARD	1	17R	A	5	GA	0.0056	0.0000	0.0014
BEC58P	APP	STANDARD	1	17R	A	6	GA	0.0056	0.0000	0.0014
BEC58P	APP	STANDARD	1	17R	A	7	GA	0.0007	0.0000	0.0002
BEC58P	APP	STANDARD	1	17R	A	8	GA	0.0007	0.0000	0.0002
BEC58P	APP	STANDARD	1	17R	B	0	GA	0.0246	0.0000	0.0061
BEC58P	APP	STANDARD	1	17R	B	1	GA	0.0197	0.0000	0.0049
BEC58P	APP	STANDARD	1	17R	B	2	GA	0.0197	0.0000	0.0049
BEC58P	APP	STANDARD	1	17R	B	3	GA	0.0098	0.0000	0.0025
BEC58P	APP	STANDARD	1	17R	B	4	GA	0.0098	0.0000	0.0025
BEC58P	APP	STANDARD	1	17R	B	5	GA	0.0028	0.0000	0.0007
BEC58P	APP	STANDARD	1	17R	B	6	GA	0.0028	0.0000	0.0007
BEC58P	APP	STANDARD	1	17R	B	7	GA	0.0004	0.0000	0.0001
BEC58P	APP	STANDARD	1	17R	B	8	GA	0.0004	0.0000	0.0001
BEC58P	APP	STANDARD	1	17R	C	0	GA	0.0246	0.0000	0.0061
BEC58P	APP	STANDARD	1	17R	C	1	GA	0.0197	0.0000	0.0049
BEC58P	APP	STANDARD	1	17R	C	2	GA	0.0197	0.0000	0.0049
BEC58P	APP	STANDARD	1	17R	C	3	GA	0.0098	0.0000	0.0025
BEC58P	APP	STANDARD	1	17R	C	4	GA	0.0098	0.0000	0.0025
BEC58P	APP	STANDARD	1	17R	C	5	GA	0.0028	0.0000	0.0007
BEC58P	APP	STANDARD	1	17R	C	6	GA	0.0028	0.0000	0.0007
BEC58P	APP	STANDARD	1	17R	C	7	GA	0.0004	0.0000	0.0001
BEC58P	APP	STANDARD	1	17R	C	8	GA	0.0004	0.0000	0.0001
BEC58P	APP	STANDARD	1	17R	D	0	GA	0.0281	0.0000	0.0070
BEC58P	APP	STANDARD	1	17R	D	1	GA	0.0211	0.0000	0.0053
BEC58P	APP	STANDARD	1	17R	D	2	GA	0.0211	0.0000	0.0053
BEC58P	APP	STANDARD	1	17R	D	3	GA	0.0084	0.0000	0.0021
BEC58P	APP	STANDARD	1	17R	D	4	GA	0.0084	0.0000	0.0021

BEC58P	APP	STANDARD 1	17R	D	5	GA	0.0014	0.0000	0.0004
BEC58P	APP	STANDARD 1	17R	D	6	GA	0.0014	0.0000	0.0004
BEC58P	APP	STANDARD 1	35A	A	0	GA	0.1756	0.0000	0.0439
BEC58P	APP	STANDARD 1	35A	A	1	GA	0.1406	0.0000	0.0352
BEC58P	APP	STANDARD 1	35A	A	2	GA	0.1406	0.0000	0.0352
BEC58P	APP	STANDARD 1	35A	A	3	GA	0.0703	0.0000	0.0176
BEC58P	APP	STANDARD 1	35A	A	4	GA	0.0703	0.0000	0.0176
BEC58P	APP	STANDARD 1	35A	A	5	GA	0.0201	0.0000	0.0050
BEC58P	APP	STANDARD 1	35A	A	6	GA	0.0201	0.0000	0.0050
BEC58P	APP	STANDARD 1	35A	A	7	GA	0.0025	0.0000	0.0006
BEC58P	APP	STANDARD 1	35A	A	8	GA	0.0025	0.0000	0.0006
BEC58P	APP	STANDARD 1	35A	B	0	GA	0.0878	0.0000	0.0219
BEC58P	APP	STANDARD 1	35A	B	1	GA	0.0703	0.0000	0.0176
BEC58P	APP	STANDARD 1	35A	B	2	GA	0.0703	0.0000	0.0176
BEC58P	APP	STANDARD 1	35A	B	3	GA	0.0352	0.0000	0.0088
BEC58P	APP	STANDARD 1	35A	B	4	GA	0.0352	0.0000	0.0088
BEC58P	APP	STANDARD 1	35A	B	5	GA	0.0101	0.0000	0.0025
BEC58P	APP	STANDARD 1	35A	B	6	GA	0.0101	0.0000	0.0025
BEC58P	APP	STANDARD 1	35A	B	7	GA	0.0013	0.0000	0.0003
BEC58P	APP	STANDARD 1	35A	B	8	GA	0.0013	0.0000	0.0003
BEC58P	APP	STANDARD 1	35A	C	0	GA	0.0878	0.0000	0.0219
BEC58P	APP	STANDARD 1	35A	C	1	GA	0.0703	0.0000	0.0176
BEC58P	APP	STANDARD 1	35A	C	2	GA	0.0703	0.0000	0.0176
BEC58P	APP	STANDARD 1	35A	C	3	GA	0.0352	0.0000	0.0088
BEC58P	APP	STANDARD 1	35A	C	4	GA	0.0352	0.0000	0.0088
BEC58P	APP	STANDARD 1	35A	C	5	GA	0.0101	0.0000	0.0025
BEC58P	APP	STANDARD 1	35A	C	6	GA	0.0101	0.0000	0.0025
BEC58P	APP	STANDARD 1	35A	C	7	GA	0.0013	0.0000	0.0003
BEC58P	APP	STANDARD 1	35A	C	8	GA	0.0013	0.0000	0.0003
BEC58P	APP	STANDARD 1	35A	D	0	GA	0.1004	0.0000	0.0251
BEC58P	APP	STANDARD 1	35A	D	1	GA	0.0753	0.0000	0.0188
BEC58P	APP	STANDARD 1	35A	D	2	GA	0.0753	0.0000	0.0188
BEC58P	APP	STANDARD 1	35A	D	3	GA	0.0301	0.0000	0.0075
BEC58P	APP	STANDARD 1	35A	D	4	GA	0.0301	0.0000	0.0075
BEC58P	APP	STANDARD 1	35A	D	5	GA	0.0050	0.0000	0.0013
BEC58P	APP	STANDARD 1	35A	D	6	GA	0.0050	0.0000	0.0013
BEC58P	APP	STANDARD 1	35L	A	0	GA	0.0211	0.0000	0.0053
BEC58P	APP	STANDARD 1	35L	A	1	GA	0.0169	0.0000	0.0042
BEC58P	APP	STANDARD 1	35L	A	2	GA	0.0169	0.0000	0.0042
BEC58P	APP	STANDARD 1	35L	A	3	GA	0.0084	0.0000	0.0021
BEC58P	APP	STANDARD 1	35L	A	4	GA	0.0084	0.0000	0.0021
BEC58P	APP	STANDARD 1	35L	A	5	GA	0.0024	0.0000	0.0006
BEC58P	APP	STANDARD 1	35L	A	6	GA	0.0024	0.0000	0.0006
BEC58P	APP	STANDARD 1	35L	A	7	GA	0.0003	0.0000	0.0001
BEC58P	APP	STANDARD 1	35L	A	8	GA	0.0003	0.0000	0.0001
BEC58P	APP	STANDARD 1	35L	B	0	GA	0.0105	0.0000	0.0026
BEC58P	APP	STANDARD 1	35L	B	1	GA	0.0084	0.0000	0.0021
BEC58P	APP	STANDARD 1	35L	B	2	GA	0.0084	0.0000	0.0021
BEC58P	APP	STANDARD 1	35L	B	3	GA	0.0042	0.0000	0.0011
BEC58P	APP	STANDARD 1	35L	B	4	GA	0.0042	0.0000	0.0011
BEC58P	APP	STANDARD 1	35L	B	5	GA	0.0012	0.0000	0.0003
BEC58P	APP	STANDARD 1	35L	B	6	GA	0.0012	0.0000	0.0003
BEC58P	APP	STANDARD 1	35L	B	7	GA	0.0002	0.0000	0.0000
BEC58P	APP	STANDARD 1	35L	B	8	GA	0.0002	0.0000	0.0000
BEC58P	APP	STANDARD 1	35L	C	0	GA	0.0105	0.0000	0.0026
BEC58P	APP	STANDARD 1	35L	C	1	GA	0.0084	0.0000	0.0021
BEC58P	APP	STANDARD 1	35L	C	2	GA	0.0084	0.0000	0.0021
BEC58P	APP	STANDARD 1	35L	C	3	GA	0.0042	0.0000	0.0011

BEC58P	APP	STANDARD	1	35L	C	4	GA	0.0042	0.0000	0.0011
BEC58P	APP	STANDARD	1	35L	C	5	GA	0.0012	0.0000	0.0003
BEC58P	APP	STANDARD	1	35L	C	6	GA	0.0012	0.0000	0.0003
BEC58P	APP	STANDARD	1	35L	C	7	GA	0.0002	0.0000	0.0000
BEC58P	APP	STANDARD	1	35L	C	8	GA	0.0002	0.0000	0.0000
BEC58P	APP	STANDARD	1	35L	D	0	GA	0.0121	0.0000	0.0030
BEC58P	APP	STANDARD	1	35L	D	1	GA	0.0090	0.0000	0.0023
BEC58P	APP	STANDARD	1	35L	D	2	GA	0.0090	0.0000	0.0023
BEC58P	APP	STANDARD	1	35L	D	3	GA	0.0036	0.0000	0.0009
BEC58P	APP	STANDARD	1	35L	D	4	GA	0.0036	0.0000	0.0009
BEC58P	APP	STANDARD	1	35L	D	5	GA	0.0006	0.0000	0.0001
BEC58P	APP	STANDARD	1	35L	D	6	GA	0.0006	0.0000	0.0001
BEC58P	DEP	STANDARD	1	17A	A	0	GA	0.5464	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	A	1	GA	0.4376	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	A	2	GA	0.4376	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	A	3	GA	0.2188	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	A	4	GA	0.2188	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	A	5	GA	0.0626	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	A	6	GA	0.0626	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	A	7	GA	0.0078	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	A	8	GA	0.0078	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	B	0	GA	0.2732	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	B	1	GA	0.2188	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	B	2	GA	0.2188	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	B	3	GA	0.1094	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	B	4	GA	0.1094	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	B	5	GA	0.0313	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	B	6	GA	0.0313	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	B	7	GA	0.0039	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	B	8	GA	0.0039	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	C	0	GA	0.2732	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	C	1	GA	0.2188	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	C	2	GA	0.2188	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	C	3	GA	0.1094	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	C	4	GA	0.1094	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	C	5	GA	0.0313	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	C	6	GA	0.0313	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	C	7	GA	0.0039	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	C	8	GA	0.0039	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	D	0	GA	0.3124	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	D	1	GA	0.2344	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	D	2	GA	0.2344	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	D	3	GA	0.0938	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	D	4	GA	0.0938	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	D	5	GA	0.0156	0.0000	0.0000
BEC58P	DEP	STANDARD	1	17A	D	6	GA	0.0156	0.0000	0.0000
BEC58P	DEP	STANDARD	1	35A	A	0	GA	0.2732	0.0000	0.0000
BEC58P	DEP	STANDARD	1	35A	A	1	GA	0.2188	0.0000	0.0000
BEC58P	DEP	STANDARD	1	35A	A	2	GA	0.2188	0.0000	0.0000
BEC58P	DEP	STANDARD	1	35A	A	3	GA	0.1094	0.0000	0.0000
BEC58P	DEP	STANDARD	1	35A	A	4	GA	0.1094	0.0000	0.0000
BEC58P	DEP	STANDARD	1	35A	A	5	GA	0.0313	0.0000	0.0000
BEC58P	DEP	STANDARD	1	35A	A	6	GA	0.0313	0.0000	0.0000
BEC58P	DEP	STANDARD	1	35A	A	7	GA	0.0039	0.0000	0.0000
BEC58P	DEP	STANDARD	1	35A	A	8	GA	0.0039	0.0000	0.0000
BEC58P	TGO	STANDARD	1	17A	A	0	GA	0.3900	0.0000	0.0000
BEC58P	TGO	STANDARD	1	17A	A	1	GA	0.2400	0.0000	0.0000
BEC58P	TGO	STANDARD	1	17A	A	2	GA	0.2400	0.0000	0.0000

BEC58P	TGO	STANDARD	1	17A	A	3	GA	0.0650	0.0000	0.0000
BEC58P	TGO	STANDARD	1	17A	A	4	GA	0.0650	0.0000	0.0000
BEC58P	TGO	STANDARD	1	17R	A	0	GA	3.9000	0.0000	0.7800
BEC58P	TGO	STANDARD	1	17R	A	1	GA	2.4000	0.0000	0.4800
BEC58P	TGO	STANDARD	1	17R	A	2	GA	2.4000	0.0000	0.4800
BEC58P	TGO	STANDARD	1	17R	A	3	GA	0.6500	0.0000	0.1300
BEC58P	TGO	STANDARD	1	17R	A	4	GA	0.6500	0.0000	0.1300
BEC58P	TGO	STANDARD	1	35L	A	0	GA	1.5600	0.0000	0.3900
BEC58P	TGO	STANDARD	1	35L	A	1	GA	0.9600	0.0000	0.2400
BEC58P	TGO	STANDARD	1	35L	A	2	GA	0.9600	0.0000	0.2400
BEC58P	TGO	STANDARD	1	35L	A	3	GA	0.2600	0.0000	0.0650
BEC58P	TGO	STANDARD	1	35L	A	4	GA	0.2600	0.0000	0.0650
CL600	APP	STANDARD	1	17A	A	0	GA	0.1392	0.0000	0.0246
CL600	APP	STANDARD	1	17A	A	1	GA	0.1115	0.0000	0.0197
CL600	APP	STANDARD	1	17A	A	2	GA	0.1115	0.0000	0.0197
CL600	APP	STANDARD	1	17A	A	3	GA	0.0557	0.0000	0.0098
CL600	APP	STANDARD	1	17A	A	4	GA	0.0557	0.0000	0.0098
CL600	APP	STANDARD	1	17A	A	5	GA	0.0159	0.0000	0.0028
CL600	APP	STANDARD	1	17A	A	6	GA	0.0159	0.0000	0.0028
CL600	APP	STANDARD	1	17A	A	7	GA	0.0020	0.0000	0.0004
CL600	APP	STANDARD	1	17A	A	8	GA	0.0020	0.0000	0.0004
CL600	APP	STANDARD	1	35A	A	0	GA	0.0596	0.0000	0.0105
CL600	APP	STANDARD	1	35A	A	1	GA	0.0478	0.0000	0.0084
CL600	APP	STANDARD	1	35A	A	2	GA	0.0478	0.0000	0.0084
CL600	APP	STANDARD	1	35A	A	3	GA	0.0239	0.0000	0.0042
CL600	APP	STANDARD	1	35A	A	4	GA	0.0239	0.0000	0.0042
CL600	APP	STANDARD	1	35A	A	5	GA	0.0068	0.0000	0.0012
CL600	APP	STANDARD	1	35A	A	6	GA	0.0068	0.0000	0.0012
CL600	APP	STANDARD	1	35A	A	7	GA	0.0009	0.0000	0.0002
CL600	APP	STANDARD	1	35A	A	8	GA	0.0009	0.0000	0.0002
CL600	DEP	STANDARD	1	17A	A	0	GA	0.2732	0.0000	0.0000
CL600	DEP	STANDARD	1	17A	A	1	GA	0.2188	0.0000	0.0000
CL600	DEP	STANDARD	1	17A	A	2	GA	0.2188	0.0000	0.0000
CL600	DEP	STANDARD	1	17A	A	3	GA	0.1094	0.0000	0.0000
CL600	DEP	STANDARD	1	17A	A	4	GA	0.1094	0.0000	0.0000
CL600	DEP	STANDARD	1	17A	A	5	GA	0.0313	0.0000	0.0000
CL600	DEP	STANDARD	1	17A	A	6	GA	0.0313	0.0000	0.0000
CL600	DEP	STANDARD	1	17A	A	7	GA	0.0039	0.0000	0.0000
CL600	DEP	STANDARD	1	17A	A	8	GA	0.0039	0.0000	0.0000
CNA441	APP	STANDARD	1	17A	A	0	COM	0.4663	0.0000	0.0823
CNA441	APP	STANDARD	1	17A	A	1	COM	0.3734	0.0000	0.0659
CNA441	APP	STANDARD	1	17A	A	2	COM	0.3734	0.0000	0.0659
CNA441	APP	STANDARD	1	17A	A	3	COM	0.1867	0.0000	0.0330
CNA441	APP	STANDARD	1	17A	A	4	COM	0.1867	0.0000	0.0330
CNA441	APP	STANDARD	1	17A	A	5	COM	0.0534	0.0000	0.0094
CNA441	APP	STANDARD	1	17A	A	6	COM	0.0534	0.0000	0.0094
CNA441	APP	STANDARD	1	17A	A	7	COM	0.0067	0.0000	0.0012
CNA441	APP	STANDARD	1	17A	A	8	COM	0.0067	0.0000	0.0012
CNA441	APP	STANDARD	1	17A	B	0	COM	0.2331	0.0000	0.0411
CNA441	APP	STANDARD	1	17A	B	1	COM	0.1867	0.0000	0.0330
CNA441	APP	STANDARD	1	17A	B	2	COM	0.1867	0.0000	0.0330
CNA441	APP	STANDARD	1	17A	B	3	COM	0.0934	0.0000	0.0165
CNA441	APP	STANDARD	1	17A	B	4	COM	0.0934	0.0000	0.0165
CNA441	APP	STANDARD	1	17A	B	5	COM	0.0267	0.0000	0.0047
CNA441	APP	STANDARD	1	17A	B	6	COM	0.0267	0.0000	0.0047
CNA441	APP	STANDARD	1	17A	B	7	COM	0.0033	0.0000	0.0006
CNA441	APP	STANDARD	1	17A	B	8	COM	0.0033	0.0000	0.0006
CNA441	APP	STANDARD	1	17A	C	0	COM	0.2331	0.0000	0.0411

CNA441	APP	STANDARD 1	17A	C	1	COM	0.1867	0.0000	0.0330
CNA441	APP	STANDARD 1	17A	C	2	COM	0.1867	0.0000	0.0330
CNA441	APP	STANDARD 1	17A	C	3	COM	0.0934	0.0000	0.0165
CNA441	APP	STANDARD 1	17A	C	4	COM	0.0934	0.0000	0.0165
CNA441	APP	STANDARD 1	17A	C	5	COM	0.0267	0.0000	0.0047
CNA441	APP	STANDARD 1	17A	C	6	COM	0.0267	0.0000	0.0047
CNA441	APP	STANDARD 1	17A	C	7	COM	0.0033	0.0000	0.0006
CNA441	APP	STANDARD 1	17A	C	8	COM	0.0033	0.0000	0.0006
CNA441	APP	STANDARD 1	17A	D	0	COM	0.2666	0.0000	0.0470
CNA441	APP	STANDARD 1	17A	D	1	COM	0.2000	0.0000	0.0353
CNA441	APP	STANDARD 1	17A	D	2	COM	0.2000	0.0000	0.0353
CNA441	APP	STANDARD 1	17A	D	3	COM	0.0800	0.0000	0.0141
CNA441	APP	STANDARD 1	17A	D	4	COM	0.0800	0.0000	0.0141
CNA441	APP	STANDARD 1	17A	D	5	COM	0.0133	0.0000	0.0023
CNA441	APP	STANDARD 1	17A	D	6	COM	0.0133	0.0000	0.0023
CNA441	APP	STANDARD 1	35A	A	0	COM	0.1998	0.0000	0.0353
CNA441	APP	STANDARD 1	35A	A	1	COM	0.1601	0.0000	0.0282
CNA441	APP	STANDARD 1	35A	A	2	COM	0.1601	0.0000	0.0282
CNA441	APP	STANDARD 1	35A	A	3	COM	0.0800	0.0000	0.0141
CNA441	APP	STANDARD 1	35A	A	4	COM	0.0800	0.0000	0.0141
CNA441	APP	STANDARD 1	35A	A	5	COM	0.0229	0.0000	0.0040
CNA441	APP	STANDARD 1	35A	A	6	COM	0.0229	0.0000	0.0040
CNA441	APP	STANDARD 1	35A	A	7	COM	0.0029	0.0000	0.0005
CNA441	APP	STANDARD 1	35A	A	8	COM	0.0029	0.0000	0.0005
CNA441	APP	STANDARD 1	35A	B	0	COM	0.0999	0.0000	0.0176
CNA441	APP	STANDARD 1	35A	B	1	COM	0.0800	0.0000	0.0141
CNA441	APP	STANDARD 1	35A	B	2	COM	0.0800	0.0000	0.0141
CNA441	APP	STANDARD 1	35A	B	3	COM	0.0400	0.0000	0.0071
CNA441	APP	STANDARD 1	35A	B	4	COM	0.0400	0.0000	0.0071
CNA441	APP	STANDARD 1	35A	B	5	COM	0.0114	0.0000	0.0020
CNA441	APP	STANDARD 1	35A	B	6	COM	0.0114	0.0000	0.0020
CNA441	APP	STANDARD 1	35A	B	7	COM	0.0014	0.0000	0.0003
CNA441	APP	STANDARD 1	35A	B	8	COM	0.0014	0.0000	0.0003
CNA441	APP	STANDARD 1	35A	C	0	COM	0.0999	0.0000	0.0176
CNA441	APP	STANDARD 1	35A	C	1	COM	0.0800	0.0000	0.0141
CNA441	APP	STANDARD 1	35A	C	2	COM	0.0800	0.0000	0.0141
CNA441	APP	STANDARD 1	35A	C	3	COM	0.0400	0.0000	0.0071
CNA441	APP	STANDARD 1	35A	C	4	COM	0.0400	0.0000	0.0071
CNA441	APP	STANDARD 1	35A	C	5	COM	0.0114	0.0000	0.0020
CNA441	APP	STANDARD 1	35A	C	6	COM	0.0114	0.0000	0.0020
CNA441	APP	STANDARD 1	35A	C	7	COM	0.0014	0.0000	0.0003
CNA441	APP	STANDARD 1	35A	C	8	COM	0.0014	0.0000	0.0003
CNA441	APP	STANDARD 1	35A	D	0	COM	0.1142	0.0000	0.0201
CNA441	APP	STANDARD 1	35A	D	1	COM	0.0857	0.0000	0.0151
CNA441	APP	STANDARD 1	35A	D	2	COM	0.0857	0.0000	0.0151
CNA441	APP	STANDARD 1	35A	D	3	COM	0.0343	0.0000	0.0061
CNA441	APP	STANDARD 1	35A	D	4	COM	0.0343	0.0000	0.0061
CNA441	APP	STANDARD 1	35A	D	5	COM	0.0057	0.0000	0.0010
CNA441	APP	STANDARD 1	35A	D	6	COM	0.0057	0.0000	0.0010
CNA441	DEP	STANDARD 1	17A	A	0	COM	0.5464	0.0000	0.0000
CNA441	DEP	STANDARD 1	17A	A	1	COM	0.4376	0.0000	0.0000
CNA441	DEP	STANDARD 1	17A	A	2	COM	0.4376	0.0000	0.0000
CNA441	DEP	STANDARD 1	17A	A	3	COM	0.2188	0.0000	0.0000
CNA441	DEP	STANDARD 1	17A	A	4	COM	0.2188	0.0000	0.0000
CNA441	DEP	STANDARD 1	17A	A	5	COM	0.0626	0.0000	0.0000
CNA441	DEP	STANDARD 1	17A	A	6	COM	0.0626	0.0000	0.0000
CNA441	DEP	STANDARD 1	17A	A	7	COM	0.0078	0.0000	0.0000
CNA441	DEP	STANDARD 1	17A	A	8	COM	0.0078	0.0000	0.0000

CNA441	DEP	STANDARD	1	17A	B	0	COM	0.2732	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	B	1	COM	0.2188	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	B	2	COM	0.2188	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	B	3	COM	0.1094	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	B	4	COM	0.1094	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	B	5	COM	0.0313	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	B	6	COM	0.0313	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	B	7	COM	0.0039	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	B	8	COM	0.0039	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	C	0	COM	0.2732	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	C	1	COM	0.2188	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	C	2	COM	0.2188	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	C	3	COM	0.1094	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	C	4	COM	0.1094	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	C	5	COM	0.0313	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	C	6	COM	0.0313	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	C	7	COM	0.0039	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	C	8	COM	0.0039	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	D	0	COM	0.3124	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	D	1	COM	0.2344	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	D	2	COM	0.2344	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	D	3	COM	0.0938	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	D	4	COM	0.0938	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	D	5	COM	0.0156	0.0000	0.0000
CNA441	DEP	STANDARD	1	17A	D	6	COM	0.0156	0.0000	0.0000
CNA441	DEP	STANDARD	1	35A	A	0	COM	0.2732	0.0000	0.0000
CNA441	DEP	STANDARD	1	35A	A	1	COM	0.2188	0.0000	0.0000
CNA441	DEP	STANDARD	1	35A	A	2	COM	0.2188	0.0000	0.0000
CNA441	DEP	STANDARD	1	35A	A	3	COM	0.1094	0.0000	0.0000
CNA441	DEP	STANDARD	1	35A	A	4	COM	0.1094	0.0000	0.0000
CNA441	DEP	STANDARD	1	35A	A	5	COM	0.0313	0.0000	0.0000
CNA441	DEP	STANDARD	1	35A	A	6	COM	0.0313	0.0000	0.0000
CNA441	DEP	STANDARD	1	35A	A	7	COM	0.0039	0.0000	0.0000
CNA441	DEP	STANDARD	1	35A	A	8	COM	0.0039	0.0000	0.0000
CNA500	APP	STANDARD	1	17A	A	0	GA	0.2783	0.0000	0.0491
CNA500	APP	STANDARD	1	17A	A	1	GA	0.2229	0.0000	0.0393
CNA500	APP	STANDARD	1	17A	A	2	GA	0.2229	0.0000	0.0393
CNA500	APP	STANDARD	1	17A	A	3	GA	0.1115	0.0000	0.0197
CNA500	APP	STANDARD	1	17A	A	4	GA	0.1115	0.0000	0.0197
CNA500	APP	STANDARD	1	17A	A	5	GA	0.0319	0.0000	0.0056
CNA500	APP	STANDARD	1	17A	A	6	GA	0.0319	0.0000	0.0056
CNA500	APP	STANDARD	1	17A	A	7	GA	0.0040	0.0000	0.0007
CNA500	APP	STANDARD	1	17A	A	8	GA	0.0040	0.0000	0.0007
CNA500	APP	STANDARD	1	35A	A	0	GA	0.1193	0.0000	0.0211
CNA500	APP	STANDARD	1	35A	A	1	GA	0.0955	0.0000	0.0169
CNA500	APP	STANDARD	1	35A	A	2	GA	0.0955	0.0000	0.0169
CNA500	APP	STANDARD	1	35A	A	3	GA	0.0478	0.0000	0.0084
CNA500	APP	STANDARD	1	35A	A	4	GA	0.0478	0.0000	0.0084
CNA500	APP	STANDARD	1	35A	A	5	GA	0.0137	0.0000	0.0024
CNA500	APP	STANDARD	1	35A	A	6	GA	0.0137	0.0000	0.0024
CNA500	APP	STANDARD	1	35A	A	7	GA	0.0017	0.0000	0.0003
CNA500	APP	STANDARD	1	35A	A	8	GA	0.0017	0.0000	0.0003
CNA500	DEP	STANDARD	1	17A	A	0	GA	0.2732	0.0000	0.0000
CNA500	DEP	STANDARD	1	17A	A	1	GA	0.2188	0.0000	0.0000
CNA500	DEP	STANDARD	1	17A	A	2	GA	0.2188	0.0000	0.0000
CNA500	DEP	STANDARD	1	17A	A	3	GA	0.1094	0.0000	0.0000
CNA500	DEP	STANDARD	1	17A	A	4	GA	0.1094	0.0000	0.0000
CNA500	DEP	STANDARD	1	17A	A	5	GA	0.0313	0.0000	0.0000

CNA500	DEP	STANDARD	1	17A	A	6	GA	0.0313	0.0000	0.0000
CNA500	DEP	STANDARD	1	17A	A	7	GA	0.0039	0.0000	0.0000
CNA500	DEP	STANDARD	1	17A	A	8	GA	0.0039	0.0000	0.0000
GASEPF	APP	STANDARD	1	17A	A	0	GA	8.9178	0.0000	2.2294
GASEPF	APP	STANDARD	1	17A	A	1	GA	7.1421	0.0000	1.7855
GASEPF	APP	STANDARD	1	17A	A	2	GA	7.1421	0.0000	1.7855
GASEPF	APP	STANDARD	1	17A	A	3	GA	3.5710	0.0000	0.8928
GASEPF	APP	STANDARD	1	17A	A	4	GA	3.5710	0.0000	0.8928
GASEPF	APP	STANDARD	1	17A	A	5	GA	1.0217	0.0000	0.2554
GASEPF	APP	STANDARD	1	17A	A	6	GA	1.0217	0.0000	0.2554
GASEPF	APP	STANDARD	1	17A	A	7	GA	0.1273	0.0000	0.0318
GASEPF	APP	STANDARD	1	17A	A	8	GA	0.1273	0.0000	0.0318
GASEPF	APP	STANDARD	1	17A	B	0	GA	4.4589	0.0000	1.1147
GASEPF	APP	STANDARD	1	17A	B	1	GA	3.5710	0.0000	0.8928
GASEPF	APP	STANDARD	1	17A	B	2	GA	3.5710	0.0000	0.8928
GASEPF	APP	STANDARD	1	17A	B	3	GA	1.7855	0.0000	0.4464
GASEPF	APP	STANDARD	1	17A	B	4	GA	1.7855	0.0000	0.4464
GASEPF	APP	STANDARD	1	17A	B	5	GA	0.5108	0.0000	0.1277
GASEPF	APP	STANDARD	1	17A	B	6	GA	0.5108	0.0000	0.1277
GASEPF	APP	STANDARD	1	17A	B	7	GA	0.0637	0.0000	0.0159
GASEPF	APP	STANDARD	1	17A	B	8	GA	0.0637	0.0000	0.0159
GASEPF	APP	STANDARD	1	17A	C	0	GA	4.4589	0.0000	1.1147
GASEPF	APP	STANDARD	1	17A	C	1	GA	3.5710	0.0000	0.8928
GASEPF	APP	STANDARD	1	17A	C	2	GA	3.5710	0.0000	0.8928
GASEPF	APP	STANDARD	1	17A	C	3	GA	1.7855	0.0000	0.4464
GASEPF	APP	STANDARD	1	17A	C	4	GA	1.7855	0.0000	0.4464
GASEPF	APP	STANDARD	1	17A	C	5	GA	0.5108	0.0000	0.1277
GASEPF	APP	STANDARD	1	17A	C	6	GA	0.5108	0.0000	0.1277
GASEPF	APP	STANDARD	1	17A	C	7	GA	0.0637	0.0000	0.0159
GASEPF	APP	STANDARD	1	17A	C	8	GA	0.0637	0.0000	0.0159
GASEPF	APP	STANDARD	1	17A	D	0	GA	5.0987	0.0000	1.2747
GASEPF	APP	STANDARD	1	17A	D	1	GA	3.8256	0.0000	0.9564
GASEPF	APP	STANDARD	1	17A	D	2	GA	3.8256	0.0000	0.9564
GASEPF	APP	STANDARD	1	17A	D	3	GA	1.5309	0.0000	0.3827
GASEPF	APP	STANDARD	1	17A	D	4	GA	1.5309	0.0000	0.3827
GASEPF	APP	STANDARD	1	17A	D	5	GA	0.2546	0.0000	0.0637
GASEPF	APP	STANDARD	1	17A	D	6	GA	0.2546	0.0000	0.0637
GASEPF	APP	STANDARD	1	17R	A	0	GA	0.9604	0.0000	0.2401
GASEPF	APP	STANDARD	1	17R	A	1	GA	0.7691	0.0000	0.1923
GASEPF	APP	STANDARD	1	17R	A	2	GA	0.7691	0.0000	0.1923
GASEPF	APP	STANDARD	1	17R	A	3	GA	0.3846	0.0000	0.0961
GASEPF	APP	STANDARD	1	17R	A	4	GA	0.3846	0.0000	0.0961
GASEPF	APP	STANDARD	1	17R	A	5	GA	0.1100	0.0000	0.0275
GASEPF	APP	STANDARD	1	17R	A	6	GA	0.1100	0.0000	0.0275
GASEPF	APP	STANDARD	1	17R	A	7	GA	0.0137	0.0000	0.0034
GASEPF	APP	STANDARD	1	17R	A	8	GA	0.0137	0.0000	0.0034
GASEPF	APP	STANDARD	1	17R	B	0	GA	0.4802	0.0000	0.1200
GASEPF	APP	STANDARD	1	17R	B	1	GA	0.3846	0.0000	0.0961
GASEPF	APP	STANDARD	1	17R	B	2	GA	0.3846	0.0000	0.0961
GASEPF	APP	STANDARD	1	17R	B	3	GA	0.1923	0.0000	0.0481
GASEPF	APP	STANDARD	1	17R	B	4	GA	0.1923	0.0000	0.0481
GASEPF	APP	STANDARD	1	17R	B	5	GA	0.0550	0.0000	0.0138
GASEPF	APP	STANDARD	1	17R	B	6	GA	0.0550	0.0000	0.0138
GASEPF	APP	STANDARD	1	17R	B	7	GA	0.0069	0.0000	0.0017
GASEPF	APP	STANDARD	1	17R	B	8	GA	0.0069	0.0000	0.0017
GASEPF	APP	STANDARD	1	17R	C	0	GA	0.4802	0.0000	0.1200
GASEPF	APP	STANDARD	1	17R	C	1	GA	0.3846	0.0000	0.0961
GASEPF	APP	STANDARD	1	17R	C	2	GA	0.3846	0.0000	0.0961

GASEPF	APP	STANDARD	1	17R	C	3	GA	0.1923	0.0000	0.0481
GASEPF	APP	STANDARD	1	17R	C	4	GA	0.1923	0.0000	0.0481
GASEPF	APP	STANDARD	1	17R	C	5	GA	0.0550	0.0000	0.0138
GASEPF	APP	STANDARD	1	17R	C	6	GA	0.0550	0.0000	0.0138
GASEPF	APP	STANDARD	1	17R	C	7	GA	0.0069	0.0000	0.0017
GASEPF	APP	STANDARD	1	17R	C	8	GA	0.0069	0.0000	0.0017
GASEPF	APP	STANDARD	1	17R	D	0	GA	0.5491	0.0000	0.1373
GASEPF	APP	STANDARD	1	17R	D	1	GA	0.4120	0.0000	0.1030
GASEPF	APP	STANDARD	1	17R	D	2	GA	0.4120	0.0000	0.1030
GASEPF	APP	STANDARD	1	17R	D	3	GA	0.1649	0.0000	0.0412
GASEPF	APP	STANDARD	1	17R	D	4	GA	0.1649	0.0000	0.0412
GASEPF	APP	STANDARD	1	17R	D	5	GA	0.0274	0.0000	0.0069
GASEPF	APP	STANDARD	1	17R	D	6	GA	0.0274	0.0000	0.0069
GASEPF	APP	STANDARD	1	35A	A	0	GA	3.4299	0.0000	0.8575
GASEPF	APP	STANDARD	1	35A	A	1	GA	2.7469	0.0000	0.6867
GASEPF	APP	STANDARD	1	35A	A	2	GA	2.7469	0.0000	0.6867
GASEPF	APP	STANDARD	1	35A	A	3	GA	1.3735	0.0000	0.3434
GASEPF	APP	STANDARD	1	35A	A	4	GA	1.3735	0.0000	0.3434
GASEPF	APP	STANDARD	1	35A	A	5	GA	0.3930	0.0000	0.0982
GASEPF	APP	STANDARD	1	35A	A	6	GA	0.3930	0.0000	0.0982
GASEPF	APP	STANDARD	1	35A	A	7	GA	0.0490	0.0000	0.0122
GASEPF	APP	STANDARD	1	35A	A	8	GA	0.0490	0.0000	0.0122
GASEPF	APP	STANDARD	1	35A	B	0	GA	1.7150	0.0000	0.4287
GASEPF	APP	STANDARD	1	35A	B	1	GA	1.3735	0.0000	0.3434
GASEPF	APP	STANDARD	1	35A	B	2	GA	1.3735	0.0000	0.3434
GASEPF	APP	STANDARD	1	35A	B	3	GA	0.6867	0.0000	0.1717
GASEPF	APP	STANDARD	1	35A	B	4	GA	0.6867	0.0000	0.1717
GASEPF	APP	STANDARD	1	35A	B	5	GA	0.1965	0.0000	0.0491
GASEPF	APP	STANDARD	1	35A	B	6	GA	0.1965	0.0000	0.0491
GASEPF	APP	STANDARD	1	35A	B	7	GA	0.0245	0.0000	0.0061
GASEPF	APP	STANDARD	1	35A	B	8	GA	0.0245	0.0000	0.0061
GASEPF	APP	STANDARD	1	35A	C	0	GA	1.7150	0.0000	0.4287
GASEPF	APP	STANDARD	1	35A	C	1	GA	1.3735	0.0000	0.3434
GASEPF	APP	STANDARD	1	35A	C	2	GA	1.3735	0.0000	0.3434
GASEPF	APP	STANDARD	1	35A	C	3	GA	0.6867	0.0000	0.1717
GASEPF	APP	STANDARD	1	35A	C	4	GA	0.6867	0.0000	0.1717
GASEPF	APP	STANDARD	1	35A	C	5	GA	0.1965	0.0000	0.0491
GASEPF	APP	STANDARD	1	35A	C	6	GA	0.1965	0.0000	0.0491
GASEPF	APP	STANDARD	1	35A	C	7	GA	0.0245	0.0000	0.0061
GASEPF	APP	STANDARD	1	35A	C	8	GA	0.0245	0.0000	0.0061
GASEPF	APP	STANDARD	1	35A	D	0	GA	1.9610	0.0000	0.4902
GASEPF	APP	STANDARD	1	35A	D	1	GA	1.4714	0.0000	0.3678
GASEPF	APP	STANDARD	1	35A	D	2	GA	1.4714	0.0000	0.3678
GASEPF	APP	STANDARD	1	35A	D	3	GA	0.5888	0.0000	0.1472
GASEPF	APP	STANDARD	1	35A	D	4	GA	0.5888	0.0000	0.1472
GASEPF	APP	STANDARD	1	35A	D	5	GA	0.0979	0.0000	0.0245
GASEPF	APP	STANDARD	1	35A	D	6	GA	0.0979	0.0000	0.0245
GASEPF	APP	STANDARD	1	35L	A	0	GA	0.4116	0.0000	0.1029
GASEPF	APP	STANDARD	1	35L	A	1	GA	0.3296	0.0000	0.0824
GASEPF	APP	STANDARD	1	35L	A	2	GA	0.3296	0.0000	0.0824
GASEPF	APP	STANDARD	1	35L	A	3	GA	0.1648	0.0000	0.0412
GASEPF	APP	STANDARD	1	35L	A	4	GA	0.1648	0.0000	0.0412
GASEPF	APP	STANDARD	1	35L	A	5	GA	0.0472	0.0000	0.0118
GASEPF	APP	STANDARD	1	35L	A	6	GA	0.0472	0.0000	0.0118
GASEPF	APP	STANDARD	1	35L	A	7	GA	0.0059	0.0000	0.0015
GASEPF	APP	STANDARD	1	35L	A	8	GA	0.0059	0.0000	0.0015
GASEPF	APP	STANDARD	1	35L	B	0	GA	0.2058	0.0000	0.0514
GASEPF	APP	STANDARD	1	35L	B	1	GA	0.1648	0.0000	0.0412

GASEPF	APP	STANDARD	1	35L	B	2	GA	0.1648	0.0000	0.0412
GASEPF	APP	STANDARD	1	35L	B	3	GA	0.0824	0.0000	0.0206
GASEPF	APP	STANDARD	1	35L	B	4	GA	0.0824	0.0000	0.0206
GASEPF	APP	STANDARD	1	35L	B	5	GA	0.0236	0.0000	0.0059
GASEPF	APP	STANDARD	1	35L	B	6	GA	0.0236	0.0000	0.0059
GASEPF	APP	STANDARD	1	35L	B	7	GA	0.0029	0.0000	0.0007
GASEPF	APP	STANDARD	1	35L	B	8	GA	0.0029	0.0000	0.0007
GASEPF	APP	STANDARD	1	35L	C	0	GA	0.2058	0.0000	0.0514
GASEPF	APP	STANDARD	1	35L	C	1	GA	0.1648	0.0000	0.0412
GASEPF	APP	STANDARD	1	35L	C	2	GA	0.1648	0.0000	0.0412
GASEPF	APP	STANDARD	1	35L	C	3	GA	0.0824	0.0000	0.0206
GASEPF	APP	STANDARD	1	35L	C	4	GA	0.0824	0.0000	0.0206
GASEPF	APP	STANDARD	1	35L	C	5	GA	0.0236	0.0000	0.0059
GASEPF	APP	STANDARD	1	35L	C	6	GA	0.0236	0.0000	0.0059
GASEPF	APP	STANDARD	1	35L	C	7	GA	0.0029	0.0000	0.0007
GASEPF	APP	STANDARD	1	35L	C	8	GA	0.0029	0.0000	0.0007
GASEPF	APP	STANDARD	1	35L	D	0	GA	0.2353	0.0000	0.0588
GASEPF	APP	STANDARD	1	35L	D	1	GA	0.1766	0.0000	0.0441
GASEPF	APP	STANDARD	1	35L	D	2	GA	0.1766	0.0000	0.0441
GASEPF	APP	STANDARD	1	35L	D	3	GA	0.0707	0.0000	0.0177
GASEPF	APP	STANDARD	1	35L	D	4	GA	0.0707	0.0000	0.0177
GASEPF	APP	STANDARD	1	35L	D	5	GA	0.0118	0.0000	0.0029
GASEPF	APP	STANDARD	1	35L	D	6	GA	0.0118	0.0000	0.0029
GASEPF	DEP	STANDARD	1	17A	A	0	GA	9.0156	0.0000	2.1856
GASEPF	DEP	STANDARD	1	17A	A	1	GA	7.2204	0.0000	1.7504
GASEPF	DEP	STANDARD	1	17A	A	2	GA	7.2204	0.0000	1.7504
GASEPF	DEP	STANDARD	1	17A	A	3	GA	3.6102	0.0000	0.8752
GASEPF	DEP	STANDARD	1	17A	A	4	GA	3.6102	0.0000	0.8752
GASEPF	DEP	STANDARD	1	17A	A	5	GA	1.0329	0.0000	0.2504
GASEPF	DEP	STANDARD	1	17A	A	6	GA	1.0329	0.0000	0.2504
GASEPF	DEP	STANDARD	1	17A	A	7	GA	0.1287	0.0000	0.0312
GASEPF	DEP	STANDARD	1	17A	A	8	GA	0.1287	0.0000	0.0312
GASEPF	DEP	STANDARD	1	17A	B	0	GA	4.3712	0.0000	1.0928
GASEPF	DEP	STANDARD	1	17A	B	1	GA	3.5008	0.0000	0.8752
GASEPF	DEP	STANDARD	1	17A	B	2	GA	3.5008	0.0000	0.8752
GASEPF	DEP	STANDARD	1	17A	B	3	GA	1.7504	0.0000	0.4376
GASEPF	DEP	STANDARD	1	17A	B	4	GA	1.7504	0.0000	0.4376
GASEPF	DEP	STANDARD	1	17A	B	5	GA	0.5008	0.0000	0.1252
GASEPF	DEP	STANDARD	1	17A	B	6	GA	0.5008	0.0000	0.1252
GASEPF	DEP	STANDARD	1	17A	B	7	GA	0.0624	0.0000	0.0156
GASEPF	DEP	STANDARD	1	17A	B	8	GA	0.0624	0.0000	0.0156
GASEPF	DEP	STANDARD	1	17A	C	0	GA	4.3712	0.0000	1.0928
GASEPF	DEP	STANDARD	1	17A	C	1	GA	3.5008	0.0000	0.8752
GASEPF	DEP	STANDARD	1	17A	C	2	GA	3.5008	0.0000	0.8752
GASEPF	DEP	STANDARD	1	17A	C	3	GA	1.7504	0.0000	0.4376
GASEPF	DEP	STANDARD	1	17A	C	4	GA	1.7504	0.0000	0.4376
GASEPF	DEP	STANDARD	1	17A	C	5	GA	0.5008	0.0000	0.1252
GASEPF	DEP	STANDARD	1	17A	C	6	GA	0.5008	0.0000	0.1252
GASEPF	DEP	STANDARD	1	17A	C	7	GA	0.0624	0.0000	0.0156
GASEPF	DEP	STANDARD	1	17A	C	8	GA	0.0624	0.0000	0.0156
GASEPF	DEP	STANDARD	1	17A	D	0	GA	4.9984	0.0000	1.2496
GASEPF	DEP	STANDARD	1	17A	D	1	GA	3.7504	0.0000	0.9376
GASEPF	DEP	STANDARD	1	17A	D	2	GA	3.7504	0.0000	0.9376
GASEPF	DEP	STANDARD	1	17A	D	3	GA	1.5008	0.0000	0.3752
GASEPF	DEP	STANDARD	1	17A	D	4	GA	1.5008	0.0000	0.3752
GASEPF	DEP	STANDARD	1	17A	D	5	GA	0.2496	0.0000	0.0624
GASEPF	DEP	STANDARD	1	17A	D	6	GA	0.2496	0.0000	0.0624
GASEPF	DEP	STANDARD	1	17R	A	0	GA	1.0928	0.0000	0.2732

GASEPF	DEP	STANDARD 1	17R	A	1	GA	0.8752	0.0000	0.2188
GASEPF	DEP	STANDARD 1	17R	A	2	GA	0.8752	0.0000	0.2188
GASEPF	DEP	STANDARD 1	17R	A	3	GA	0.4376	0.0000	0.1094
GASEPF	DEP	STANDARD 1	17R	A	4	GA	0.4376	0.0000	0.1094
GASEPF	DEP	STANDARD 1	17R	A	5	GA	0.1252	0.0000	0.0313
GASEPF	DEP	STANDARD 1	17R	A	6	GA	0.1252	0.0000	0.0313
GASEPF	DEP	STANDARD 1	17R	A	7	GA	0.0156	0.0000	0.0039
GASEPF	DEP	STANDARD 1	17R	A	8	GA	0.0156	0.0000	0.0039
GASEPF	DEP	STANDARD 1	17R	B	0	GA	0.5464	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	B	1	GA	0.4376	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	B	2	GA	0.4376	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	B	3	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	B	4	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	B	5	GA	0.0626	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	B	6	GA	0.0626	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	B	7	GA	0.0078	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	B	8	GA	0.0078	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	C	0	GA	0.5464	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	C	1	GA	0.4376	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	C	2	GA	0.4376	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	C	3	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	C	4	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	C	5	GA	0.0626	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	C	6	GA	0.0626	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	C	7	GA	0.0078	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	C	8	GA	0.0078	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	D	0	GA	0.6248	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	D	1	GA	0.4688	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	D	2	GA	0.4688	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	D	3	GA	0.1876	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	D	4	GA	0.1876	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	D	5	GA	0.0312	0.0000	0.0000
GASEPF	DEP	STANDARD 1	17R	D	6	GA	0.0312	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35A	A	0	GA	3.5516	0.0000	0.8196
GASEPF	DEP	STANDARD 1	35A	A	1	GA	2.8444	0.0000	0.6564
GASEPF	DEP	STANDARD 1	35A	A	2	GA	2.8444	0.0000	0.6564
GASEPF	DEP	STANDARD 1	35A	A	3	GA	1.4222	0.0000	0.3282
GASEPF	DEP	STANDARD 1	35A	A	4	GA	1.4222	0.0000	0.3282
GASEPF	DEP	STANDARD 1	35A	A	5	GA	0.4069	0.0000	0.0939
GASEPF	DEP	STANDARD 1	35A	A	6	GA	0.4069	0.0000	0.0939
GASEPF	DEP	STANDARD 1	35A	A	7	GA	0.0507	0.0000	0.0117
GASEPF	DEP	STANDARD 1	35A	A	8	GA	0.0507	0.0000	0.0117
GASEPF	DEP	STANDARD 1	35A	B	0	GA	1.6392	0.0000	0.5464
GASEPF	DEP	STANDARD 1	35A	B	1	GA	1.3128	0.0000	0.4376
GASEPF	DEP	STANDARD 1	35A	B	2	GA	1.3128	0.0000	0.4376
GASEPF	DEP	STANDARD 1	35A	B	3	GA	0.6564	0.0000	0.2188
GASEPF	DEP	STANDARD 1	35A	B	4	GA	0.6564	0.0000	0.2188
GASEPF	DEP	STANDARD 1	35A	B	5	GA	0.1878	0.0000	0.0626
GASEPF	DEP	STANDARD 1	35A	B	6	GA	0.1878	0.0000	0.0626
GASEPF	DEP	STANDARD 1	35A	B	7	GA	0.0234	0.0000	0.0078
GASEPF	DEP	STANDARD 1	35A	B	8	GA	0.0234	0.0000	0.0078
GASEPF	DEP	STANDARD 1	35A	C	0	GA	1.6392	0.0000	0.5464
GASEPF	DEP	STANDARD 1	35A	C	1	GA	1.3128	0.0000	0.4376
GASEPF	DEP	STANDARD 1	35A	C	2	GA	1.3128	0.0000	0.4376
GASEPF	DEP	STANDARD 1	35A	C	3	GA	0.6564	0.0000	0.2188
GASEPF	DEP	STANDARD 1	35A	C	4	GA	0.6564	0.0000	0.2188
GASEPF	DEP	STANDARD 1	35A	C	5	GA	0.1878	0.0000	0.0626
GASEPF	DEP	STANDARD 1	35A	C	6	GA	0.1878	0.0000	0.0626

GASEPF	DEP	STANDARD 1	35A	C	7	GA	0.0234	0.0000	0.0078
GASEPF	DEP	STANDARD 1	35A	C	8	GA	0.0234	0.0000	0.0078
GASEPF	DEP	STANDARD 1	35A	D	0	GA	1.8744	0.0000	0.6248
GASEPF	DEP	STANDARD 1	35A	D	1	GA	1.4064	0.0000	0.4688
GASEPF	DEP	STANDARD 1	35A	D	2	GA	1.4064	0.0000	0.4688
GASEPF	DEP	STANDARD 1	35A	D	3	GA	0.5628	0.0000	0.1876
GASEPF	DEP	STANDARD 1	35A	D	4	GA	0.5628	0.0000	0.1876
GASEPF	DEP	STANDARD 1	35A	D	5	GA	0.0936	0.0000	0.0312
GASEPF	DEP	STANDARD 1	35A	D	6	GA	0.0936	0.0000	0.0312
GASEPF	DEP	STANDARD 1	35L	A	0	GA	0.5464	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	A	1	GA	0.4376	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	A	2	GA	0.4376	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	A	3	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	A	4	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	A	5	GA	0.0626	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	A	6	GA	0.0626	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	A	7	GA	0.0078	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	A	8	GA	0.0078	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	B	0	GA	0.2732	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	B	1	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	B	2	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	B	3	GA	0.1094	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	B	4	GA	0.1094	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	B	5	GA	0.0313	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	B	6	GA	0.0313	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	B	7	GA	0.0039	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	B	8	GA	0.0039	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	C	0	GA	0.2732	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	C	1	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	C	2	GA	0.2188	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	C	3	GA	0.1094	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	C	4	GA	0.1094	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	C	5	GA	0.0313	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	C	6	GA	0.0313	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	C	7	GA	0.0039	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	C	8	GA	0.0039	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	D	0	GA	0.3124	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	D	1	GA	0.2344	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	D	2	GA	0.2344	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	D	3	GA	0.0938	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	D	4	GA	0.0938	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	D	5	GA	0.0156	0.0000	0.0000
GASEPF	DEP	STANDARD 1	35L	D	6	GA	0.0156	0.0000	0.0000
GASEPF	TGO	STANDARD 1	17A	A	0	GA	4.6800	0.0000	1.1700
GASEPF	TGO	STANDARD 1	17A	A	1	GA	2.8800	0.0000	0.7200
GASEPF	TGO	STANDARD 1	17A	A	2	GA	2.8800	0.0000	0.7200
GASEPF	TGO	STANDARD 1	17A	A	3	GA	0.7800	0.0000	0.1950
GASEPF	TGO	STANDARD 1	17A	A	4	GA	0.7800	0.0000	0.1950
GASEPF	TGO	STANDARD 1	17R	A	0	GA	43.6800	0.0000	10.9200
GASEPF	TGO	STANDARD 1	17R	A	1	GA	26.8800	0.0000	6.7200
GASEPF	TGO	STANDARD 1	17R	A	2	GA	26.8800	0.0000	6.7200
GASEPF	TGO	STANDARD 1	17R	A	3	GA	7.2800	0.0000	1.8200
GASEPF	TGO	STANDARD 1	17R	A	4	GA	7.2800	0.0000	1.8200
GASEPF	TGO	STANDARD 1	35A	A	0	GA	1.9500	0.0000	0.3900
GASEPF	TGO	STANDARD 1	35A	A	1	GA	1.2000	0.0000	0.2400
GASEPF	TGO	STANDARD 1	35A	A	2	GA	1.2000	0.0000	0.2400
GASEPF	TGO	STANDARD 1	35A	A	3	GA	0.3250	0.0000	0.0650
GASEPF	TGO	STANDARD 1	35A	A	4	GA	0.3250	0.0000	0.0650

GASEPF	TGO	STANDARD	1	35L	A	0	GA	16.7700	0.0000	4.2900
GASEPF	TGO	STANDARD	1	35L	A	1	GA	10.3200	0.0000	2.6400
GASEPF	TGO	STANDARD	1	35L	A	2	GA	10.3200	0.0000	2.6400
GASEPF	TGO	STANDARD	1	35L	A	3	GA	2.7950	0.0000	0.7150
GASEPF	TGO	STANDARD	1	35L	A	4	GA	2.7950	0.0000	0.7150
GASEPV	APP	STANDARD	1	17A	A	0	GA	2.2294	0.0000	0.5574
GASEPV	APP	STANDARD	1	17A	A	1	GA	1.7855	0.0000	0.4464
GASEPV	APP	STANDARD	1	17A	A	2	GA	1.7855	0.0000	0.4464
GASEPV	APP	STANDARD	1	17A	A	3	GA	0.8927	0.0000	0.2232
GASEPV	APP	STANDARD	1	17A	A	4	GA	0.8927	0.0000	0.2232
GASEPV	APP	STANDARD	1	17A	A	5	GA	0.2554	0.0000	0.0639
GASEPV	APP	STANDARD	1	17A	A	6	GA	0.2554	0.0000	0.0639
GASEPV	APP	STANDARD	1	17A	A	7	GA	0.0318	0.0000	0.0080
GASEPV	APP	STANDARD	1	17A	A	8	GA	0.0318	0.0000	0.0080
GASEPV	APP	STANDARD	1	17A	B	0	GA	1.1147	0.0000	0.2787
GASEPV	APP	STANDARD	1	17A	B	1	GA	0.8927	0.0000	0.2232
GASEPV	APP	STANDARD	1	17A	B	2	GA	0.8927	0.0000	0.2232
GASEPV	APP	STANDARD	1	17A	B	3	GA	0.4464	0.0000	0.1116
GASEPV	APP	STANDARD	1	17A	B	4	GA	0.4464	0.0000	0.1116
GASEPV	APP	STANDARD	1	17A	B	5	GA	0.1277	0.0000	0.0319
GASEPV	APP	STANDARD	1	17A	B	6	GA	0.1277	0.0000	0.0319
GASEPV	APP	STANDARD	1	17A	B	7	GA	0.0159	0.0000	0.0040
GASEPV	APP	STANDARD	1	17A	B	8	GA	0.0159	0.0000	0.0040
GASEPV	APP	STANDARD	1	17A	C	0	GA	1.1147	0.0000	0.2787
GASEPV	APP	STANDARD	1	17A	C	1	GA	0.8927	0.0000	0.2232
GASEPV	APP	STANDARD	1	17A	C	2	GA	0.8927	0.0000	0.2232
GASEPV	APP	STANDARD	1	17A	C	3	GA	0.4464	0.0000	0.1116
GASEPV	APP	STANDARD	1	17A	C	4	GA	0.4464	0.0000	0.1116
GASEPV	APP	STANDARD	1	17A	C	5	GA	0.1277	0.0000	0.0319
GASEPV	APP	STANDARD	1	17A	C	6	GA	0.1277	0.0000	0.0319
GASEPV	APP	STANDARD	1	17A	C	7	GA	0.0159	0.0000	0.0040
GASEPV	APP	STANDARD	1	17A	C	8	GA	0.0159	0.0000	0.0040
GASEPV	APP	STANDARD	1	17A	D	0	GA	1.2747	0.0000	0.3187
GASEPV	APP	STANDARD	1	17A	D	1	GA	0.9564	0.0000	0.2391
GASEPV	APP	STANDARD	1	17A	D	2	GA	0.9564	0.0000	0.2391
GASEPV	APP	STANDARD	1	17A	D	3	GA	0.3827	0.0000	0.0957
GASEPV	APP	STANDARD	1	17A	D	4	GA	0.3827	0.0000	0.0957
GASEPV	APP	STANDARD	1	17A	D	5	GA	0.0637	0.0000	0.0159
GASEPV	APP	STANDARD	1	17A	D	6	GA	0.0637	0.0000	0.0159
GASEPV	APP	STANDARD	1	17R	A	0	GA	0.2401	0.0000	0.0600
GASEPV	APP	STANDARD	1	17R	A	1	GA	0.1923	0.0000	0.0481
GASEPV	APP	STANDARD	1	17R	A	2	GA	0.1923	0.0000	0.0481
GASEPV	APP	STANDARD	1	17R	A	3	GA	0.0961	0.0000	0.0240
GASEPV	APP	STANDARD	1	17R	A	4	GA	0.0961	0.0000	0.0240
GASEPV	APP	STANDARD	1	17R	A	5	GA	0.0275	0.0000	0.0069
GASEPV	APP	STANDARD	1	17R	A	6	GA	0.0275	0.0000	0.0069
GASEPV	APP	STANDARD	1	17R	A	7	GA	0.0034	0.0000	0.0009
GASEPV	APP	STANDARD	1	17R	A	8	GA	0.0034	0.0000	0.0009
GASEPV	APP	STANDARD	1	17R	B	0	GA	0.1200	0.0000	0.0300
GASEPV	APP	STANDARD	1	17R	B	1	GA	0.0961	0.0000	0.0240
GASEPV	APP	STANDARD	1	17R	B	2	GA	0.0961	0.0000	0.0240
GASEPV	APP	STANDARD	1	17R	B	3	GA	0.0481	0.0000	0.0120
GASEPV	APP	STANDARD	1	17R	B	4	GA	0.0481	0.0000	0.0120
GASEPV	APP	STANDARD	1	17R	B	5	GA	0.0138	0.0000	0.0034
GASEPV	APP	STANDARD	1	17R	B	6	GA	0.0138	0.0000	0.0034
GASEPV	APP	STANDARD	1	17R	B	7	GA	0.0017	0.0000	0.0004
GASEPV	APP	STANDARD	1	17R	B	8	GA	0.0017	0.0000	0.0004
GASEPV	APP	STANDARD	1	17R	C	0	GA	0.1200	0.0000	0.0300

GASEPV	APP	STANDARD 1	17R	C	1	GA	0.0961	0.0000	0.0240
GASEPV	APP	STANDARD 1	17R	C	2	GA	0.0961	0.0000	0.0240
GASEPV	APP	STANDARD 1	17R	C	3	GA	0.0481	0.0000	0.0120
GASEPV	APP	STANDARD 1	17R	C	4	GA	0.0481	0.0000	0.0120
GASEPV	APP	STANDARD 1	17R	C	5	GA	0.0138	0.0000	0.0034
GASEPV	APP	STANDARD 1	17R	C	6	GA	0.0138	0.0000	0.0034
GASEPV	APP	STANDARD 1	17R	C	7	GA	0.0017	0.0000	0.0004
GASEPV	APP	STANDARD 1	17R	C	8	GA	0.0017	0.0000	0.0004
GASEPV	APP	STANDARD 1	17R	D	0	GA	0.1373	0.0000	0.0343
GASEPV	APP	STANDARD 1	17R	D	1	GA	0.1030	0.0000	0.0258
GASEPV	APP	STANDARD 1	17R	D	2	GA	0.1030	0.0000	0.0258
GASEPV	APP	STANDARD 1	17R	D	3	GA	0.0412	0.0000	0.0103
GASEPV	APP	STANDARD 1	17R	D	4	GA	0.0412	0.0000	0.0103
GASEPV	APP	STANDARD 1	17R	D	5	GA	0.0069	0.0000	0.0017
GASEPV	APP	STANDARD 1	17R	D	6	GA	0.0069	0.0000	0.0017
GASEPV	APP	STANDARD 1	35A	A	0	GA	0.8575	0.0000	0.2144
GASEPV	APP	STANDARD 1	35A	A	1	GA	0.6867	0.0000	0.1717
GASEPV	APP	STANDARD 1	35A	A	2	GA	0.6867	0.0000	0.1717
GASEPV	APP	STANDARD 1	35A	A	3	GA	0.3434	0.0000	0.0858
GASEPV	APP	STANDARD 1	35A	A	4	GA	0.3434	0.0000	0.0858
GASEPV	APP	STANDARD 1	35A	A	5	GA	0.0982	0.0000	0.0246
GASEPV	APP	STANDARD 1	35A	A	6	GA	0.0982	0.0000	0.0246
GASEPV	APP	STANDARD 1	35A	A	7	GA	0.0122	0.0000	0.0031
GASEPV	APP	STANDARD 1	35A	A	8	GA	0.0122	0.0000	0.0031
GASEPV	APP	STANDARD 1	35A	B	0	GA	0.4287	0.0000	0.1072
GASEPV	APP	STANDARD 1	35A	B	1	GA	0.3434	0.0000	0.0858
GASEPV	APP	STANDARD 1	35A	B	2	GA	0.3434	0.0000	0.0858
GASEPV	APP	STANDARD 1	35A	B	3	GA	0.1717	0.0000	0.0429
GASEPV	APP	STANDARD 1	35A	B	4	GA	0.1717	0.0000	0.0429
GASEPV	APP	STANDARD 1	35A	B	5	GA	0.0491	0.0000	0.0123
GASEPV	APP	STANDARD 1	35A	B	6	GA	0.0491	0.0000	0.0123
GASEPV	APP	STANDARD 1	35A	B	7	GA	0.0061	0.0000	0.0015
GASEPV	APP	STANDARD 1	35A	B	8	GA	0.0061	0.0000	0.0015
GASEPV	APP	STANDARD 1	35A	C	0	GA	0.4287	0.0000	0.1072
GASEPV	APP	STANDARD 1	35A	C	1	GA	0.3434	0.0000	0.0858
GASEPV	APP	STANDARD 1	35A	C	2	GA	0.3434	0.0000	0.0858
GASEPV	APP	STANDARD 1	35A	C	3	GA	0.1717	0.0000	0.0429
GASEPV	APP	STANDARD 1	35A	C	4	GA	0.1717	0.0000	0.0429
GASEPV	APP	STANDARD 1	35A	C	5	GA	0.0491	0.0000	0.0123
GASEPV	APP	STANDARD 1	35A	C	6	GA	0.0491	0.0000	0.0123
GASEPV	APP	STANDARD 1	35A	C	7	GA	0.0061	0.0000	0.0015
GASEPV	APP	STANDARD 1	35A	C	8	GA	0.0061	0.0000	0.0015
GASEPV	APP	STANDARD 1	35A	D	0	GA	0.4902	0.0000	0.1226
GASEPV	APP	STANDARD 1	35A	D	1	GA	0.3678	0.0000	0.0920
GASEPV	APP	STANDARD 1	35A	D	2	GA	0.3678	0.0000	0.0920
GASEPV	APP	STANDARD 1	35A	D	3	GA	0.1472	0.0000	0.0368
GASEPV	APP	STANDARD 1	35A	D	4	GA	0.1472	0.0000	0.0368
GASEPV	APP	STANDARD 1	35A	D	5	GA	0.0245	0.0000	0.0061
GASEPV	APP	STANDARD 1	35A	D	6	GA	0.0245	0.0000	0.0061
GASEPV	APP	STANDARD 1	35L	A	0	GA	0.1029	0.0000	0.0257
GASEPV	APP	STANDARD 1	35L	A	1	GA	0.0824	0.0000	0.0206
GASEPV	APP	STANDARD 1	35L	A	2	GA	0.0824	0.0000	0.0206
GASEPV	APP	STANDARD 1	35L	A	3	GA	0.0412	0.0000	0.0103
GASEPV	APP	STANDARD 1	35L	A	4	GA	0.0412	0.0000	0.0103
GASEPV	APP	STANDARD 1	35L	A	5	GA	0.0118	0.0000	0.0029
GASEPV	APP	STANDARD 1	35L	A	6	GA	0.0118	0.0000	0.0029
GASEPV	APP	STANDARD 1	35L	A	7	GA	0.0015	0.0000	0.0004
GASEPV	APP	STANDARD 1	35L	A	8	GA	0.0015	0.0000	0.0004

GASEPV	APP	STANDARD 1	35L	B	0	GA	0.0514	0.0000	0.0129
GASEPV	APP	STANDARD 1	35L	B	1	GA	0.0412	0.0000	0.0103
GASEPV	APP	STANDARD 1	35L	B	2	GA	0.0412	0.0000	0.0103
GASEPV	APP	STANDARD 1	35L	B	3	GA	0.0206	0.0000	0.0052
GASEPV	APP	STANDARD 1	35L	B	4	GA	0.0206	0.0000	0.0052
GASEPV	APP	STANDARD 1	35L	B	5	GA	0.0059	0.0000	0.0015
GASEPV	APP	STANDARD 1	35L	B	6	GA	0.0059	0.0000	0.0015
GASEPV	APP	STANDARD 1	35L	B	7	GA	0.0007	0.0000	0.0002
GASEPV	APP	STANDARD 1	35L	B	8	GA	0.0007	0.0000	0.0002
GASEPV	APP	STANDARD 1	35L	C	0	GA	0.0514	0.0000	0.0129
GASEPV	APP	STANDARD 1	35L	C	1	GA	0.0412	0.0000	0.0103
GASEPV	APP	STANDARD 1	35L	C	2	GA	0.0412	0.0000	0.0103
GASEPV	APP	STANDARD 1	35L	C	3	GA	0.0206	0.0000	0.0052
GASEPV	APP	STANDARD 1	35L	C	4	GA	0.0206	0.0000	0.0052
GASEPV	APP	STANDARD 1	35L	C	5	GA	0.0059	0.0000	0.0015
GASEPV	APP	STANDARD 1	35L	C	6	GA	0.0059	0.0000	0.0015
GASEPV	APP	STANDARD 1	35L	C	7	GA	0.0007	0.0000	0.0002
GASEPV	APP	STANDARD 1	35L	C	8	GA	0.0007	0.0000	0.0002
GASEPV	APP	STANDARD 1	35L	D	0	GA	0.0588	0.0000	0.0147
GASEPV	APP	STANDARD 1	35L	D	1	GA	0.0441	0.0000	0.0110
GASEPV	APP	STANDARD 1	35L	D	2	GA	0.0441	0.0000	0.0110
GASEPV	APP	STANDARD 1	35L	D	3	GA	0.0177	0.0000	0.0044
GASEPV	APP	STANDARD 1	35L	D	4	GA	0.0177	0.0000	0.0044
GASEPV	APP	STANDARD 1	35L	D	5	GA	0.0029	0.0000	0.0007
GASEPV	APP	STANDARD 1	35L	D	6	GA	0.0029	0.0000	0.0007
GASEPV	DEP	STANDARD 1	17A	A	0	GA	2.1856	0.0000	0.5464
GASEPV	DEP	STANDARD 1	17A	A	1	GA	1.7504	0.0000	0.4376
GASEPV	DEP	STANDARD 1	17A	A	2	GA	1.7504	0.0000	0.4376
GASEPV	DEP	STANDARD 1	17A	A	3	GA	0.8752	0.0000	0.2188
GASEPV	DEP	STANDARD 1	17A	A	4	GA	0.8752	0.0000	0.2188
GASEPV	DEP	STANDARD 1	17A	A	5	GA	0.2504	0.0000	0.0626
GASEPV	DEP	STANDARD 1	17A	A	6	GA	0.2504	0.0000	0.0626
GASEPV	DEP	STANDARD 1	17A	A	7	GA	0.0312	0.0000	0.0078
GASEPV	DEP	STANDARD 1	17A	A	8	GA	0.0312	0.0000	0.0078
GASEPV	DEP	STANDARD 1	17A	B	0	GA	1.0928	0.0000	0.2732
GASEPV	DEP	STANDARD 1	17A	B	1	GA	0.8752	0.0000	0.2188
GASEPV	DEP	STANDARD 1	17A	B	2	GA	0.8752	0.0000	0.2188
GASEPV	DEP	STANDARD 1	17A	B	3	GA	0.4376	0.0000	0.1094
GASEPV	DEP	STANDARD 1	17A	B	4	GA	0.4376	0.0000	0.1094
GASEPV	DEP	STANDARD 1	17A	B	5	GA	0.1252	0.0000	0.0313
GASEPV	DEP	STANDARD 1	17A	B	6	GA	0.1252	0.0000	0.0313
GASEPV	DEP	STANDARD 1	17A	B	7	GA	0.0156	0.0000	0.0039
GASEPV	DEP	STANDARD 1	17A	B	8	GA	0.0156	0.0000	0.0039
GASEPV	DEP	STANDARD 1	17A	C	0	GA	1.0928	0.0000	0.2732
GASEPV	DEP	STANDARD 1	17A	C	1	GA	0.8752	0.0000	0.2188
GASEPV	DEP	STANDARD 1	17A	C	2	GA	0.8752	0.0000	0.2188
GASEPV	DEP	STANDARD 1	17A	C	3	GA	0.4376	0.0000	0.1094
GASEPV	DEP	STANDARD 1	17A	C	4	GA	0.4376	0.0000	0.1094
GASEPV	DEP	STANDARD 1	17A	C	5	GA	0.1252	0.0000	0.0313
GASEPV	DEP	STANDARD 1	17A	C	6	GA	0.1252	0.0000	0.0313
GASEPV	DEP	STANDARD 1	17A	C	7	GA	0.0156	0.0000	0.0039
GASEPV	DEP	STANDARD 1	17A	C	8	GA	0.0156	0.0000	0.0039
GASEPV	DEP	STANDARD 1	17A	D	0	GA	1.2496	0.0000	0.3124
GASEPV	DEP	STANDARD 1	17A	D	1	GA	0.9376	0.0000	0.2344
GASEPV	DEP	STANDARD 1	17A	D	2	GA	0.9376	0.0000	0.2344
GASEPV	DEP	STANDARD 1	17A	D	3	GA	0.3752	0.0000	0.0938
GASEPV	DEP	STANDARD 1	17A	D	4	GA	0.3752	0.0000	0.0938
GASEPV	DEP	STANDARD 1	17A	D	5	GA	0.0624	0.0000	0.0156

GASEPV	DEP	STANDARD	1	17A	D	6	GA	0.0624	0.0000	0.0156
GASEPV	DEP	STANDARD	1	17R	A	0	GA	0.2732	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17R	A	1	GA	0.2188	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17R	A	2	GA	0.2188	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17R	A	3	GA	0.1094	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17R	A	4	GA	0.1094	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17R	A	5	GA	0.0313	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17R	A	6	GA	0.0313	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17R	A	7	GA	0.0039	0.0000	0.0000
GASEPV	DEP	STANDARD	1	17R	A	8	GA	0.0039	0.0000	0.0000
GASEPV	DEP	STANDARD	1	35A	A	0	GA	0.8196	0.0000	0.2732
GASEPV	DEP	STANDARD	1	35A	A	1	GA	0.6564	0.0000	0.2188
GASEPV	DEP	STANDARD	1	35A	A	2	GA	0.6564	0.0000	0.2188
GASEPV	DEP	STANDARD	1	35A	A	3	GA	0.3282	0.0000	0.1094
GASEPV	DEP	STANDARD	1	35A	A	4	GA	0.3282	0.0000	0.1094
GASEPV	DEP	STANDARD	1	35A	A	5	GA	0.0939	0.0000	0.0313
GASEPV	DEP	STANDARD	1	35A	A	6	GA	0.0939	0.0000	0.0313
GASEPV	DEP	STANDARD	1	35A	A	7	GA	0.0117	0.0000	0.0039
GASEPV	DEP	STANDARD	1	35A	A	8	GA	0.0117	0.0000	0.0039

David W. Fitz

From: jon.pietrak@faa.gov
Sent: Wednesday, January 04, 2006 8:30 AM
To: David W. Fitz
Subject: Re: INM Substitution

Hi David,

Sorry for the delay in responding. I just returned to the office today.
I consulted with my colleagues and we agree that the only INM substitution at this time would be the aircraft you proposed; the GASEPF.

Regards,

Jon F. Pietrak
Office of Environment and Energy
Noise Division, AEE-100
(202) 267-3493
jon.pietrak@faa.gov

"David W. Fitz" <dfitz@coffmanassociates.com>
12/28/2005 10:22 AM

To: Jon Pietrak/AWA/FAA@FAA
cc:
Subject: INM Substitution

Jon,

We are preparing an aircraft noise analysis for Buckeye Municipal Airport in Arizona and need a substitute for an unusual aircraft- a SparrowHawk Gyroplane. This two seat aircraft is powered by a Subaru EJ25- 160 horse power engine with a gross weight of 1,500 pounds. The gyroplane has a 3 blade push propeller and 30-foot 2 blade rotor. It takes off more like a fixed wing aircraft but can get off the ground on about 100 feet of pavement. Would the GASEPF work?

Thanks for you help Jon.

David Fitz, AICP
Associate
Coffman Associates
1-800-892-7772

Coffman Associates
Airport Consultants

Technical Information Paper

Glossary of Noise Compatibility Terms

Technical Information Paper

Glossary of Noise Compatibility Terms

A-WEIGHTED SOUND LEVEL - A sound pressure level, often noted as dBA, which has been frequency filtered or weighted to quantitatively reduce the effect of the low frequency noise. It was designed to approximate the response of the human ear to sound.

AMBIENT NOISE - The totality of noise in a given place and time — usually a composite of sounds from varying sources at varying distances.

APPROACH LIGHT SYSTEM (ALS) - An airport lighting facility which provides visual guidance to landing aircraft by radiating light beams in a directional pattern by which the pilot aligns the aircraft with the extended centerline of the runway on the final approach for landing.

ATTENUATION - Acoustical phenomenon whereby a reduction in sound energy is experienced between the noise source and receiver. This energy loss can be attributed to atmospheric conditions, terrain, vegetation, and man-made and natural features.

AZIMUTH - Horizontal direction expressed as the angular distance between true north and the direction of a fixed point (as the observer's heading).

BASE LEG - A flight path at right angles to the landing runway off its approach end. The base leg normally extends from the downwind leg to the intersection of the extended runway centerline. See "traffic pattern."

CNEL - The 24-hour average sound level, in A-weighted decibels, obtained after the addition of 4.77 decibels to sound levels between 7 p.m. and 10 p.m. and 10 decibels to sound levels between 10 p.m. and 7 a.m., as averaged over a span of one year. In California, it is the required metric for determining the cumulative exposure of individuals to aircraft noise. Also see "Leq" and "DNL".

COMMUNITY NOISE EQUIVALENT LEVEL - See CNEL.

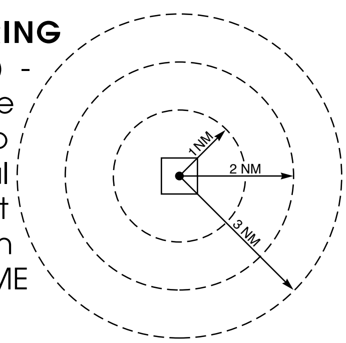
CROSSWIND LEG - A flight path at right angles to the landing runway off its upwind end. See "traffic pattern."

DAY-NIGHT AVERAGE SOUND LEVEL - See DNL.

DECIBEL (dB) - The physical unit commonly used to describe noise levels. The decibel represents a relative measure or ratio to a reference power. This reference value is a sound pressure of 20 micropascals which can be referred to as 1 decibel or the weakest sound that can be heard by a person with very good hearing in an extremely quiet room.

DISPLACED THRESHOLD - A threshold that is located at a point on the runway other than the designated beginning of the runway.

DISTANCE MEASURING EQUIPMENT (DME) - Equipment (airborne and ground) used to measure, in nautical miles, the slant range distance of an aircraft from the DME navigational aid.



DNL - The 24-hour average sound level, in A-weighted decibels, obtained after the addition of ten decibels to sound levels for the periods between 10 p.m. and 7 a.m. as averaged over a span of one year. It is the FAA standard metric for determining the cumulative exposure of individuals to noise. Also see "Leq."

DOWNWIND LEG - A flight path parallel to the landing runway in the direction opposite to landing. The downwind leg normally extends between the crosswind leg and the base leg. Also see "traffic pattern."

DURATION - Length of time, in seconds, a noise event such as an aircraft flyover is experienced. (May refer to the length of time a noise event exceeds a specified dB threshold level.)

EASEMENT - The legal right of one party to use a portion of the total rights in real estate owned by another party. This may include the right of passage over, on, or below the property; certain air rights above the property, including view rights; and the rights to any specified form of development or activity, as well as any other legal rights in the property that may be specified in the easement document.

EQUIVALENT SOUND LEVEL - See Leq.

FINAL APPROACH - A flight path in the direction of landing along the extended runway centerline. The final approach normally extends from the base leg to the runway. See "traffic pattern."

FIXED BASE OPERATOR (FBO) - A provider of services to users of an airport. Such services include, but are not limited to, hangaring, fueling, flight training, repair and maintenance.

GLIDE SLOPE (GS) - Provides vertical guidance for aircraft during approach and landing. The glide slope consists of the following:

1. Electronic components emitting signals which provide vertical guidance by reference to airborne instruments during instrument approaches such as ILS, or

2. Visual ground aids, such as VASI, which provide vertical guidance for VFR approach or for the visual portion of an instrument approach and landing.

GLOBAL POSITIONING SYSTEM - See "GPS."

GPS - GLOBAL POSITIONING SYSTEM - A system of 24 satellites used as reference points to enable navigators equipped with GPS receivers to determine their latitude, longitude, and altitude. The accuracy of the system can be further refined by using a ground receiver at a known location to calculate the error in the satellite range data. This is known as Differential GPS (DGPS).

GROUND EFFECT - The attenuation attributed to absorption or reflection of noise by man-made or natural features on the ground surface.

HOURLY NOISE LEVEL (HNL) - A noise summation metric which considers primarily those single events which exceed a specified threshold or duration during one hour.

INSTRUMENT APPROACH - A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing, or to a point from which a landing may be made visually.

INSTRUMENT FLIGHT RULES (IFR) -Rules governing the procedures for conducting instrument flight. Also a term used by pilots and controllers to indicate type of flight plan.

INSTRUMENT LANDING SYSTEM (ILS) - A precision instrument approach system which normally consists of the following electronic components and visual aids:

1. Localizer.
2. Glide Slope.
3. Outer Marker.
4. Middle Marker.
5. Approach Lights.

Ldn - (See DNL). Ldn used in place of DNL in mathematical equations only.

Leq - Equivalent Sound Level. The steady A-weighted sound level over any specified period (not necessarily 24 hours) that has the same acoustic energy as the fluctuating noise during that period (with no consideration of a nighttime weighting.) It is a measure of cumulative acoustical energy. Because the time interval may vary, it should be specified by a subscript (such as Leq 8) for an 8-hour exposure to workplace noise) or be clearly understood.

LOCALIZER - The component of an ILS which provides course guidance to the runway.

MERGE - Combining or merging of noise events which exceed a given threshold level and occur within a variable selected period of time.

MISSED APPROACH COURSE (MAC) - The flight route to be followed if, after an instrument approach, a landing is not effected, and occurring normally:

1. When the aircraft has descended to the decision height and has not established visual contact, or

2. When directed by air traffic control to pull up or to go around again.

NOISE CONTOUR - A continuous line on a map of the airport vicinity connecting all points of the same noise exposure level.

NONDIRECTIONAL BEACON (NDB) -A beacon transmitting nondirectional signals whereby the pilot of an aircraft equipped with direction finding equipment can determined his bearing to and from the radio beacon and home on or track to or from the station. When the radio beacon is installed in conjunction with the Instrument Landing System marker, it is normally called a Compass Locator.

NONPRECISION APPROACH - A standard instrument approach procedure providing runway alignment but no glide slope or descent information.

PRECISION APPROACH - A standard instrument approach procedure providing runway alignment and glide slope or descent information.

PRECISION APPROACH PATH INDICATOR (PAPI) - A lighting system providing visual approach slope guidance to aircraft during a landing approach. It is similar to a VASI but provides a sharper transition between the colored indicator lights.

PROFILE - The physical position of the aircraft during landings or takeoffs in terms of altitude in feet above the runway and distance from the runway end.

PROPAGATION - Sound propagation refers to the spreading or radiating of sound energy from the noise source. Propagation characteristics of sound normally involve a reduction in sound energy with an increased distance from source. Sound propagation is affected by atmospheric conditions, terrain, and man-made and natural objects.

RUNWAY END IDENTIFIER LIGHTS (REIL) - Two synchronized flashing lights, one on each side of the runway threshold, which provide rapid and positive identification of the approach end of a particular runway.

RUNWAY USE PROGRAM - A noise abatement runway selection plan designed to enhance noise abatement efforts with regard to airport communities for arriving and departing aircraft. These plans are developed into runway use programs and apply to all turbojet aircraft 12,500 pounds or heavier. Turbojet aircraft less than 12,500 pounds are included only if the airport proprietor determines that the aircraft creates a noise problem. Runway use programs are coordinated with FAA offices as outlined in Order 1050.11. Safety criteria used in these programs are developed by the Office of Flight Operations. Runway use programs are administered by the Air Traffic Service as "Formal" or "Informal" programs.

RUNWAY USE PROGRAM (FORMAL) - An approved noise abatement program which is defined and acknowledged in a Letter of Understanding between FAA - Flight Standards, FAA - Air Traffic Service, the airport proprietor, and the users. Once established, participation in the program is mandatory for aircraft operators and pilots as provided for in F.A.R. Section 91.87.

RUNWAY USE PROGRAM (INFORMAL) - An approved noise abatement program which does not require a Letter of Understanding and participation in the program is voluntary for aircraft operators/pilots.

SEL - Sound Exposure Level. SEL expressed in dB, is a measure of the effect of duration and magnitude for a single-event measured in A-weighted sound level above a specified threshold which is at least 10 dB below the maximum value. In typical aircraft noise model calculations, SEL is used in computing aircraft acoustical contribution to the Equivalent Sound Level (Leq), the Day-Night Sound Level (DNL), and the Community Noise Equivalent Level (CNEL).

SINGLE EVENT - An occurrence of audible noise usually above a specified minimum noise level caused by an intrusive source such as an aircraft overflight, passing train, or ship's horn.

SLANT-RANGE DISTANCE - The straight line distance between an aircraft and a point on the ground.

SOUND EXPOSURE LEVEL - See SEL.

TACTICAL AIR NAVIGATION (TACAN) -An ultra-high frequency electronic air navigation system which provides suitably-equipped aircraft a continuous indication of bearing and distance to the TACAN station.

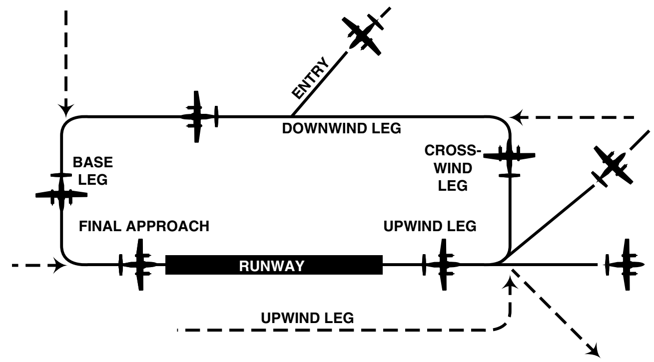
TERMINAL RADAR SERVICE AREA (TRSA) - Airspace surrounding designated airports wherein ATC provides radar vectoring, sequencing, and separation on a full-time basis for all IFR and participating VFR aircraft. Service provided in a TRSA is called Stage III Service.

THRESHOLD - Decibel level below which single event information is not printed out on the noise monitoring equipment tapes. The noise levels below the threshold are, however, considered in the accumulation of hourly and daily noise levels.

TIME ABOVE (TA) - The 24-hour TA noise metric provides the duration in minutes for which aircraft-related noise exceeds specified A-weighted sound levels. It is expressed in minutes per 24-hour period.

TOUCHDOWN ZONE LIGHTING (TDZ) -Two rows of transverse light bars located symmetrically about the runway centerline normally at 100 foot intervals. The basic system extends 3,000 feet along the runway.

TRAFFIC PATTERN - The traffic flow that is prescribed for aircraft landing at or taking off from an airport. The components of a typical traffic pattern are the upwind leg, crosswind leg, downwind leg, base leg, and final approach.

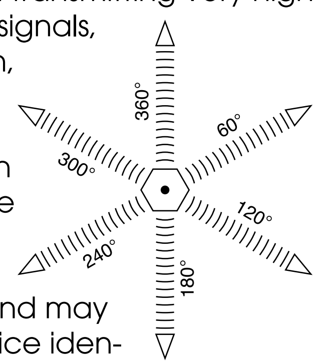


UNICOM - A nongovernment communication facility which may provide airport information at certain airports. Locations and frequencies of UNICOM's are shown on aeronautical charts and publications.

UPWIND LEG - A flight path parallel to the landing runway in the direction of landing. See "traffic pattern."

VECTOR - A heading issued to an aircraft to provide navigational guidance by radar.

VERY HIGH FREQUENCY OMNIDIRECTIONAL RANGE STATION (VOR) - A ground-based electric navigation aid transmitting very high frequency navigation signals, 360 degrees in azimuth, oriented from magnetic north. Used as the basis for navigation in the national airspace system. The VOR periodically identifies itself by Morse Code and may have an additional voice identification feature.



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VERY HIGH FREQUENCY OMNIDIRECTIONAL RANGE STATION/TACTICAL AIR NAVIGATION (VORTAC) - A navigation aid providing VOR azimuth, TACAN azimuth, and TACAN distance-measuring equipment (DME) at one site.

VICTOR AIRWAY - A control area or portion thereof established in the form of a corridor, the centerline of which is defined by radio navigational aids.

VISUAL APPROACH - An approach wherein an aircraft on an IFR flight plan, operating in VFR conditions under the control of an air traffic control facility and having an air traffic control authorization, may proceed to the airport of destination in VFR conditions.

VISUAL APPROACH SLOPE INDICATOR (VASI) - An airport lighting facility providing vertical visual approach slope guidance to aircraft during approach to landing by radiating an directional pattern of high intensity red and white focused light beams which indicate to the pilot that he is on path if he sees red/white, above path if white/white, and below path if red/red. Some airports serving large aircraft have three-bar VASI's which provide two visual guide paths to the same runway.

VISUAL FLIGHT RULES (VFR) - Rules that govern the procedures for conducting flight under visual conditions. The term VFR is also used in the United States to indicate weather conditions that are equal to or greater than minimum VFR requirements. In addition, it is used by pilots and controllers to indicate type of flight plan.

VOR - See "Very High Frequency Omnidirectional Range Station."

VORTAC - See "Very High Frequency Omnidirectional Range Station/Tactical Air Navigation."

YEARLY DAY-NIGHT AVERAGE SOUND LEVEL - See DNL.

TECHNICAL INFORMATION PAPER

Federal Aviation Noise Regulations

TECHNICAL INFORMATION PAPER

FEDERAL AVIATION NOISE REGULATIONS

As air travel expanded, residents living in close proximity to the nation's airports became increasingly concerned. Citizens began to form activist groups and take action against local policy makers and airport operators.

In the early days of commercial aviation, communities close to an airport were not greatly affected by the occasional propeller aircraft overflight. However, in the late 1960s and early 1970s, the problem of aircraft noise became increasingly apparent with the beginning of the jet age. The Deregulation Act of 1978 intensified the issue of airport noise as the act allowed for a more competitive environment between air carriers and the routes that they served. The increased competition brought better and more affordable services, an increase in demand, and an increase in jet noise.

As air travel expanded, residents living in close proximity to the nation's airports became increasingly concerned. Citizens began to form activist groups and take action against local policy makers and airport operators. With the increasing concerns, complaints and environmental awareness, the airport noise issue became a serious problem between the airports, airlines, and the residents living close to the nation's airports.

From a national perspective, aircraft noise became a concern in 1970 when federal agencies began studying the problem and developing planning guidelines. The National Environmental Policy Act of 1969 (NEPA) was the first act of federal legislation that required airport operators to study and analyze aircraft noise impacts

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before undertaking major development or improvement projects. For airport operators to gain approval for major projects, they had to develop an Environmental Impact Statement (EIS) that outlined the potential noise impacts of any proposed project on residents surrounding the airport.

After the NEPA was passed, the Department of Transportation (DOT) and the Federal Aviation Administration (FAA) adopted the Aviation Noise Abatement Policy (ANAP) in 1976. The ANAP clearly identified aircraft noise responsibilities for the FAA, air carriers, airport operators, and local jurisdictions.

The importance of airport noise impacts was first recognized at a national level in the *Aviation Safety and Noise Abatement Act of 1979*. This act required the FAA to adopt regulations establishing a single system of measuring aircraft noise and determining the exposure of individuals to noise in the vicinity of airports.

Reduction of aircraft noise impacts is a complex issue with several parties sharing in the responsibility: the federal government, state and local governments, planning agencies, the airport proprietor, airport users, airport manufacturers, and local residents. The purpose of this technical information paper is to provide a summary of the aviation noise regulations and responsibilities at the federal level.

Reduction of aircraft noise impacts is a complex issue with several parties sharing in the responsibility: the federal government, state and local governments, planning agencies, the airport proprietor, airport users, and local residents.

FEDERAL REGULATIONS

Aviation plays a vital role in interstate commerce. Recognizing this, the federal government has assumed the role of coordinator and regulator of the nation's aviation system. Congress has assigned administrative and regulatory authority to the Federal Aviation Administration (FAA) whose responsibilities include:

- The regulation of air commerce in order to promote its development, safety, and to fulfill the requirements of national defense.

- The promotion, encouragement, and development of civil aeronautics.

Congress passed legislation and the FAA established regulations governing the preparation of noise compatibility programs. Laws and regulations were also implemented that required the conversion of the commercial aircraft fleet to quieter aircraft.

- The control of the use of navigable airspace and the regulation of civil and military aircraft operations to promote the safety and efficiency of both.

- The development and operation of a common system of air traffic control and navigation for both military and civil aircraft.

The FAA also administers a program of federal grants-in-aid for the development of airport master plans, the acquisition of land, and for planning, design, and construction of eligible airport improvements. In addition, Congress passed legislation and the FAA established regulations governing the preparation of noise compatibility programs. Laws and regulations were also implemented that required the conversion of the commercial aircraft fleet to quieter aircraft. The following sections summarize these regulations found in Title 14 of the Code of Federal Regulations (14 CFR).

Part 150 Noise Compatibility Studies

The *Aviation Safety and Noise Abatement Act of 1979* (ASNA, P.L. 96-193), signed into law on February 18, 1980, was enacted, ". . . to provide and carry out noise compatibility programs, to provide assistance to assure continued safety in aviation, and for other purposes." The FAA was vested with the authority to implement and administer the Act.

Part 150, the administrative rule promulgated to implement the Act, sets requirements for airport operators who choose to undertake an airport noise compatibility study with federal funding assistance. Part 150 provides for the development of two final documents: the Noise Exposure Maps and the Noise Compatibility Program.

Noise Exposure Maps. The Noise Exposure Maps (NEM) document describes existing and future noise conditions at the airport. It can be thought of as a baseline analysis defining the scope of the noise situation at the airport and including maps of noise exposure for the current year, five-year, and long-range forecasts. The noise contours are depicted on various land use maps to reveal areas of non-compatible land use. Included in the document is detailed supporting information which explains the methods used to develop the maps.

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Part 150 establishes guidelines for the identification of land uses which are incompatible with different noise levels.

Part 150 requires the use of standard methodologies and metrics for analyzing and describing noise. It also establishes guidelines for the identification of land uses which are incompatible with different noise levels. Airport proprietors are required to update noise exposure maps when changes in the operation of the airport would create any new, substantial non-compatible use. This is defined as an increase in the yearly day-night average sound level (DNL) of 1.5 decibels over non-compatible land uses.

A limited degree of legal protection can be afforded to the airport proprietor through preparation of noise exposure maps. Section 47506 of the recodified Aviation Safety and Noise Abatement Act of 1979 (ASNA) provides that:

> A person acquiring an interest in property…in an area surrounding an airport for which a noise exposure map has been submitted…and having actual or constructive knowledge of the existence of the map may recover damages for noise attributable to the airport only if, in addition to any other elements for recovery of damages, the person shows that:
>
> (1) after acquiring the interest, there was a significant
> (A) change in the type or frequency of aircraft operations at the airport;
> (B) change in the airport layout;
> (C) change in flight patterns; or
> (D) increase in nighttime operations; and
>
> (2) the damages resulted from the change or increase.

The ASNA Act provides that "constructive knowledge" shall be attributed to any person if a copy of the noise exposure map was provided to him at the time of property acquisition, or if notice of the existence of the noise exposure map was published three times in a newspaper of general circulation in the area. In addition, Part 150 defines "significant increase" as an increase of 1.5 DNL. (See Part 150, Section 150.21 (d), (f), and (g); and *Airport Environmental Handbook*, Order 5050.4B, 9(n).) For purposes of this provision, FAA officials consider the term "area surrounding an airport" to mean an area within the 65 DNL contour.

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Acceptance of the noise exposure maps by the FAA is required before it will approve a noise compatibility program for the airport.

A Noise Compatibility Program (NCP) includes provisions for the abatement of aircraft noise through aircraft operating procedures, air traffic control procedures, airport regulations, or airport facility modifications.

Noise Compatibility Program. A Noise Compatibility Program (NCP) includes provisions for the abatement of aircraft noise through aircraft operating procedures, air traffic control procedures, airport regulations, or airport facility modifications. It also includes provisions for land use compatibility planning and may include actions to mitigate the impact of noise on noncompatible land uses. The program must contain provisions for updates and periodic revisions.

Part 150 establishes procedures and criteria for FAA evaluation of noise compatibility programs. Among these, two criteria are of particular importance: the airport proprietor may take no action that imposes an undue burden on interstate or foreign commerce, nor may the proprietor unjustly discriminate between different categories of airport users.

With an approved noise compatibility program, an airport proprietor becomes eligible for funding through the Federal Airport Improvement Program (AIP) to implement the eligible items of the program.

In 1998, the FAA established a policy for Part 150 approval and funding of noise mitigation measures which stated that the FAA will not approve measures in Noise Compatibility Programs that propose corrective noise mitigation actions for new, non-compatible development, which is allowed to occur in the vicinity of airports after October 1, 1998, the effective date of the policy. Therefore, corrective noise mitigation measures for non-compatible development that occurs after October 1, 1998 is not eligible for AIP funding under the noise set-aside regardless of previous FAA approvals under Part 150. This policy increased the incentives for airport operators to discourage the development of new non-compatible land uses around airports, and to assure the most cost-effective use of federal funds spent on noise mitigation measures.

The FAA has required reduction of aircraft noise at the source through certification, modification of engines, or replacement of aircraft.

14 CFR Part 36
Federal Aircraft Noise Regulations

The FAA has required reduction of aircraft noise at the source through certification, modification of engines, or replacement of aircraft. Part 36 prohibits the further escalation of noise levels of subsonic civil turbojet and transport category aircraft and also requires new airplane types to be markedly quieter than earlier models. Subsequent amendments have extended the noise standards to include large and small, propeller-driven airplanes and supersonic transport aircraft.

Part 36 has four stages of certification. Stage 4 is the most recent amendment, having been adopted in July, 2005 and applies to aircraft designs submitted for review after January 1, 2006. Stage 3 applies to aircraft certificated since November 5, 1975; Stage 2 applies to aircraft certificated between December 1, 1969 and November 5, 19 75; and Stage 1 includes all previously certificated aircraft.

Stage 4 certification standards for jet aircraft set the noise standard 10 decibels below the Stage 3 standards. These standards apply to all jet aircraft, regardless of weight. Aircraft weight restrictions are addressed in 14 CFR Part 91. The 10 dB reduction for Stage 4 aircraft is the cumulative total of noise reductions for three of the measurement points (approach, flyover, lateral). The standard requires that aircraft noise is reduced at two of the three measurement points. It is estimated that nearly all currently produced aircraft will be able to meet these requirements and therefore minimal benefits are expected for those communities surrounding airports. There is no planned phase-out of Stage 2 aircraft weighing less than 75,000 pounds or Stage 3 aircraft in this amendment.

14 CFR Part 91
Federal Aircraft Noise Regulations

Part 91, Subpart I, commonly known as the "Fleet Noise Rule," mandated a compliance schedule under which Stage 1 aircraft were to be retired or refitted with hush kits or quieter engines by January 1, 1988. A very limited number of exemptions have been granted by the U.S. Department of Transportation for foreign aircraft operating into specified international airports.

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Neither Part 36 nor Part 91 apply to military aircraft. Nevertheless, many of the advances in quiet engine technology are being used by the military as they upgrade aircraft to improve performance and fuel efficiency.

Pursuant to the Congressional mandate in the Airport Noise and Capacity Act of 1990 (ANCA), FAA has established amendments to Part 91 by setting December 31, 1999 as the date for discontinuing use of all Stage 2 aircraft exceeding 75,000 pounds. Stage 2 aircraft over 75,000 lbs. utilized for non-revenue flights can operate beyond the December 31, 1999 deadline for the following purposes:

- To sell, lease, or scrap the aircraft;
- To obtain modifications to meet Stage 3 standards;
- To obtain scheduled heavy maintenance or significant modifications;
- To deliver the aircraft to a lessee or return it to a lessor;
- To park or store the aircraft;
- To prepare the aircraft for any of these events; or
- To operate under an experimental airworthiness certificate.

Neither Part 36 nor Part 91 apply to military aircraft. Nevertheless, many of the advances in quiet engine technology are being used by the military as they upgrade aircraft to improve performance and fuel efficiency.

14 CFR Part 161
Regulation Of Airport Noise And Access Restrictions

Part 161 sets forth requirements for notice and approval of local restrictions on aircraft noise levels and airport access. Part 161, which was developed in response to the Airport Noise and Capacity Act of 1990, applies to local airport restrictions that would have the effect of limiting operations of Stage 2 or 3 aircraft. Restrictions regulated under Part 161 include direct limits on maximum noise levels, nighttime curfews, and special fees intended to encourage changes in airport operations to lessen noise.

In order to implement noise or access restrictions on Stage 2 aircraft, the airport operator must provide public notice of the proposal and provide at least a 45-day comment period. This includes notification of FAA and publication of the proposed restriction in the Federal

Register. An analysis must be prepared describing the proposal, alternatives to the proposal, and the costs and benefits of each.

Noise or access restrictions on Stage 3 aircraft can be implemented only after receiving FAA approval. Before granting approval, the FAA must find that the six conditions specified in the statute are met.

Noise or access restrictions on Stage 3 aircraft can be implemented only after receiving FAA approval. Before granting approval, the FAA must find that the six conditions specified in the statute, and listed below, are met.

(1) The restriction is reasonable, non-arbitrary, and nondiscriminatory.

(2) The restriction does not create an undue burden on interstate or foreign commerce.

(3) The proposed restriction maintains safe and efficient use of the navigable airspace.

(4) The proposed restriction does not conflict with any existing federal statute or regulation.

(5) The applicant has provided adequate opportunity for public comment on the proposed restriction.

(6) The proposed restriction does not create an undue burden on the national aviation system.

In its application for FAA review and approval of the restriction, the airport operator must include an environmental assessment of the proposal and a complete analysis addressing the six conditions. Within 30 days of the receipt of the application, the FAA must determine whether the application is complete. After a complete application has been filed, the FAA publishes a notice of the proposal in the Federal Register. FAA must approve or disapprove the restriction within 180 days of receipt of the completed application. Very few Part 161 studies have been undertaken since the enactment of ANCA. **Table 1A** summarizes the studies that have been done to date. Currently, only one Part 161 Study, in Naples, Florida, has been deemed complete by FAA. However, FAA has also ruled that the restriction is a violation of grant assurances Naples signed when accepting federal funds.

Airport operators that implement noise and access restrictions in violation of Part 161 are subject to termination of eligibility for airport grant funds and authority to impose and collect passenger facility charges.

TABLE 1A

SUMMARY OF PART 161 STUDIES

AIRPORT	YEAR STARTED	YEAR ENDED	COST	PROPOSAL, STATUS
Aspen-Pitken County Airport, Aspen, Colorado	N.A.	N.A.	N.A.	The study has not yet been submitted to FAA.
Kahului Airport, Kahului, Maui, Hawaii	1991	1994	$50,000 (est.)	Proposed nighttime prohibition of Stage 2 aircraft pursuant to court stipulation. Cost-benefit and statewide impact analysis found to be deficient by FAA. Airport never submitted a complete Part 161 Study. Suspended consideration of restriction.
Minneapolis-St. Paul International Airport, Minneapolis, Minnesota	1992	1992	N.A.	Proposed nighttime prohibition of Stage 2 aircraft. Cost-benefit analysis was deficient. Never submitted complete Part 161 study. Suspended consideration of restriction and entered into negotiations with carriers for voluntary cooperation.
Pease International Tradeport, Portsmouth, New Hampshire	1995	N.A.	N.A.	Have not yet submitted Part 161 Study for FAA review.
San Francisco International Airport, San Francisco, California	1998	1999	$200,000	Proposed extension of nighttime curfew on Stage 2 aircraft over 75,000 pounds. Started study in May 1998. Submitted to FAA in early 1999 and subsequently withdrawn.
San Jose International Airport San Jose, California	1994	1997	Phase 1 - $400,000 Phase 2 - $5 to $10 million (est.)	Study undertaken as part of legal settlement agreement. Studied a Stage 2 restriction. Suspended study after Phase 1 report showed costs to airlines at San Jose greater than benefits in San Jose. Never undertook Phase 2, systemwide analysis. Never submitted study for FAA review.
Burbank-Glendale-Pasadena Airport (Bob Hope Airport), Burbank, California	2000	Ongoing	Phase 1 - $2 to $4 million (est.) Phase 2 - $1.8 million	Phase 1 - Evaluation of a restrictive curfew of all operations between 10:00 p.m. and 7:00 a.m. has been completed. Phase 2 - Determination of whether an environmental impact review is necessary is underway.
Naples Municipal Airport Naples, Florida	1999	2003	Estimated cost of $1.0 to $1.5 million for consulting and legal fees due to litigation	Enactment of a total an on Stage 2 general aviation jet aircraft under 75,000 pounds. The airport began enforcing the restriction on March 1, 2002. FAA has deemed the Part 161 Study complete; however, FAA has ruled the restriction violated federal grant assurances.
Van Nuys Airport Van Nuys, California	2004	Ongoing	Estimated cost of $3.0 to $3.5 million	Review of multiple noise restriction measures including monetary fines for violations of noise abatement policies, a future capacity restriction, and a phase out of helicopter operations.
Los Angeles International Airport, Los Angeles, California	2005	Ongoing	N.A.	The Purpose of the study will be to prohibit east departures from 12:00 a.m. to 6:30 a.m.

N.A. - Not available.

Sources: Telephone interviews with Federal Aviation Administration officials and staffs of various airports.

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TECHNICAL INFORMATION PAPER

The Measurement and Analysis of Sound

TECHNICAL INFORMATION PAPER

THE MEASUREMENT AND ANALYSIS OF SOUND

Rock-and-roll on the stereo of the resident of apartment 3A is music to her ears, but it is intolerable racket to the next door neighbor in 3B.

Sound is energy — energy that conveys information to the listener. Although measuring this energy is a straightforward technical exercise, describing sound energy in ways that are meaningful to people is complex. This TIP explains some of the basic principles of sound measurement and analysis.

NOISE - UNWANTED SOUND

Noise is often defined as unwanted sound. For example, rock-and-roll on the stereo of the resident of apartment 3A is music to her ears, but it is intolerable racket to the next door neighbor in 3B. One might think that the louder the sound, the more likely it is to be considered noise. This is not necessarily true. In our example, the resident of apartment 3A is surely exposed to higher sound levels than her neighbor in 3B, yet she considers the sound as pleasant while the neighbor considers it "noise." While it is possible to measure the sound level objectively, characterizing it as "noise" is a subjective judgement.

The characterization of a sound as "noise" depends on many factors, including the information content of the sound, the familiarity of the sound, a person's control over the sound, and a person's activity at the time the sound is heard.

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A person's ability to hear a sound depends on its character as compared with all other sounds in the environment.

MEASUREMENT OF SOUND

A person's ability to hear a sound depends on its character as compared with all other sounds in the environment. Three characteristics of sound to which people respond are subject to objective measurement: magnitude or loudness; the frequency spectrum; and the time variation of the sound.

LOUDNESS

The unit used to measure the magnitude of sound is the decibel. Decibels are used to measure loudness in the same way that "inches" and "degrees" are used to measure length and temperature. Unlike the linear length and temperature scales, the decibel scale is logarithmic. By definition, a sound which has ten times the mean square sound pressure of the reference sound is 10 decibels (dB) greater than the reference sound. A sound which has 100 times (10 x 10 or 10^2) the mean square sound pressure of the reference sound is 20 dB greater (10 x 2).

The logarithmic scale is convenient because the mean square sound pressures of normal interest extend over a range of 11 trillion to one. This huge number (a "1" followed by 14 zeros or 10^{14}) is much more conveniently represented on the logarithmic scale as 140 dB (10 x 14).

The use of the logarithmic decibel scale requires different arithmetic than we use with linear scales. For example, if two equally loud but independent noise sources operate simultaneously, the measured mean square sound pressure from both sources will be twice as great as either source operating alone. When expressed on the decibel scale, however, the sound pressure level from the combined sources is only 3 dB higher than the level produced by either source alone. Furthermore, if we have two sounds of different magnitude from independent sources, then the level of the sum will never be more than 3 dB above the level produced by the greater source alone.

This equation describes the mathematics of sound level summation:

$$S_t = 10 \log \sum_i 10^{S_i/10}$$

where S_t is the total sound level, in decibels, and S_i is the sound level of the individual sources.

A simpler process of summation is also available and often used where a level of accuracy of less than one decibel is not required. Table 1 lists additive factors applicable to the difference between the sound levels of two sources.

TABLE 1

ADDITIVE FACTORS FOR SUMMATION OF TWO SOUND TYPES

DIFFERENCE IN SOUND LEVEL (DB)	ADD TO LARGER LEVEL (DB)	DIFFERENCE IN SOUND LEVEL (DB)	ADD TO LARGER LEVEL (DB)
0	3.0	8	0.6
1	2.5	9	0.5
2	2.1	10	0.4
3	1.8	12	0.3
4	1.5	14	0.2
5	1.2	16	0.1
6	1.0	Greater than 16	0
7	0.8		

Source: HUD 1985, p. 51.

The loudest sound levels are the dominant influence in the averaging process.

The noise values to be added should be arrayed from lowest to highest. The additive factor derived from the difference between the lowest and next highest noise level should be added to the higher level. An example is shown below.

EXAMPLE OF SOUND LEVEL SUMMATION

59.0 dB
60.0 dB } Add 2.5 to 60 = 62.5
66.5 dB } Add 1.5 to 66.5 = 68

59 dB + 60 dB + 66.5 dB = 68 dB

Logarithmic math also produces interesting results when averaging sound levels. As the following example shows, the loudest sound levels are the dominant influence in the averaging process. In the example, two sound levels of equal duration are averaged. One is 100 dB; the other 50 dB. The result is not 75 as it would be with linear math but 97 dB. This is because 100 dB contains 100,000 times the sound energy as 50 dB.

Scientists researching human hearing have determined that most people perceive a 10 dB increase in sound energy over a given frequency range as roughly a doubling of the loudness.

Another interesting attribute of sound is the human perception of loudness. Scientists researching human hearing have determined that most people perceive a 10 dB increase in sound energy over a given frequency range as, roughly, a doubling of the loudness. Recalling the logarithmic nature of the decibel scale, this means that most people perceive a ten-fold increase in sound energy as a two-fold increase in loudness (Kryter 1984, p. 188). Furthermore, when comparing sounds over the same frequency range, most people cannot distinguish between sounds varying by less than two or three decibels.

Exhibit A presents examples of various noise sources at different noise levels, comparing the decibel scale with the relative sound energy and the human perception of loudness. In the exhibit, 60 dB is taken as the reference or "normal" sound level. A sound of 70 dB, involving ten times the sound energy, is perceived as twice as loud. A sound of 80 dB contains 100 times the sound energy and is perceived as four times as loud as 60 dB. Similarly, a sound of 50 dB contains ten times less sound energy than 60 dB and is perceived as half as loud.

FREQUENCY WEIGHTING

Two sounds with the same sound pressure level may "sound" quite different (e.g., a rumble versus a hiss) because of differing distributions of sound energy in the audible frequency range. The distribution of sound energy as a function of frequency is known as the "frequency spectrum." The spectrum is important to the measurement of sound because the human ear is more sensitive to sounds at some frequencies than others. People hear best in the frequency range of 1,000 to 5,000 cycles per second (Hertz) than at very much lower or higher frequencies. If the magnitude of a sound is to be measured so that it is proportional to its perception by a human, it is necessary to weight more heavily that part of the sound energy spectrum humans hear most easily.

Over the years, many different sound measurement scales have been developed, including the A-weighted scale (and also the B, C, D, and E-weighted scales). A-weighting, developed in the 1930s, is the most

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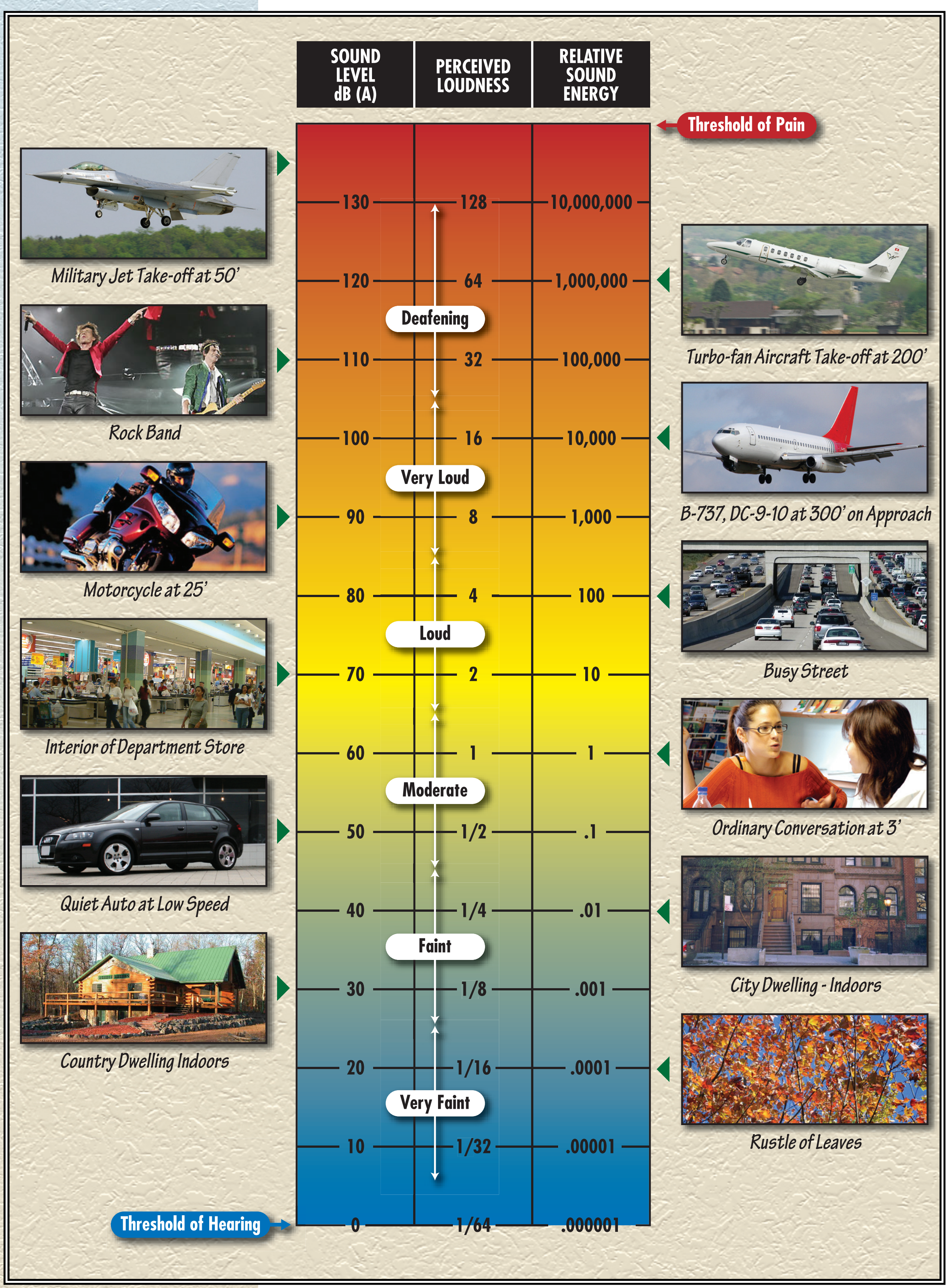
TYPICAL SOUND LEVELS



An important advantage of the Leq metric is that it correlates well with the effects of noise on humans.

commonly used scale for approximating the frequency spectrum to which humans are sensitive. Because of its universality, it was adopted by the U.S. Environmental Protection Agency and other government agencies for the description of sound in the environment.

The zero value on the A-weighted scale is the reference pressure of 20 micro-newtons per square meter (or micro-pascals). This value approximates the smallest sound pressure that can be detected by a human. The average sound level of a whisper at a distance of 1 meter is 40 dB; the sound level of a normal voice at 1 meter is 57 dB; a shout at 1 meter is 85 dB; and the threshold of pain is 130 dB.

TIME VARIATION OF SOUND LEVEL

Generally, the magnitude of sound in the environment varies randomly over time. Of course, there are many exceptions. For example, the sound of a waterfall is steady with time, as is the sound of a room air conditioner or the sound inside a car or airplane cruising at a constant speed. But, in most places, the loudness of outdoor sound is constantly changing because it is influenced by sounds from many sources.

While the continuous variation of sound levels can be measured, recorded, and presented, comparisons of sounds at different times or at different places is very difficult without some way of reducing the time variation. One way of doing this is to calculate the value of a steady-state sound which contains the same amount of sound energy as the time-varying sound under consideration. This value is known as the Equivalent Sound Level (Leq). An important advantage of the Leq metric is that it correlates well with the effects of noise on humans. On the basis of research, scientists have formulated the "equal energy rule." It is the total sound energy perceived by a human that accounts for the effects of the sound on the person. In other words, a very loud noise lasting a short time will have the same effect as a quieter noise lasting a longer time if the total energy of both sound events (the Leq value) is the same.

KEY DESCRIPTORS OF SOUND

The SEL is the quantity that best describes the total noise from an aircraft overflight.

Four descriptors or metrics are useful for quantifying sound (Newman and Beattie 1985, pp. 9-15). All are based on the logarithmic decibel (dB) scale and incorporate A-weighting to account for the frequency response of the ear.

Sound Level

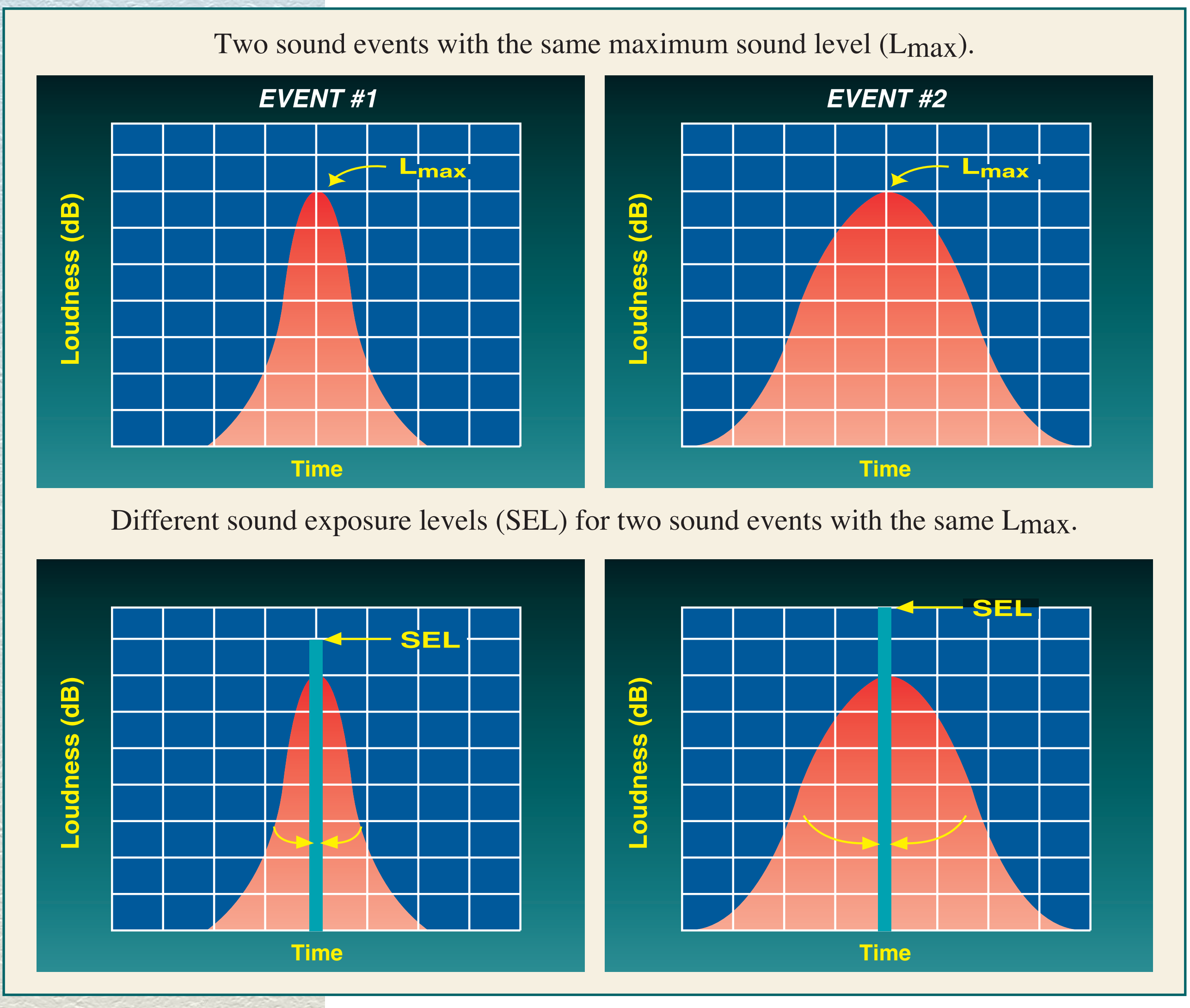
The sound level (L) in decibels is the quantity read on an ordinary sound level meter. It fluctuates with time following the fluctuations in magnitude of the sound. Its maximum value (Lmax) is one of the descriptors often used to characterize the sound of an airplane overflight. However, Lmax only gives the maximum magnitude of a sound — it does not convey any information about the duration of the sound. Clearly, if two sounds have the same maximum sound level, the sound which lasts longer will cause more interference with human activity.

Sound Exposure Level

Both loudness and duration are included in the Sound Exposure Level (SEL), which adds up all sound occurring in a stated time period or during a specific event, integrating the total sound over a one-second duration. The SEL is the quantity that best describes the total noise from an aircraft overflight. Based on numerous sound measurements, the SEL from a typical aircraft overflight is usually four to seven decibels higher than the Lmax for the event.

Exhibit B shows graphs of two different sound events. In the top half of the graph, we see that the two events have the same Lmax, but the second event lasts longer than the first. It is clear from the graph that the area under the noise curve is greater for the second event than the first. This means that the second event contains more total sound energy than the first, even though the peak levels for each event are the same. In the bottom half of the graph, the Sound Exposure Levels (SELs) for each event are compared. The SELs are computed by mathematically compressing the total sound energy into a one-second period. The SEL for the second event is

COMPARISON OF L_{max} AND SEL



greater than the SEL for the first. Again, this simply means that the total sound energy for the second event is greater than for the first.

Equivalent Sound Level

The equivalent sound level (Leq) is simply the logarithm of the average value of the sound exposure during a stated time period. It is typically used for durations of one hour, eight hours, or 24 hours. In airport noise compatibility studies, use of the Leq term applies to 24-hour periods unless otherwise noted. It is often used to describe sounds with respect to their potential for interfering with human activity.

The multiplication factor of 10 applied to nighttime sound is often referred to as a 10 decibel penalty. It is intended to account for the increased annoyance attributable to noise during the night when ambient levels are lower and people are trying to sleep.

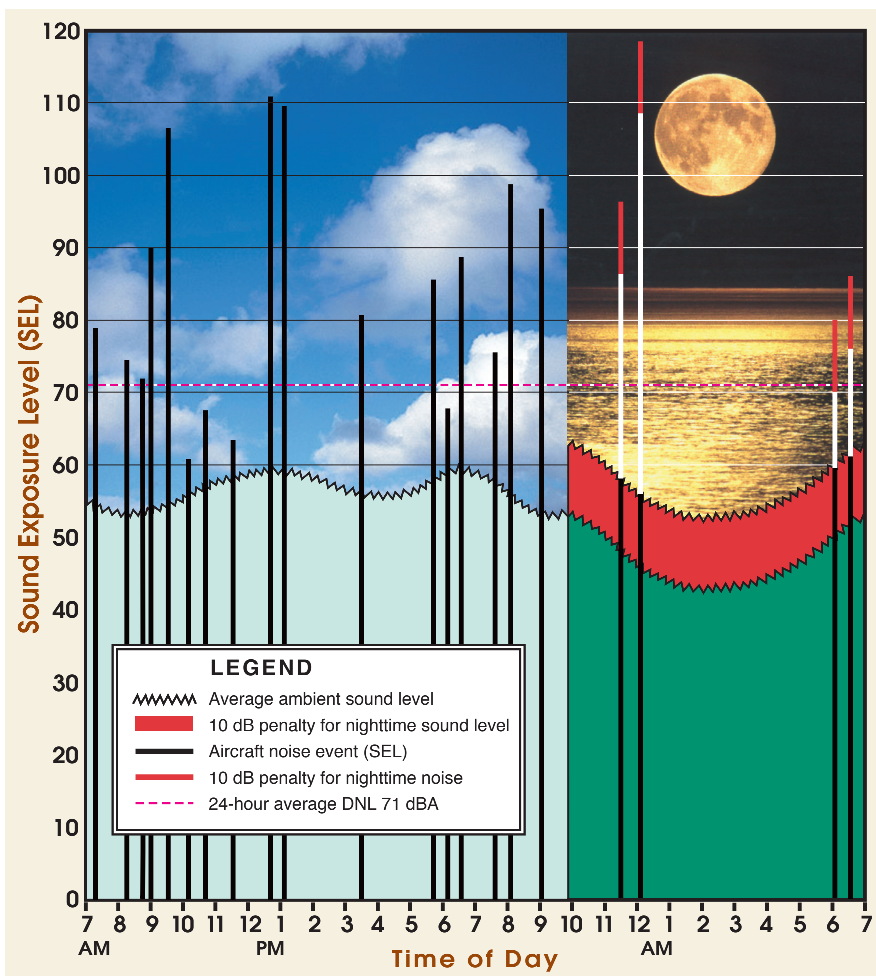
Day-Night Sound Level

A special form of Leq is the day-night sound level, abbreviated as DNL in discussions and Ldn in equations. DNL is calculated by summing the sound exposure during daytime hours (0700 - 2200) plus 10 times the sound exposure occurring during nighttime hours (2200 - 0700) and averaging this sum by the number of seconds during a 24-hour day. The multiplication factor of 10 applied to nighttime sound is often referred to as a 10 decibel penalty. It is intended to account for the increased annoyance attributable to noise during the night when ambient levels are lower and people are trying to sleep.

Exhibit C shows how the sound occurring during a 24-hour period is weighted and averaged by the DNL descriptor (or metric). In that example, the sound

EXHIBIT C

TYPICAL NOISE PATTERN AND DNL SUMMATION



Source: Coffman Associates 2003

occurring during the period, including aircraft noise and background sound, yields a DNL value of 71. As a practical matter, this is a reasonably close estimate of the aircraft noise alone because, in this example, the background noise is low enough to contribute only a little to the overall DNL value during the period of observation.

Where the basic element of sound measurement is Leq, DNL is calculated from:

$$Ldn = 10\log \frac{1}{24}\left(\sum_{d=1}^{15} 10^{[Leq(d)]/10} + \sum_{n=1}^{9} 10^{[Leq(n)+10]/10}\right)$$

where DNL is represented mathematically as Ldn, and Leq(d) and Leq(n) are the daytime and nighttime hour values combined. This expression is convenient where Leq values for only a few hours are available and the values for the remainder of the day can be predicted from a knowledge of day/night variation in levels. The hourly Leq values are summed for the 15 hours from 0700 to 2200 and added to the sum of hourly Leq figures for the 9 nighttime hours with a 10 dB penalty added to the nighttime Leqs.

Another way of computing DNL is described in this equation:

$$Ldn = 10\log \frac{1}{86400}\left(\int_{day} 10^{LA/10} dt + \int_{night} 10^{(LA+10)} dt\right)$$

where LA is the time-varying, A-weighted sound level, measured with equipment meeting the requirements for sound level meters (as specified in a standard such as ANSI SI.4-1971), and dt is the duration of time in seconds. The averaging constant of 86,400 is the number of seconds in a day. The integrals are taken over the daytime (0700 - 2200) and the nighttime (2200 - 0700) periods, respectively. If the sound level is sampled at a rate of once per second rather than measured continuously, the equation still applies if the samples replace LA and the integrals are changed to summations.

The DNL developed over a long period of time, for example one year, defines the noise environment of the area, allowing us to make predictions about the average response of people living in areas exposed to various DNL levels.

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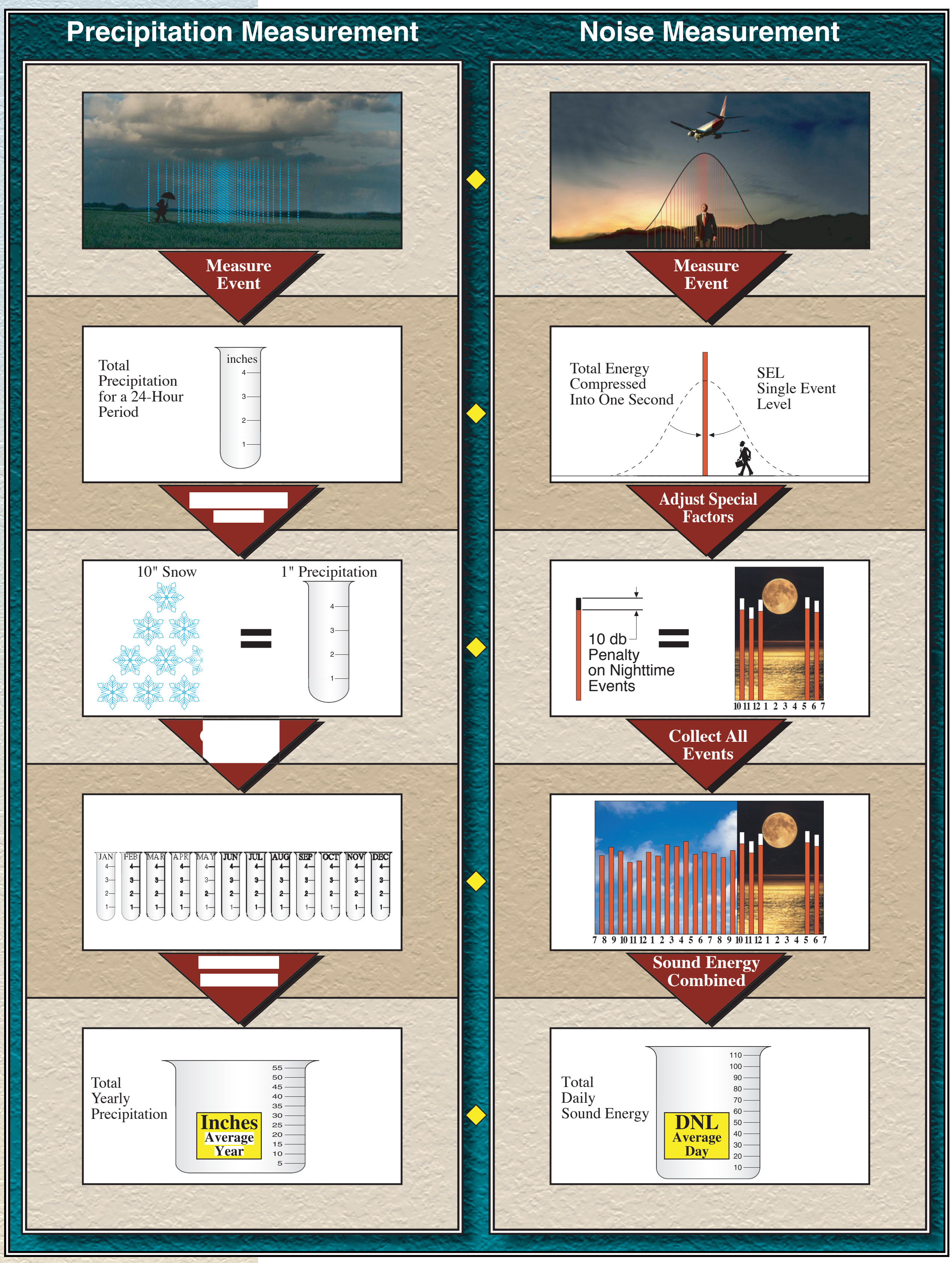
Use of the DNL metric to describe aircraft noise is required for all airport noise studies developed under the regulations of F.A.R. Part 150. In addition, DNL is preferred by all federal agencies as the appropriate single measure of cumulative sound exposure. These agencies include the FAA, the Federal Highway Administration, Environmental Protection Agency, Department of Defense, and Department of Housing and Urban Development.

One might think of the DNL metric as a summary description of the "noise climate" of an area. DNL accumulates the noise energy from passing aircraft in the same way that a precipitation gauge accumulates rain from passing storms. This analogy is presented in **Exhibit D**. Rain usually starts as a light sprinkle, building in intensity as the squall line passes over, then diminishing as the squall moves on. At the end of a 24-hour period, a rain gauge indicates the total rainfall received for that day, although the rain fell only during brief, sometimes intense, showers. Over a year, total precipitation is summarized in inches. When snow falls, it is converted to its equivalent measure as water. Although the total volume of precipitation during the year may be billions or trillions of gallons of water, its volume is expressed in inches because it provides for easier summation and description. We have learned how to use total annual precipitation to describe the climate of an area and make predictions about the environment.

Aircraft noise is similar to precipitation. The noise level from a single overflight begins quietly and builds in intensity as the aircraft draws closer. The sound of the aircraft is loudest as it passes over the receiver, diminishing as it passes. The total noise occurring during the event is accumulated and described as a Sound Exposure Level (SEL). Over a 24-hour period, the SELs can be summed, adding a special 10-decibel factor for nighttime noise, yielding a DNL value. The DNL developed over a long period of time, for example one year, defines the noise environment of the area, allowing us to make predictions about the average response of people living in areas exposed to various DNL levels.

EXHIBIT D

PRECIPITATION AND NOISE MEASUREMENT COMPARISON



Source: Coffman Associates 1990

HELPFUL RULES-OF-THUMB

Despite the complex mathematics involved in noise analysis, several simple rules-of-thumb can help in understanding the noise evaluation process.

- *When sound events are averaged, the loud events dominate the calculation.*

- *A 10 decibel change in noise is equal to a tenfold change in sound energy. For example, the noise from ten aircraft is ten decibels louder than the noise from one aircraft of the same type, operated in the same way.*

- *Most people perceive an increase of 10 decibels as a relative doubling of the sound level.*

- *The DNL metric assumes one nighttime operation (between 10:00 p.m. and 7:00 a.m.) is equal in impact to ten daytime operations by the same aircraft.*

- *A doubling of aircraft operations results in a three decibel noise increase if done by the same aircraft operated in the same way.*

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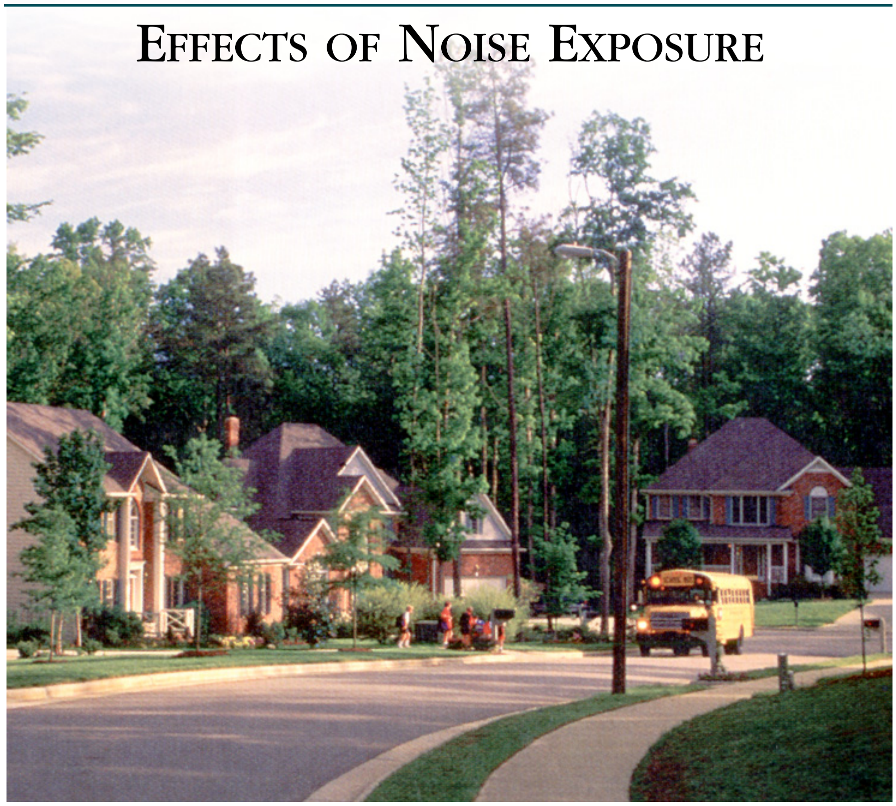
TECHNICAL INFORMATION PAPER

Effects of Noise Exposure

Technical Information Paper

Effects of Noise Exposure



Studies which examined hearing loss among people living near airports found that, under normal circumstances, people in the community near an airport are at no risk of suffering hearing damage from aircraft noise.

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Aircraft noise can affect people both physically and psychologically. It is difficult, however, to make sweeping generalizations about the impacts of noise on people because of the wide variations in individual reactions. While much has been learned in recent years, some physical and psychological responses to noise are not yet fully understood and continue to be debated by researchers.

EFFECTS ON HEARING

Hearing loss is the major health danger posed by noise. A study published by the U.S. Environmental Protection Agency (1974) found that exposure to noise of 70 Leq or higher on a continuous basis, over a very long time, at the human ear's most damage-sensitive frequency, may result in a very small but permanent loss of hearing. (Leq is a pure noise dosage metric, measuring cumulative noise energy over a given time.)

In Aviation Noise Effects (Newman and Beattie, 1985, pp. 33-42), three studies are cited which examined hearing

Airport noise in areas off airport property is far too low to be considered potentially damaging to hearing. Those most at risk [of hearing loss] are personnel in the transportation industry, especially airport ground staff.

loss among people living near airports. They found that, under normal circumstances, people in the community near an airport are at no risk of suffering hearing damage from aircraft noise.

The Occupational Safety and Health Administration (OSHA) has established standards for permissible noise exposure in the work place to guard against the risk of hearing loss. Hearing protection is required when noise levels exceed the legal limits. The standards, shown in **Table 1**, establish a sliding scale of permissible noise levels by duration of exposure. The standards permit noise levels of up to 90 dBA for eight hours per day without requiring hearing protection. The regulations also require employers to establish hearing conservation programs where noise levels exceed 85 Leq during the 8-hour workday. This involves the monitoring of work place noise, the testing of employees' hearing, the provision of hearing protectors to employees at risk of hearing loss, and the establishment of a training program to inform employees about the effects of work place noise on hearing and the effectiveness of hearing protection devices.

TABLE 1

PERMISSIBLE NOISE EXPOSURE - OSHA STANDARDS

DURATION PER DAY, HOURS	SOUND LEVEL dBA SLOW RESPONSE	DURATION PER DAY, HOURS	SOUND LEVEL dBA SLOW RESPONSE
8	90	$1^1/_2$	102
6	92	1	105
4	95	$^1/_2$	110
3	97	$^1/_4$ or less	115
2	100		

Source: 29 CFR Ch. XVII, Section 1910.95(b)

Experience at other airports has shown that even at sites with cumulative noise exposure near 75 DNL, the total time noise levels exceed 80 dBA typically ranges from 10 to 20 minutes, far below the critical hearing damage thresholds (Coffman Associates 1993, pp. 2-11). This supports the conclusion that airport noise in areas off airport property is far too low to be considered potentially damaging to hearing.

With respect to the risk of hearing loss, the authors of an authoritative summary of the research conclude: "Those most at risk (of hearing loss) are personnel in the transportation industry, especially airport ground staff.

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Beyond this group, it is unlikely that the general public will be exposed to sustained high levels of transportation noise sufficient to result in hearing loss. Transportation noise control in the community can therefore not be justified on the grounds of hearing protection." (See Taylor and Wilkins 1987.)

NON-AUDITORY HEALTH EFFECTS

It is sometimes claimed that aviation noise can harm the general physical and mental health of airport neighbors. Effects on the cardiovascular system, mortality rates, birth weights, achievement scores, and psychiatric admissions have been examined in the research literature. The question of pathological effects remains unsettled because of conflicting findings based on differing methodologies and uneven study quality. It is quite possible that the contribution of noise to pathological effects is so low that it has not been clearly isolated. While research is continuing, there is insufficient scientific evidence to support these concerns (Newman and Beattie 1985, pp. 59-62). Taylor and Wilkins (1987, p. 4/10) offer the following conclusions in their review of the research.

The evidence of non-auditory effects of transportation noise is more ambiguous, leading to differences of opinion regarding the burden of prudence for noise control. There is no strong evidence that noise has a direct causal effect on such health outcomes as cardiovascular disease, reproductive abnormality, or psychiatric disorder. At the same time, the evidence is not strong enough to reject the hypothesis that noise is in someway involved in the multi-causal process leading to these disorders. . . . But even with necessary improvements in study design, the inherent difficulty of isolating the effect of a low dose agent such as transportation noise within a complex aetiological system will remain. It seems unlikely, therefore, that research in the near future will yield findings which are definitive in either a positive or negative direction. Consequently, arguments for transportation noise control will probably continue to be based primarily on welfare criteria such as annoyance and activity disturbance.

Case studies on mental illness and hypertension indicate that this conclusion remains valid. Yoshida and Nakamura (1990) found that long-term exposure to

There is no strong evidence that noise has a direct causal effect on such health outcomes as cardiovascular disease, reproductive abnormality, or psychiatric disorder.

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Reviews of laboratory research on sleep disturbance report that the level of noise which can cause awakenings or interfere with falling asleep ranges from 35 dBA to 80 dBA, depending on the sleep stage and variability among individuals.

sound pressure levels above 65 DNL may contribute to reported ill effects on mental well-being. This case study, however, concluded that more research is needed because the results also contained some contrary effects, indicating that in some circumstances, ill effects were negatively correlated with increasing noise.

Griefahn (1992) studied the impact of noise exposure ranging from 62 dBA to 80 dBA on people with hypertension. She found that there is a tendency for vasoconstriction to increase among untreated hypertensive people as noise levels increase. However, she also found that beta-blocking medication prevented any increase in vasoconstriction attributable to noise. She concluded that while noise may be related to the onset of hypertension, especially in the presence of other risk factors, hypertensive people do not run a higher risk of ill-health effects if they are properly treated.

A three-year study sponsored by the European Commission titled Road Traffic and Aircraft Noise Exposure and Children's Cognition and Health (RANCH) studied nearly 3,000 children in schools located near busy roads and airports. The study evaluated the effects of chronic noise exposure on children's reading development. The study suggests that long-term noise exposure can delay a child's reading age up to two months. Additionally, the study found that persistent noise exposure increases the level of annoyance in children. While the effect was found to be significant, researchers felt it was small in magnitude and that the long-term effects remain unclear.

SLEEP DISTURBANCE

There is a large body of research documenting the effect of noise on sleep disturbance, but the long-range effects of sleep disturbance caused by nighttime airport operations are not well understood. It is clear that sleep is essential for good physical and emotional health, and noise can interfere with sleep, even when the sleeper is not consciously awakened. While the long-term effect of sleep deprivation on mental and physical function is not clear, it is known to be harmful. It is also known that sleepers do not fully adjust to noise disruption over time. Although they may awaken less often and have fewer conscious memories of disturbance, noise-induced shifts in sleep levels continue to occur.

Research has shown that, when measured through awakenings, people tend to become somewhat accustomed to noise.

Reviews of laboratory research on sleep disturbance report that the level of noise which can cause awakenings or interfere with falling asleep ranges from 35 dBA to 80 dBA, depending on the sleep stage and variability among individuals (Newman and Beattie 1985, pp. 51-58; Kryter 1984, pp. 422-431). There is evidence that older people tend to be much more sensitive to noise-induced awakenings than younger people. Research has shown that, when measured through awakenings, people tend to become somewhat accustomed to noise. On the other hand, electroencephalograms, which reveal information about sleep stages, show little habituation to noise. Kryter describes these responses to noise as "alerting responses." He suggests that because they occur unconsciously, they may simply be reflexive responses, reflecting normal physiological functions which are probably not a cause of stress to the organism.

Most studies of sleep disturbance have been conducted under controlled laboratory conditions. The laboratory studies do not allow generalizations about the potential for sleep disturbance in an actual airport setting, and, more importantly, the impact of these disturbances on the residents. Furthermore, the range of sound levels required to cause sleep disturbance, ranging from a whisper to a shout (35 dB to 80 dB), and the prevalence of sleep disruption in the absence of any noise, greatly complicates the making of reasonable generalizations about the effect of noise on sleep.

Fortunately, some studies have examined the effect of nighttime noise on sleep disturbance in actual community settings. One report summarizes the results of eight studies conducted in homes (Fields 1986). Four studies examined aircraft noise, the others highway noise. In all of them, sleep disturbance was correlated with cumulative noise exposure metrics such as Leq and L10. All studies showed a distinct tendency for increased sleep disturbance as cumulative noise exposure increased. The reviewer notes, however, that sleep disturbance was very common, regardless of noise levels, and that many factors contributed to it. He points out that, "the prevalence of sleep disturbance in the absence of noise means that considerable caution must be exercised in interpreting any reports of sleep disturbance in noisy areas."

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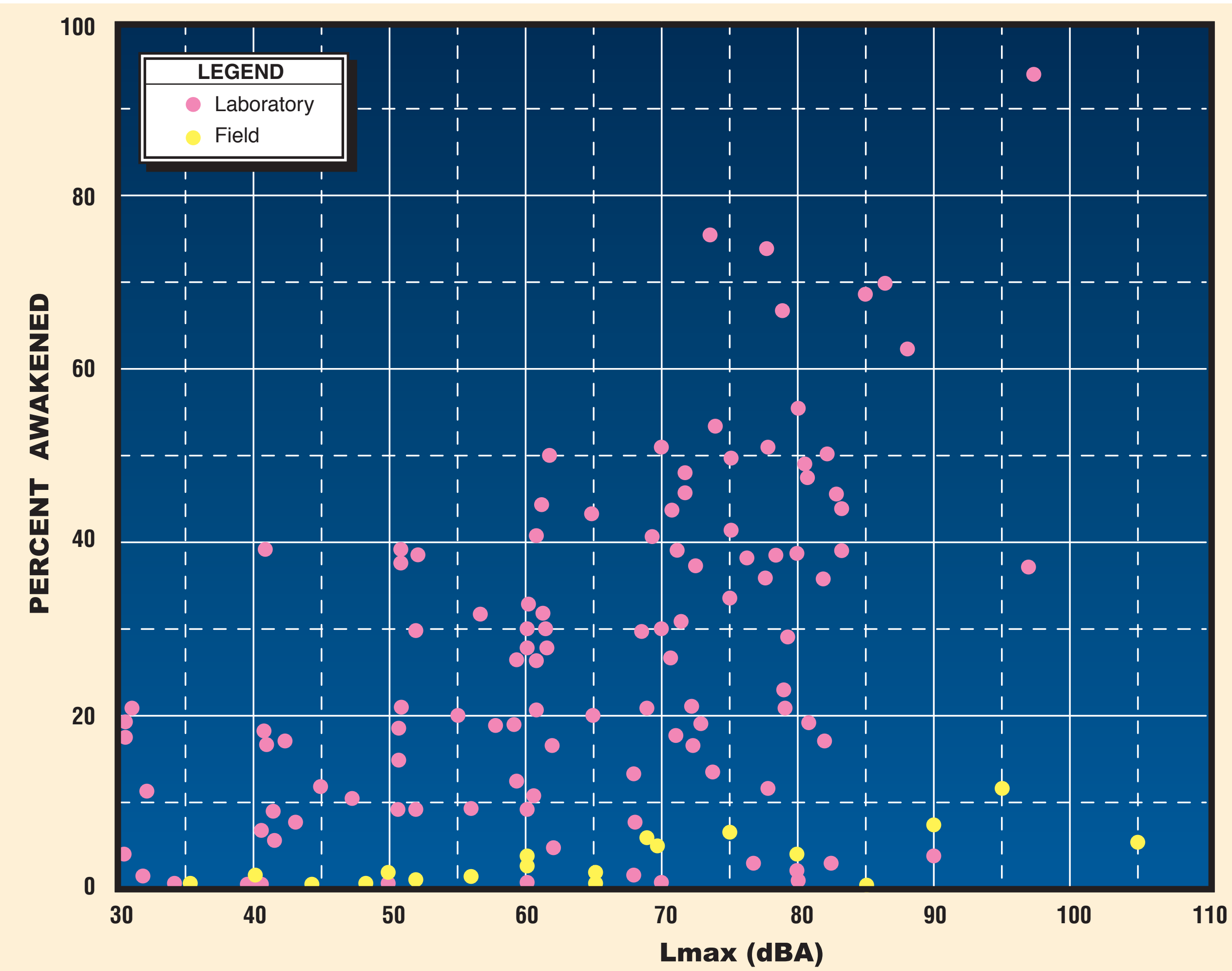
A review of the literature, Pearsons, et al. (1990), compared the data and findings of laboratory and field studies conducted in the homes of subjects. They found that noise-induced awakenings in the home were much less prevalent than in the laboratory. They also found that much higher noise levels were required to induce awakenings in the home than in the laboratory. **Exhibit A** compares the percentage of people awakened at different sound levels in laboratory and field studies. The graph clearly shows a marked tendency for people in laboratory settings to be much more sensitive to noise than in their homes. The reason for the large difference is apparently that people in their homes are fully habituated to their environment, including the noise levels.

EXHIBIT A

COMPARISON OF AWAKENING DUE TO NOISE EVENTS FROM LABORATORY VERSUS FIELD STUDIES



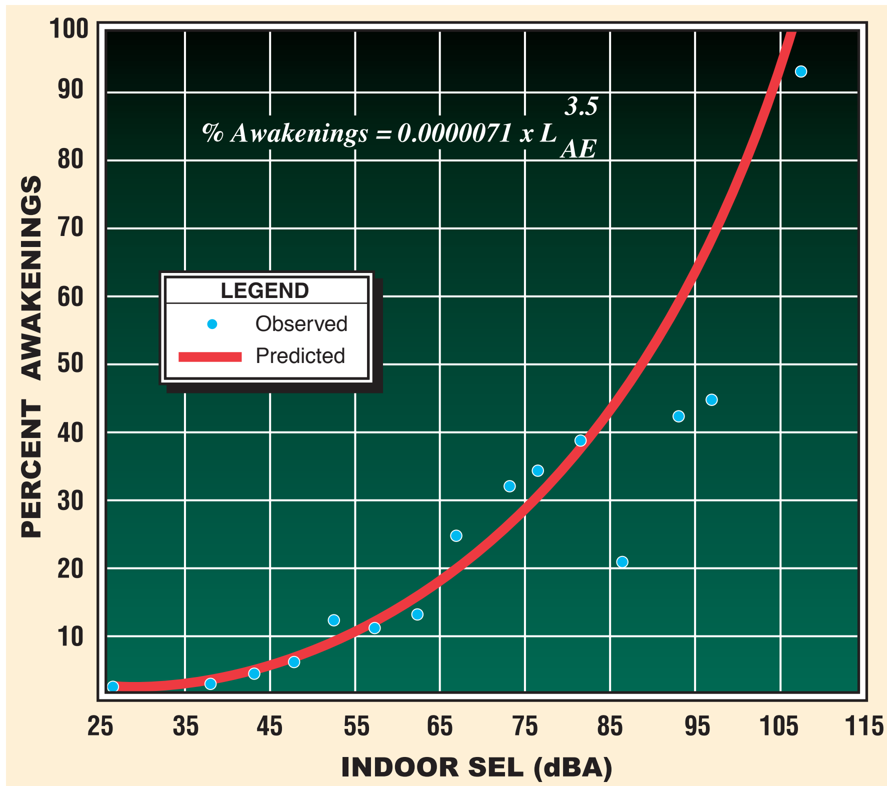
Source: Pearson, K.S. et al. 1990.

The findings of many of these sleep disturbance studies are of little usefulness to policy-makers and airport residents. For them, the important question is, "When does sleep disturbance caused by environmental noise become severe enough to constitute a problem in the community?"

Finegold et al. (1994) reviewed the data in the Pearsons report of 1990 and developed a regression analysis. As shown in **Exhibit B**, an exponential curve was found to fit the categorized data reasonably well. They recommend that this curve be used as a provisional means of predicting potential sleep disturbance from aircraft noise. They caution that because the curve was derived using Pearsons' laboratory, as well as in-home data, the predictions of sleep disruption in an actual community setting derived from this curve are likely to be high.

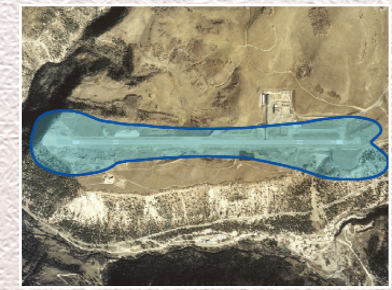
EXHIBIT B

FINEGOLD'S SLEEP DISTURBANCE CURVE



Source: Finegold et al. 1994.
Note: Based on laboratory and field data reported in Pearsons et al. 1989.

The findings of many of these sleep disturbance studies, while helping to answer basic research questions, are of little usefulness to policy-makers and airport residents. For them, the important question is, "When does sleep disturbance caused by environmental noise become severe enough to constitute a problem in the community?" Kryter (1984, pp. 434-443) reviews in detail one important study that sheds light on this question. The Directorate of Operational Research and Analysis (DORA) of the British Civil Aviation Authority conducted an in-depth survey of 4,400 residents near London's Heathrow and Gatwick Airports over a four-month period in 1979 (DORA 1980). The study was intended to answer two policy-related questions: "What is the level of aircraft noise which will disturb a sleeping person?" and "What level of aircraft noise prevents people from getting to sleep?"



The 65 DNL contour defines a noise impact envelope which encompasses all of the area within which significant sleep disturbance may be expected.

Analysis of the survey results indicated that the best correlations were found using cumulative energy dosage metrics, namely Leq. Kryter notes that support for the use of the Leq metric is provided by the finding that some respondents could not accurately recall the time association of a specific flight with an arousal from sleep. This suggests that the noise from successive overflights increased the general state of arousability from sleep.

With regard to difficulty in getting to sleep, the study found 25 percent of the respondents reporting this problem at noise levels of 60 Leq, 33 percent at 65 Leq, and 42 percent at 70 Leq. The percentage of people who reported being awakened at least once per week by aircraft noise was 19 percent at 50 Leq, 24 percent at 55 Leq, and 28 percent at 60 Leq. The percentage of people bothered "very much" or "quite a lot" by aircraft noise at night when in bed was 22 percent at 55 Leq and 30 percent at 60 Leq. Extrapolation of the trend line would put the percentage reporting annoyance at 65 Leq well above 40 percent.

DORA concluded with the following answers to the policy-related questions: (1) A significant increase in reports of sleep arousal will occur at noise levels at or above 65 Leq; (2) A significant increase in the number of people reporting difficulty in getting to sleep will occur at noise levels at or above 70 Leq. Kryter disagrees with these findings. He believes that a more careful reflection upon the data leads to the conclusion that noise levels approximately 10 decibels lower would represent the appropriate thresholds — 55 and 60 Leq.

At any airport, the 65 DNL contour developed from total daily aircraft activity will be larger than the 55 Leq developed from nighttime activity only. (At an airport with only nighttime use, the 65 DNL contour will be identical with the 55 Leq contour because of the effect of the 10 dB penalty in the DNL metric.) Thus, the 65 DNL contour defines a noise impact envelope which encompasses all of the area within which significant sleep disturbance may be expected based on Kryter's interpretation of the DORA findings discussed above. A

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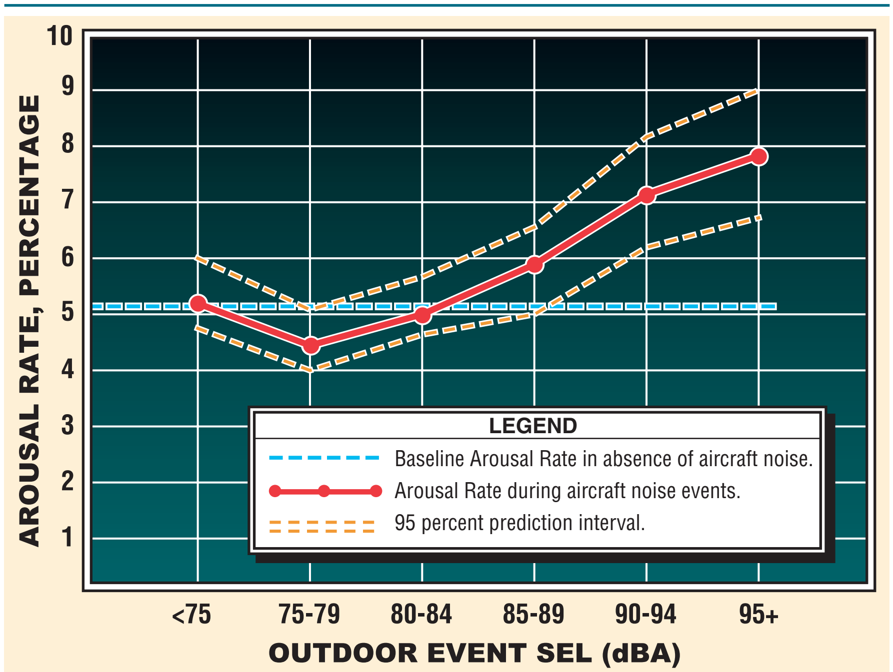
Researchers found that for aircraft noise events below 90 SEL, as measured outdoors, there was likely to be no measurable increase in rates of sleep disturbance.

study was conducted by the British Civil Aviation Authority to examine the relationship of nighttime aircraft noise and sleep disturbance near four major airports — Heathrow, Gatwick, Stansted, and Manchester (Ollerhead, et al. 1992). A total of 400 subjects were monitored for a total of 5,742 subject-nights. Nightly awakenings were found to be very common as part of natural sleep patterns. Researchers found that for aircraft noise events below 90 SEL, as measured outdoors, there was likely to be no measurable increase in rates of sleep disturbance. (The indoor level can be roughly estimated as approximately 20 to 25 decibels less than the outdoor level.) Where noise events ranged from 90 to 100 SEL, a very small rate of increase in disturbance was possible. Overall, rates of sleep disturbance were found to be more closely correlated with sleep stage than with periods of peak aircraft activity. That is, sleep was more likely to be disrupted, from any cause, during light stages than during heavy stages.

Exhibit C shows the relationship between arousal from sleep and outdoor sound exposure levels (SELs) found in the 1992 British study. The results have been statistically adjusted to control for the effects of individual variability in sleep disturbance. The study found that the arousal

EXHIBIT C

RELATIONSHIP BETWEEN AVERAGE SLEEP DISTURBANCE AND AIRCRAFT NOISE LEVEL



Source: Ollerhead, J.B. et al. 1992, p. 25.
Note: Estimates controlled for the effects of individual arousability.

While vibration contributes to annoyance reported by residents near airports, especially when it is accompanied by high audible sound levels, it rarely carries enough energy to damage safely constructed structures.

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rate for the average person, with no aircraft noise, was 5.1 percent. Aircraft noise of less than SEL 90 dBA was found not to be statistically significant as a cause of sleep disturbance. (According to the study, this would correspond to an Lmax of approximately 81 dBA. Lmax is the loudest sound the human ear would actually hear during the 90 SEL noise event. The interior Lmax would be approximately 20 to 25 decibels less — roughly 56 to 61 dBA.) The 95 percent prediction interval is shown on the graph not to rise above the 5.1 percent base arousal rate until it is above 90 dBA. Again, it should be emphasized that these conclusions relate to the average person. More easily aroused people will be disturbed at lower noise levels, but they are also more likely to be aroused from other sources (Ollerhead, et al. 1992).

STRUCTURAL DAMAGE

Structural vibration from aircraft noise in the low frequency ranges is sometimes a concern of airport neighbors. While vibration contributes to annoyance reported by residents near airports, especially when it is accompanied by high audible sound levels, it rarely carries enough energy to damage safely constructed structures. High-impulse sounds such as blasting, sonic booms, and artillery fire are more likely to cause damage than continuous sounds such as aircraft noise. A document published by the National Academy of Sciences suggested that one may conservatively consider noise levels above 130 dB lasting more than one second as potentially damaging to structures (CHABA 1977). Aircraft noise of this magnitude occurs on the ramp and runway and seldom, if ever, occurs beyond the boundaries of a commercial or general aviation airport.

The risk of structural damage from aircraft noise was studied as part of the environmental assessment of the Concorde supersonic jet transport. The probability of damage from Concorde overflights was found to be extremely slight. Actual overflight noise from the Concorde at Sully Plantation near Dulles International Airport in Fairfax County, Virginia was recorded at 115 dBA. No damage to the historic structures was found, despite their age. Since the Concorde causes significantly more vibration than conventional commercial jet aircraft, the risk of structural damage caused by aircraft noise near airports is considered to be negligible (Hershey et al. 1975; Wiggins 1975).

OTHER ANNOYANCES

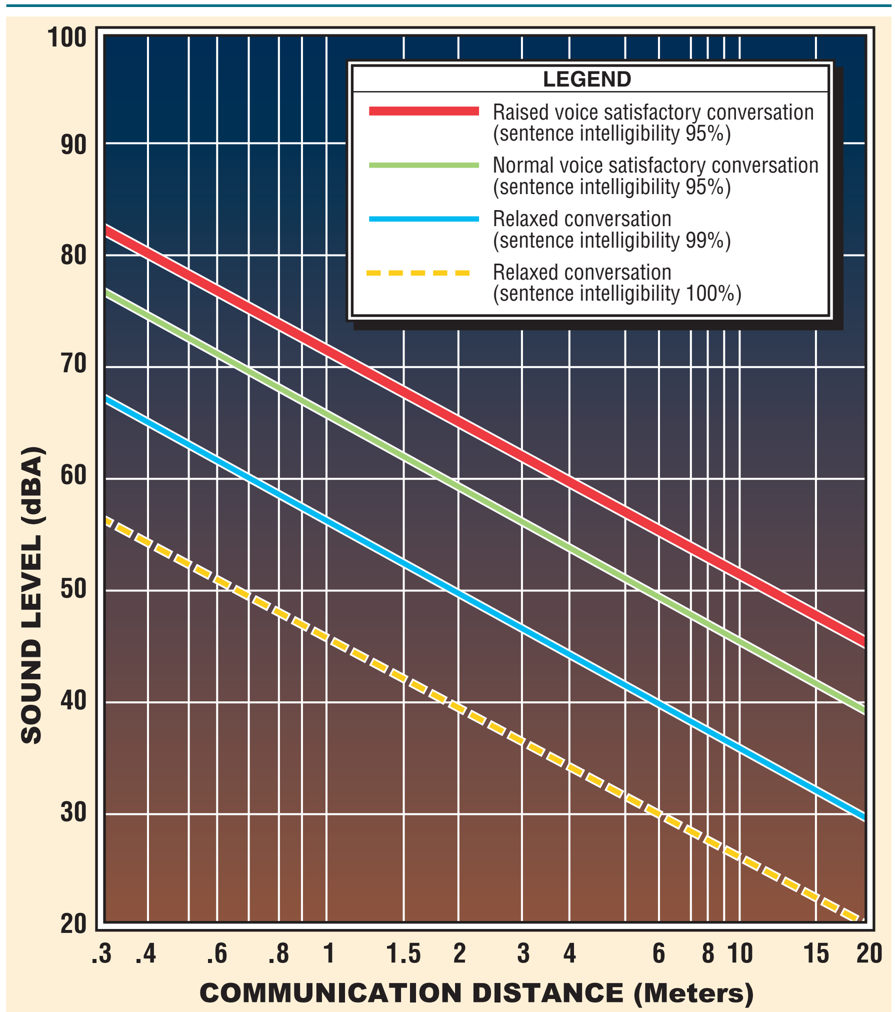
The psychological impact of aircraft noise is a more serious concern than direct physical impact.

The psychological impact of aircraft noise is a more serious concern than direct physical impact. Studies conducted in the late 1960s and early 1970s found that the interruption of communication, rest, relaxation, and sleep are important causes for complaints about aircraft noise. Disturbance of television viewing, radio listening, and telephone conversations are also sources of serious annoyance.

Exhibit D shows the relationship between sound levels and communicating distance for different voice levels. Assuming a communicating distance of 2 meters, communication becomes unsatisfactory with a steady

EXHIBIT D

MAXIMUM DISTANCES OUTDOORS OVER WHICH CONVERSATION IS SATISFACTORILY INTELLIGIBLE IN STEADY NOISE



Source: U.S. Environmental Protection Agency, 1974. Cited in Caltrans, 1993.

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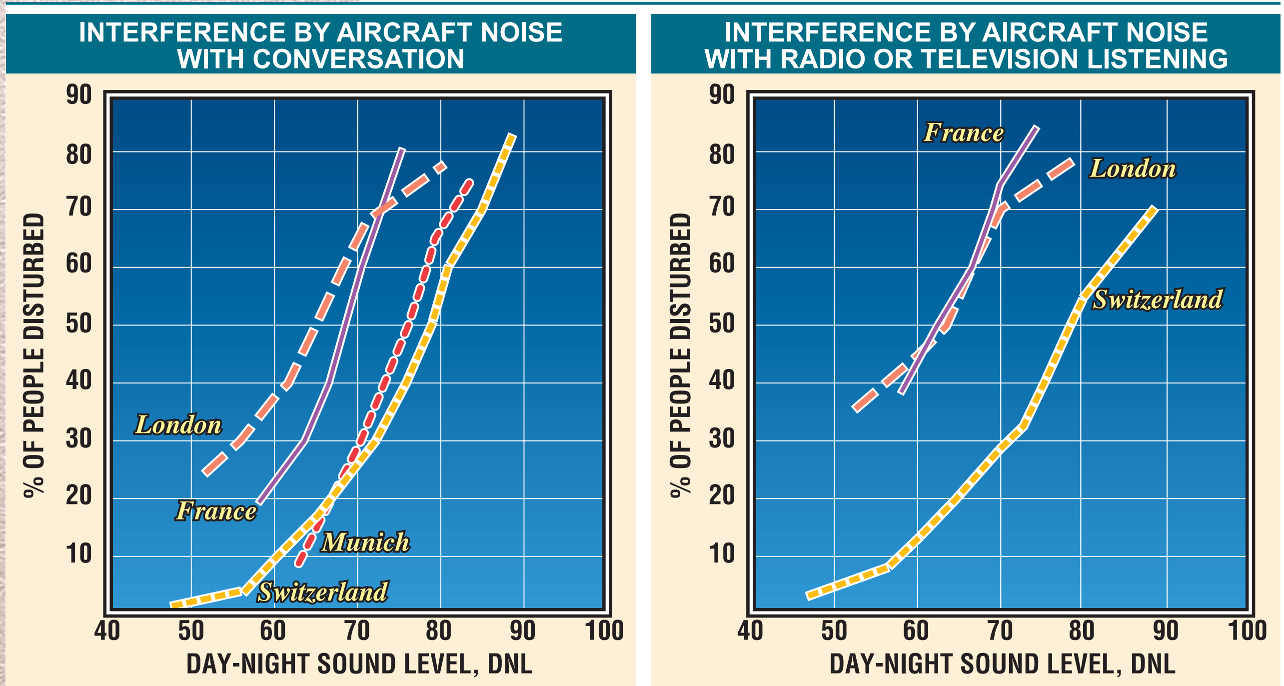
noise level above approximately 65 decibels. At 65 decibels, a raised voice is required to maintain satisfactory conversation. Another way to interpret this is that a raised voice would be interrupted by a sound event above 65 decibels. A normal voice would be interrupted, at 2 meters, by a sound event of 60 decibels.

Exhibit E shows the impact of aircraft noise on conversation and radio or television listening. These results, summarized by Schultz (1978), were derived from surveys conducted in London, France, Munich, and Switzerland. Differences in the amount of disturbance reported in each study are based on how each survey defined disturbance. The British study counted mild disturbance, the French moderate disturbance, and the German and Swiss great disturbance.

EXHIBIT E

INTERFERENCE BY AIRCRAFT NOISE WITH VARIOUS ACTIVITIES



Note: Differences in amount of interference reported are related to how individual surveys defined interference. London counted mild disturbance, France moderate disturbance, and Munich and Switzerland great disturbance.

Source: Shultz, T.J. 1978.

In the case of conversation disruption, nine percent were greatly annoyed by noise of 60 DNL in the Swiss study. About 12 to 16 percent of those in the Swiss and German studies considered themselves to be greatly disturbed by aircraft noise of 65 DNL. At 75 DNL, 40 to 50 percent

Individual human response to noise is highly variable and is influenced by many emotional and physical factors.

considered themselves greatly disturbed. In the French study, 23 percent considered themselves moderately disturbed by aircraft noise at 60 DNL, 35 percent at 65 DNL, and 75 percent at 75 DNL. In the British study, 37 percent were mildly disturbed by aircraft noise at 60 DNL, 50 percent at 65 DNL, and about 72 percent at 75 DNL.

Regarding interference with television and radio listening, about 13 percent in the Swiss study were greatly disturbed by aircraft noise above 60 DNL, 21 percent at 65 DNL, and 40 percent at 75 DNL. In the British and French studies, 42 to 45 percent were mildly to moderately disturbed by noise at 60 DNL, 55 percent at 65 DNL, and 75 to 82 percent at 75 DNL.

In some cases, noise is only an indirect indicator of the real concern of airport neighbors — safety. The sound of approaching aircraft may cause fear in some people about the possibility of a crash. This fear is a factor motivating some complaints of annoyance in neighborhoods near airports around the country. (See Richards and Ollerhead 1973; FAA 1977; Kryter 1984, p. 533.) This effect tends to be most pronounced in areas directly beneath frequently used flight tracks (Gjestland 1989).

The EPA has also found that continuous exposure to high noise levels can affect work performance, especially in high-stress occupations. Based on the FAA's land use compatibility guidelines, discussed in the Technical Information Paper on Noise and Land Use Compatibility, these adverse affects are most likely to occur within the 75 DNL contour.

Individual human response to noise is highly variable and is influenced by many factors. These include emotional variables, feelings about the necessity or preventability of the noise, judgments about the value of the activity creating the noise, an individual's activity at the time the noise is heard, general sensitivity to noise, beliefs about the impact of noise on health, and feelings of fear associated with the noise. Physical factors influencing an individual's reaction to noise include the background noise in the community, the time of day, the season of the year, the predictability of the noise, and the individual's control over the noise source.

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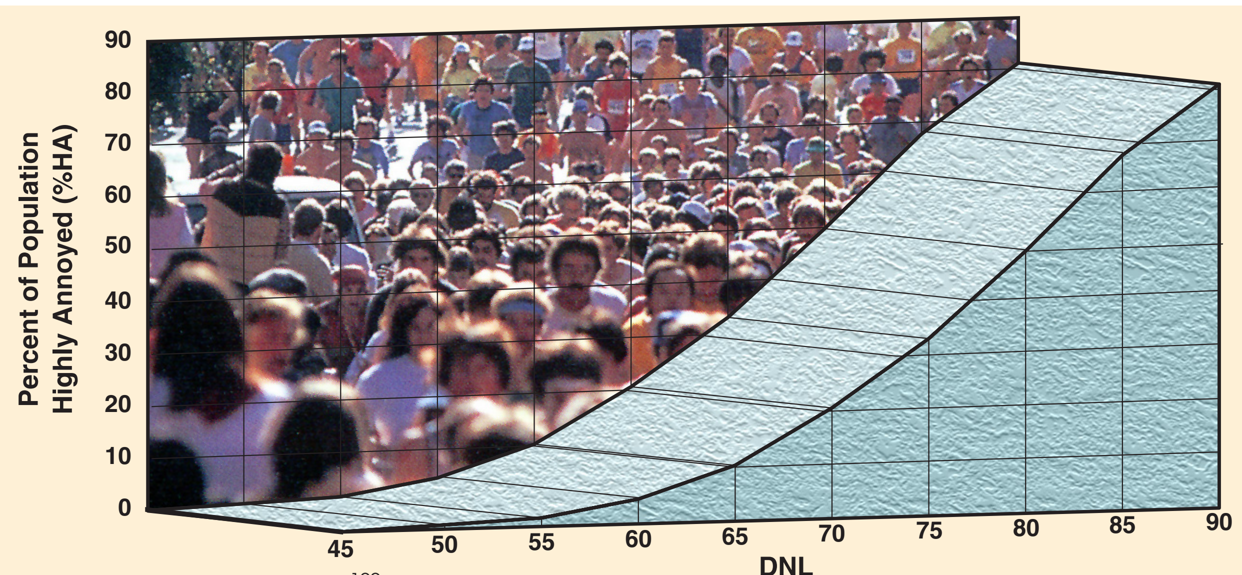
AVERAGE COMMUNITY RESPONSE TO NOISE

Although individual responses to noise can vary greatly, the average response among a group of people is much less variable. This enables us to generalize about the average impacts of aircraft noise on a community despite the wide variations in individual response.

Many studies have examined average residential community response to noise, focusing on the relationship between annoyance and noise exposure. (See DORA 1980; Fidell et al. 1989; Finegold et al. 1992 and 1994; Great Britain Committee on the Problem of Noise 1963; Kryter 1970; Richards and Ollerhead 1973; Schultz 1978; U.S. EPA 1974.) These studies have produced similar results, finding that annoyance is most directly related to cumulative noise exposure, rather than single-event exposure.

EXHIBIT F

PERCENTAGE OF POPULATION HIGHLY ANNOYED BY GENERAL TRANSPORTATION NOISE



Equation for Curve: $\% HA = \frac{100}{1 + e^{(11.13 - .14\, Ldn)}}$

PERCENT HIGHLY ANNOYED AT SELECTED NOISE LEVELS

DNL	45	50	55	60	65	70	75	80	85	90
%HA	0.8%	1.6%	3.1%	6.1%	11.6%	20.9%	34.8%	51.7%	68.4%	81.3%

Source: Finegold et al. 1992 and 1994.

Annoyance has been found to increase along an S-shaped or logistic curve as cumulative noise exposure increases, as shown in **Exhibit F**. Developed by Finegold et al. (1992 and 1994), it is based on data derived from a

The updated Schultz Curve shows that annoyance is measurable beginning at 45 DNL, where 0.8 percent of people are highly annoyed. It increases gradually to 6.1 percent at 60 DNL. Starting at 65 DNL, the percentage of people expected to be highly annoyed increases steeply from 11.6 percent up to 68.4 percent at 85 DNL.

number of studies of transportation noise (Fidell 1989). It shows the relationship between DNL levels and the percentage of people who are highly annoyed. Known as the "updated Schultz Curve" because it is based on the work of Schultz (1978), it represents the best available source of data for the noise dosage-response relationship (FICON 1992, Vol. 2, pp. 3-5; Finegold et al. 1994, pp. 26-27).

The updated Schultz Curve shows that annoyance is measurable beginning at 45 DNL, where 0.8 percent of people are highly annoyed. It increases gradually to 6.1 percent at 60 DNL. Starting at 65 DNL, the percentage of people expected to be highly annoyed increases steeply from 11.6 percent up to 68.4 percent at 85 DNL. Note that this relationship includes only those reported to be "highly annoyed." Based on other research, the percentages would be considerably higher if they also included those who were "moderately or mildly annoyed" (Richards and Ollerhead 1973; Schultz 1978).

SUMMARY

The effects of noise on people include hearing loss, other ill health effects, and annoyance. While harm to physical health is generally not a problem in neighborhoods near airports, annoyance is a common problem. Annoyance is caused by sleep disruption, interruption of conversations, interference with radio and television listening, and disturbance of quiet relaxation.

Individual responses to noise are highly variable, making it very difficult to predict how any person is likely to react to environmental noise. The average response among a large group of people, however, is much less variable and has been found to correlate well with cumulative noise dosage metrics such as Leq, DNL, and CNEL. The development of aircraft noise impact analysis techniques has been based on this relationship between average community response and cumulative noise exposure.

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TECHNICAL INFORMATION PAPER

Measuring the Impact of Noise on People

Technical Information Paper

Measuring the Impact of Noise on People

In aircraft noise analysis, the effect of noise on residents near airports is often the most important concern.

In aircraft noise analysis, the effect of noise on residents near airports is often the most important concern. While certain public institutions and, at very high noise levels, some types of businesses may also be disturbed by noise, people in their homes are typically the most vulnerable to noise problems.

The most common way to measure the impact of noise on residents is to estimate the number of people residing within the noise contours. This is done by overlaying noise contours on census block maps or on maps of dwelling units. The number of people within each 5 DNL range (e.g., from 65 to 70 DNL, from 70 to 75 DNL, etc.) is then estimated.

This is the approach required in F.A.R. Part 150 noise compatibility studies. While it has the advantage of simplicity, it has one disadvantage: it implicitly assumes that all people are equally affected by noise, regardless of the noise level they experience. Clearly, however, the louder the noise, the greater the noise problem. As noise increases, more people become concerned about it, and the concerns of each individual become more serious.

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AVERAGE COMMUNITY RESPONSE TO NOISE

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Individual human response to noise is highly variable and is influenced by many factors. These include emotional variables, feelings about the necessity or preventability of the noise, judgments about the value of the activity creating the noise, an individual's activity at the time the noise is heard, general sensitivity to noise, beliefs about the impact of noise on health, and feelings of fear associated with the noise.

Physical factors influencing an individual's reaction to noise include the background noise in the community, the time of day, the season of the year, the predictability of the noise, and the individual's control over the noise source.

Although individual responses to noise can vary greatly, the average response among a group of people is much less variable. This enables us to generalize about the average impacts of aircraft noise on a community despite the wide variations in individual response.

Many studies have examined average community response to noise, focusing on the relationship between annoyance and noise exposure. (See DORA 1980; Fidell et al. 1989; Finegold et al. 1992 and 1994; Great Britain Committee on the Problem of Noise 1963; Kryter 1970; Richards and Ollerhead 1973; Schultz 1978; U.S. EPA 1974.) These studies have produced similar results, finding that annoyance is most directly related to cumulative noise exposure, rather than single-event exposure.

Annoyance has been found to increase along an S-shaped or logistic curve as cumulative noise exposure increases, as shown in **Exhibit A**. This graph shows the percentage of residents either somewhat annoyed or seriously annoyed by noise of varying DNL levels. It was developed from research in the early 1970s (Richards and Ollerhead 1973). It is interesting that the graph indicates that at even extremely low noise levels, below 45 DNL, a very small percentage of people remain annoyed by aircraft noise. Conversely, the graph shows that while the percentage of people annoyed by noise exceeds 95 percent at 75 DNL, it only approaches, and does not reach, 100 percent even at the extremely high noise level of 85 DNL.

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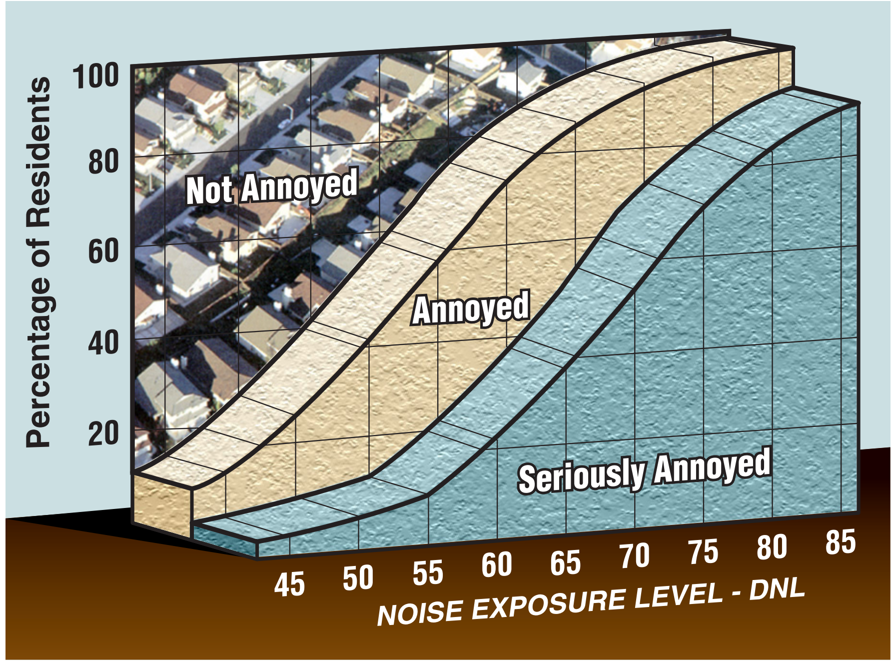
EXHIBIT A

ANNOYANCE CAUSED BY AIRCRAFT NOISE IN RESIDENTIAL AREAS



Source: Richards and Ollerhead 1973, p.31

Starting at 65 DNL, the percentage of people expected to be highly annoyed increases steeply from 11.6 percent up to 68.4 percent at 85 DNL.

A similar graph is shown in **Exhibit B**. Developed by Finegold et al. (1992 and 1994), it is based on data derived from a number of studies of transportation noise (Fidell 1989). It shows the relationship between DNL levels and the percentage of people who are highly annoyed. Known as the "updated Schultz Curve" because it is based on the work of Schultz (1978), it represents the best available source of data for the noise dosage-response relationship (FICON 1992, Vol. 2, pp. 3-5; Finegold et al. 1994, pp. 26-27).

The updated Schultz Curve shows that annoyance is measurable beginning at 45 DNL, where 0.8 percent of people are highly annoyed. It increases gradually to 6.1 percent at 60 DNL. Starting at 65 DNL, the percentage of people expected to be highly annoyed increases steeply from 11.6 percent up to 68.4 percent at 85 DNL. Note that this relationship includes only those reported to be "highly annoyed." Based on the findings shown in **Exhibit A**, the percentages would be considerably higher if they also included those who were "moderately annoyed."

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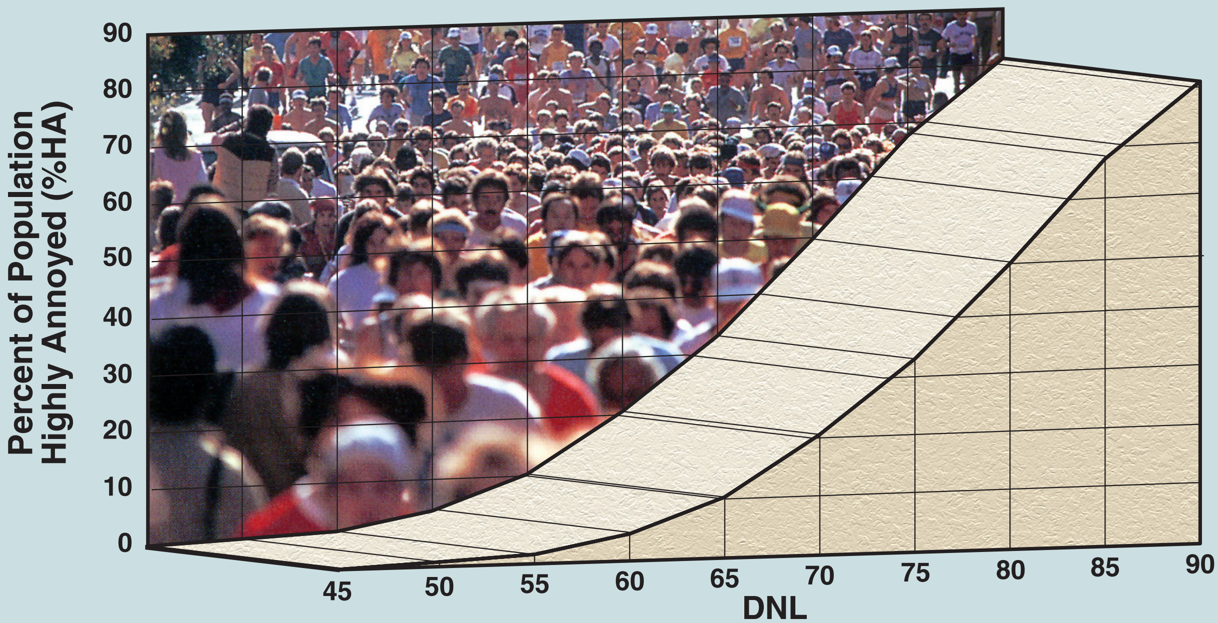
EXHIBIT B

PERCENTAGE OF POPULATION HIGHLY ANNOYED BY GENERAL TRANSPORTATION NOISE



Equation for Curve: $\% HA = \frac{100}{1 + e^{(11.13 - .14 Ldn)}}$

PERCENT HIGHLY ANNOYED AT SELECTED NOISE LEVELS

DNL	45	50	55	60	65	70	75	80	85	90
%HA	0.8%	1.6%	3.1%	6.1%	11.6%	20.9%	34.8%	51.7%	68.4%	81.3%

Source: Finegold et al. 1992 and 1994.

THE DEVELOPMENT OF WEIGHTING FUNCTIONS

Recognizing the tendency of annoyance response rates to increase systematically as noise increases, researchers in the 1960s began developing weighting functions to help estimate the total impact of noise on a population (CHABA 1977, p. B-1). The population impacted by noise at a given level would be multiplied by the appropriate weighting function. The higher the noise level, the higher the weighting function. The results for all noise levels would be added together. The sum would be a single number purported to represent the net impact of noise on the affected population.

The CHABA report (p. VII-5) recommended the use of the original Schultz Curve as the basis for developing weighting functions. It recommended that weighting functions be developed by calculating the percentage

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Based on the response curve shown in Exhibit A, the weighting functions can be considered as roughly equivalent to the proportion of people likely to be either highly annoyed or somewhat annoyed by noise.

of people likely to be highly annoyed by noise at various DNL levels. These values were then converted to weighting functions by arbitrarily setting the function for 75 DNL at 1.00. Functions for the other noise levels were set in proportion to the percent highly annoyed. The results of applying these weighting functions to a population was known as the "sound level-weighted population" impacted by noise, or the "level-weighted population."

UPDATED LEVEL-WEIGHTED POPULATION FUNCTIONS

As discussed above, the original Schultz Curve has been updated to take into account additional studies of community response to noise. The updated curve is shown in **Exhibit B**. Coffman Associates has updated the weighting functions developed by CHABA (1977, p. B-7) to correspond with the updated Schultz Curve. **Table 1** shows the percentage of people likely to be highly annoyed by aircraft noise for 5 DNL increments ranging from 45 to 80 DNL. It also shows weighting functions for use in calculating level-weighted population. These were developed by setting the function for the 75 to 80 DNL range at unity (1.000). The other functions were computed in proportion to the values for "percent highly annoyed."

TABLE 1

PERCENT HIGHLY ANNOYED AND WEIGHTED FUNCTION BY DNL RANGE

DNL RANGE	AVERAGE PERCENT HIGHLY ANNOYED	WEIGHTING FUNCTION
45-50	1.19%	0.028
50-55	2.36%	0.055
55-60	4.63%	0.107
60-65	8.87%	0.205
65-70	16.26%	0.376
70-75	27.83%	0.644
75-80	43.25%	1.000

Based on the response curve shown in **Exhibit A**, the weighting functions can be considered as roughly equivalent to the proportion of people likely to be either highly annoyed or somewhat annoyed by noise.

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The response to noise among a group of people varies systematically with changes in noise levels. As noise increases, the proportion of people disturbed by noise increases.

EXAMPLE USE OF LEVEL-WEIGHTED POPULATION

In airport noise compatibility planning, the level-weighted population (LWP) methodology is particularly useful in comparing the results of different noise analysis scenarios. Since the percentage of people who are highly annoyed increases with increasing noise levels, the LWP values may differ between operating scenarios even though the total population within the noise impact boundary is equal. An example below illustrates the LWP methodology. Scenarios A and B show the effects of two airport operating scenarios. While the population subject to noise above 65 DNL is the same for both, Scenario B has a lower LWP because fewer people are impacted by the higher noise levels.

TABLE 2

LEVEL-WEIGHTED POPULATION METHODOLOGY - EXAMPLE

	SCENARIO A			SCENARIO B		
DNL Range	LWP Factor	Population	LWP	LWP Factor	Population	LWP
65-70	.376	x 2,000	= 752	.376	x 3,000	= 1,128
70-75	.644	x 1,400	= 902	.644	x 700	= 451
75+	1.000	x 600	= 600	1.000	x 300	= 300
Total		4,000	2,254		4,000	1,879

SUMMARY

The response to noise among a group of people varies systematically with changes in noise levels. As noise increases, the proportion of people disturbed by noise increases. This relationship has been estimated and is presented in the "updated Schultz Curve" shown in **Exhibit B**.

The data in the updated Schultz Curve can be used to develop weighting functions for computing the numbers of people likely to be annoyed by noise. This is especially useful in comparing the net impact of different noise scenarios.

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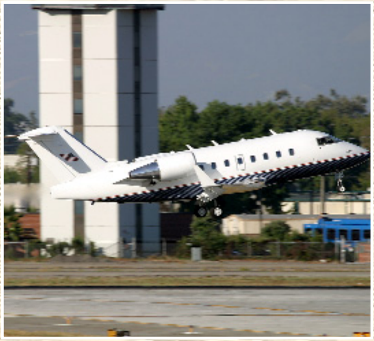

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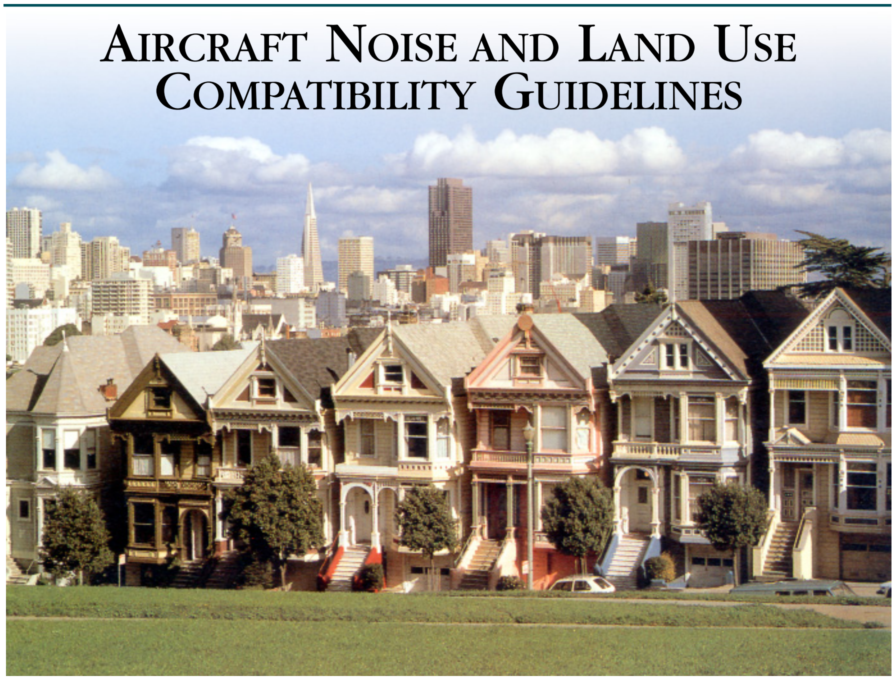
TECHNICAL INFORMATION PAPER

Aircraft Noise and Land Use Compatibility Guidelines

Technical Information Paper

Aircraft Noise and Land Use Compatibility Guidelines



DNL accumulates the total noise occurring over a 24-hour period, with a 10 decibel penalty applied to noise occurring between 10:00 p.m. and 7:00 a.m.

In past years, noise has become a recognized factor in the land use planning process for cities, metropolitan planning organizations, counties, and states. Significant strides have been made in the reduction of noise at its source; however, noise cannot be entirely eliminated. Local, state, and federal agencies, in recognition of this fact, have developed guidelines and regulations to address noise within the land use planning process.

The fundamental variability in the way individuals react to noise makes it impossible to accurately predict how any one individual will respond to a given noise level. However, when one considers the community as a whole, trends emerge which relate noise to annoyance. This enables us to make reasonable evaluations of the average impacts of aircraft noise on a community.

According to scientific research, noise response is most readily correlated with noise as measured with cumulative noise metrics. A variety of cumulative noise exposure metrics have been used in research studies over the years. In the United States, the DNL (day-night noise level) metric has been widely used. DNL accumulates the total noise occurring over a 24-hour period, with a 10 decibel penalty applied to noise occurring between 10:00 p.m. and 7:00 a.m. DNL correlates well with average community response to

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Research has shown that even at extremely high noise levels, there are at least some people, albeit a small percentage, who are not annoyed. Conversely, it also shows that at even very low noise levels, at least some people will be annoyed.

noise. (For more information on noise measurement, see the TIP entitled, "The Measurement and Analysis of Sound.")

In California, the CNEL (community noise equivalent level) metric is used instead of the DNL metric. The two metrics are very similar. DNL accumulates the total noise occurring during a 24-hour period, with a 10 decibel penalty applied to noise occurring between 10:00 p.m. and 7:00 a.m. The CNEL metric is the same except that it also adds a 4.77 decibel penalty for noise occurring between 7:00 p.m. and 10:00 p.m. There is little actual difference between the two metrics in practice. Calculations of CNEL and DNL from the same data generally yield values with less than a 0.7 decibel difference (Caltrans 1983, p. 37).

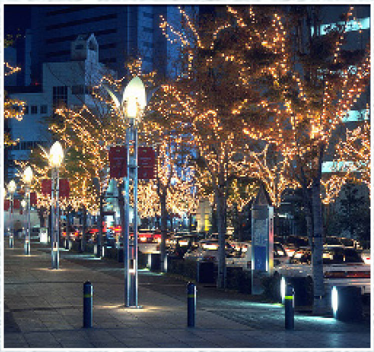
The results of studies on community noise impacts show that the number of people expressing concerns with noise increases as the noise level increases. The level of concern increases along an S-shaped curve, as shown in **Exhibit A**. Research has shown that even at extremely high noise levels, there are at least some people, albeit a small percentage, who are not annoyed. Conversely, it also shows that at even very low noise levels, at least some people will be annoyed.

AMBIENT NOISE LEVEL AS A FACTOR OF ANNOYANCE LEVEL

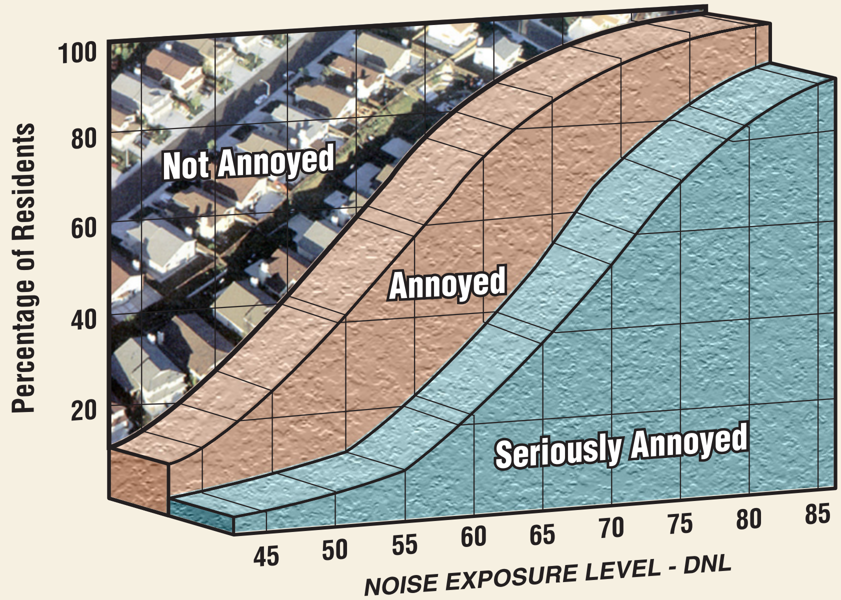
Noise analysts have speculated that the overall ambient noise level in an environment determines to what degree people will be annoyed by a given level of aircraft noise. That is, in a louder environment it takes a louder level of aircraft noise to generate complaints than it does in a quieter environment.

Kryter (1984, p. 582) reviewed some of the research on this question. He noted that the effects of laboratory tests and attitude surveys on this question are somewhat inconclusive. A laboratory test he reviewed found that recordings of aircraft noise were judged to be less intrusive as the background road traffic noise was increased. On the other hand, an attitude survey in the Toronto Airport area found that the effects of background noise were not significant.

ANNOYANCE CAUSED BY AIRCRAFT NOISE IN RESIDENTIAL AREAS

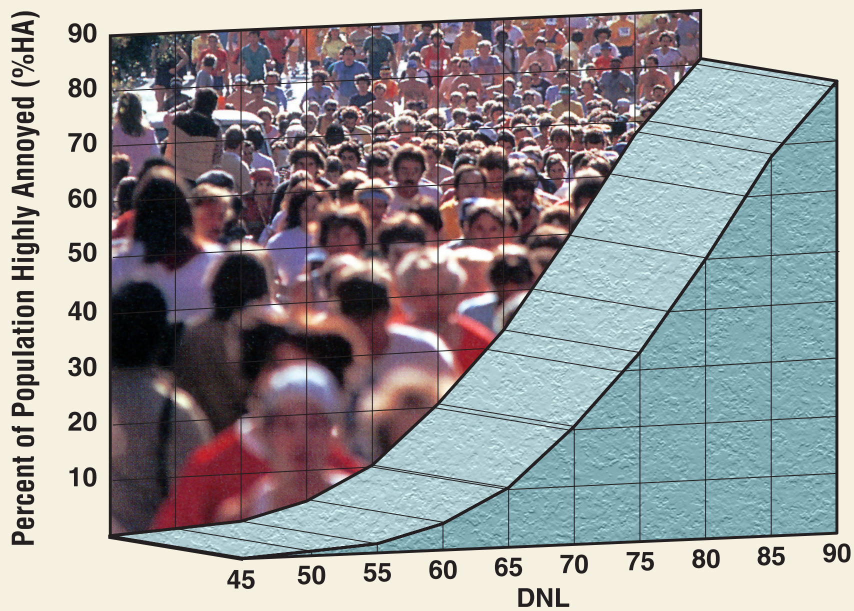


Noise analysts have speculated that the overall ambient noise level in an environment determines to what degree people will be annoyed by a given level of aircraft noise.



Source: Richards and Ollerhead 1973, p.31

UPDATED SCHULTZ CURVE



Equation for Curve: $\% \text{ HA} = \frac{100}{1 + e^{(11.13 - .14 \text{ Ldn})}}$

Source: Finegold et al. 1992 and 1994.

The studies reviewed by Kryter were intended to evaluate whether or not background noise provided some degree of masking of aircraft noise. They did not, however, take into consideration the subjects' rating of the overall quality of the noise environment.

The U.S. Environmental Protection Agency (EPA) has provided guidelines to address the question of background noise and its relationship to aircraft noise.

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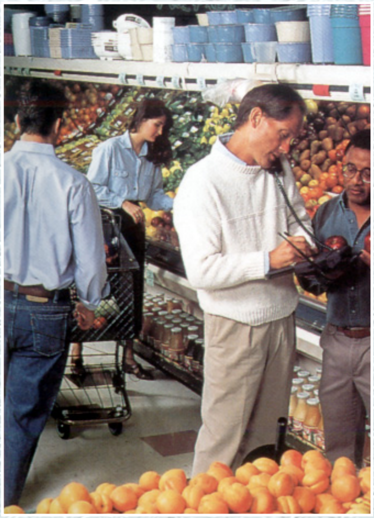

The degree of annoyance which people suffer from aircraft noise varies depending on their activities at any given time.

The EPA has determined that complaints can be expected when the intruding DNL exceeds the background DNL by more than 5 decibels (U.S. EPA 1974). The California Department of Transportation (Caltrans 2000, pp. 7- 24 - 7-25) notes that the level of background (ambient) noise should be used in determining the suitable aircraft noise contour of significance. Specifically, adjustments have been made in areas with quiet background noise levels of 50 to 55 CNEL. In those cases, aircraft CNEL contours are prepared down to 55 or 60 CNEL, and land use compatibility criteria are adjusted to apply to those areas. The State of Oregon Department of Aviation (Oregon 2003) also requires the preparation of noise contours down to the 55 DNL level. This noise contour is used to establish the noise impact boundary for air carrier airports within the state.

The Federal Interagency Committee on Noise (FICON 1992, p. 2-6) examined the question of background noise and its relationship to perceptions of aircraft noise. It reviewed the research in this field, concluding that there was a basis for believing that, in addition to the magnitude of aircraft noise, the difference between background noise and aircraft noise was in some way related to human perceptions of noise disturbance. It noted, however, that there was insufficient scientific data to provide authoritative guidance on the consideration of these effects. FICON advocated further research in this area.

LAND USE COMPATIBILITY GUIDELINES

The degree of annoyance which people suffer from aircraft noise varies depending on their activities at any given time. People rarely are as disturbed by aircraft noise when they are shopping, working, or driving as when they are at home. Transient hotel and motel residents seldom express as much concern with aircraft noise as do permanent residents of an area. The concept of "land use compatibility" has arisen from this systematic variation in human tolerance to aircraft noise. Since the 1960s, many different sets of land use compatibility guidelines have been proposed and used. This section reviews some of the more well known guidelines.

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The U.S. Department of Housing and Urban Development (HUD) first published noise assessment requirements in 1971 for evaluating the acceptability of sites for housing assistance.

FEDERAL LAND USE COMPATIBILITY GUIDELINES

FAA-DOD Guidelines

In 1964, the Federal Aviation Administration (FAA) and the U.S. Department of Defense (DOD) published similar documents setting forth guidelines to assist land use planners in areas subjected to aircraft noise from nearby airports. These guidelines, presented in **Table 1**, establish three zones and the expected responses to aircraft noise from residents of each zone. In Zone 1, areas exposed to noise below 65 DNL, essentially no complaints would be expected although noise could be an occasional annoyance. In Zone 2, areas exposed to noise between 65 and 80 DNL, individuals may complain, perhaps vigorously. In Zone 3, areas in excess of 80 DNL, vigorous complaints would be likely and concerted group action could be expected.

TABLE 1

CHART FOR ESTIMATING RESPONSE OF COMMUNITIES EXPOSED TO AIRCRAFT NOISE - 1964 FAA-DOD GUIDELINES

NOISE LEVEL	ZONE	DESCRIPTION OF EXPECTED RESPONSE
Less than 65 DNL	1	No complaints would be expected. The noise may, however, interfere occasionally with certain activities of the residents.
65 to 80 DNL	2	Individuals may complain, perhaps vigorously. Concerted group action is possible.
Greater than 80 DNL	3	Individual reactions would likely include repeated, vigorous complaints. Concerted group action might be expected.

Source: U.S. DOD 1964. Cited in Kryter 1984, p. 616.

HUD Guidelines

The U.S. Department of Housing and Urban Development (HUD) first published noise assessment requirements in 1971 for evaluating the acceptability of sites for housing assistance. These requirements contained standards for exterior noise levels along with policies for approving HUD-supported or assisted housing projects in high noise areas. In general, the requirements established three zones: an acceptable zone where all projects could be approved, a normally unacceptable zone where

mitigation measures would be required and where each project would have to be individually evaluated for approval or denial, and an unacceptable zone in which projects would not, as a rule, be approved.

In 1979, HUD issued revised regulations which kept the same basic standards, but adopted new descriptor systems which were considered advanced over the old system. **Table 2** summarizes the revised HUD requirements.

TABLE 2

SITE EXPOSURE TO AIRCRAFT NOISE
1979 HUD REQUIREMENTS

ACCEPTABLE CATEGORY	DAY-NIGHT AVERAGE SOUND LEVEL	SPECIAL APPROVALS AND REQUIREMENTS
Acceptable	Not exceeding 65 dB	None
Normally Unacceptable	Above 65 dB but not exceeding 75 dB	Special approvals, environmental review, attenuation
Unacceptable	Above 75 dB	Special approvals, environmental review, attenuation

Source: U.S. HUD 1979

Veterans Administration Guidelines

The Veterans Administration has established policies and procedures for the appraisal and approval of VA loans relative to residential properties located near major civilian airports and military air bases. The agency's regulations, contained within M26-2, Change 15, state that "the VA must recognize the possible unsuitability for residential use of certain properties and the probable adverse effect on livability and/or value of homes in the vicinity of major airports and air bases. Such adverse effects may be due to a variety of factors including noise intensity." **Table 3** contains the VA's noise zones and associated development requirements and limitations.

EPA Guidelines

The U.S. Environmental Protection Agency published a document in 1974 suggesting maximum noise exposure levels to protect public health with an adequate margin of safety. These are shown in **Table 4**. They note that the risk of hearing loss may become a concern with exposure

TABLE 3

VETERANS ADMINISTRATION NOISE GUIDELINES NOVEMBER 23, 1992

NOISE ZONE	CNR (Composite Noise Rating)	NEF (Noise Exposure Forecasts)	DNL (Day/Night Average Sound Level)
1	Under 100	Under 30	Under 65
2	100-115	30-40	65-75
3	Over 115	Over 40	Over 75

Specific Limitations:

(1) Proposed or existing properties located in zone 1 are generally acceptable as security for VA-guaranteed loans.

(2) Proposed construction to be located in zone 2 will be acceptable provided:

- (a) Sound attenuation features are built into the dwelling to bring the interior DNL of the living unit to 45 decibels or below.
- (b) There is evidence of market acceptance of the subdivision.
- (c) The veteran-purchaser signs a statement which indicates his/her awareness that (1) the property being purchased is located in an area adjacent to an airport, and (2) the aircraft noise may affect normal livability, value, and marketability of the property.

(3) Proposed subdivisions located in zone 3 are not generally acceptable. The only exception is a situation in which VA has previously approved a subdivision, and the airport noise contours are subsequently changed to include the subdivision in zone 3. In such cases, VA will continue to process loan applications provided the requirements in the above subparagraphs (2) are met.

(4) Existing dwellings in zones 2 and 3 are not to be rejected because of airport influence if there is evidence of acceptance by a fully informed veteran.

Source: Veterans Administration, M26-2, June 1992

TABLE 4

SUMMARY OF NOISE LEVELS IDENTIFIED AS REQUISITE TO PROTECT PUBLIC HEALTH AND WELFARE WITH AN ADEQUATE MARGIN OF SAFETY - 1974 EPA GUIDELINES

EFFECT	LEVEL	AREA
Hearing loss	75 DNL and above	All areas
Outdoor activity interference and annoyance	55 DNL and above	Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis of use.
	59 DNL and above	Outdoor areas where people spend limited amounts of time, such as school years, playgrounds, etc.
Indoor activity interference and annoyance	45 DNL and above	Indoor residential areas
	49 DNL and above	Other indoor areas with human activities such as schools, etc.

Note: All Leq values from EPA document were converted by FAA to DNL for ease of comparison. (DNL=Leq(24) + 4 dB).

Source: U.S. EPA 1974. Cited in FAA 1977a, p. 26.

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LAND USE GUIDANCE CHART I: AIRPORT NOISE INTERPOLATION

LAND USE GUIDANCE ZONES (LUG)	NOISE EXPOSURE CLASS	INPUTS: AIRCRAFT NOISE ESTIMATING METHODOLOGIES				HUD NOISE ASSESSMENT GUIDELINES (1977)	SUGGESTED NOISE CONTROLS
		Ldn DAY-NIGHT AVERAGE SOUND LEVEL	NEF NOISE EXPOSURE FORECAST	CNR COMPOSITE NOISE RATING	CNEL COMMUNITY NOISE EQUIVALENT LEVEL		
A	MINIMAL EXPOSURE	0 TO 55	0 TO 20	0 TO 90	0 TO 55	"CLEARLY ACCEPTABLE"	NORMALLY REQUIRES NO SPECIAL CONSIDERATIONS
B	MODERATE EXPOSURE	55 TO 65	20 TO 30	90 TO 100	55 TO 65	"NORMALLY ACCEPTABLE"	LAND USE CONTROLS SHOULD BE CONSIDERED
C	SIGNIFICANT EXPOSURE	65 TO 75	30 TO 40	100 TO 115	65 TO 75	"NORMALLY UNACCEPTABLE"	NOISE EASEMENTS, LAND USE, AND OTHER COMPATIBILITY CONTROLS RECOMMENDED
D	SEVERE EXPOSURE	75 & HIGHER	40 & HIGHER	115 & HIGHER	75 & HIGHER	"CLEARLY UNACCEPTABLE"	CONTAINMENT WITHIN AIRPORT BOUNDARY OR USE OF POSITIVE COMPATIBILITY CONTROLS RECOMMENDED

Source: FAA 1977b, p. 12.

to noise above 74 DNL. Interference with outdoor activities may become a problem with noise levels above 55 DNL. Interference with indoor residential activities may become a problem with interior noise levels above 45 DNL. If we assume that standard construction attenuates noise by about 20 decibels, with doors and windows closed, this corresponds to an exterior noise level of 65 DNL.

FAA Land Use Guidance System

In 1977, FAA issued an advisory circular on airport land use compatibility planning (FAA 1977b). It describes land use guidance (LUG) zones corresponding to aircraft noise of varying levels as measured by four different noise metrics **(Exhibit B)**. It also includes suggested land use noise sensitivity guidelines **(Exhibit C)**.

In **Exhibit B**, LUG Chart I, four land use guidance zones are described, corresponding to DNL levels of 55 or less (A), 55 to 65 (B), 65 to 75 (C), and 75 and over (D). LUG Zone

In 1979, the Federal Interagency Committee on Urban Noise (FICUN), including representatives of the Environmental Protection Agency, the Department of Transportation, the Housing and Urban Development Department, the Department of Defense, and the Veterans Administration, was established to coordinate various federal programs relating to the promotion of noise-compatible development.

A is described as minimal exposure, normally requiring no special noise control considerations. LUG Zone B is described as moderate exposure where land use controls should be considered. LUG Zone C is subject to significant exposure, and various land use controls are recommended. In LUG Zone D, severe exposure, containment of the area within airport property, or other positive control measures, are suggested.

In LUG Chart II, **Exhibit C**, most noise-sensitive uses are suggested as appropriate only within LUG Zone A. These include single-family and two-family dwellings, mobile homes, cultural activities, places of public assembly, and resorts and group camps. Uses suggested for Zones A and B include multi-family dwellings and group quarters; financial, personal, business, governmental, and educational services; and manufacturing of precision instruments. In Zones C and D, various manufacturing, trade, service, resource production, and open space uses are suggested.

Federal Interagency Committee on Urban Noise

In 1979, the Federal Interagency Committee on Urban Noise (FICUN), including representatives of the Environmental Protection Agency, the Department of Transportation, the Housing and Urban Development Department, the Department of Defense, and the Veterans Administration, was established to coordinate various federal programs relating to the promotion of noise-compatible development. In 1980, the Committee published a report which contained detailed land use compatibility guidelines for varying DNL noise levels (FICUN 1980). The work of the Interagency Committee was very important as it brought together for the first time all federal agencies with a direct involvement in noise compatibility issues and forged a general consensus on land use compatibility for noise analysis on federal projects.

The Interagency guidelines describe the 65 DNL contour as the threshold of significant impact for residential land uses and a variety of noise-sensitive institutions (such as hospitals, nursing homes, schools, cultural activities, auditoriums, and outdoor music shells). Within the 55 to 65 DNL contour range, the guidelines note that cost and

EXHIBIT C

LAND USE GUIDANCE CHART II: LAND USE NOISE SENSITIVITY INTERPOLATION

LAND USE		LUG ZONE[1]
SLUCM No.	Name	Suggested
10	**Residential**	**A-B**
11	Household units.	
11,11	Single units - detached.	A
11,12	Single units - semi attached.	A
11,13	Single units - attached row.	B
11,21	Two units - side-by-side.	A
11,22	Two units - one above the other.	A
11,31	Apartments - walk up.	B
11,32	Apartments - elevator.	B-C
12	Group quarters.	A-B
13	Residential hotels.	B
14	Mobile home parks or courts.	A
15	Transient lodgings.	C
19	Other residential.	A-C
20	**Manufacturing[2]**	**C-D**
21	Food and kindred products-manufacturing.	
22	Textile mill products-manufacturing.	C-D
23	Apparel and other finished products made from fabrics, leather, and similar materials-manufacturing.	C-D
24	Lumber and wood products (except furniture)-manufacturing.	C-D
25	Furniture and fixtures-manufacturing.	C-D
26	Paper and allied products-manufacturing.	C-D
27	Printing, publishing, and allied industries.	C-D
28	Chemicals and allied products-manufacturing.	C-D
29	Petroleum refining and related industries.[3]	C-D
30	**Manufacturing[2]**	
31	Rubber and miscellaneous plastic products-manufacturing.	C-D
32	Stone, clay, and glass products-manufacturing.	C-D
33	Primary metal industries.	D
34	Fabricated metal products-manufacturing.	D
35	Professional, scientific, and controlling instruments: photographic and optical goods; watches and clocks-manufacturing.	B
39	Miscellaneous manufacturing.	C-D
40	**Transportation, communications, and utilities**	
41	Railroad, rapid rail transit, and street railway transportation.	D
42	Motor vehicle transportation.	D
43	Aircraft transportation.	D
44	Marine craft transportation.	D
45	Highway and street right-of-way.	D
46	Automobile parking.	D
47	Communication.	A-D
48	Utilities.	D
49	Other transportation communications and utilities.	A-D

LAND USE		LUG ZONE[1]
SLUCM No.	Name	Suggested
50	**Trade[4]**	
51	Wholesale trade.	C-D
52	Retail trade-building materials, hardware, and farm equipment.	C
53	Retail trade-general merchandise.	C
54	Retail trade-food.	C
55	Retail trade-automotive, marine craft, aircraft and accessories.	C
56	Retail trade-apparal and accessories.	C
57	Retail trade-furniture, home furnishings, and equipment.	C
59	Retail trade-eating and drinking.	C-D
	Other retail trade.	
60	**Services[4]**	
61	Financial, insurance, and real estate services.	B
62	Personal services.	B
63	Business services.	B
64	Repair services.	C
65	Professional services.	B-C
66	Contract construction services.	C
67	Governmental services.	B
68	Educational services.	A-B
69	Miscellaneous services.	A-C
70	**Cultural, entertainment, and recreational**	
71	Cultural activities and nature exhibitions.	A
72	Public assembly.	A
73	Amusements.	C
74	Recreational activities.[5]	B-C
75	Resorts and group camps.	A
76	Parks.	A-C
79	Other cultural, entertainment, and recreational.[5]	A-B
80	**Resource production and extraction**	
81	Agriculture.	C-D
82	Agricultural related activities.	C-D
83	Forestry activities and related services.	D
84	Fishing activities and related services.	D
85	Mining activities and related services.	D
89	Other resource production and extraction.	C-D
90	**Undeveloped land and water areas**	
91	Undeveloped and unused land area (excluding noncommercial forest development).	D
92	Noncommercial forest development.	D
93	Water areas.	A-D
94	Vacant floor area.	A-D
95	Under construction.	A-D
99	Other undeveloped land and water areas.	A-D

1 Refer to Land Use Guidance Chart I, Exhibit C-1.
2 Zone "C" suggested maximum except where exceeded by self generated noise.
3 Zone "D" for noise purposes; observe normal hazard precautions.
4 If activity is not in substantial, air-conditioned building, go to next higher zone.
5 Requirements likely to vary - individual appraisal recommended.

SLUCM: *Standard Land Use Coding Manual*, U.S. Urban Renewal Administration and Bureau of Public Roads, 1965.

Source: FAA 1977b, p. 14.

The ANSI standard acknowledges the potential for noise effects below the 65 DNL level, describing several uses as "marginally compatible" with noise below 65 DNL.

feasibility factors were considered in defining residential development and several of the institutions as compatible. In other words, the guidelines are not based solely on the effects of noise. They also consider the cost and feasibility of noise control.

ANSI Guidelines

In 1980, the American National Standards Institute (ANSI) published recommendations for land use compatibility with respect to noise (ANSI 1980). Kryter (1984, p. 621) notes that no supporting data for the recommended standard is provided.

The ANSI guidelines are shown in **Exhibit D**. While generally similar to the Federal Interagency guidelines, there are some important differences. First, ANSI's land use classification system is less detailed. Second, the ANSI standard acknowledges the potential for noise effects below the 65 DNL level, describing several uses as "marginally compatible" with noise below 65 DNL. These include single-family residential (from 55 to 65 DNL), multi-family residential, schools, hospitals, and auditoriums (60 to 65 DNL), and outdoor music shells (50 to 65 DNL). Other outdoor activities, such as parks, playgrounds, cemeteries, and sports arenas, are described as marginally compatible with noise levels as low as 55 or 60 DNL.

14 CFR Part 150 Guidelines

The FAA adopted a revised and simplified version of the Federal Interagency guidelines when it promulgated Title 14, Part 150 of the Code of Federal Regulations in the early 1980s. (The Interim Rule was adopted on January 19, 1981. The final rule was adopted on December 13, 1984, published in the Federal Register on December 18, and became effective on January 18, 1985.) Among the changes made by FAA include the use of a coarser land use classification system and the deletion of any reference to any potential for noise impacts below the 65 DNL level.

The determination of the compatibility of various land uses with various noise levels, however, is very similar to the Interagency determinations.

EXHIBIT D

LAND USE COMPATIBILITY WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVEL AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED

LAND USE	Yearly Day-Night Average Sound Level (DNL) in Decibels			
	50-60	60-70	70-80	80-90
Residential - Single Family, Extensive Outdoor Use	Compatible / with Insulation	with Insulation / Incompatible	Incompatible	Incompatible
Residential - Multiple Family, Moderate Outdoor Use	Compatible	with Insulation / Incompatible	Incompatible	Incompatible
Residential - Multi-Story, Limited Outdoor Use	Compatible	with Insulation / Marginally Compatible	Marginally Compatible / Incompatible	Incompatible
Transient Lodging	Compatible	Compatible / with Insulation	Marginally Compatible / Incompatible	Incompatible
School Classrooms, Libraries, Religious Facilities	Compatible	with Insulation / Marginally Compatible	Marginally Compatible / Incompatible	Incompatible
Hospitals, Clinics, Nursing Homes, Health-Related Facilities	Compatible	with Insulation / Marginally Compatible	Marginally Compatible / Incompatible	Incompatible
Auditoriums, Concert Halls	Compatible	with Insulation / Incompatible	Incompatible	Incompatible
Music Shells	with Insulation	with Insulation / Incompatible	Incompatible	Incompatible
Sports Arenas, Outdoor Spectator Sports	Compatible	with Insulation	Incompatible	Incompatible
Neighborhood Parks	Compatible / with Insulation	with Insulation	Incompatible	Incompatible
Playgrounds, Golf Courses, Riding Stables, Water Rec., Cemeteries	Compatible	with Insulation	with Insulation / Incompatible	Incompatible
Office Buildings, Personal Services, Business and Professional	Compatible	Compatible / with Insulation	with Insulation / Incompatible	Incompatible
Commercial - Retail, Movie Theaters, Restaurants	Compatible	Compatible / with Insulation	with Insulation / Incompatible	Incompatible
Commercial - Wholesale, Some Retail, Ind., Mfg., Utilities	Compatible	Compatible	with Insulation	Incompatible
Livestock Farming, Animal Breeding	Compatible	Compatible / with Insulation	with Insulation / Incompatible	Incompatible
Agriculture (Except Livestock)	Compatible	Compatible	Compatible / with Insulation	with Insulation / Incompatible
Extensive Natural Wildlife and Recreation Areas	Compatible	with Insulation	with Insulation / Incompatible	Incompatible

LEGEND

Compatible · with Insulation · Marginally Compatible · Incompatible

Source: ANSI 1980. Cited in Kryter 1984, p. 624.

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Exhibit E lists the Part 150 land use compatibility guidelines. These are only guidelines. Part 150 explicitly states that determinations of noise compatibility and regulation of land uses are purely local responsibilities.

14 CFR PART 150 LAND USE COMPATIBILITY GUIDELINES

LAND USE	Yearly Day-Night Average Sound Level (DNL) 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	Y	N[1]	N[1]	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Government 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, hardware 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, parks, resorts, and camps	Y	Y	Y	N	N	N
Golf courses, riding stables, and water recreation	Y	Y	25	30	N	N

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The designations contained in this table do not constitute a federal determination that any use of land covered by the program is acceptable under federal, state, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests 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.

See other side for notes and key to table.

14 CFR PART 150 LAND USE COMPATIBILITY GUIDELINES

KEY

Y (Yes)	Land Use and related structures compatible without restrictions.
N (No)	Land Use and related structures are not compatible and should be prohibited.
NLR	Noise Level Reduction (outdoor-to-indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
25, 30, 35	Land Use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structure.

NOTES

1 Where the community determines that residential or school uses must be allowed, measures to achieve outdoor-to-indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB, respectively, should be incorporated into building codes and be considered in individual approvals. Normal residential 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 round. However, the use of NLR criteria will not eliminate outdoor noise problems.

2 Measures to achieve NLR of 25 dB 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 the normal noise level is low.

3 Measures to achieve NLR of 30 dB 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 the normal noise level is low.

4 Measures to achieve NLR of 35 dB 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 the 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 a NLR of 30.

8 Residential buildings not permitted.

Source: ***14 CFR Part 150***, Appendix A, Table 1.

SELECTED STATE LAND USE COMPATIBILITY GUIDELINES

State of Oregon

The State of Oregon's Airport Planning Rule (APR) establishes a series of local government requirements and rules which pertain to aviation facility planning. These requirements are intended to promote land use compatibility around airports as well as promote a convenient and economic system of airports in the state. To assist local governments and airports in meeting the requirements of the APR, the Oregon Department of Aviation published the *Airport Land Use Compatibility Guidebook* in January 2003.

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The State of Oregon recognizes that, in some instances, land use controls and restrictions that apply to the 65 DNL may be appropriate for applications to areas impacted by noise levels above 55 DNL.

The Oregon guidelines contained within the guidebook, as they relate to land use compatibility around airports, are based on administrative regulations of the Department of Environmental Quality, adopted by the Oregon Environmental Quality Commission in 1979 (Oregon Administrative Rules, Chapter 340, Division 35, Section 45). Although the FAA regards the 65 DNL contours and above as significant, the State of Oregon considers the 55 and 60 DNL contours as significant. The state recognizes that, in some instances, land use controls and restrictions that apply to the 65 DNL may be appropriate for applications to areas impacted by noise levels above 55 DNL. For example, a rural area exposed to 55 to 65 DNL noise levels may be more affected by these levels than an urban area. This is because there is typically a higher level of background noise associated with an urban area (Oregon 2003). Air carrier airports are required to do studies defining the airport impact boundary, corresponding to the 55 DNL contour. Where any noise-sensitive property occurs within the noise impact boundary, the airport must develop a noise abatement program.

An Oregon airport noise abatement program may include many different recommendations for promoting land use compatibility. These include changes in land use planning, zoning, and building codes within the 55 DNL contour. In addition, disclosure of potential noise impacts may be required and purchase of land for non-noise sensitive public uses may be permitted within the 55 DNL contour.

Within the 65 DNL contour, purchase assurance, voluntary relocation, soundproofing, and purchase of land is permitted.

State of California

California law sets the standard for the acceptable level of aircraft noise for persons residing near airports at 65 CNEL (California Code of Regulations, Title 21, Division 2.5, Chapter 6). The 65 CNEL criterion was chosen for urban residential areas where houses are of typical construction with windows partially open. Four types of land uses are defined as incompatible with noise above 65 CNEL: residences, schools, hospitals and convalescent

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The guidelines contained within the California Airport Land Use Planning Handbook suggest that no new residential uses should be permitted within the 65 CNEL noise contour.

homes, and places of worship. These land uses are regarded as compatible if they have been insulated to assure an interior sound level, from aircraft noise, of 45 CNEL. They are also to be considered compatible if an avigation easement over the property has been obtained by the airport operator.

California noise insulation standards apply to new hotels, motels, apartment buildings, and other dwellings, not including detached single-family homes. They require that "interior noise levels attributable to outdoor sources shall not exceed 45 decibels (based on the DNL or CNEL metric) in any habitable room." In addition, any of these residential structures proposed within a 60 CNEL noise contour requires an acoustical analysis to show that the proposed design will meet the allowable interior noise level standard. (California Code of Regulations, Title 24, Part 2, Appendix Chapter 35.)

In the *California Airport Land Use Planning Handbook* (Caltrans 2002), land use compatibility guidelines are suggested for use in the preparation of comprehensive airport land use plans. The guidelines suggest that no new residential uses should be permitted within the 65 CNEL noise contour. In quiet communities, it is recommended that the 60 CNEL should be used as the maximum permissible noise level for residential uses. At rural airports, it is noted that 55 CNEL may be suitable for use as a maximum permissible noise level for residential uses.

These guidelines are similar to those proposed in earlier editions of the *Airport Land Use Planning Handbook*. However, the 2002 handbook provides much more definitive guidance for compatible land use planning around airports.

State of Florida

In 1990, the State of Florida passed legislation which created the Airport Safety and Land Use Compatibility Study Commission. The charge to this commission was to assure that airports in Florida will have the capacity to accommodate future growth without jeopardizing public health, safety, and welfare. One of the Commissions' recommendations was to require the Florida Department

Within the State of Florida's Airport Compatible Land Use Guidance for Florida Communities, it was requested that each local government prohibit new residential development and other noise-sensitive uses for areas within the 65 DNL contour. Where practical, new residential development should be limited in areas down to the 55 DNL contour.

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of Transportation (FDOT) to establish guidelines regarding compatible land use around airports. In 1994, FDOT responded to this recommendation by publishing a guidance document entitled *Airport Compatible Land Use Guidance for Florida Communities*.

As part of this document's conclusions, it was recommended that all commercial service airports, or airports with significant numbers of general aviation operations, establish a noise compatibility planning program in accordance with the provisions of F.A.R. Part 150. All communities within the airport environs should participate in the preparation of this program. It was requested that each local government prohibit new residential development and other noise-sensitive uses for areas within the 65 DNL contour. Where practical, new residential development should be limited in areas down to the 55 DNL contour.

State of Wisconsin

Wisconsin State Law 114.136 was established to give local governments the authority to regulate land uses within three miles of the airport boundary. These land use controls supercede any other applicable zoning limits by other jurisdictions that may apply to the area surrounding the airport. To assist airports with the development of land use controls, the Wisconsin Department of Transportation (WisDOT) published a document titled *Land Use Planning Around Airports in Wisconsin* in 2001. Various land use tools such as avigation easements, noise overlay zones, height and hazard zoning, and subdivision regulations are presented within the land use planning guide. WisDOT has recognized that the types of airport compatible land uses depend on the location and size of the airport as well as the type and volume of aircraft using the facility. The 65 DNL contour should be used as a starting point for land use regulations, but lesser contours should be considered if deemed necessary.

The 1985 Wisconsin Act 136 takes State Law 114.136 one step further by requiring counties and municipalities to depict airport locations and areas affected by aircraft operations on official maps. The law also requires the zoning authority to notify the airport owner of any proposed zoning changes within the airport environs.

Within the Airports and Compatible Land Use document, jurisdictions are encouraged to work with airports to ensure that airport noise is factored into land use decisions for the protection of the health, safety, and welfare of its residents.

State of Washington

In 1996, Washington State Senate Bill 6442 was passed. This bill requires that every city, town, and county, having a general aviation airport in its jurisdiction, discourage the siting of land uses that are incompatible with airport operations. Policies protecting airport facilities must be implemented within the comprehensive plan and development regulations. Formal consultation with the aviation community is required and all plans must be filed with the Washington State Department of Transportation Aviation Division (WADOT). To assist jurisdictions with establishing appropriate land use planning tools and regulations, WADOT published a revised *Airports and Compatible Land Use* document in February 1999. Within this planning document, jurisdictions are encouraged to work with airports to ensure that airport noise is factored into land use decisions for the protection of the health, safety, and welfare of its residents.

TRENDS IN LAND USE COMPATIBILITY GUIDELINES

In recent years, citizen activists, anti-noise groups, and environmental organizations have become concerned that the current methods of assessing aircraft noise are not sufficient. Among the concerns is that 65 DNL does not adequately represent the true threshold of significant noise impact. It has been argued that the impact threshold should be lowered to 60 or even 55 DNL, especially in areas of quiet background noise and in areas impacted by large increases in noise (ANR, V. 4, N. 12, p. 91; V. 5, No. 3, p. 21; V. 5, N. 11, p. 82). The purpose of this section is to provide a time line of events which, taken together, indicate a distinct movement toward the consideration of airport noise impacts below the 65 DNL level.

YEAR

1992

In the 1992 session of Congress, a bill was introduced to lower the threshold for non-compatible land uses from 65 to 55 DNL (ANR, V. 4, N. 11, p. 83). The bill, however, was not passed. In 1995, a bill (HR 1971) was introduced in the House of Representatives to require the Department of Transportation to develop a plan to reduce the number of people residing within the 60 DNL contours around airports by 75 percent by January 1, 2001 (ANR, V. 7, N.

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13, p. 101). This bill was not passed either. Nevertheless, these developments indicate concerns about aircraft noise below 65 DNL are coalescing into specific proposals to address the situation.

Also in 1992, an important arbitration proceeding between Raleigh-Durham International Airport and airport neighbors was concluded. Residents residing between the 55 and 65 DNL contours were awarded compensation for noise damages. This was apparently the first time damages had been awarded beyond the 65 DNL contour at any domestic airport (ANR V. 4, No. 14, p. 107). While, strictly speaking, this case sets no legal precedent, it provides further evidence that a change in the definition of the threshold of significant noise impact may be gathering momentum.

After the arbitration was concluded, the Raleigh-Durham Airport Authority developed a model noise ordinance that would require new housing between the 55 and 60 DNL contours to be sound-insulated to achieve an outdoor-to-indoor noise level reduction of 30 dB. Between the 60 and 65 DNL contours, a 35 dB reduction would be required. The model ordinance was proposed for use by local governments exercising land use control. (See ANR, V. 6, N. 3, p. 17.)

In August 1992, the Federal Interagency Committee on Noise (FICON 1992) issued its final report. FICON included representatives of the Departments of Transportation, Defense, Justice, Veterans Affairs, Housing and Urban Development; the Environmental Protection Agency; and the Council on Environmental Quality. FICON was formed to review federal policies for the assessment of aircraft noise in environmental studies. The Committee advocated the continued use of the DNL metric as the principal means of assessing long-term aircraft noise exposure. It further reinforced the designation of 65 DNL as the threshold of significant impact on non-compatible land use. FICON recognized, however, the potential for noise impacts down to the 60 DNL level, providing guidance for analyzing noise between 60 and 65 DNL in reports prepared under the National Environmental Policy Act (NEPA). This includes environmental assessments and environmental impact statements. (It does not include F.A.R. Part 150 studies.) FICON offered this explanation for this action (FICON 1992, p. 3-5).

1992 (cont.)

There are a number of reasons for moving in this direction at this time. First, the Schultz Curve (see the bottom panel in **Exhibit A**) recognizes that some people will be highly annoyed at relatively low levels of noise. This is further evidenced from numerous public response forums that some people living in areas exposed to DNL values less than 65 dB believe they are substantially impacted (U.S. EPA 1991). Secondly, the FICON Technical Subgroup has shown clearly that large changes in levels of noise exposure (on the order of 3 dB or more) below DNL 65 dB can be perceived by people as a degradation of their noise environment. Finally, there now exist computational techniques that allow for cost-effective calculation of noise exposure and impact data in the range below DNL 65 dB.

The specific FICON recommendation was as follows (FICON 1992, p. 3-5):

If screening analysis shows that noise-sensitive areas will be at or above DNL 65 dB and will have an increase of DNL 1.5 dB or more, further analysis should be conducted of noise-sensitive areas between DNL 60-65 dB having an increase of DNL 3 dB or more due to the proposed airport noise exposure.

FICON further recommended that if any noise-sensitive areas between 60 and 65 DNL are projected to have an increase of 3 DNL or more as a result of the proposed airport noise exposure, mitigation actions should be included for those areas (FICON 1992, p. 3-7). The FICON recommendations represent the first uniform guidelines issued by the federal government for the consideration of aircraft noise impacts below the 65 DNL level. At this time, these remain recommendations and are not official policy.

1995

The Federal Transit Administration (FTA) released a guidance document entitled *Transit Noise and Vibration Impact Assessment*. Within this document, FTA cites the EPA recommendation of 55 DNL to develop their curve of impact. Further, FTA states that they use the FAA criteria of 65 DNL to define their curve of severe impact.

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1996

The American National Standards Institute (ANSI) recommends 55 DNL as the criterion level for housing and similar noise-sensitive land uses within their report *ANSI Quantities and Procedures for Description and Measurement of Environmental Sounds - Part 3: Short-Term Measurements with an Observer Present*.

The International Organization for Economic Cooperation and Development suggests the following environmentally sustainable transport noise levels: 55 DNL in urban areas and 50 DNL in rural areas.

1998

Within the Federal Railroad Administration's (FRA) *High-Speed Ground Transportation Noise and Vibration Impact Assessment*, the same criteria used by the FTA is used to assess impacts of new, high-speed trains.

In this same year, the Surface Transportation Board (STB) utilizes 55 DNL as a threshold of impact within the Draft Environmental Impact Statement for the proposed Conrail acquisition by Norfolk Southern Railway Company.

The World Bank Group (WBG) set noise limits for general industrial projects to ensure that projects they fund, such as iron and steel manufacturing and thermal power plants, do not negatively impact noise-sensitive development. The WBG set their threshold of impact at 55 DNL.

1999

The Federal Energy Regulatory Commission adopts a revision to their regulations (Part 157) which states "the noise attributable to any new compressor stations, compression added to an existing station, or any modification, upgrade, or update of an existing station, must not exceed a day-night level (Ldn) of 55 dBA at any pre-existing noise-sensitive area."

The World Health Organization's *Guidelines for Community Noise* recommends a "criteria of annoyance" daytime threshold of 55 DNL and nighttime threshold of 50 DNL for residential areas.

Early in 2003, the FAA announced the establishment of the Center of Excellence for Aircraft Noise Mitigation. This research center is a partnership between academia, industry, and government. Part of the center's focus will be on what level of noise is significant as well as other noise metrics that can be used to assess the impact of aircraft noise on individuals.

RECENT DEVELOPMENTS AT THE FAA

In the late 1990s, the Naples Airport Authority determined that the short-term viability of the airport was in jeopardy due to the noise impacts at the airport. An F.A.R. Part 150 Study determined that the majority of the noise complaints were from individuals which reside outside the 65 DNL noise contour and were, therefore, not eligible for federal mitigation funding.

For several decades, the airport authority had led efforts to balance the competing needs of airport users with those of the surrounding community and had adopted numerous measures to control noise and limit incompatible land uses surrounding the facility. The surrounding jurisdictions had gone as far as to adopt the 60 DNL noise contour as the threshold of significant impact and had limited development within this contour.

Naples adopted a ban on Stage 2 aircraft under 75,000 pounds in June 2000 pursuant to the Noise Act and its implementing regulations, commonly referred to as Part 161. The restriction at Naples is important not only because it was the first, but also because it was, and is, the subject of several challenges, the results of which may prove precedential for other airport operators' efforts to address local noise issues.

Early in 2003, the FAA announced the establishment of the Center of Excellence for Aircraft Noise Mitigation. This research center is a partnership between academia, industry, and government. Part of the center's focus will be on what level of noise is significant as well as other noise metrics that can be used to assess the impact of aircraft noise on individuals.

On March 10, 2003, the FAA ruled that the ban on Stage 2 business jet operations imposed by Naples Airport Authority violates federal grant assurance obligations. This ruling came after years of research and debate regarding the restriction at Naples Airport.

CONCLUSIONS

This technical information paper has presented information on land use compatibility guidelines with

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There is a strong and long-lasting consensus among various government agencies that 65 DNL represents an appropriate threshold for defining significant impacts on non-compatible land use. Nonetheless, both research and empirical evidence suggest that noise at levels below 65 DNL is often a concern.

respect to noise. It is intended to serve as a reference for the development of policy guidelines for F.A.R. Part 150 Noise Compatibility Studies.

There is a strong and long-lasting consensus among various government agencies that 65 DNL represents an appropriate threshold for defining significant impacts on non-compatible land use. Nonetheless, both research and empirical evidence suggest that noise at levels below 65 DNL is often a concern. Increased concern about these lower levels of noise has been registered in public forums across the country. Official responses by public agencies indicate at least a partial acknowledgment of these concerns. Indeed, according to many agencies and organizations as well as in the states of Oregon, Florida, Wisconsin, and California, airport noise analysis and compatibility planning below the 65 DNL level is strongly advised or required.

In urbanized areas with relatively high background noise levels, 65 DNL continues to be a reasonable threshold for defining airport noise impacts. In suburban and rural locations, lower noise thresholds deserve consideration. Given emerging national trends and the experience at many airports, it can be important to assess aircraft noise below 65 DNL, especially in areas with significant amounts of undeveloped land where land use compatibility planning is still possible. Future planning in undeveloped areas around airports should recognize that the definition of critical noise thresholds is undergoing transition. In setting a prudent course for future land use near airports, planners and policy-makers should try to anticipate these changes.

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