Chicago Executive Airport

DRAFT FAR Part 150 Noise Exposure Map Update

2017

Chapter A, Inventory of Existing Conditions

Chicago Executive Airport (PWK or the Airport), formerly Palwaukee Municipal Airport, is the busiest reliever airport in the Chicago metropolitan area. In terms of itinerant operations (trips exceeding 20 miles), PWK is the 3rd busiest airport in the state of Illinois. The Airport, co-located and co-owned by the Village of Wheeling and the City of Prospect Heights, is located approximately 18 miles northwest of downtown Chicago, serves private, corporate, charter, and air freight aircraft, and represents a vital and significant regional economic asset. In 2013, businesses operating at the Airport produced more than $2.3 million in sales and real estate tax revenues combined.[1]

The Airport is located within both the Village of Wheeling (to the north and west) and Prospect Heights (to the south) (Figure A1, *AIRPORT LOCATION MAP)*. PWK is unique in that land use authority within the bounds of the Airport resides with both jurisdictions. The Airport functions under an intergovernmental cooperative agreement between the Village of Wheeling and Prospect Heights, and is governed by a board of appointed directors representing the interests of the Airport and its surrounding communities.

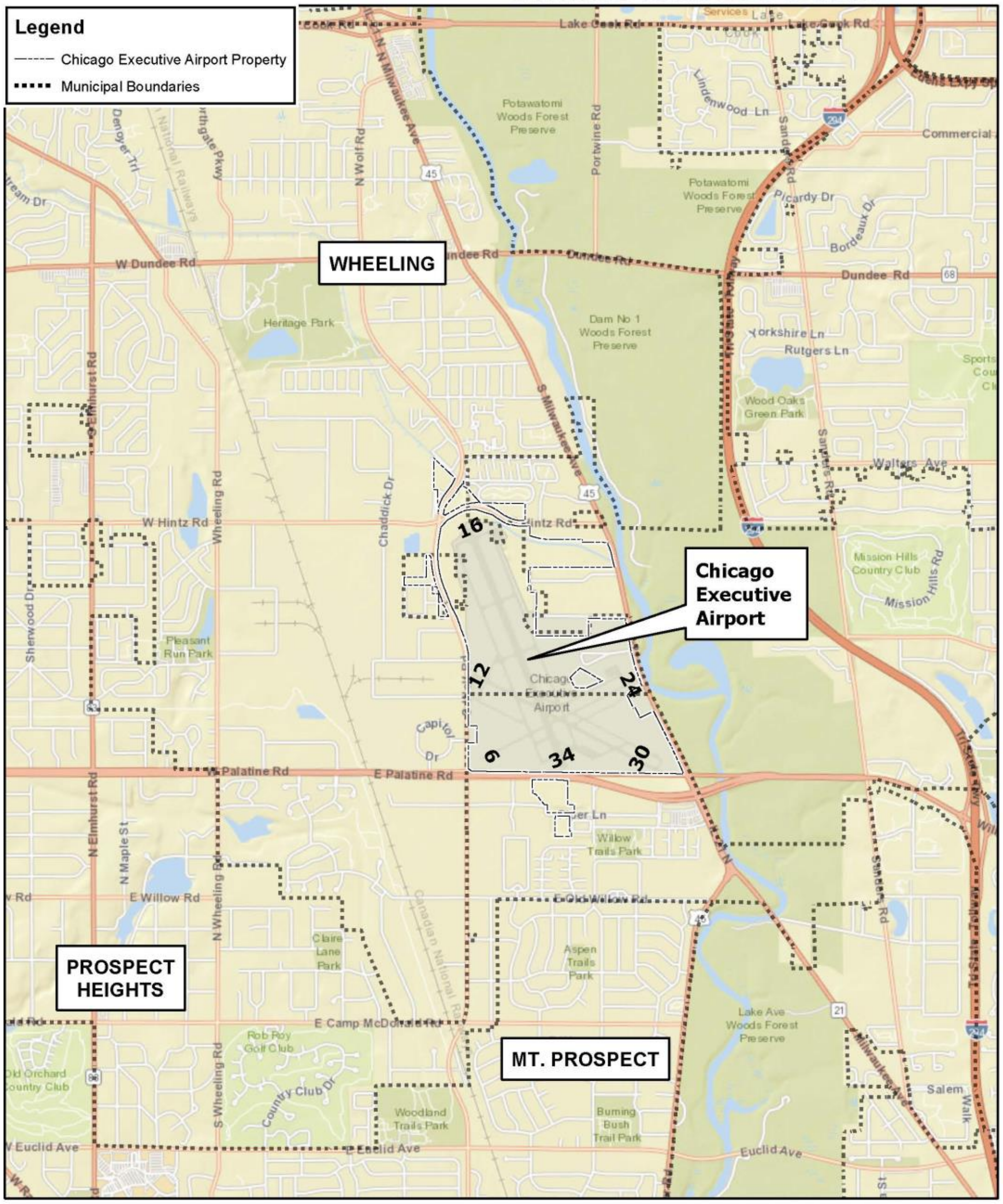
While numerous studies and master plan updates have been conducted at Chicago Executive Airport, the last full master plan was completed more than 30 years ago. The previous CFR Part 150 Study, including a Noise Exposure Map Update and Noise Compatibility Program (NCP), was conducted in 2010. As part of the NCP, the Airport developed noise abatement measures. The FAA approved some of the measures, however PWK has not yet implemented most of them.

Airport Physical Facilities

The Chicago Executive Airport has three runways: Runway 16/34 runs north and south, Runway 6/24 runs southwest to northeast and Runway 12/30 runs northwest to southeast. All three runways are constructed of asphalt. Runway 16/34, the main runway, is 5,001 feet in length and 150 feet in width. This runway is equipped with High Intensity Runway Lights (HIRL and Runway End Identifier Lights (REIL). Precision Approach Path Indicators (PAPI) serve both Runways 16 and 34, while only Runway 16 has a Runway Lead In Lighting System (RLLS) and an Instrument Landing System (ILS). Runway 12/30 is the secondary runway at the Airport and is 4,415 feet in length and 75 feet in width. The runway is equipped with PAPI serving both Runways 12 and 30. Runway 6/24 functions as a light general aviation runway and is 3,677 feet in length and 50 feet in width. PAPI serve Runway 6 only.

[1] Chicago Executive Airport Visioning Report, Master Plan Update Phase 1

NOISE EXPOSURE MAP UPDATE



N

0 3,000 6,000 Feet

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User

FIGURE A1 **Airport Location Map**

Parallel taxiways are located on either side of Runway 16/34. Various connector taxiways connect the taxiways with their respective parallel runways and the various landside development areas. Landside facilities, including three Fixed Base Operators, are located throughout airport property. T-hangars and various storage hangars are located on the north and south sides of the Airport. The Airport Traffic Control Tower (ATCT) is located on the east side of the airport, north of Runway 6/24. Vehicular access to the airport administration offices is provided by Industrial Lane or Sumac Road. South Wolf Road provides access to facilities on the west side of the airport, while South Milwaukee Road provides access to facilities on the east side. These areas are illustrated in Figure A2, *EXISTING AIRPORT LAYOUT PLAN*.

Air Traffic Operations Activity

Chicago Executive Airport has experienced a steady decline in overall operations in the past decade. However, operations have started to increase as of late. Specifically, (itinerant) general aviation operations decreased more than 40% from 2006 to 2015. Starting ten years ago, this trend was observed across the country, where GA activity declined in the wake of the financial crisis and increased fuel prices. An operation is defined as either a take-off or a landing. As shown in Table A1, *SUMMARY OF HISTORICAL OPERATIONS*, operations have decreased from approximately 112,000 in 2006 to approximately 79,000 in 2016.

Airspace/Air Traffic Control

The Federal Aviation Administration (FAA) is responsible for the safe and efficient use of the National Airspace System. This airspace is divided into three specific types: local, terminal, and enroute. When an aircraft departs an airport, it is located in airspace handled by controllers working in an ATCT. When the aircraft is approximately one to five miles away from its departure airport, the aircraft is handed off to controllers working the Chicago Terminal Radar Approach Control Facility (TRACON). The Chicago TRACON controllers are responsible for the airspace extending approximately 40 nautical miles out from the Chicago O'Hare International Airport (ORD or simply O'Hare) in all directions. Outside of this approximate 40 nautical mile radius, the aircraft enters the third type of airspace and becomes the responsibility of enroute controllers working in an Air Route Traffic Control Center (ARTCC). The enroute controllers retain control until the aircraft nears its intended destination. The process is then reversed for landings.

NOISE EXPOSURE MAP UPDATE

Based on Source Data From FAA 5010 Information for KPWK, May 13, 2014.

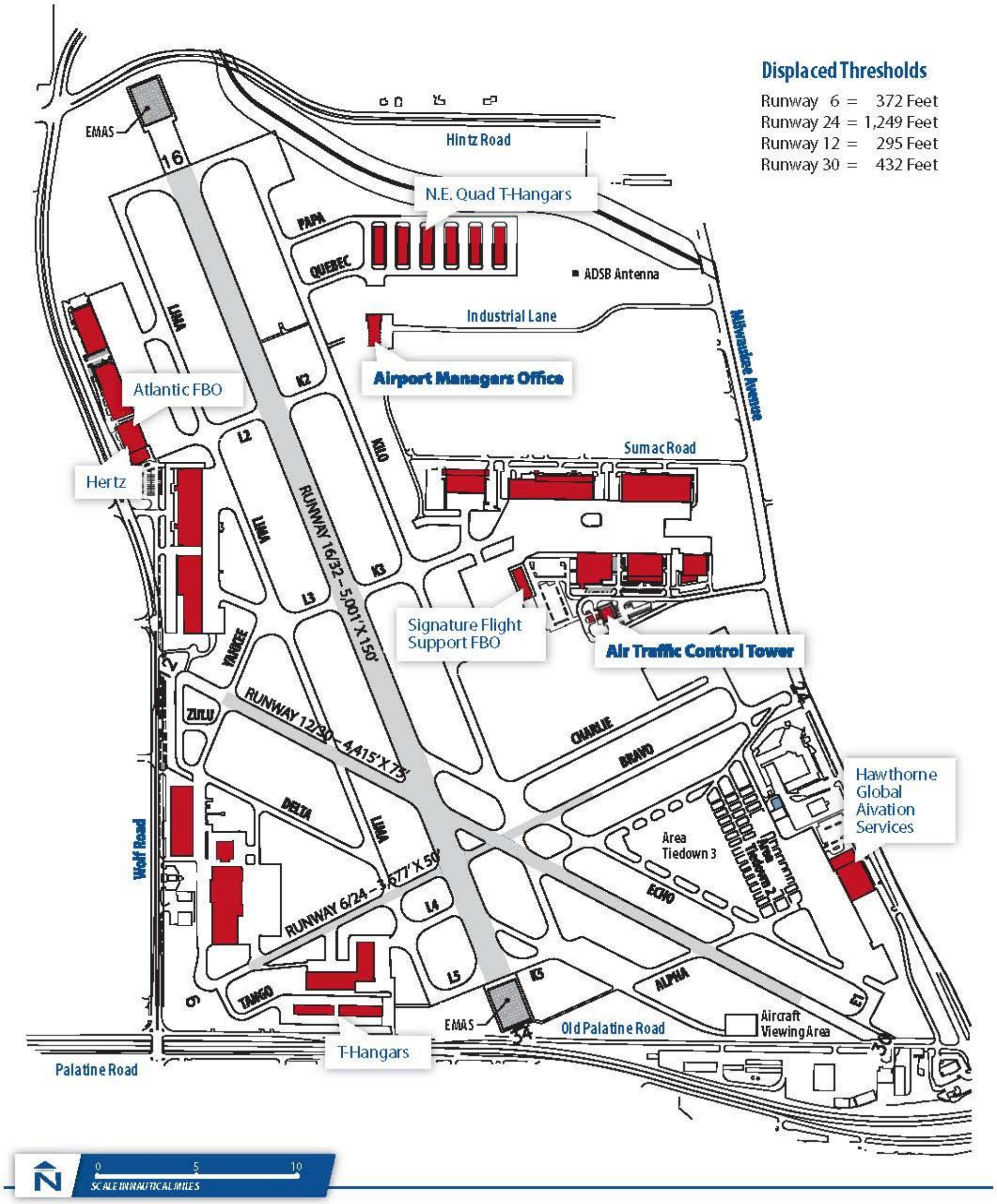


FIGURE A2 ***Existing Airport Layout***

Table A1, SUMMARY OF HISTORICAL OPERATIONS, 2006-2015

	Itinerant					Local			
	Air Carrier	Air Taxi	General Aviation	Military	Total	Civil	Military	Total	Total Operations
2006	0	12,126	75,297	42	87,465	25,396	14	25,410	112,875
2007	0	13,247	74,948	55	88,250	25,870	0	25,870	114,120
2008	44	13,369	60,626	43	74,082	24,144	21	24,165	98,247
2009	0	10,999	50,862	154	62,015	23,209	23	23,232	85,247
2010	0	12,495	52,714	155	65,364	23,943	46	23,989	89,353
2011	9	13,379	47,717	99	61,204	22,820	86	22,906	84,110
2012	17	14,342	49,465	198	64,022	20,908	61	20,969	84,991
2013	24	13,142	45,104	91	58,361	21,161	22	21,183	79,544
2014	41	12,872	44,185	98	57,196	19,248	6	19,254	76,450
2015	67	13,204	42,510	154	55,935	19,432	98	19,530	75,465
2016	25	12,621	45,931	41	58,618	20,295	6	20,301	78,919
Total	**227**	**141,796**	**589,359**	**1,130**	**732,512**	**246,426**	**383**	**246,809**	**979,321**

Source: Sources: Air Traffic Activity System (ATADS), Report created in August 2017.

Note: Itinerant operations are operations performed by an aircraft that lands at an airport, arriving from outside the airport area, or departs an airport and leaves the airport area. Local operations are those operations performed by aircraft that remain in the local traffic pattern in a designated practice area within a 20–mile radius of the tower. Air carrier operations at a general aviation (GA) airport include aircraft that have more than 60 seats (which can include chartered or private aircraft operations).

There are several airports located in the Chicago Metropolitan Area that are under the control of the Chicago TRACON. Although O'Hare and Chicago Midway International Airport account for a significant percentage of all area aircraft operations, the cumulative number of aircraft operations at the other airports, including Chicago Executive Airport, also contributes significantly to the demand placed on terminal airspace and the Chicago TRACON. There are also other general aviation airports without operational control towers or published instrument procedures that contribute to the total number of area wide aircraft operations.

While aircraft using these other general aviation airports often operate under visual flight rules (VFR), they use the terminal airspace, and aircraft using PWK must be segregated. Chicago TRACON provides full arrival and departure services for Chicago Executive Airport, as well as for O'Hare and Midway Airports and many other airports throughout the Chicago metropolitan area.

Chicago Executive Airport has an ATCT associated with Class D Airspace area that operates from 6:00 a.m. to 10:00 p.m. Aircraft that operate within Class D Airspace must be in contact, at all times, with the tower controllers, especially to receive approval for take-offs and landings. Standard Tower Controlled Airspaces (TCAs) are designated to include all airspace within five miles of the Airport from the surface of the ground up to (but not including) 3,000 feet. The Chicago Executive Airport airspace encompasses a semi-circle to the north and unique dimensions to the east, west and south due to the Airport's proximity to O'Hare. Chicago Executive Airport essentially exists within a cutout of one of O'Hare's Class B airspace rings. Airspace operational activities are explained in greater detail in the following paragraphs.

Airspace Configuration

Local airspace surrounding the Airport is designated as Class D airspace. Class D airspace usually consists of airspace surrounding airports that have an operational control tower, but do not meet the requirements for the more restrictive Class B or Class C airspace. The Chicago Executive Airport Class D airspace extends from the ground surface up to, but not including, 3,000 feet above mean sea level (AMSL). Chicago Executive Airport's proximity to O'Hare greatly influences the way aircraft operate in and out of the Airport and requires some non-standard means to the basic straight-in/out approach/departure corridors typical to many airports. At Chicago Executive Airport, approaches from and departures to the south (off Runway end 34) are generally constrained by the boundary of the Class B airspace at O'Hare, causing operators to either avoid it entirely by approaching from or departing to the north (off Runway end 16) or by flying under the airspace.

Figure A3, *GENERALIZED AIRSPACE*, presents an illustration of Chicago Executive's Class D airspace. The exact configuration of each Class D airspace area is tailored to the individual airport. However, Class D airspace usually consists of a five-nautical mile radius circle surrounding an airport. Unless otherwise authorized, each aircraft must establish two-way radio communications with the Air Traffic Control (ATC) facility providing air traffic services prior to entering the airspace and thereafter maintain those communications while in the airspace.

Above 3,000 feet AMSL, Chicago Executive Airport is located under a ring of O'Hare Class B airspace extending from 3,000 feet AMSL up to 10,000 feet AMSL. Class B airspace usually consists of a 20-Nautical Mile (NM) radius circle surrounding an airport; the floor and ceiling of the airspace is unique to each airport. PWK is also located within the Chicago mode C veil as shown in the illustration. This airspace has been delegated to the Chicago TRACON facility by the Chicago ARTCC or Center. The Center provides ATC services to aircraft between terminal areas. The Chicago TRACON provides approach/departure control services within its delegated airspace. Seven of the busiest airports within the Chicago TRACON's airspace have ATCTs (or "towers"). These towers provide control within the TRACON's airspace. Airports that have towers are listed below:

- Chicago Executive Airport (PWK)
- Chicago O'Hare International Airport (ORD)
- Chicago Midway International Airport (MDW)
- Gary/Chicago International Airport (GYY)
- Aurora Airport (ARR)
- Waukegan Regional Airport (UGN)
- DuPage Airport (DPA)

The Center and TRACON provide control primarily to aircraft operating under instrument flight rules (IFR). In addition, TRACON provides control or service to aircraft operating under VFR within the Chicago Class B Airspace. An ATC clearance and control is mandatory for VFR aircraft operating within Class B airspace. Published instrument approach procedures exist for at least ten different airports within the Chicago TRACON airspace and include both precision and non-precision approaches. A precision approach, by definition, provides electronic vertical guidance to the pilot as well as horizontal (azimuth) guidance. A non-precision approach provides horizontal guidance only. Generally, the azimuth guidance for a precision approach is more precise. For an ILS approach procedure, a localizer transmitter provides the azimuth guidance and a glide slope transmitter provides the vertical guidance.

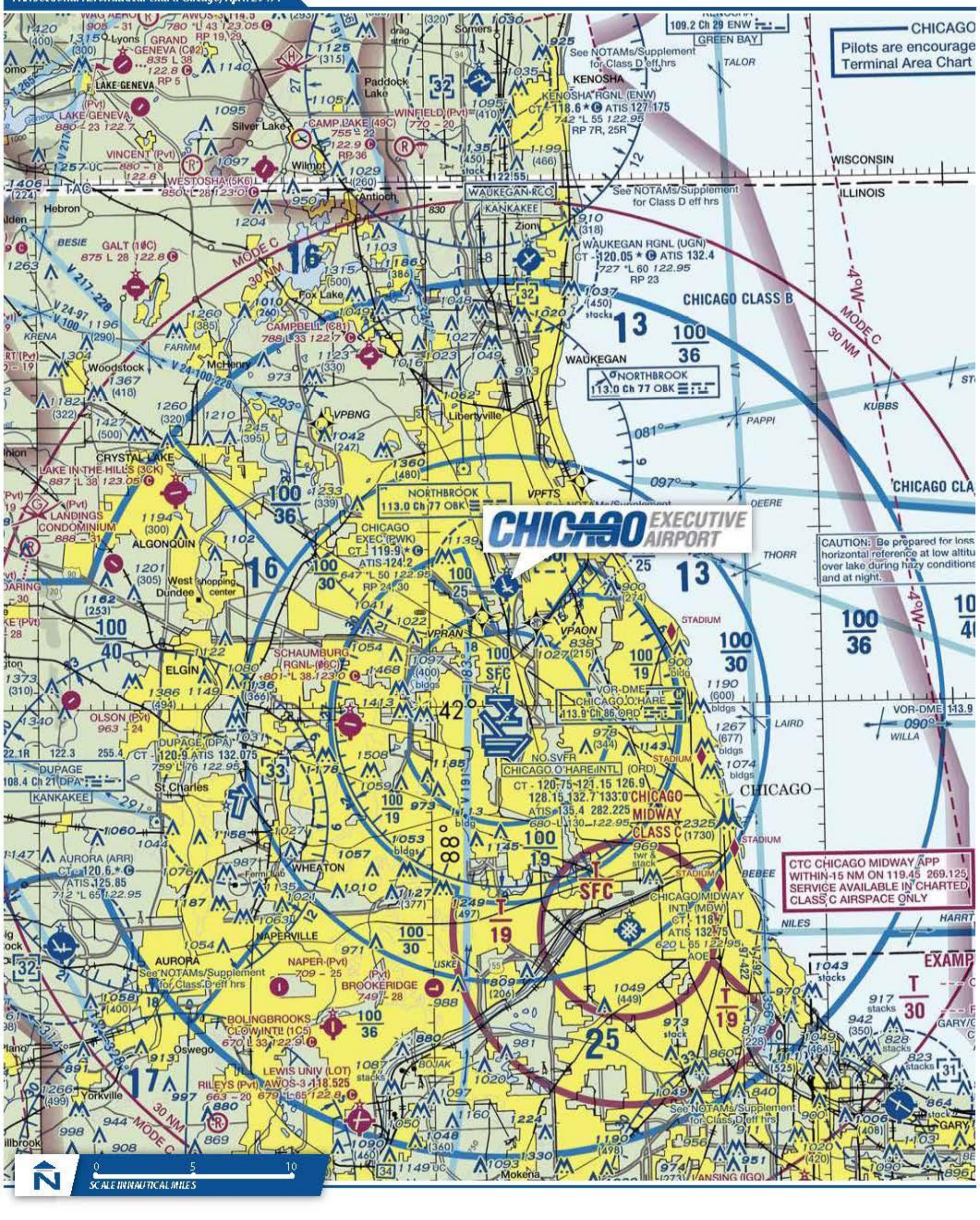


FIGURE A3 *Generalized Airspace*

Radar Data Availability

To obtain the detailed operational assumptions, a full year of radar data was used to determine: fleet mix, runway use, time of day, flight tracks, and flight track use. This includes records of each flight, the time of the operation, the type of operation (departure/arrival), runway used and type of aircraft. The radar track points for each flight were also obtained. These inputs also served as a starting point to assess future aircraft noise levels for the future year scenario.

In reviewing the 2016 base case radar flight tracks, the consultant team analyzed the data for the runway closures on weekends between June and November. During this time, aircraft still operated at the same amount, but were on Runway 12/30. Runway 16/34, which is typically the primary runway, was closed during the closure period for 12 weekends from 10:00 pm on Friday night through 3:00 pm on Sunday afternoon, for a total of 41 hours each closure. This closure equates to an average of 115 flights/per closure period that were using Runway 12/30 instead of Runway 16/34, or approximately 1.7% of the total operations. During these weekend nighttime closures, of all the flights that operated on Runway 16/34, there were approximately 60 flights that operated during FAA-designated nighttime hours of 10:00 pm – 7:00 am for the entire closure period. While it was determined that this small number of operations would not significantly change the noise contour, the closure period operations were included in the base year 2016 DNL noise contour inputs.

Airport Environs

Chicago Executive Airport is located in the western portion of Cook County, approximately 27 miles from the central business district (CBD) of Chicago. The Airport is located within both the Village of Wheeling and the City of Prospect Heights, approximately 13 miles from the Chicago O'Hare Airport. The City of Mount Prospect is located just south of Prospect Heights, but does not include PWK property. CFR Part 150 specifies that the 65 DNL noise contour is the threshold contour for land use compatibility purposes and the official Noise Exposure Maps (NEM) reflect this contour. The 65 DNL contour will be further used to define land use compatibility for the existing (2016) condition and the future (2022) condition.

<u>Existing Land Use</u>

The generalized existing land use for the area surrounding the Airport was compiled directly from the previous Part 150 Study and field checked with a windshield survey in early 2017. Existing land use is presented in Figure A4, *GENERALIZED EXISTING LAND USE*.

Areas north and west of PWK are located within the jurisdiction of the Village of Wheeling. Existing land uses immediately west of the Airport comprise mostly industrial uses with some residential and public/institutional uses. Cultural (Korean Cultural Center of Chicago) and religious centers (Grace

Church) are located southwest of the Airport near the intersection of E Palatine Rd and S. Wolff Rd. Land use north of PWK consists of a mixture of single- and multi-family residential, commercial use, and open space (Lake County Forest Preserve and Potawatomi Woods). A Metra station (Northeast Illinois commuter rail system) is located approximately two miles northwest of the Airport. The Metra North Central Service line connects Wheeling to Chicago, running roughly north- south, paralleling the Airport.

The area south of the Airport is under the jurisdiction of the City of Prospect Heights. Land uses south of PWK are a mixture of single- and multi-family residential, industrial, and open space (Willow Trails Park). Educational facilities including Northbrook College of Healthcare and Harper College Learning and Career Center are located southwest of PWK along S. Wolff Rd. Land south of Prospect Heights falls under the jurisdiction of Mount Prospect. This area comprises residential uses and recreational areas. Frost Elementary School is located south of E. Palatine Road and east of Wolff Road. A detailed evaluation of land use and population is presented later in the document for how each relates to the noise contours.

<u>Future Land Use</u>

The Village of Wheeling Comprehensive Plan (2003) and City of Prospect Heights Comprehensive Plan (2014) work in concert with Chicago Executive Airport to guide land use and development in the area. Both jurisdictions recommend an expansion of mixed-use development and redevelopment near the Airport to attract employees, utilize vacant parcels and support local business growth. The adopted Comprehensive Plans are illustrated in Figure A5, *GENERALIZED FUTURE LAND USE*.

The Village of Wheeling Comprehensive Plan discusses potential plans to promote Milwaukee Avenue (east of the Airport) as “Restaurant Row” to encourage pedestrian-oriented mixed-use development and business growth. Additionally, the plan discusses the benefits in annexing the Wolf Ridge subdivision (immediately west of the Airport) in order to facilitate a transition to airport-related industrial uses.

The City of Prospect Heights Comprehensive Plan discusses developing additional industrial uses just south of the Airport along Palatine Road. Existing infrastructure could support compatible land uses in this area.

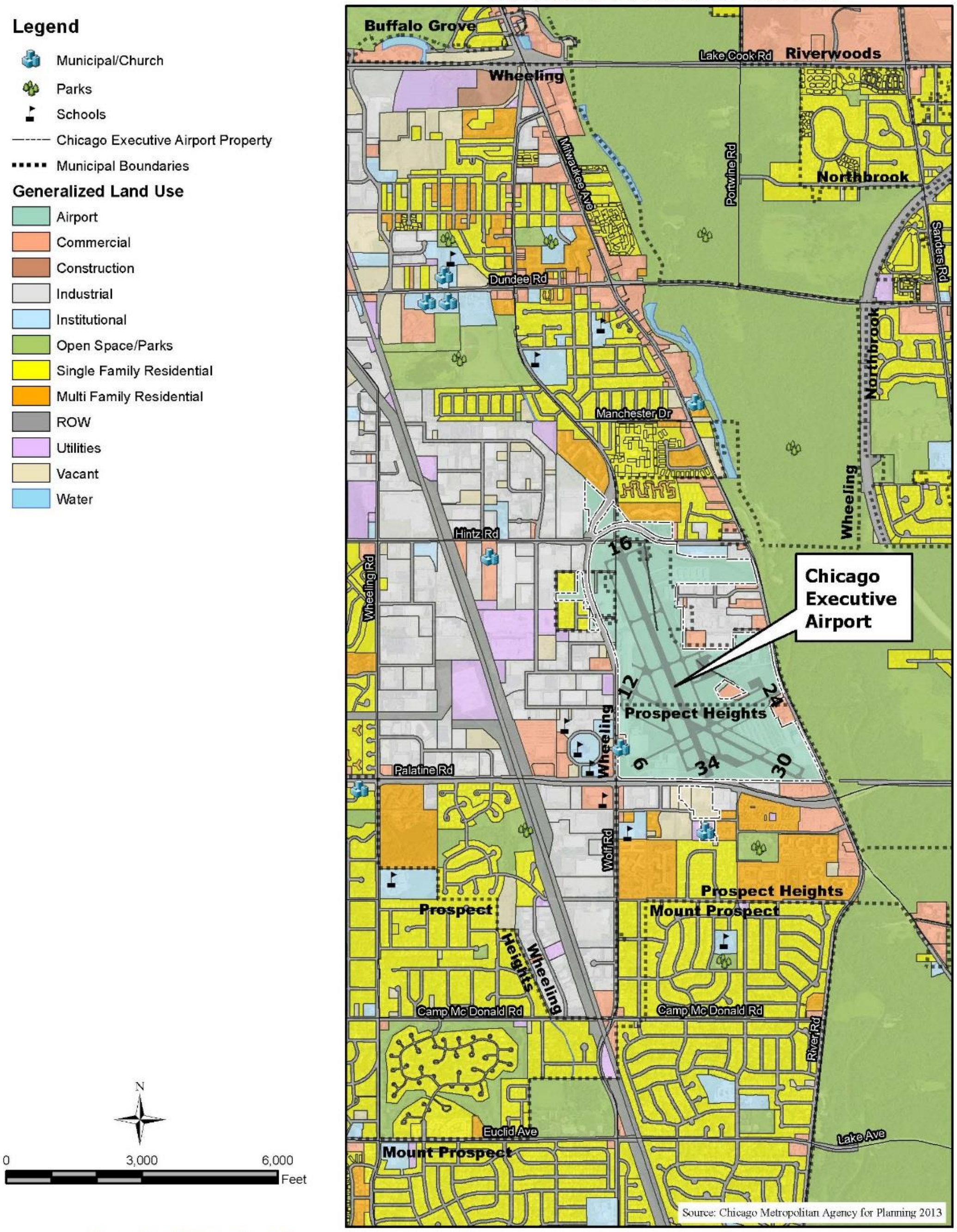


FIGURE A4 *Generalized Existing Land Use*

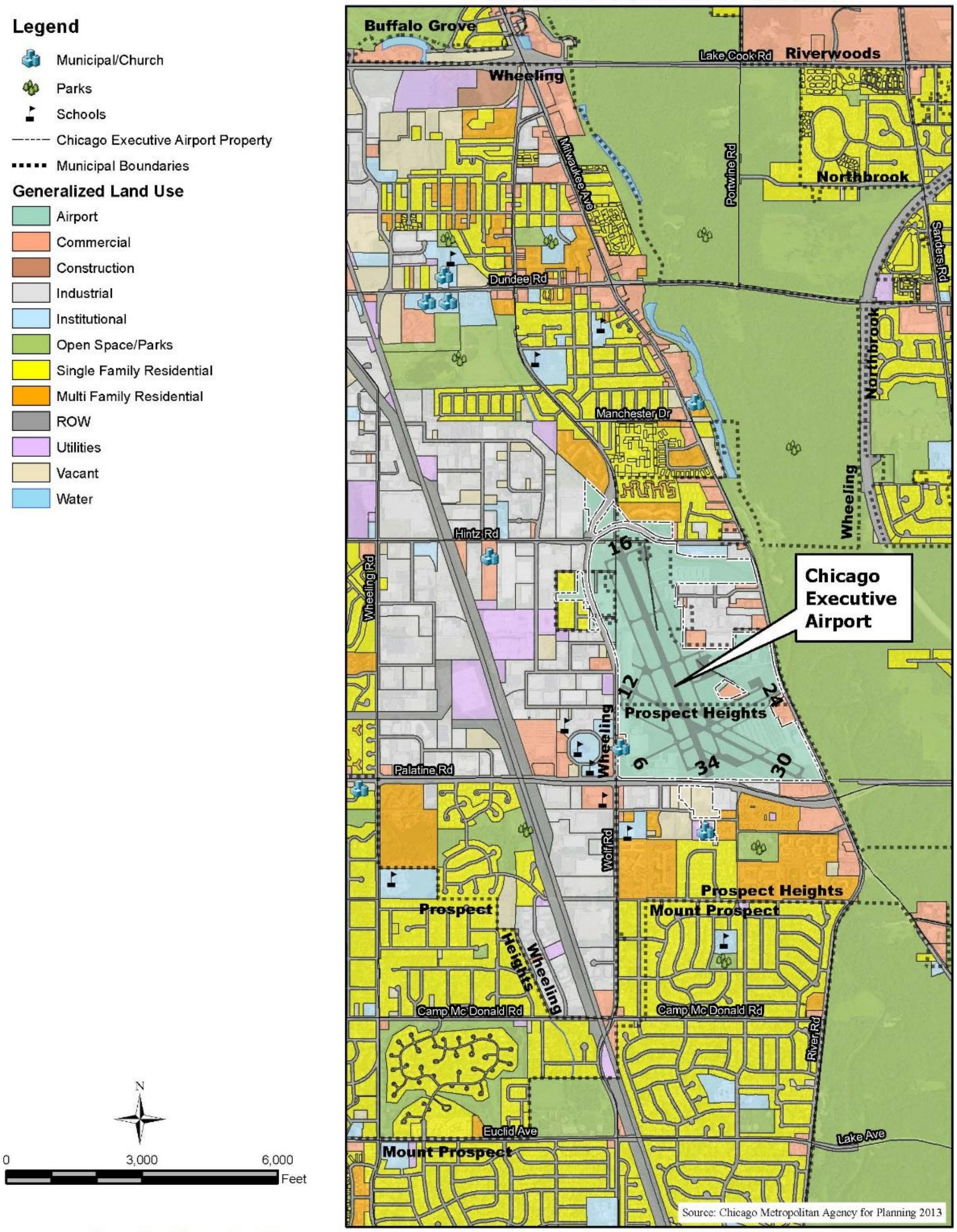
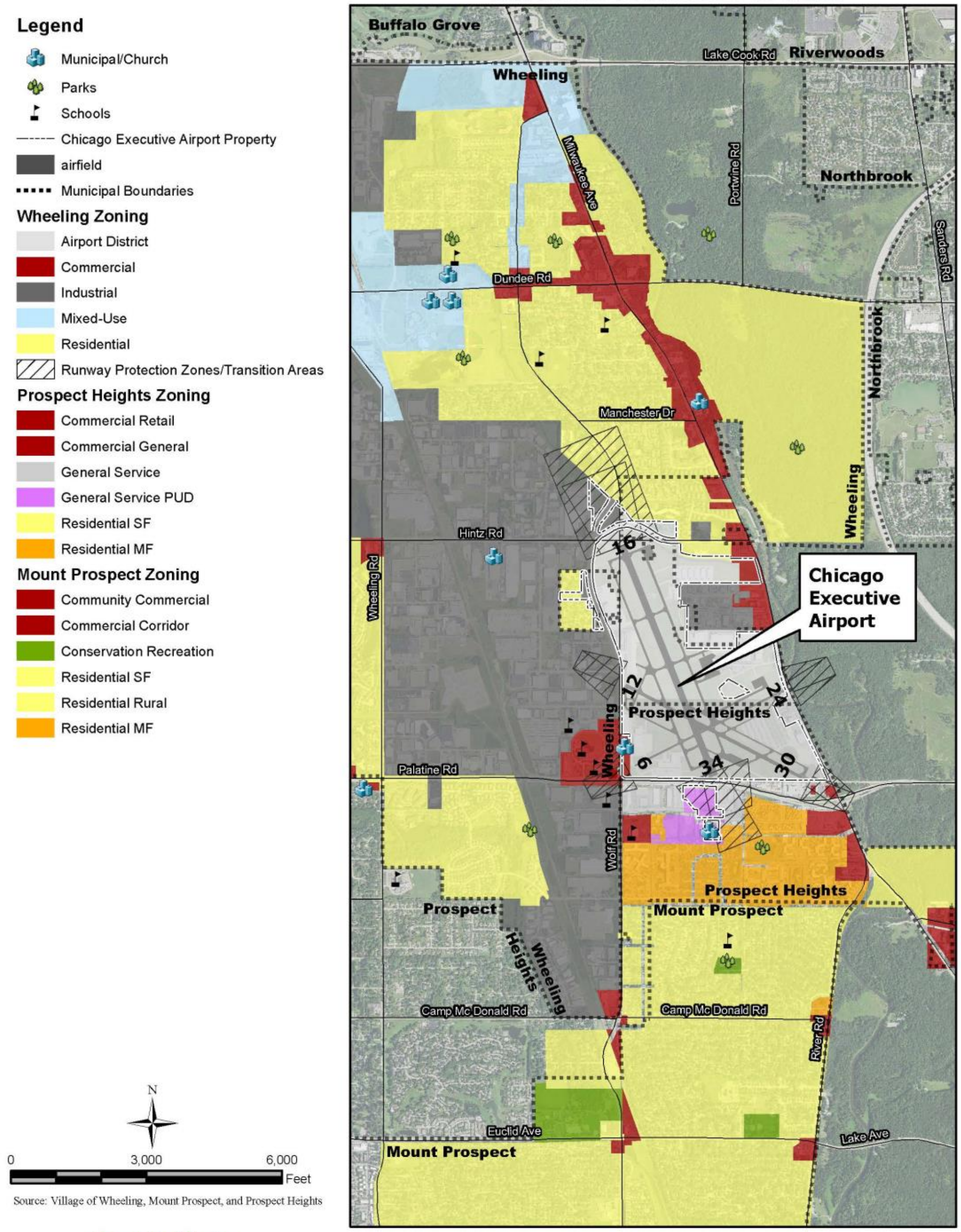


FIGURE A5 *Generalized Future Land Use*

Zoning

Prospect Heights and the Village of Wheeling have adopted land use zoning ordinances that control the development of land within their boundaries and set criteria for types of land use to be developed within certain zones. In conjunction with zoning ordinances, Prospect Heights and Wheeling have implemented zoning maps that congregate the municipalities into individual zones consistent with local ordinances. The Airport itself has been designated as an A-P, Airport District, by the Village of Wheeling, and B-3, General Service, by Prospect Heights. South of PWK existing zoning comprises primarily commercial uses, planned urban development, and multi-family residential. Areas in northern Mount Prospect are zoned single-family residential. Areas north of PWK consist of residential, industrial and commercial zoning designations. West of the Airport are primarily industrial uses with some commercial businesses. Zoning within the vicinity of the Airport is shown in the following illustration entitled Figure A6, ZONING.



Source: Village of Wheeling, Mount Prospect, and Prospect Heights

FIGURE A6 *Generalized Zoning*

Land Use Controls Evaluation

Land use controls and development planning offer ways in which the local jurisdictions and the Airport may achieve desired objectives. These measures involve various opportunities and options that are available for influencing, directing, managing, and controlling the nature and sequence of development within the Airport environs. The various techniques and mechanisms range from fee simple land acquisition programs to more advanced regulatory mechanisms and advisory programs. Each mechanism can be useful in accomplishing desired objectives and can be used separately or in conjunction with others as the situation dictates. The following is a discussion of the land use planning and control measures within the vicinity of the Chicago Executive Airport.

Fee Simple Land Acquisition

Fee simple land acquisition is often the most effective means that is available to an airport or community for controlling land use development and ensuring compatibility; it is also the most expensive. Land acquisition can be accomplished through negotiation and purchase from the owner or through condemnation proceedings. Although it is the most expensive option, resale for a compatible use or joint purchase with another government agency for a compatible public use may help reduce the net cost of the property.

The acquisition of property affected or potentially affected by airport operations is the most effective and efficient means of controlling land use in noise impacted areas. It is possible that compatible public use could compensate for the direct cost of purchasing the property. It should be noted that the acquisition of property is used more often than not in circumstances where the noise situation is critical for the continuation of existing uses or where such preventive measures as comprehensive planning and zoning are not working.

Zoning

Zoning is the most traditional approach, and the most common and widely used legal device to control land use development. It can be defined as “the division of a city by legislative regulation into districts and the prescription and application in each district of regulations having to do with structural and architectural design of buildings and of regulations prescribing use to which buildings within designated districts may be put.” This regulation is accomplished through the adoption of a zoning ordinance, which specifies the use, size, height, and bulk of structures within each district. The Village of Wheeling and the City of Prospect Heights have the statutory authority to adopt zoning ordinances

Zoning is a useful tool for controlling land use development and promoting compatibility while supporting private land ownership. However, zoning cannot be relied upon as a “corrective measure” as it can only be applied proactively, not retroactively. It should also be realized that zoning is subject to shifting political conditions and situations; therefore the zoning classification of any particular tract of land can be subject to change by review of the local zoning authority.

In summary, zoning is the most widely used land use control mechanism and offers an acceptable tool for implementing a land use compatibility plan. There are several Illinois Statutes that grant zoning authority, which can have an effect on the area around Chicago Executive Airport. Zoning can be a time-consuming effort in that the designation of zoning classifications and implementation must be closely monitored to ensure continuing compatibility.

Comprehensive Planning

A comprehensive plan is an expression of the community's policies and goals toward land use and development, and serves as a guide for policy implementation. As stated earlier, The Village of Wheeling and City of Prospect Heights have adopted comprehensive plans to guide development within the Airport environs. A comprehensive plan by itself may not control development or relieve noise impacts/incompatibilities without implementation of a development plan.

Subdivision Regulations

The Village of Wheeling and City of Prospect Heights have adopted subdivision regulations pursuant to Illinois Statutes, which govern the process of changing undeveloped land to subdivisions. Subdivision regulations are an exercise by the local unit of government, as is the enactment of a zoning ordinance. To be most effective, subdivision regulations must be coordinated with the comprehensive plan and the zoning ordinance for proper implementation and goal achievement. Subdivision regulations can be used to ensure the granting of an avigation easement as part of the building permit process. In addition, the regulations can be utilized to control utility size and placement, street design and the timing of the installation of these facilities when coupled with a capital improvements program (CIP).

Easements

An easement is the right of the owner of land to make lawful and beneficial use of the land of another. It is a limited right, not an estate, or fee, in the land of another. Easements are a means of land use control.

Easements can be classified as one of two types, depending on what type of interest is involved. A positive easement is one in which the owner of the easement has the right to do something with the land, where a negative easement is one where the landowner gives up his right to do something. The right to construct an access road across someone's property is an example of a positive easement, compared to a landowner who gives up his right to build a tower, which is a negative easement.

Easements may be acquired through grant, gift, devise, acquisition, or condemnation. The purchase of an easement in some cases can be as expensive as an outright fee simple purchase. Easement acquisition by condemnation is usually restricted to certain types of easements outlined in state enabling legislation and many times noise easements are not specifically mentioned in the legislation.

Avigation easements are a common example of the type of easement commonly required within the Airport environs. An avigation easement allows aircraft to fly over the property, make noise, and may limit the height of objects on the burdened property within approach areas.

Building Codes

Building codes are regulations that govern the construction practices in any given jurisdiction and must be followed in order to obtain a building permit from the governing body. Adoption of a building code can guide noise attenuation throughout the city or county by requiring noise reduction construction practices from outside noise levels to inside noise levels.. Certain sound attenuation requirements can be included in the building code and referred to for specific areas through the zoning ordinance and subdivision regulations. The code is most easily enforced through the building permit process.

Capital Improvements Program (CIP)

The implementation of capital improvements often encourages growth and development. To avoid incompatible land uses, capital improvements should be programmed to encourage compatible development and discourage incompatible development. Any programs that may discourage noise sensitive uses should be undertaken within the established aircraft-generated noise areas. This can be particularly effective in directing industrial/commercial development to areas that would be incompatible for residential development.

Chapter B, Forecast of Aviation Activity

This chapter summarizes existing aviation activity at Chicago Executive Airport and estimates future activity. This forecast of aviation activity serves as the basis for analyzing existing aircraft noise levels and predicting future noise levels associated with aircraft activity. Forecasts, like the prediction of next month's weather, are never exact; rather, the forecast indicates, based on past conditions and available information, how activity may change in the future. In that manner, the forecast serves as a basis for evaluating how noise exposure may change in the future. The following section describes the basic methodology for developing the forecast of aircraft operations at Chicago Executive Airport. This information serves as the basis for the future fleet mix forecasts described in Chapter D, Existing and Future Baseline Noise Conditions chapter. The year 2016 is used for the existing conditions and the year 2022 is used for the future conditions for the Noise Exposure Maps (NEMs).

Background

As discussed in Chapter A, Inventory of Existing Conditions, Chicago Executive Airport has experienced a steady decline in overall operations in the past decade. Operations have decreased from approximately 112,000 in 2006 to approximately 79,000 in 2016. Table B1, *HISTORICAL OPERATIONS, 2006-2016,* shows a generalized summary of historical operations at the Airport.

Table B1, HISTORICAL OPERATIONS, 2006-2016

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Operations	112,875	114,120	98,247	85,247	89,353	84,110	84,991	79,544	76,450	75,465	78,919

Source: Air Traffic Activity System (ATADS), Report created in August 2017.

The purpose of this Study is to update the NEMs for Chicago Executive Airport, which identify the existing (2016) and future (2022) noise exposure. Note that the year 2022 was identified as the future year contour because it represents five years into the future from the date of submission of the NEMs. Both NEMs were prepared using the Federal Aviation Administration's Aviation Environmental Design Tool (AEDT) v2b. To prepare a noise exposure contour map for a particular year, the AEDT requires information concerning the number of aircraft operations, the types of aircraft (fleet mix), and the time of day (day or night) that the activity occurs.

The forecast presented in this NEM Update is taken from the Airport Master Plan Update being prepared by the Airport. No additional forecasts were prepared as part of this NEM Update. The forecasts were approved by the FAA in January, 2017. The Forecast Chapter from the Master Plan Update and the FAA approval letter are included in Appendix A.

Existing Operations and Forecasts Summary

This section presents the summary of the existing operations for the year 2016 and future operations for the year 2022. At the onset of this study, 2016 provided the last full year of data available that represented “normal” operations, prior to the rehabilitation of Runway 16/34.

According to the forecast included in the Master Plan Update, total operations at Chicago Executive Airport are predicted to increase slightly from 2016 to 2022, and to continue to increase into the future. Table B2, *SUMMARY OF ANNUAL AIRCRAFT OPERATIONS FORECAST,* depicts existing and future operations at Chicago Executive Airport broken down by aircraft type for AEDT analysis.

Table B2, SUMMARY OF ANNUAL AIRCRAFT OPERATIONS FORECAST

Year	2016	2022	2027	2032
Piston	14,898	12,246	10,307	8,668
Turbo-prop	9,657	9,935	10,189	10,463
Light Jet	6,473	6,907	7,304	7,734
Small Jet	34,702	36,412	37,993	39,733
Medium Jet	7,979	8,318	8,901	9,470
Large Jet	3,152	3,369	3,786	4,257
TOTAL	**76,860**	**77,187**	**78,480**	**80,325**

Source: Chicago Executive Airport Master Plan Update, 2016. CMT.
Note: The table shows 2016 as base year conditions. However, because the NEM Update was submitted in 2017, five year increments are accounted for after that date (2017). Because the Master Plan Update was published in 2016, the year 2016 in Table B2 does not reflect a full year’s actual data.

Chapter C, Background Information on Noise

Noise, by definition, is unwanted sound. Noise is perceived by and consequently affects people in a variety of ways. This chapter presents background information on the characteristics of sound and provides insight into the human perception of noise. It also provides a means to relate the sound made by aircraft operating to and from Chicago Executive Airport (PWK) to the noise in the surrounding communities. The metric (the way noise is measured or described) and methodologies used in the Part 150 Noise Exposure Map (NEM) Update to describe noise generated by aircraft operating at Chicago Executive Airport is also presented. This metric (Day Night-Noise Level) enables the characterization of existing and future noise. This chapter is divided into the following sub-sections:

- **Characteristics of Sound**. Presents properties of sound that are important for describing noise in the airport setting.
- **Factors Influencing Human Response to Sound**. Discusses sound level conditions that produce subjective perceptions and elicit a response in humans.
- **Health Effects of Noise**. Summarizes the potential disturbances and health effects of noise to humans.
- **Sound Rating Scales**. Presents various sound rating scales and how these scales are applied to assessing noise from aircraft operations.
- **Noise/Land Use Compatibility Guidelines**. Summarizes the current guidelines and regulations used to control the use of land in areas affected by aircraft noise.
- **Airport Noise Assessment Methodology**. Describes the analysis completed to measure aircraft and other noise in the vicinity of airports.

Characteristics of Sound

Sound Level and Frequency. Sound is described in terms of the sound pressure (amplitude) and frequency (similar to pitch).

Sound pressure is a direct measure of the magnitude of a sound without consideration for other factors that may influence its perception. The range of sound pressures that occur in the environment is so large that it is convenient to express them on a logarithmic scale. The standard unit of measurement for sound pressure is the Decibel (dB). One decibel is used to describe the reference point of 20 micro Pascals or about 0.000000003 pounds per square inch of energy. Thus, 65 decibels is that amount to the 65th power. A logarithmic scale is used because of the difficulty in expressing such large numbers.

Highlights of Sound

Noise by definition is unwanted sound. There are many ways to describe noise (metrics), however, the most commonly relied on metric is the decibel (dB), which uses a weighting system that most closely reflects the human ear (the A-weighted decibel – dBA).

A number of factors affect sound, including weather, ground effects, as well as human reaction to the noise source. Health effects associated with aircraft noise are typically impacts to sleep and communication that cause stress.

As required by Federal law, aircraft noise must be measured using the Day-Night Average Level (DNL), which is based on averaging dBA.

FAA and other federal agencies have established land use compatibility guidelines based on the DNL, that identify the acceptability of various types of land use with aircraft noise exposure.

On the logarithmic scale, a sound level of 70 dB has 10 times the energy as a level of 60 dB, while a sound level of 80 has 100 times as much acoustic energy as 60 dB. This differs from the human perception to noise, which typically judges a sound 10 dB higher than another to be twice as loud, 20 dB higher to be four times as loud, and so forth.

The *frequency* of a sound is expressed as Hertz (Hz) or cycles per second. The normal audible frequency range for young adults is 20 Hz to 20,000 Hz. The prominent frequency range for community noise, including aircraft and motor vehicles, is between 50 Hz and 5,000 Hz. The human ear is not equally sensitive to all frequencies, with some frequencies judged to be louder for a given signal than others. As a result, research studies have analyzed how individuals make relative judgments as to the "loudness" or "annoyance" of a sound. The most prominent of these scales includes Loudness Level, Frequency-Weighted Contours (such as the A-weighted scale), and Perceived Noise Level. Noise metrics used in aircraft noise assessments are based upon these frequency weighting scales. Below is a glossary of noise metric terminologies, which is discussed in the following paragraphs.

Loudness Level. This scale has been devised to approximate the human subjective assessment of the "loudness" of a sound. Loudness is the subjective judgment of an individual as to how loud or quiet a particular sound is perceived.

Frequency-Weighted Contours (dBA, dBB, and dBC). To simplify the measurement and computation of sound loudness levels, frequency-weighted metrics are used. These frequency-weighted contours demonstrate different aspects of noise, and are presented in Figure C1, *FREQUENCY WEIGHTED CONTOURS (dBA, dBB, and dBC*)

The most common frequency weighting is the A-weighted noise curve. The A-weighted decibel scale (dBA) focuses on frequencies approximating the sensitivity of the human ear. In the A-weighted decibel, everyday sounds normally range from 30 dBA (very quiet) to 100 dBA (very loud). Most community noise analyses are based upon the A-weighted decibel scale. Examples of various sound environments, expressed in dBA, are presented in Figure C2, *EXAMPLE OF VARIOUS SOUND ENVIRONMENTS*.

Some interest has developed in using a noise curve that measures lower frequency noise sources. For example, the C-weighted curve is used for the analysis of the noise impacts from artillery noise, which captures the low rumble that many associate with vibration.

Perceived Noise Level. Perceived noisiness was originally developed for the assessment of aircraft noise. Perceived noisiness is defined as "the subjective impression of the unwantedness of a not unexpected, non-pain or fear-provoking sound as part of one's environment," (Kryter, 1970) "Noisiness" curves differ from "loudness curves" in that they have been developed to rate the noisiness or annoyance of a sound as opposed to the loudness of a sound (i.e., perception of the noise).

As with loudness curves, noisiness curves have been developed from laboratory surveys of individuals. However, in noisiness surveys, individuals are asked to judge in a laboratory setting when two sounds are equally noisy or disturbing if heard regularly in their own environment. These surveys are more complex and are therefore subject to greater variability.

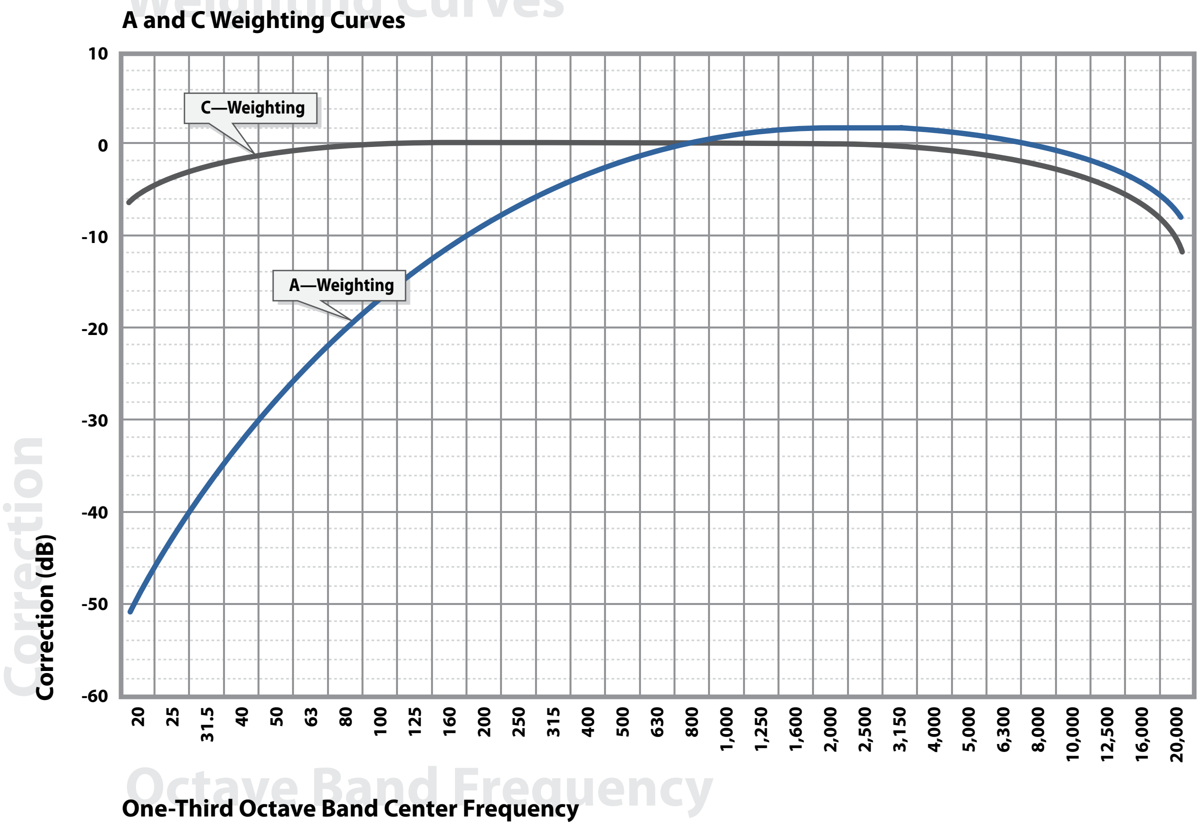


Figure C1 Frequency Weighted Contours (dBA, dBB, dBC)

SOURCE: BridgeNet International.

EXAMPLES OF VARIOUS A-WEIGHTED DECIBEL SOUND ENVIRONMENTS

dB(A)	OVER-ALL LEVEL Sound Pressure Level Approx. 0.0002 Microbar	COMMUNITY (Outdoor)	HOME or INDUSTRY	LOUDNESS Human Judgement of Different Sound Levels
130		Military Jet Aircraft Takeoff with Afterburner from Aircraft Carrier @ 50 ft. (130)	Oxygen Torch (121)	120 dB(A) 32 Times as Loud
120 110	UNCOMFORTABLY LOUD	Concorde Takeoff (113)	Riveting Machine (110) Rock and Roll Band (108-114)	110 dB(A) 16 Times as Loud
100		Boeing 747-200 Takeoff (101)		100 dB(A) 8 Times as Loud
90	VERY LOUD	Power Mower (96) DC-10-30 Takeoff (96)	Newspaper Press (97)	90 dB(A) 4 Times as Loud
80		Car Wash @ 20 ft. (89) Boeing 727 Hushkit Takeoff (89)	Food Blender (88) Milling Machine (85) Garbage Disposal (80)	80 dB(A) 2 Times as Loud
70	MODERATELY LOUD	High Urban Ambient Sound (80) Passenger Car, 65 mph @ 25 ft. (77) Boeing 757 Takeoff (76)	Living Room Music (76) TV-Audio, Vacumn Cleaner	70 dB(A)
60		Propeller Airplane Takeoff (67) Air Conditioning Unit @ 100 ft. (60)	Cash Register @ 10 ft. (65-70) Electric Typewriter @ 10 ft. (64) Conversation (60)	60 dB(A) 1/2 Times as Loud
50	QUIET	Large Transformers @ 100 ft. (50)		50 dB(A) 1/4 Times as Loud
40		Bird Calls (44) Low Urban Ambient Sound (40)		40 dB(A) 1/8 Times as Loud

"Aircraft takeoff noise measured 6,500 meters from beginning of takeoff roll
(Source: Advisory Circular AC-36-3G)"

Figure C2 Example of Various Sound Environments

SOURCE: Reproduced From Melville C. Branch And R. Dale Beland, "Outdoor Noise In The Metropolitan Environment". Published By The City Of Los Angeles. 1970.

Propagation of Noise. Outdoor sound levels decrease as a result of several factors, including increasing the distance from the sound source, atmospheric absorption (characteristics in the atmosphere that actually absorb sound), and ground attenuation (characteristics on the ground that absorb sound). Sound typically travels in spherical waves, similar to waves created from dropping a stone into water. As the sound wave travels away from the source, the sound energy is spread over a greater area, dispersing the sound power of the wave.

Temperature and humidity of the atmosphere also influence the sound levels at a particular location. These influences increase with distance and become particularly important at distances greater than 1,000 feet. The degree of absorption depends on the frequency of the sound, as well as humidity and air temperature. For example, when the air is cold and humid, and therefore denser, atmospheric absorption is lowest. Higher frequencies are more readily absorbed than the lower frequencies. Over large distances, lower frequency sounds become dominant as the higher frequencies are attenuated. Examples of the effects of temperature and humidity on sound absorption are presented in Figure C3, *ATMOSPHERIC ATTENUATION: HOW NOISE CHANGES OVER DISTANCE BASED ON HUMIDITY AND TEMPERATURE*.

Noise propagation is particularly relevant within the environs of Chicago Executive Airport due to winter weather conditions. During the winter, high humidity and cold, overcast conditions result in lowered noise attenuation, causing noise levels to remain higher farther from a noise source than would occur under standard summer conditions. Winter weather facilitates an atmospheric inversion (when the air nearest the earth is colder than the air above), which also results in higher aircraft noise than when inversion layer is not present.

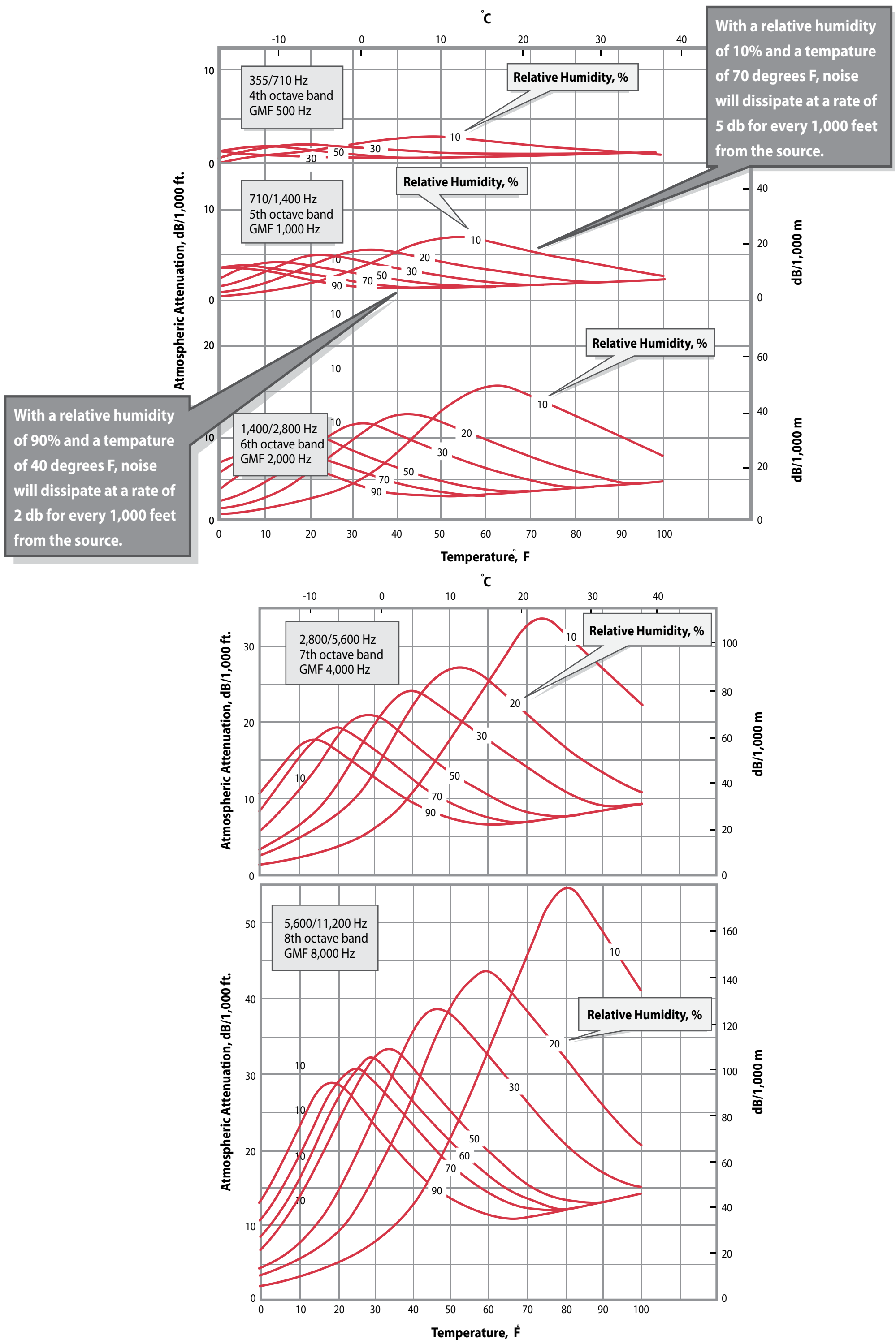


Figure C3 Atmospheric Attenuation - How Noise Changes Over Distance Based on Humidity and Temperature

SOURCE: Beranek, 1981.

Duration of Sound. Duration of a noise event is an important factor in describing sound in a community setting. The longer the noise event, the more likely the sound will be perceived as annoying. The "effective duration" of a sound starts when a sound rises above the background sound level and ends when it drops back below the background level. Studies have confirmed a relationship between duration and annoyance, and have established the amount a sound must be reduced to be judged equally annoying over an increased duration time.

This relationship between duration and noise level forms the basis of how the equivalent energy principal of sound exposure is measured. Reducing the acoustic energy of a sound by one-half results in a 3 dB reduction. Conversely, doubling the duration of the sound event increases the total energy of the event by 3 dB. This *equivalent energy principle* is based upon the premise that the potential for a noise to impact a person is dependent on the total acoustical energy content of the noise. Noise descriptors explained below (DNL, LEQ and SEL) are all based upon this *equivalent energy principle*.

Change in Noise Levels. The concept of change in sound levels is related to the reaction of the human ear to sound. The human ear detects relative differences between sound levels better than absolute values of levels. Under controlled laboratory conditions, a human listening to a steady unwavering pure tone sound can barely detect a change of approximately one decibel for sound levels in the mid-frequency region. However, when ordinary noises are heard, a young healthy ear can only detect changes of two to three decibels. A five-decibel change is noticeable while a 10-decibel change is judged by the majority of people as a doubling effect of the sound.

Masking Effect. One characteristic of sound is its ability to interfere with the listener's ability to hear another sound. This is defined as the masking effect. The presence of one sound effectively raises the threshold of audibility for the hearing of a second sound. For a sound to be heard, it must exceed the threshold of hearing for that particular individual and exceed the masking threshold for the background noise.

The masking characteristic is dependent upon many factors, including the spectral (frequency) characteristics of the two sounds, the sound pressure levels, and the relative start time of sound events. The masking effect is greatest when it is closest to the frequency of the signal. Low frequency sounds can mask higher frequency sounds; however, high frequency sounds do not easily mask low frequency sounds.

Ground Effects. This term describes the effects of vegetation on noise. As sound travels away from the source, some of it is absorbed by grass, plants, and trees. The amount of such ground attenuation (rate that noise level reduces at distances farther from the noise source) depends on the structure and density of trees and foliage, as well as the height of both the source and receiver and the frequency of the sound being absorbed. If the source and the receiver of the sound are both located below the average height of the intervening foliage, the ground covering will be most effective. If either the source or the receiver rises above the height of the ground covering, the excess attenuation will become less effective. Reflected sound, however, will still be reduced.

Factors Influencing Human Response to Sound

Many factors influence how a sound is perceived and whether or not it is considered annoying to the listener. This includes not only physical characteristics of the sound, but also secondary influences such as sociological and external factors. The "Handbook of Noise Control" describes human response to sound in terms of both acoustic and non-acoustic factors. These factors are summarized in Table C1, *FACTORS THAT AFFECT INDIVIDUAL ANNOYANCE TO NOISE.*

Sound rating scales are developed to account for human response to sound and how sounds are perceived in the community. Many non-acoustic parameters affect individual response to noise. Background sound, which is an additional acoustic factor, is important in describing sound in rural settings. Research has identified a clear association of reported noise annoyance and fear of an accident. In particular, there is firm evidence that noise annoyance is associated with: (1) the fear of an aircraft crashing or of danger from nearby surface transportation; (2) the belief that aircraft noise could be prevented or reduced by pilots or authorities related to airlines; and, (3) an expressed sensitivity to noise generally. Thus, it is important to recognize that such non-acoustic factors, as well as acoustic factors, contribute to human response to noise.

Table C1, FACTORS THAT AFFECT INDIVIDUAL ANNOYANCE TO NOISE

Primary Acoustic Factors	Sound Level
	Frequency
	Duration
Secondary Acoustic Factors	Spectral (Frequency) Complexity
	Fluctuations in Sound Level
	Fluctuations in Frequency
	Rise-time of the Noise
	Localization of Noise Source
Non-acoustic Factors	Physiology
	Adaptation and Past Experience
	How the Listener's Activity Affects Annoyance
	Predictability of When a Noise will Occur
	Whether the Noise is Necessary
	Individual Differences and Personality

Source: C. Harris, 1979

Health Effects of Noise

Noise is known to have adverse effects on people. From these effects, criteria have been established to help protect the public health and safety and prevent disruption of certain human activities. These criteria are based on effects of noise on people, such as hearing loss (not a factor with typical community noise), communication interference, sleep interference, physiological responses, and annoyance. Each of these potential noise impacts is briefly discussed in the following points:

Hearing Loss is generally not a concern in community/aircraft noise situations, even when close to a major airport or a freeway. The potential for noise-induced hearing loss is more commonly associated with occupational noise exposure in heavy industry; very noisy work environments with long-term, sometimes close-proximity exposure; or, certain very loud recreational activities such as target shooting, motorcycle or car racing, etc. The Occupational Safety and Health Administration (OSHA) identifies a noise exposure limit of 90 dBA for 8 hours per day to protect from hearing loss (higher limits are allowed for shorter duration exposures). Noise levels in neighborhoods near airports, even in very noisy neighborhoods, do not exceed the OSHA standards and are not sufficiently loud to cause hearing loss.

Communication Interference is one of the primary concerns with aircraft noise. Communication interference includes interference with hearing, speech, or other forms of communication such as watching television and talking on the telephone. Normal conversational speech produces sound levels in the range of 60 to 65 dBA, and any noise in this range or louder may interfere with the ability of another individual to hear or understand what is spoken. There are specific methods for describing speech interference as a function of the distance between speaker, listener, and voice level. Figure C4, *QUALITY OF SPEECH COMMUNICATION IN RELATION TO THE DISTANCE BETWEEN THE TALKER AND THE LISTENER*, shows the relationship between the quality of speech communication and various noise levels.

Sleep Interference, particularly during nighttime hours, is one of the major causes of annoyance due to noise. Noise may make it difficult to fall asleep, create momentary disturbances of natural sleep patterns by causing shifts from deep to lighter stages, and may cause awakenings that a person may not be able to recall.

Research has shown that once a person is asleep in his own home, it is much more unlikely that he will be awakened by a noise. Some of this research has been criticized because it has been conducted in areas where subjects had become accustomed to aircraft noise. On the other hand, some of the earlier laboratory sleep studies have been criticized because of the extremely small sample sizes of most laboratory studies and because the laboratory was not necessarily a representative sleep environment.

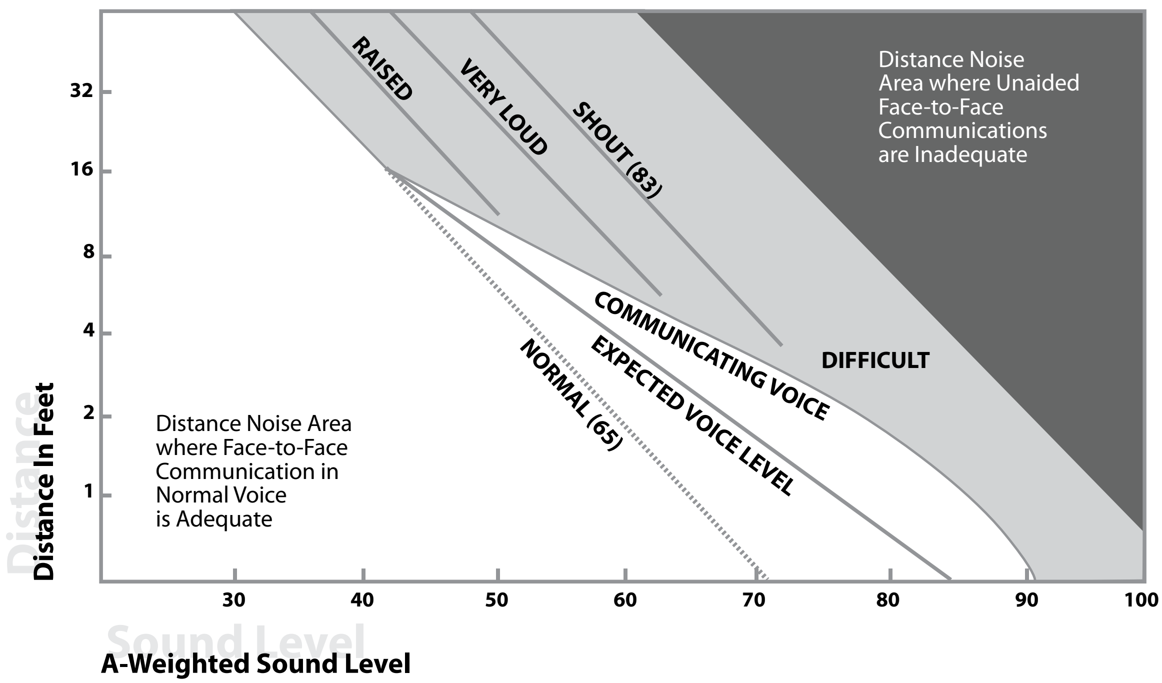


Figure C4 Quality of Speech Communication in Relation to the Distance Between the Talker and the Listener

SOURCE: Noise Effects Handbook, EPA.

An English study assessed the effects of nighttime aircraft noise on sleep in 400 people (211 women and 189 men; 20-70 years of age; one per household) living at eight sites adjacent to four United Kingdom (U.K.) airports, with different levels of night flying. The main finding was that only a minority of aircraft noise events affected sleep, and, for most subjects, that domestic and other non-aircraft factor had much greater effects. As shown in Figure C5, *CAUSES OF REPORTED AWAKENINGS*, aircraft noise is a minor contributor among a host of other factors that lead to awakening response.

Likewise, the Federal Interagency Committee on Noise (FICON) in an earlier 1992 document, entitled *Federal Interagency Review of Selected Airport Noise Analysis Issues*, recommended an interim dose-response curve for sleep disturbance based on laboratory studies of sleep disturbance. This review was updated in June 1997, when the Federal Interagency Committee on Aviation Noise (FICAN) replaced the FICON recommendation with an updated curve based on the more recent in-home sleep disturbance studies. The FICAN recommended a curve based on the upper limit of the data presented, and, therefore, considers the curve to represent the "maximum percent of the exposed population expected to be behaviorally awakened," or the "maximum awakened."

In 2008, FICAN issued a finding that supersedes its 1997 recommendation. The 2008 finding recommends using the procedure in American National Standards Institute, Inc. (ANSI) S12.9-2008, *Quantities and Procedures for Description and Measurement of Environmental Sound – Part 6: Methods for Estimation of Awakenings Associated with Outdoor Noise Events Heard in Homes* to determine night awakenings. Prior studies relied on night awakenings being tested in a laboratory setting, or in homes that had been exposed to aircraft noise for a long period of time. The ANSI study was based on in home testing of people that had not been exposed to aircraft noise before. This study based on observations of 10,000 nights of sleep for the study participants living in close proximity to an airport in the United States and the Netherlands. ANSI S12.9-2008 developed standards on probability of awakenings from a full night of noise events.

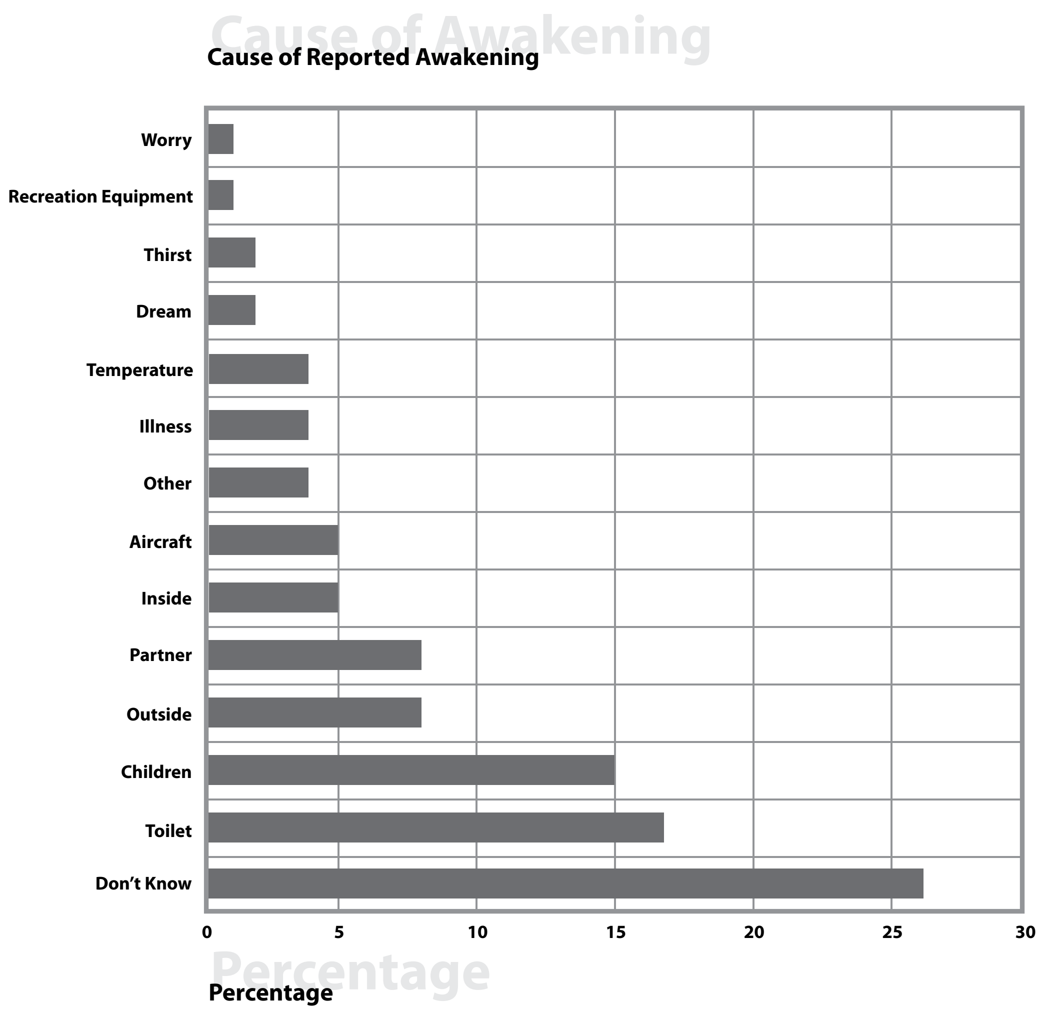


Figure C5 Causes of Reported Awakenings

SOURCE: Report Of A Field Study Of Aircraft Noise And Sleep Disturbance, 1992. London Department Of Safety.

The ANSI recommendation is shown on Figure C6, *THE PLOT OF THE SLEEP AWAKENING DATA.* This is a very conservative approach. A more common statistical curve for the data points is also reflected in Figure C6. The differences indicate, for example, a 7% awakening rate at a level of approximately 100 dB SEL, while the "maximum awakened" curve prescribed by FICAN shows the 3% awakening rate being reached at 80 dB SEL. Sleep interference continues to be a major concern to the public and an area of debate among researchers.

Physiological Responses reflect measurable changes in pulse rate, blood pressure, etc. Generally, physiological responses reflect a reaction to a loud short-term noise, such as a rifle shot or a very loud jet over flight. While such effects can be induced and observed, the extent to which these physiological responses cause harm is not known.

Annoyance is the most difficult of all noise responses to describe. Annoyance is an individual characteristic and can vary widely from person to person. What one person considers tolerable may be unbearable to another of equal hearing capability. The level of annoyance also depends on the characteristics of the noise (i.e., loudness, frequency, time, and duration), and how much activity interference (e.g., speech interference and sleep interference) results from the noise. However, the level of annoyance is also a function of the attitude of the receiver. Personal sensitivity to noise varies widely. It has been estimated that 2 to 10 percent of the population are highly susceptible to annoyance from noise not of their own making, while approximately 20 percent are unaffected by noise. Attitudes are affected by the relationship between the listener and the noise source as well (for example, is it *your* dog barking or the *neighbor's* dog?). Whether one believes that someone is trying to abate the noise will also affect their level of annoyance.

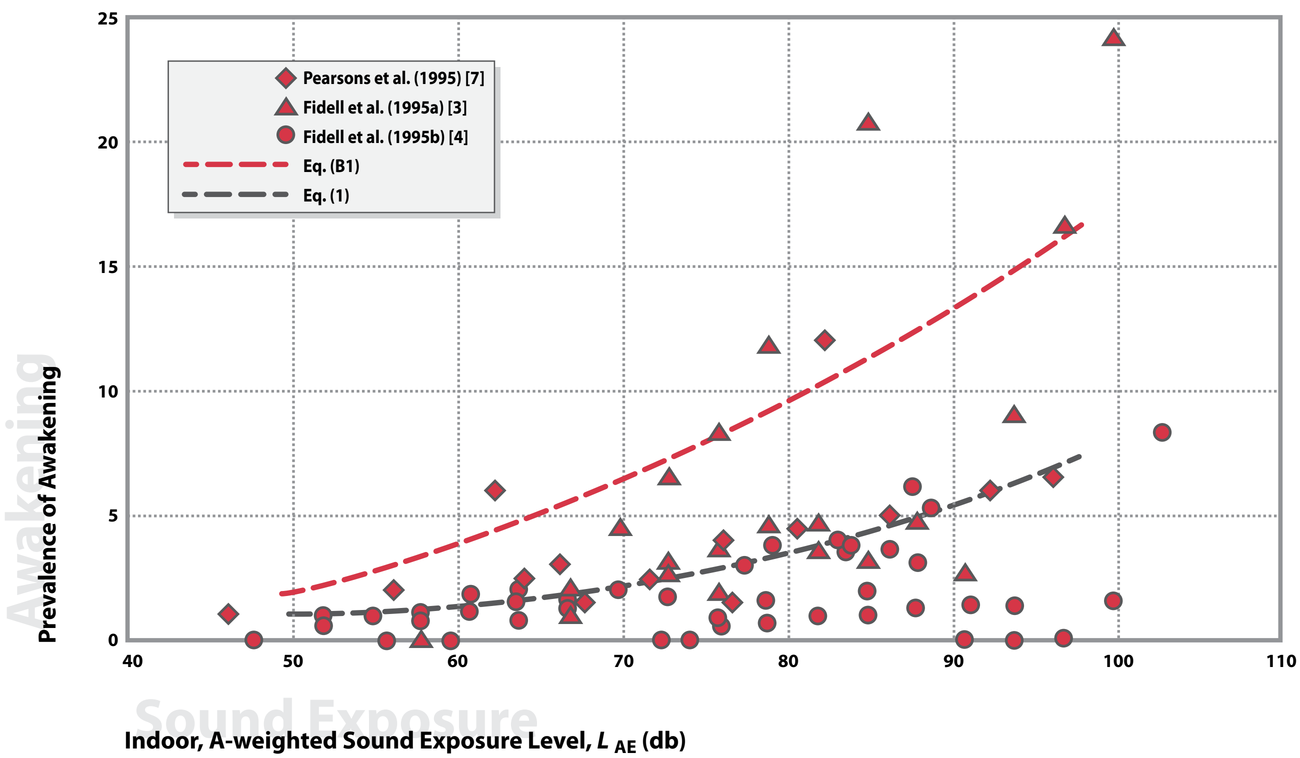


Figure C6 A Plot of the Sleep Awakening Data: Equation (1) and Equation (B1) Versus Indoor, A-weighted Sound Exposure Level

SOURCE: Acoustical Society of America, 2008.

Sound Rating Scales

The description, analysis, and reporting of community sound levels are made difficult by the complexity of human response to sound, and the myriad of sound-rating scales and metrics that have been developed for describing acoustic effects. Various rating scales have been devised to approximate the human subjective assessment of "loudness" or "noisiness" of a sound.

Noise metrics can be categorized as single event metrics and cumulative metrics. Single event metrics describe the noise from individual events, such as an aircraft flyover. Cumulative metrics describe the noise in terms of the total noise exposure throughout the day. These noise metrics are summarized below.

<u>Single Event Metrics</u>

A-Weighted Metrics (dBA). To simplify the measurement and computation of sound loudness levels, frequency weighted metrics have obtained wide acceptance. The A-weighting (dBA) scale has become the most prominent of these scales and is widely used in community noise analysis. This metric has shown good correlation with community response and may be easily measured. The metrics used in this study are all based upon the dBA scale.

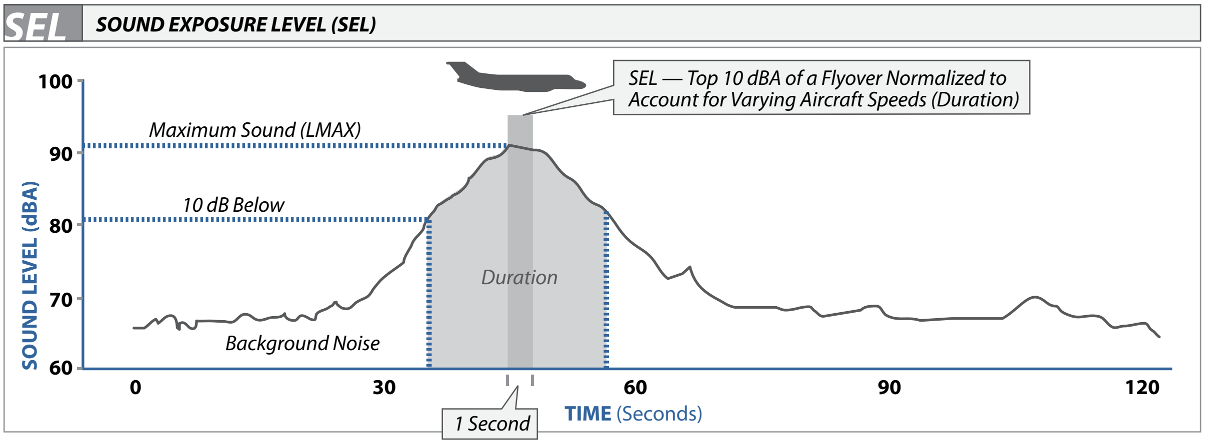
Maximum Noise Level. The highest noise level reached during a noise event is called the "Maximum Noise Level," or Lmax. For example, as an aircraft approaches, the sound of the aircraft begins to rise above ambient noise levels. The closer the aircraft gets, the louder it is until the aircraft is at its closest point directly overhead. As the aircraft passes, the noise level decreases until the sound level settles to ambient levels. This is plotted at the top of Figure C7, *EXAMPLES OF Lmax, SEL, LEQ and DNL NOISE LEVELS*. It is this metric to which people generally respond when an aircraft flyover occurs.

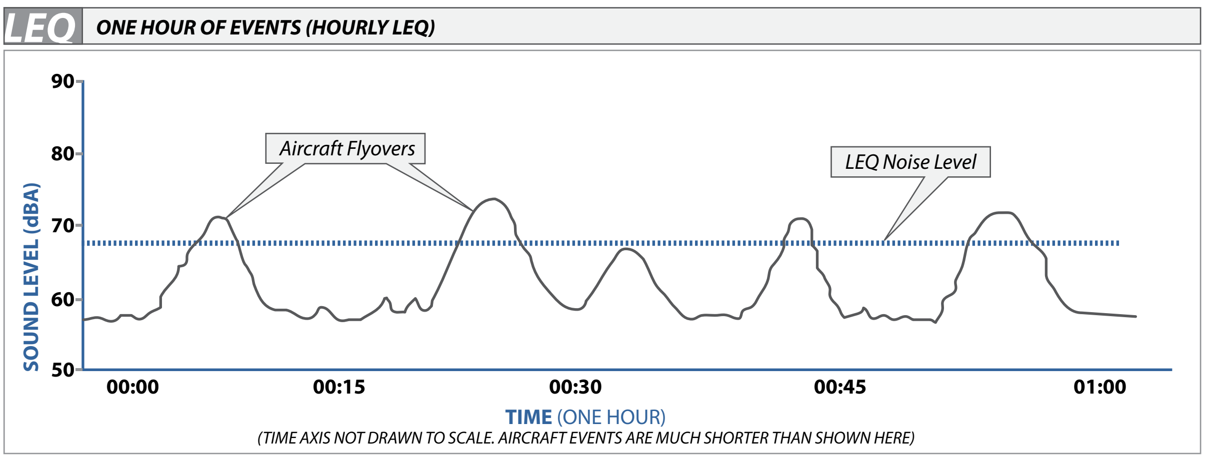
Sound Exposure Level (SEL). The duration of a noise event, or an aircraft flyover, is an important factor in assessing annoyance and is measured most typically as SEL. The effective duration of a sound starts when a sound rises above the background sound level and ends when it drops back below the background level. An SEL is calculated by summing the dB level at each second during a noise event (referring again to the shaded area at the top of Figure C7, *EXAMPLES OF Lmax, SEL, LEQ, and DNL NOISE LEVELS*) and compressing that noise into one second. It is the level the noise would be if it all occurred in one second. The SEL value is the integration of all the acoustic energy contained within the event. This metric takes into account the maximum noise level of the event and the duration of the event. For aircraft flyovers, the SEL value is numerically about 10 dBA higher than the maximum noise level. Single event metrics are a convenient method for describing noise from individual aircraft events. Airport noise models contain aircraft noise curve data based upon the SEL metric. In addition, cumulative noise metrics such as Equivalent Noise Level (LEQ) and Day Night Noise Level (DNL) can be computed from SEL data (these metrics are described in the next paragraphs).

Cumulative Metrics

Cumulative noise metrics have been developed to assess community response to noise. They are useful because these scales attempt to include the loudness and duration of the noise, the total number of noise events, and the time of day these events occur into one rating scale.

Equivalent Noise Level (LEQ). LEQ is the sound level corresponding to a steady-state A-weighted sound level containing the same total energy as a time-varying signal (noise that constantly changes over time) over a given sample period. LEQ is the "energy" average taken from the sum of all the sound that occurs during a certain time period; however, it is based on the observation that the potential for a noise to impact people is dependent on the total acoustical energy content. This is graphically illustrated in the middle graph of Figure C7, *EXAMPLES OF Lmax, SEL, LEQ, and DNL NOISE LEVELS*. LEQ can be measured for any time period, but is typically measured for 15 minutes, 1 hour, or 24 hours. LEQ for one hour is used to develop the DNL values for aircraft operations.





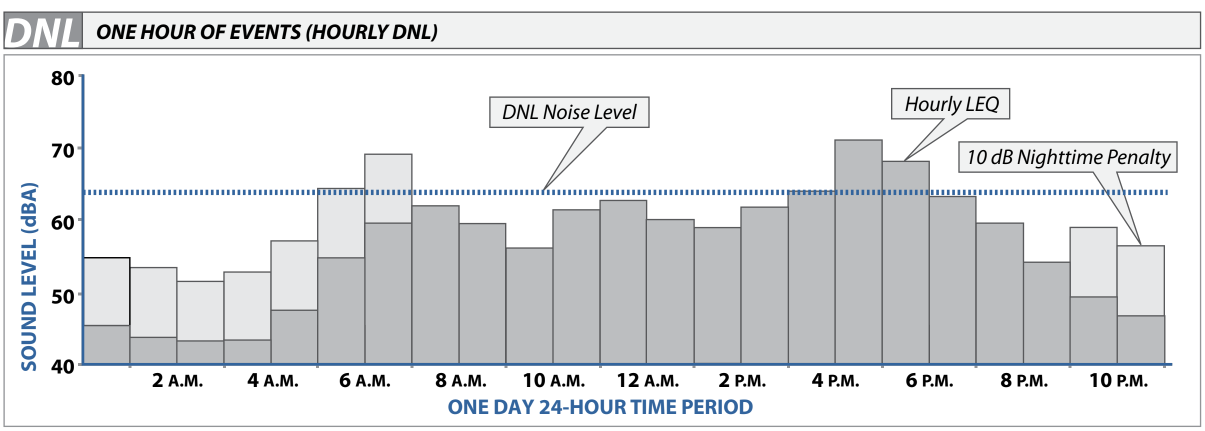


Figure C7 Examples of Lmax, SEL, LEQ, and DNL Noise Levels

Day Night Noise Level (DNL). The DNL describes noise experienced during an entire (24-hour) day. DNL calculations account for the SEL of aircraft, the number of aircraft operations, and include a penalty for nighttime operations. In the DNL scale, noise occurring between the hours of 10 p.m. to 7 a.m. is penalized by 10 dB. This penalty was selected to account for the higher sensitivity to noise in the nighttime and the expected further decrease in background noise levels that typically occur at night. *DNL is required by the FAA for the measurement of aircraft noise and in evaluating noise during a Part 150 Study.* In addition, it is used by other federal agencies including the Environmental Protection Agency (EPA), the Department of Defense (DOD), and the Department of Housing and Urban Development (HUD). DNL is graphically illustrated in the bottom of Figure C7, *EXAMPLES OF Lmax, SEL, LEQ, and DNL NOISE LEVELS*. Examples of various noise environments in terms of DNL are presented in Figure C8, *TYPICAL OUTDOOR NOISE LEVELS IN TERMS OF DNL*. The FAA, with the support of these agencies, has developed land use compatibility guidelines that identify the acceptability of various land uses with aircraft noise.

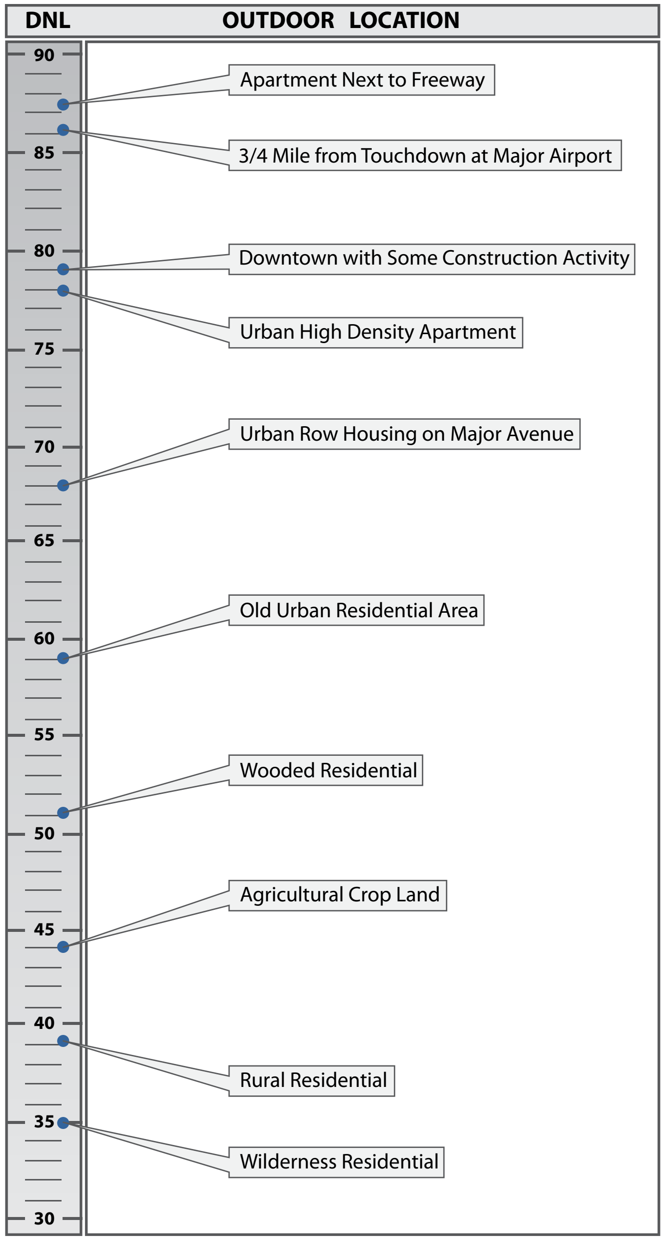


Figure C8 Typical Outdoor Noise Levels in Terms of DNL

SOURCE: EPA Levels Document, 1974.

Noise/Land Use Compatibility Standards and Guidelines

Noise metrics describe noise exposure and help predict community response to various noise exposure levels. The public reaction to different noise levels has been estimated based upon extensive research on human responses to exposure of different levels of aircraft noise. Figure C9, *EXAMPLE OF COMMUNITY REACTION TO AIRCRAFT NOISE*, relates DNL noise levels to community response. Based on human response, land use compatibility guidelines have been developed that are defined in terms of the DNL described earlier (a 24-hour average that includes a sound level weighting for noise at night). Using these metrics and surveys, agencies have developed guidelines for assessing the compatibility of various land uses with the noise environment.

Highlights of Land Use Compatibility Guidelines

FAA and other federal agencies have established land use compatibility guidelines based on the DNL that identify the acceptability of various types of land use with aircraft noise exposure.

- Residential uses are compatible with noise up to 65 DNL and up to 75 DNL with sound insulation;
- Schools are compatible with noise up to 65 DNL and up to 75 DNL with sound insulation;
- Commercial development is compatible with noise up to 75 DNL

Numerous laws have been passed concerning aircraft noise.

- ASNA: FAA required to use DNL
- Phase-out of Stage 2 aircraft >175,000 lbs. in the year 2000
- Phase-out of Stage 2 aircraft < 75,000 lbs. in December 2015
- ANCA prevents adoption of airport access restrictions (i.e., curfews, and

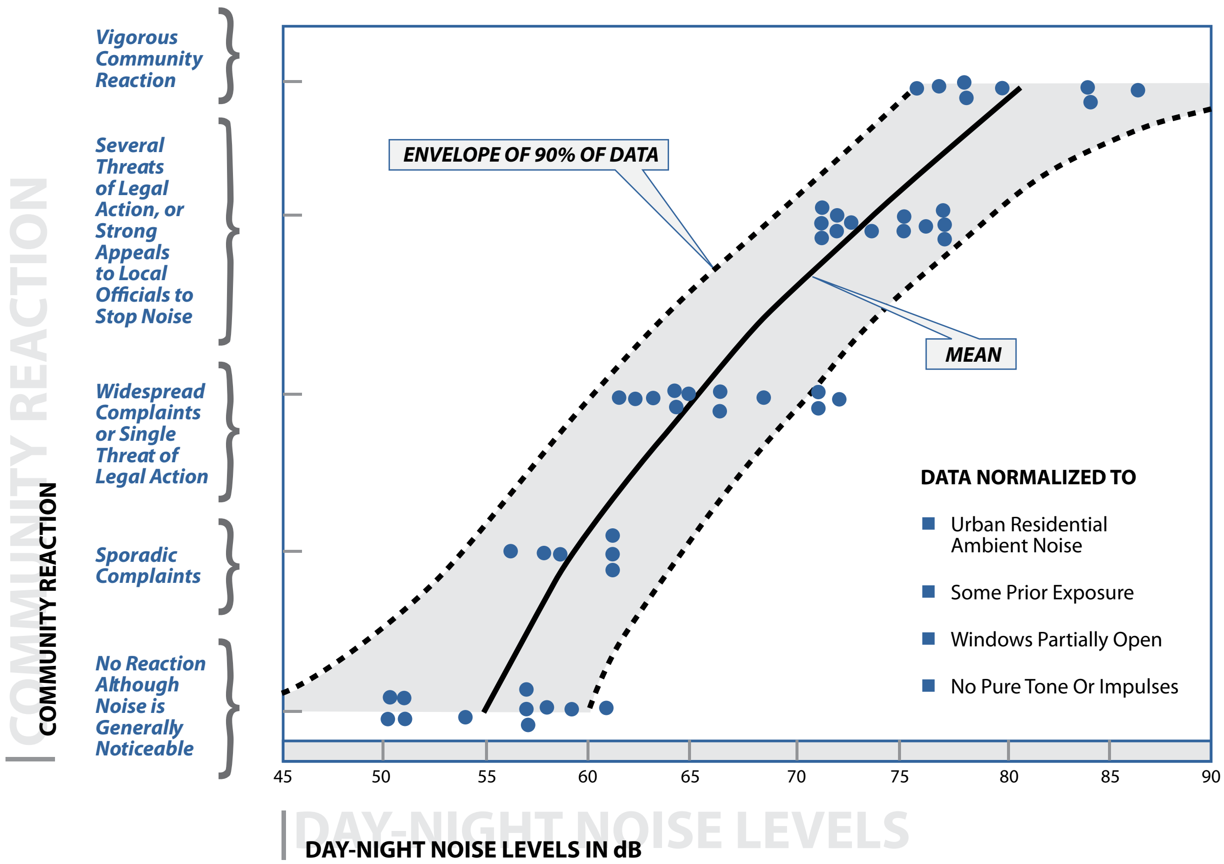


Figure C9 Example of Community Reaction to Aircraft Noise

SOURCE: EPA Levels Document, 1974.

The most common noise/land use compatibility guidelines or criteria used are 65 dBA DNL. The Schultz curve, as shown in Figure C9, predicts approximately 14% of the exposed population would be highly annoyed with exposure to the 65 dBA DNL. At 60 dB DNL, it decreases to approximately 8% of the population highly annoyed. However, recent updates to the Schultz curve, done by the U.S. Air Force, indicate that even a higher percentage of residents may experience annoyance with 65 DNL.

A summary of pertinent regulations and guidelines is presented below:

Code of Federal Regulations, Part 36, "Noise Standards: Aircraft Type and Airworthiness Certification"

Originally adopted in 1960, CFR Part 36 prescribes noise standards for issuance of new aircraft type certificates; it also limited noise levels for certification of new types of propeller-driven, small airplanes as well as for transport category, large airplanes. Subsequent amendments extended the standards to certain newly produced aircraft of older type designs. Other amendments extended the required compliance dates. Aircraft may be certificated as Stage 1, Stage 2, Stage 3, or Stage 4 (also called Chapter number outside the U.S.) aircraft based on their noise level, weight, number of engines, and, in some cases, number of passengers. Stage 1 aircraft over 75,000 pounds are no longer permitted to operate in the U.S. Stage 2 aircraft over 75,000 pounds were phased-out of the U.S. fleet effective at the start of 2000, as discussed below by the Airport Noise and Capacity Act of 1990. After December 2015, Stage 2 turbojet aircraft under 75,000 lbs. were no longer permitted to operate in the U.S. Any aircraft applying for a type certificate after 2006 must meet Stage 4 guidelines, which are cumulatively about 10 dBA lower than Stage 3 standards.

Code of Federal Regulations, Part 150, "Airport Noise Compatibility Planning"

As a means of implementing the Aviation Safety and Noise Abatement Act (ASNA), the FAA adopted Code of Federal Regulations Part 150, Airport Noise Compatibility Planning Programs. CFR Part 150 established a uniform program for developing balanced and cost effective programs for reducing existing and future aircraft noise at individual airports. Included in CFR Part 150 was the FAA's adoption of noise and land use compatibility guidelines discussed earlier. An expanded version of these guidelines/chart appears in Aviation Circular 150/5020-1 (dated August 5, 1983) and is reproduced in Figure C10**,** *FAA CFR PART 150 LAND USE COMPATIBILITY MATRIX*.

These guidelines offer recommendations for determining acceptability and compatibility of land uses. The guidelines specify the maximum amount of noise exposure (in terms of the cumulative noise metric DNL) that would be considered acceptable or compatible to people in living and working areas.

Federal Aviation Administration Order 5050.4B and Order 1050.1F, Appendix B., Requirements for Assessing Impacts Related to Noise and Noise-Compatible Land Use and Section 4(f) of the Department of Transportation on Act (49 U.S.C. §303)

FAA, like many other federal agencies, issues guidance for compliance with the National Environmental Policy Act (NEPA). FAA Order 1050.1F *Environmental Impacts: Policies and Procedures*, identifies the procedures for complying with NEPA for all divisions of the FAA. FAA Order 5050.4B supplements 1050.1F and identifies issues specific to the Airports Division of the FAA. These orders specify the processes for considering environmental factors when evaluating federal actions under NEPA, and include methodologies for assessing noise, as well as thresholds of significant project-related noise changes. This guidance requires the use of the FAA's Aviation Environmental Design Tool (AEDT), the preparation of noise contours showing 65 and 75 DNL, and note that a significant noise impact would occur if analysis shows that "the action would increase noise by DNL 1.5 dB or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dB noise exposure level, or that will be exposed at or above the DNL 65 dB level due to a 1.5 dB or greater increase, when compared to the no action alternative for the same timeframe." Noise abatement alternatives that result in shifting of noise may trigger an environmental review process, subject to one of these orders, before they can be implemented.

LAND USE	BELOW 65	YEARLY DAY-NIGHT NOISE LEVEL (DNL) IN DECIBELS 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
Governmental services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
COMMERCIAL USE						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail-building materials, 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

Numbers in parentheses refer to NOTES.

The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State or local law. The responsibility for determining the acceptable and permissible land uses 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.

TABLE KEY

SLUCM	Standard Land Use Coding Manual.
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 or 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 to 30 dB 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 that special sound reinforcement systems are installed.

(6) Residential buildings require an NLR of 25.

(7) Residential buildings require an NLR of 30.

(8) Residential buildings not permitted.

Figure C10 FAA FAR Part 150 Land Use Compatibility Matrix

SOURCE: FAR Part 150 Guidelines.

Airport Noise and Capacity Act of 1990 (ANCA)

The Airport Noise and Capacity Act of 1990 (PL 101-508, 104 Stat. 1388), also known as ANCA or the Noise Act, established two broad directives for the FAA: (1) establish a method to review aircraft noise, and airport use or access restriction, imposed by airport proprietors, and (2) institute a program to phase-out Stage 2 aircraft over 75,000 pounds by December 31, 1999 [Stage 2 aircraft are older, noisier aircraft (B-737-200, B-727 and DC-9); Stage 3 aircraft are newer, quieter aircraft (B-737-300, B-757, MD-80/90)]. To implement ANCA, FAA amended Part 91 to address the phase-out of large Stage 2 aircraft and the phase-in of Stage 3 aircraft. In addition, Part 91 states that all Stage 2 aircraft over 75,000 pounds were to be removed from the domestic fleet or modified to meet Stage 3 by December 31, 1999. There are a few exceptions, but only Stage 3 aircraft greater than 75,000 pounds are now in the domestic fleet. The airlines have phased out Stage 2 aircraft, and the mainland domestic fleet is now all Stage 3 and Stage 4 aircraft.

Furthermore, CFR Part 161 was adopted to institute a highly stringent review and approval process for implementing use or access restrictions by airport proprietors. Part 161 sets out the requirements and procedures for implementing new airport use and access restrictions by airport proprietors. They must use the DNL metric to measure noise effects, and the Part 150 land use guideline table, including 65 DNL as the threshold contour to determine compatibility.

ANCA applies to all local noise restrictions that are proposed after October 1990, and to amendments to existing restrictions proposed after October 1990. The FAA has approved only one completed Part 161 Study to date (for restricting Stage 2 corporate jets). Recent litigation has upheld the validity and reasonableness of that Part 161 restriction.

Federal Interagency Committee on Noise (FICON) Report of 1992

The use of the DNL metric criteria has been criticized by various interest groups concerning its usefulness in assessing aircraft noise impacts. As a result, at the direction of the EPA and the FAA, the Federal Interagency Committee on Noise (FICON) was formed to review specific elements of the assessment on airport noise impacts and to recommend procedures for potential improvements. FICON included representatives from the Departments of Transportation, Defense, Justice, Veterans Affairs, Housing and Urban Development, the Environmental Protection Agency, and the Council on Environmental Quality.

The FICON review focused primarily on the manner in which noise impacts are determined, including whether aircraft noise impacts are fundamentally different from other transportation noise impacts; how noise impacts are described; and, whether impacts outside of Day-Night Average A-Weighted Sound Level (DNL) 65 decibels (dB) should be reviewed in a National Environmental Policy Act (NEPA) document.

The committee determined that there are no new descriptors or metrics of sufficient scientific standing to substitute for the present DNL cumulative noise exposure metric. FICON determined that the DNL method contains appropriate dose-response relationships (expected community reaction for a given noise level) to determine the noise impact is properly used to assess noise impacts at both civil and military airports. The report does support agency discretion in the use of supplemental noise analysis, recommends public understanding of the DNL and supplemental methodologies, as well as aircraft noise impacts. FICON did, however, recommend that if screening analysis shows a 1.5 dB increase within a 65 DNL or a 3.0 dB increase within a 60-65 DNL, then additional analysis should be conducted.

Noise Assessment Methodology

Existing and future aircraft noise environments for airports are typically determined through computer modeling. Once reliable computer generated contours are developed for existing conditions, the computer input files are altered to reflect future conditions based on forecasts of future operations and/or proposed noise abatement aircraft operational measures. New computer generated data and contours are then developed to assess those future conditions. The following narrative provides details of this process. This section is focuses on the following information.

Highlights of Noise Assessment

Two tools were used in this NEM Update to evaluate aircraft operations:

- Aircraft radar data
- Aviation Environmental Design Tool (AEDT) computer model

FAA Part 150 Studies and NEM updates are required to model aircraft noise with the FAA AEDT computer model.

Actual noise monitoring is not required for FAA Part 150 studies. It is used to supplement the computer model and as a tool to show citizens actual noise measurements.

Noise measurements from aircraft operations were not used in this Part 150 Noise Exposure Map Update.

Aircraft radar data for all of 2016 was collected to identify the flight paths and use of the runways.

Computer Modeling

Computer modeling generates maps or tabular data of an airport's noise environment expressed in the metrics described above, such as DNL. Computer models are most useful in developing contours that depict, like elevation contours on a topography map, areas of equal noise exposure. Accurate noise contours are largely dependent on the use of reliable, validated, and updated noise models, and collection of accurate aircraft operational data.

The FAA's Aviation Environmental Design Tool (AEDT) models civilian and military aviation operations. The latest version, AEDT Version 2c, was released for use in March 2017 and is the state-of-the-art in airport noise modeling. The program includes standard aircraft noise and performance data for hundreds of aircraft types that can be tailored to the characteristics of specific individual airports. Version 2c includes many additional features such as more comprehensive aircraft noise modeling information the ability for the user to build and edit flight tracks in the model, which allows for more precise development of the noise contours in this Noise Exposure Map Update.

Chapter D, Existing and Future Baseline Noise Conditions

This chapter presents the existing (2016) and future (2022) noise conditions. The noise environment is presented in terms of noise contours. These contours are referred to as the base case or baseline noise contours, as they represent the same operational and land use conditions, with the only difference being a change in annual operations and fleet mix in the future. In addition, the future contours are the contours which the various alternatives will be compared if a Noise Compatibility Program (NCP) is prepared. DNL noise contours for this Part 150 Noise Exposure Map (NEM) Update were developed in terms of Day-Night Noise Level (DNL) noise levels using the Aviation Environmental Design Tool (AEDT) v2b, and show the 60 DNL, 65 DNL, 70 DNL, and 75 DNL contours per 14 CFR Part 150 Study guidance. (Note that the 60 DNL contour are included only for informational purposes).

Existing Baseline Noise Modeling Inputs

Existing Aircraft Operations

The existing noise environment for Chicago Executive Airport was analyzed based upon 2016 calendar year annual operational conditions. 2016 was used as the base year because it was the last full year of operations when this Study was initiated and operations are still representative of current conditions. As noted in the Inventory chapter, this year included summer closures of Runway 12/30 on weekends in June, July, August, September and November. The closures are reflected in the base year noise contours. A Part 150 Noise Exposure Map Update requires that the baseline or existing noise exposure contours reflect annual conditions using a recent continuous 12-month period. The development of the baseline conditions utilizes data from a variety of sources. The sources of data for this report are listed below:

- Air Traffic Activity System (ATADS) tower counts (OPSNET);
- FAA Traffic Flow Management System Counts (TFMSC);
- Radar Fight Track Data; and
- Terminal Area Forecast Reports (TAF).

As noted earlier, the Aviation Environmental Design Tool (AEDT) v2b was used to develop the noise contours. The noise model requires a variety of operational data to model the noise environment around an airport. These data include the following information, which are discussed in detail in the following paragraphs:

- Total Aircraft Activity Levels
- Aircraft Fleet Mix Categories
- Detailed Fleet Mix
- Time of Day
- Runway Use
- Departure and Arrival Procedures
- Flight Paths and Flight Path Utilization

Total Aircraft Activity Levels

The total aircraft operational levels were derived directly from the FAA's Air Traffic Activity System (ATADS) tower counts. The ATADS data showed that for the 2016 base period, there were a total of 78,920 annual operations, or an average of 216 operations per day (an operation is one takeoff or one landing).

Aircraft Fleet Mix Categories

The categories of aircraft operations are defined relative to type of user (i.e. air taxi or general aviation) and type of aircraft (i.e. jet or propeller). The breakdown by these categories was determined from the aviation forecast for future operations. The ATADS information contained a breakdown as to Air Traffic Control (ATC) category of operations, shown in Table D1, *AIRPORT TOWER COUNTS FOR BASELINE PERIOD (2016).*

Table D1, *AIRPORT TOWER COUNTS FOR BASELINE PERIOD (2016)*

Category	Annual Operations	Average Daily Operations
ITINERANT		
*Air Carrier**	25	<1
Air Taxi	12,621	34
General Aviation	45,931	126
Military	41	<1
LOCAL		
Civil	20,295	56
Military	7	<1
TOTAL	**78,920**	**216**

Source: FAA Air Traffic Activity System, calendar year 2016
*Air carrier operations at a general aviation (GA) airport include aircraft that have more than 60 seats (which can include chartered or private aircraft operations).

<u>Detailed Aircraft Fleet Mix Categories</u>

The category breakdown used by ATC, shown above, is useful for air traffic purposes, but does not provide sufficient detail necessary for the noise analysis or the details that are often of interest to the general public. As a result, the breakdowns by aircraft fleet mix categories of aircraft operations are presented within this section. The categories are defined relative to type of aircraft (i.e., jet or propeller), as well as size and weight. The breakdown by these categories was determined from the different sources of operational data that were described above with the primary source being the ATADS. Table D2, *DETAILED AIRCRAFT FLEET MIX ASSUMPTIONS FOR EXISTING CONDITIONS (2016)* presents a more in-depth operational breakdown of the different categories and types of aircraft.

It is not possible to definitively categorize all of the operations into unique groups. For example, some general aviation propeller operations are actually unscheduled commuter propeller flights. Similarly, some air taxi operations are small single-engine piston aircraft that may be categorized as general aviation piston, or vice versa. But these generally define the categories of operations that occur at the Airport and will be used within this report. If an aircraft is not in the model, AEDT will assign in a noise profile that most closely matches the aircraft.

Table D2, *DETAILED AIRCRAFT FLEET MIX ASSUMPTIONS FOR EXISTING CONDITIONS (2016)*

2016 Fleet Mix Summary
Chicago Executive Airport
Period: January 1, 2016 thru December 31, 2016
Modeling Software: AEDT v. 2c SP2
Number of Days in 2016: 366

Jet Category by Max Gross Takeoff Weight (lbs)
Light Jet: <10,000
Small Jet: between 10,000 and 20,000
Medium Jet: between 20,001 and 45,000
Large Jet: >45,001

Operations Category		ICAO AC Type	ADET Modeling AC	Daily Arrivals Day	Daily Arrivals Night	Daily Departures Day	Daily Departures Night	Annual Operations
Business Jets								
	Light Jet	C510, E50P, PA47	CNA510	1.38	0.03	1.38	0.03	1,035
		EA50	ECLIPSE500	2.16	0.08	2.16	0.07	1,636
	Small Jet	C650	CIT3	0.39	0.01	0.36	0.04	291
		F900, FA50	COMJET	3.17	0.39	3.24	0.32	2,608
		BE40, C25A, C25B, C25C C500, C501, C525, PRM1	CNA500	3.26	0.21	3.26	0.20	2,534
		C25A, C25C, C525	CNA525C	2.76	0.09	2.70	0.16	2,091
		C550, C551, C56X, E55P	CNA55B	5.53	0.39	5.38	0.54	4,334
		C560	CNA560U	3.79	0.38	3.76	0.40	3,051
		C56X	CNA560XL	6.30	0.40	6.28	0.41	4,900
		LJ25	LEAR 25	0.11		0.11		79
		L29B, FA10, H25C, LJ31 LJ35, LJ40, LJ45, LJ55	LEAR35	5.24	0.50	5.38	0.36	4,200
		MU30	MU3001	0.40	0.05	0.41	0.04	325
	Medium Jet	CL30, CL60, GALX	CL600	7.53	0.65	7.56	0.61	5,985
		C680	CNA680	4.88	0.33	4.74	0.46	3,810
		C750, F2TH, HA4T, J328 LJ60, LJ70, LJ75	CNA750	7.23	0.40	6.96	0.67	5,585
		H25B, FA20	FAL20	4.83	0.51	4.93	0.41	3,910
		ASTR, GALX, G150, WW24	IA1125	2.08	0.22	2.11	0.19	1,686
		SBR1, SBR2	SABR80	0.02		0.02		15
	Large Jet	E135, E145, E45X	EMB14L	0.24		0.24		177
		GLF3	GII	0.06		0.06		44
		G280, GLF4, FA7X	GIV	3.06	0.30	3.13	0.23	2,460
		GL5T, GLEX, GLF5, GLF6	GV	2.56	0.34	2.71	0.20	2,125
Business Jets (Total)								**52,882**
TurboProp								
	Multi Engine	B190	1900D	0.09		0.09		69
		AC95, C425, C441, P46T PAY1, PAY2, TBM8	CNA441	1.30	0.04	1.27	0.07	979
		AC90, B350, BE10, BE20 BE99, BE9L, BE9T, E110 MU2, P180, PAT4 SW2, SW3, SW4	DHC6	6.24	0.41	6.22	0.43	4,871
		PA42	PA42	1.24	0.01	1.20	0.04	909
	Single Engine	B36T, C208, PC12, TBM7	CNA208	4.55	0.15	4.26	0.43	3,435
TurboProp (Total)								**10,264**
Piston Engine								
	Multi Engine	AC50, AC80, BE55, BE58 BE60, C310, C340, C421 PA23, PA31, PA34	BEC58P	5.20	0.17	5.31	0.07	3,933
		PA30, P68	PA30	0.12		0.12		89
	Single Engine	BE17, C172,	CNA172	3.68	0.15	3.77	0.05	2,801
		C182	CNA182	1.60	0.06	1.60	0.06	1,216
		C206	CNA20T	1.08	0.07	1.15		840
		SR20, SR22	COMSEP	2.59	0.12	2.62	0.09	1,986
		C150, P28A, P46T	GASEPF	0.83	0.06	0.88		646
		AT5T, PA32, TBM7	GASEPV	3.93	0.13	3.90	0.15	2,970
		P28A	PA28	1.73	0.04	1.74	0.02	1,293
Piston Engine (Total)								**15,773**
		Grand Totals		**101.14**	**6.68**	**101.06**	**6.75**	**78,920**

Source: BridgeNet International, April 2017

Time of Day

In the DNL metric, any operations that occur after 10 p.m. and before 7 a.m. are considered more intrusive and their noise levels are penalized by adding 10 dBA. The nighttime operations assumptions were determined from radar data during the base period. The overall percentage of nighttime operations at Chicago Executive Airport was determined to be 6.0 percent. The time of day assumptions used in the model were specific to each aircraft operation.

Runway Use

An additional important consideration in developing the noise exposure contours is the percentage of time each runway is utilized. The speed and direction of the wind dictate the runway direction that is utilized by an aircraft. From a safety and stability standpoint, it is desirable, and usually necessary, to arrive and depart an aircraft into the wind. When the wind direction changes, the operations are shifted to the runway end that favors the new wind direction.

Aircraft use Runway 16/34 the most, followed by Runway 12/30, then Runway 6/24. Aircraft arrive from the north on Runway 16 approximately 75% of the time and from the south on Runway 34 approximately 15% of the time. The remaining 10% of arrivals use Runway 12/30, with a minority of the arrivals utilizing the crosswind runway, Runway 6/24. For departures, aircraft predominately use Runway 16/34, departing to the south approximately 40% and to the north approximately 36% of the time. Table D3, *AIRPORT PERCENTAGE RUNWAY UTILIZATION, ARRIVALS AND DEPARTURES,* shows runway use by aircraft category. Note that runway utilization for 2016 takes into consideration runway closure periods (actual use) for the year.

Table D3, *AIRPORT PERCENTAGE RUNWAY UTILIZATION, ARRIVALS AND DEPARTURES*

Category	Arrivals, By Runway						
	16	**34**	**12**	**30**	**6**	**24**	**Total**
Business Jet	77%	20%	1%	2%	<1%	<1%	100%
Turboprop	77%	14%	2%	6%	<1%	<1%	100%
Piston Engine	69%	12%	6%	10%	1%	2%	100%
	Departures, By Runway						
	16	**34**	**12**	**30**	**6**	**24**	**Total**
Business Jet	48%	44%	6%	2%	<1%	<1%	100%
Turboprop	38%	37%	15%	9%	<1%	<1%	100%
Piston Engine	33%	26%	19%	13%	4%	5%	100%

Source: BridgeNet International, April 2017

Departure Climb Profile

The aircraft departure stage length is the distance the aircraft flies from the Airport to its first destination. The stage length of a flight can be used as a rough surrogate for the aircraft departure weight. Generally, heavier aircraft climb at a slower rate. The rate of climb of an aircraft is called the departure climb profile. The stage length assumption is used to determine the rate of climb of each of the different aircraft operating at the airport. However, this only applies to commercial service aircraft in the AEDT model.

At Chicago Executive Airport, there are no commercial service aircraft. The aircraft modeled that are of most interest are the business jets, as they conduct the majority of the operations. For business jets, AEDT assigns all aircraft the same departure stage length profile.

Flight Paths and Flight Path Utilization

The Federal Aviation Administration (FAA) along with the Airport have established paths for aircraft arriving and departing from Chicago Executive Airport. These paths are not precisely defined ground tracks, but represent a path along the ground over which aircraft generally fly. The identification of the location and use of the flight tracks is based upon the FAA's radar data. Over 16,000 flight tracks were used in the development of the AEDT flight paths, derived from all of the actual flight paths flown throughout the base period study year. Previous to this methodology used in AEDT, noise models used a system that assigned a percentage of flights to the backbone and ancillary flight tracks. For this study (using AEDT), all arrival flight tracks and departure flight tracks are mapped to identify this approximate backbone.

In the development of the existing noise contours it is important to aggregate the flight tracks into a set of generalized flight paths of aircraft operating at the Airport to allow the modeling of different alternative scenarios that may involve the shifting or redesign of the flight procedures. A flight path consists of a backbone or center flight path, and the dispersion or spread of all flights that use that backbone; this dispersion is based on radar data. The radar flight tracks used in the modeling analysis are presented in Figure D1, *ARRIVAL FLIGHT TRACKS* and Figure D2, *DEPARTURE FLIGHT TRACKS* for all arrivals and departure operations. These radar tracks show arrivals and departures, respectively, from all runways.

Legend

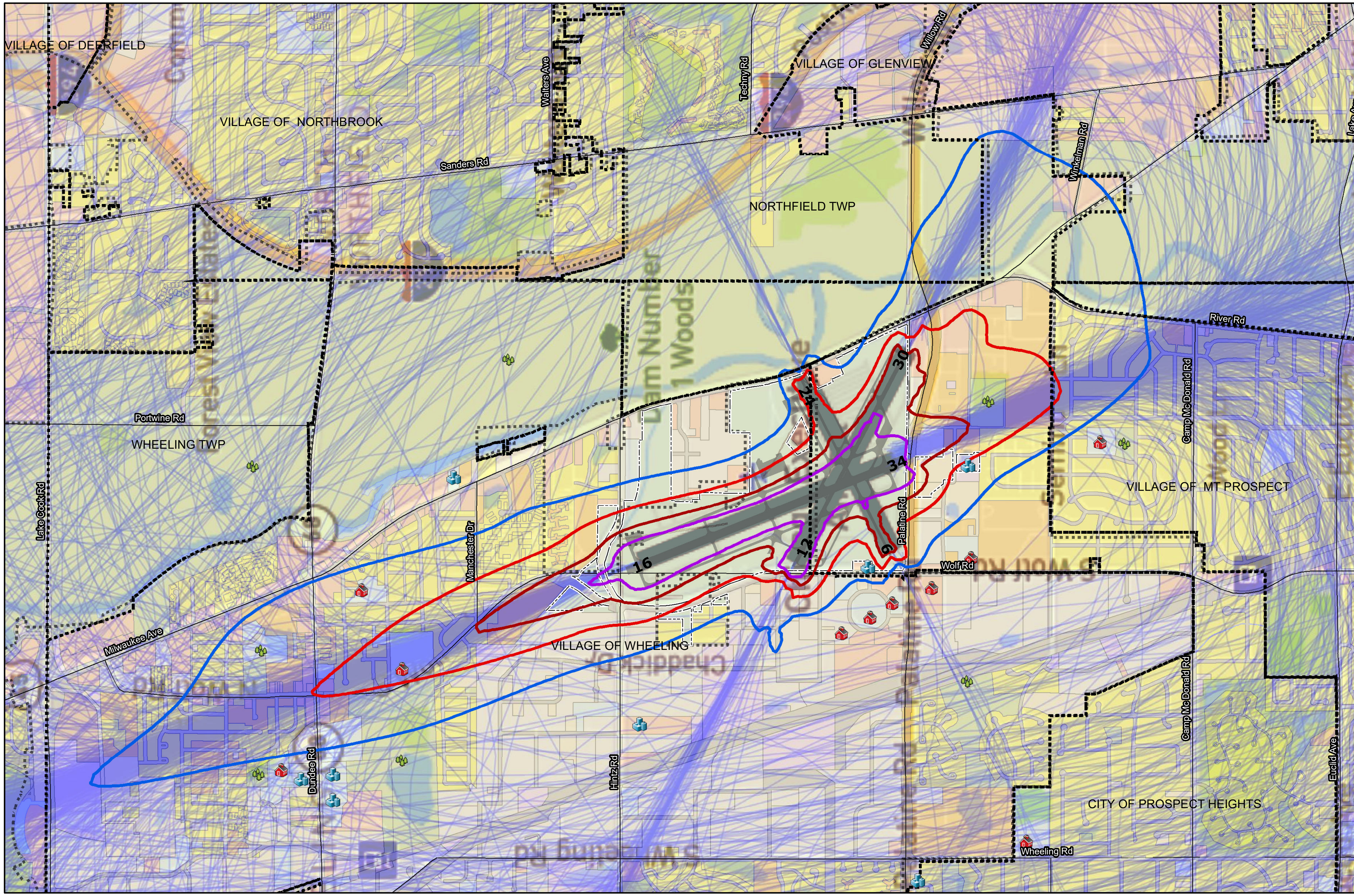
- Municipal/Church
- Parks
- Schools
- Municipality/Jurisdiction
- Chicago Executive Airport Property
- Municipal Boundaries
- Arrival Flight Tracks

2016 Noise Contours

- 60 DNL
- 65 DNL
- 70 DNL
- 75 DNL

Generalized Land Use

- Airport
- Commercial
- Construction
- Industrial
- Institutional
- Open Space/Parks
- Single Family Residential
- Multi Family Residential
- ROW
- Utilities
- Vacant
- Water



Note: The 65 DNL contour is the threshold contour for identifying land use compatibility. The other contours are shown for informational purposes

N

0 2,000 4,000 Feet

Source: BridgeNet International

FIGURE D1 *Arrival Flight Tracks*

Legend

- Municipal/Church
- Parks
- Schools
- Municipality/Jurisdiction
- Chicago Executive Airport Property
- Municipal Boundaries
- Departure Flight Tracks

2016 Noise Contours

- 60 DNL
- 65 DNL
- 70 DNL
- 75 DNL

Generalized Land Use

- Airport
- Commercial
- Construction
- Industrial
- Institutional
- Open Space/Parks
- Single Family Residential
- Multi Family Residential
- ROW
- Utilities
- Vacant
- Water

Note: The 65 DNL contour is the threshold contour for identifying land use compatibility. The other contours are shown for informational purposes

N

0 2,000 4,000 Feet

Source: BridgeNet International

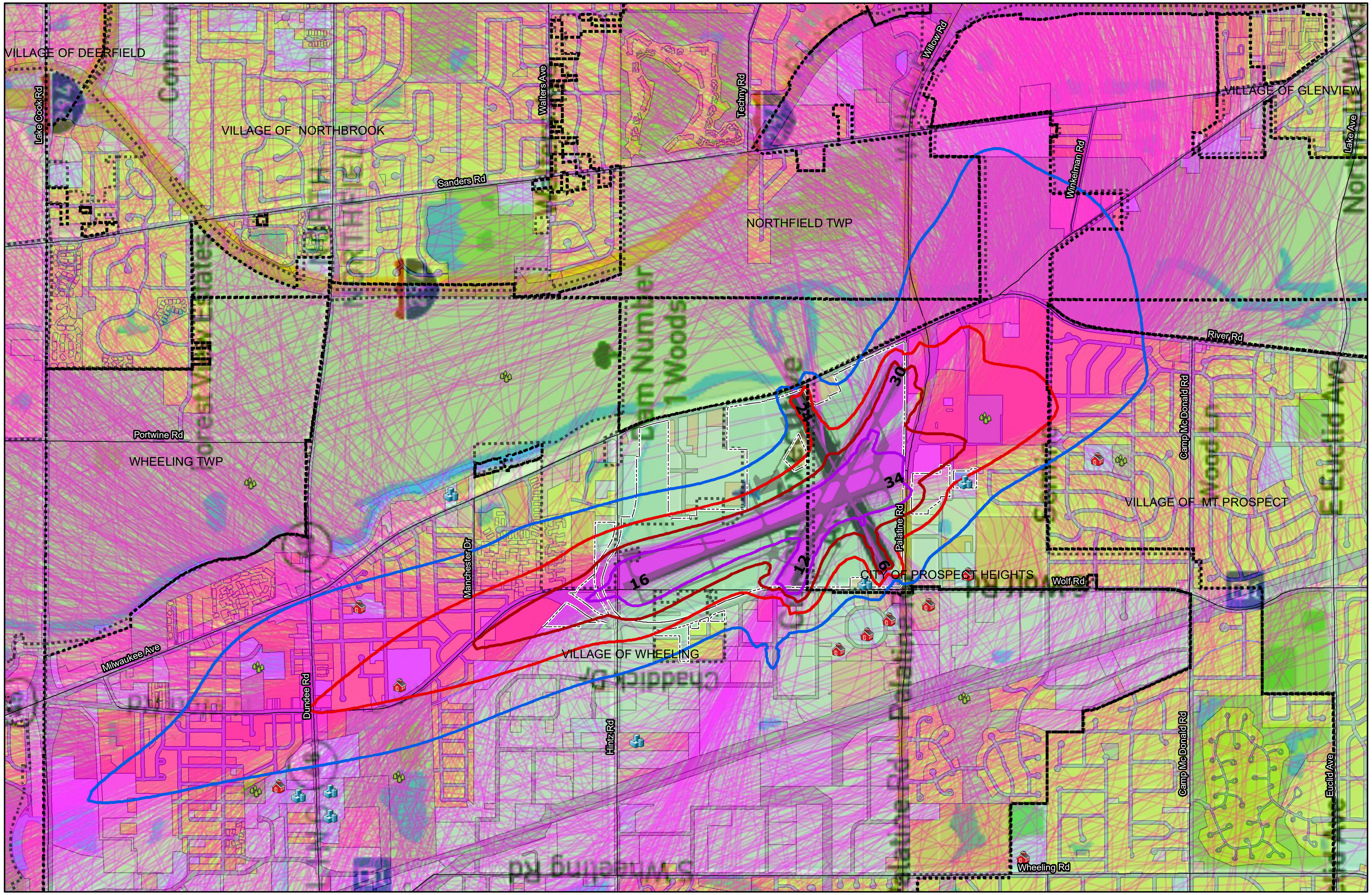


FIGURE D2 *Departure Flight Tracks*

CHICAGO EXECUTIVE AIRPORT

Existing Baseline Noise Conditions

The primary noise criterion to describe the existing noise environment is the annual average day night noise level, DNL. The compiled data as described in the preceding sections is used as input to the FAA's AEDT computer model for the calculation of noise in the airport environs.

The noise contours do not represent the noise levels present on any specific day; rather they represent the daily energy-average of all 365 days of operation during the year. The noise contour pattern extends from the Airport from the runway end, reflective of the flight tracks used by all aircraft. The relative distance of the contours from the Airport along each route is a function of the frequency of use of each runway for total arrivals and departures, time of day, and the type of aircraft assigned to it.

According to *Land Use Guidance Table* in *CFR Part 150,* the 65 DNL is the threshold to determine land use compatibility.

<u>DNL Noise Contours</u>

Based upon the operational conditions presented previously, and the AEDT noise model, noise contours were developed. The data show that for the 2016 base period, there were a total of 78,920 annual operations. The existing annual base period 2016 DNL noise exposure contours for Chicago Executive Airport are presented in Figure D3, *EXISTING 2016 NOISE CONTOURS*. This figure presents the 60 DNL, 65 DNL, 70 DNL and 75 DNL noise exposure contours. Note that the 60 DNL contour are included only for informational purposes.

Legend

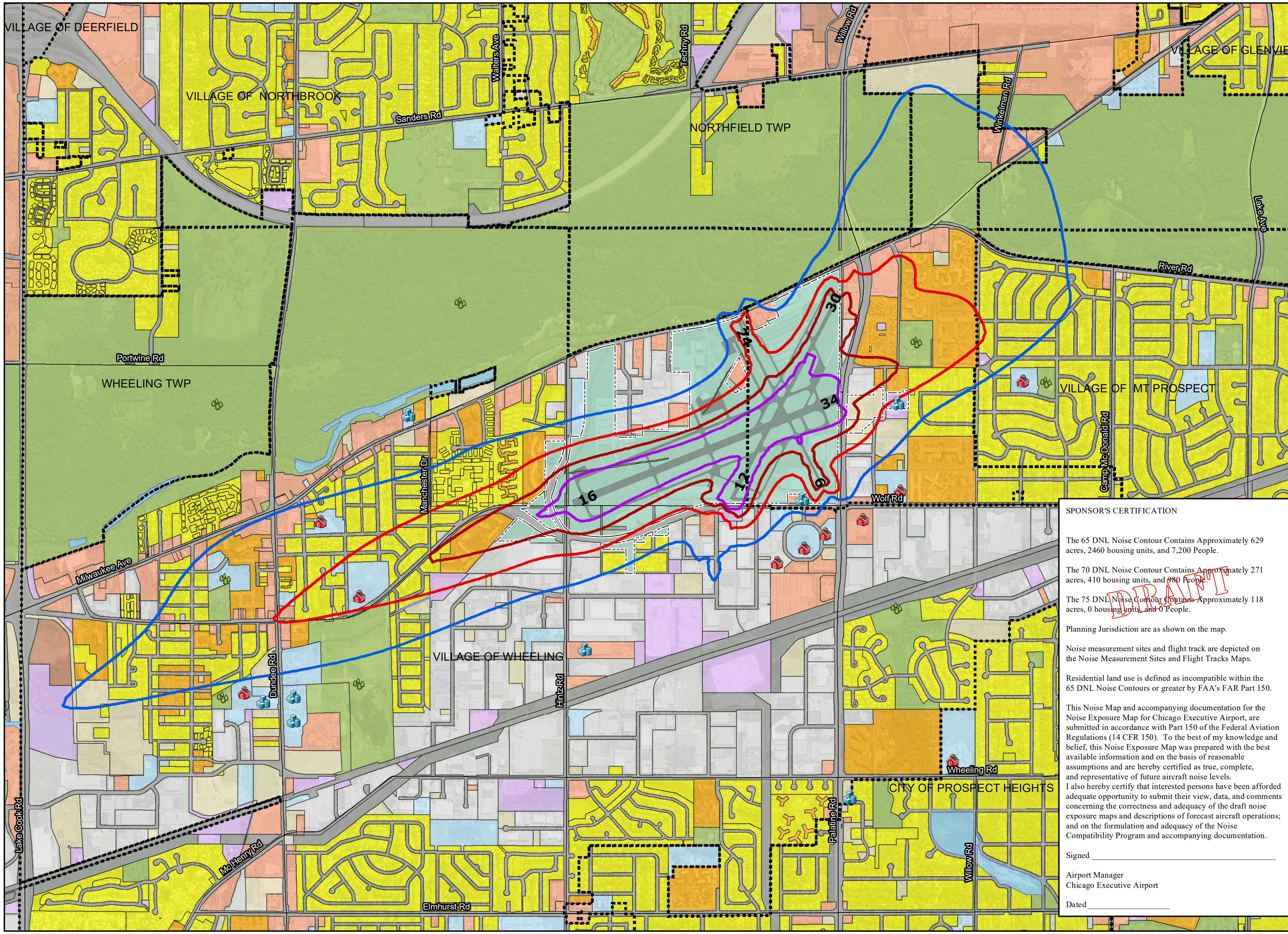
- Municipal/Church
- Parks
- Schools

2016 Noise Contours

- 60 DNL
- 65 DNL
- 70 DNL
- 75 DNL
- Municipality/Jurisdiction
- Chicago Executive Airport Property

Generalized Land Use

- Airport
- Commercial
- Construction
- Industrial
- Institutional
- Open Space/Parks
- Single Family Residential
- Multi Family Residential
- ROW
- Utilities
- Vacant
- Water



Note: The 65 DNL contour is the threshold contour for identifying land use compatibility. The other contours are shown for informational purposes

N

0 2,000 4,000 Feet

Source: Chicago Metropolitan Agency for Planning 2013

SPONSOR'S CERTIFICATION

The 65 DNL Noise Contour Contains Approximately 629 acres, 2460 housing units, and 7,200 People.

The 70 DNL Noise Contour Contains Approximately 271 acres, 410 housing units, and 980 People.

The 75 DNL Noise Contour Contains Approximately 118 acres, 0 housing units, and 0 People.

DRAFT

Planning Jurisdiction are as shown on the map.

Noise measurement sites and flight track are depicted on the Noise Measurement Sites and Flight Tracks Maps.

Residential land use is defined as incompatible within the 65 DNL Noise Contours or greater by FAA's FAR Part 150.

This Noise Map and accompanying documentation for the Noise Exposure Map for Chicago Executive Airport, are submitted in accordance with Part 150 of the Federal Aviation Regulations (14 CFR 150). To the best of my knowledge and belief, this Noise Exposure Map was prepared with the best available information and on the basis of reasonable assumptions and are hereby certified as true, complete, and representative of future aircraft noise levels.
I also hereby certify that interested persons have been afforded adequate opportunity to submit their view, data, and comments concerning the correctness and adequacy of the draft noise exposure maps and descriptions of forecast aircraft operations; and on the formulation and adequacy of the Noise Compatibility Program and accompanying documentation.

Signed ____

Airport Manager
Chicago Executive Airport

Dated ___________________

FIGURE D3 *Existing Noise Exposure Map - 2016*

Future 2022 Noise Modeling Inputs

Future Aircraft Operations

The future noise environment for Chicago Executive Airport was analyzed based upon 2022 operational conditions. The future 5-year contour (2022) is a reasonable representation of future conditions. The aircraft operational levels come directly from the approved aviation forecast from the ongoing Master Plan study. These forecast data show that for Year 2022, a total of 77,249 operations are anticipated to occur at PWK. This equates to an average of 212 operations per day (an operation is either one takeoff or one landing). Although the future total annual operations are less than 2016 operations, the reduction is primarily in the small aircraft categories, with the business jet operations actually increasing.

The noise modeling inputs for runway use, flight tracks, flight track use and time of day are the same as the base case for existing conditions.

Aircraft Fleet Mix Categories

The breakdown by categories of aircraft operations and fleet mix are presented in the next two tables. The categories of aircraft are defined relative to type of user (i.e. air taxi or general aviation) and type of aircraft (i.e. jet or propeller). The breakdown by these categories was determined from the aviation forecast. Table D4, *OPERATIONS BY AIRCRAFT CATEGORY FOR FUTURE 2022 BASE CASE CONDITIONS* presents operations for the different categories of aircraft.

Table D4, *OPERATIONS BY AIRCRAFT CATEGORY FOR FUTURE 2022 BASE CASE CONDITIONS*

Category	Annual Operations	Average Daily Operations
Business Jets	55,070	149
Turboprop	9,934	24
Piston	12,246	38
TOTAL	**77,249***	**212**

Source: PWK Master Plan

*Numbers may not add due to internal rounding.

Detailed Aircraft Fleet Mix Categories

The breakdowns by aircraft fleet mix categories of aircraft operations are presented within this section. The fleet mix categories are defined relative to type of aircraft (i.e., jet or propeller), as well as size and weight.. The breakdown by these categories was determined from the different sources of operational data that were described above with the primary source being the ATADS. Table D5, *DETAILED AIRCRAFT FLEET MIX ASSUMPTIONS FOR FUTURE YEAR BASE CASE (2022)* presents a more in-depth operational breakdown of the different types of aircraft.

Table D5, *DETAILED AIRCRAFT FLEET MIX ASSUMPTIONS FOR FUTURE YEAR BASE CASE (2022)*

2022 Fleet Mix Summary
Chicago Executive Airport
Period: January 1, 2022 thru December 31, 2022
Modeling Software: AEDT v. 2c SP2
Number of Days in 2022: 365

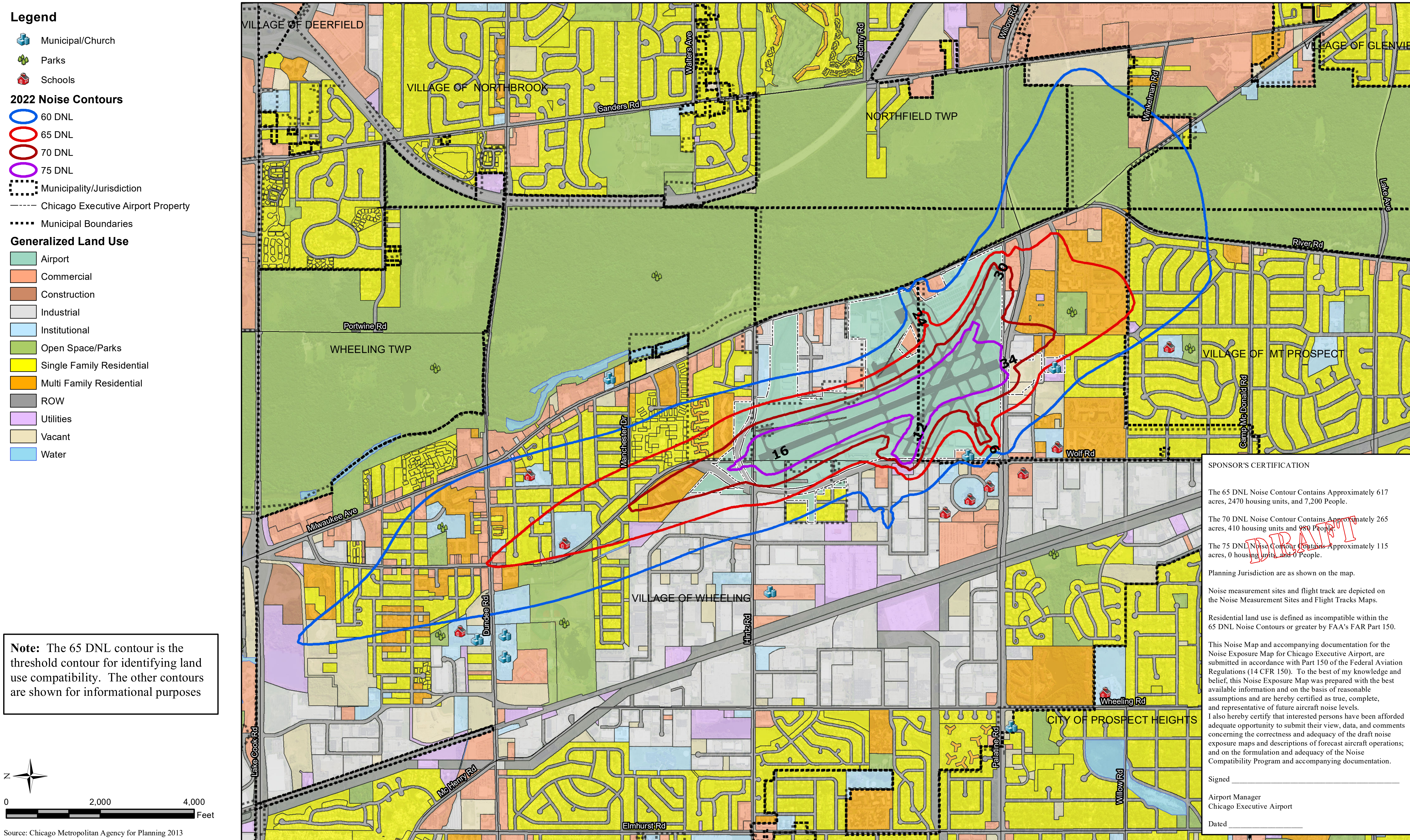
Jet Category by Max Gross Takeoff Weight (lbs)
Light Jet: <10,000
Small Jet: between 10,000 and 20,000
Medium Jet: between 20,001 and 45,000
Large Jet: >45,001

Operations Category		ICAO AC Type	ADET Modeling AC	Daily Arrivals Day	Daily Arrivals Night	Daily Departures Day	Daily Departures Night	Annual Operations
Business Jets								
	Light Jet	C510, E50P, PA47	CNA510	4.35	0.11	4.35	0.11	3,252
		EA50	ECLIPSE500	2.08	0.07	2.08	0.07	1,570
	Small Jet	C650	CIT3	0.37	0.01	0.34	0.04	276
		F900, FA50	COMJET	3.24	0.40	3.31	0.32	2,654
		BE40, C25A, C25B, C25C						
		C500, C501, C525, PRM1	CNA500	3.14	0.20	3.15	0.19	2,439
		C25A, C25C, C525	CNA525C	3.22	0.11	3.15	0.18	2,430
		C550, C551, C56X, E55P	CNA55B	5.60	0.39	5.45	0.54	4,373
		C560	CNA560U	4.37	0.44	4.35	0.47	3,514
		C56X	CNA560XL	6.39	0.40	6.38	0.42	4,962
		L29B, FA10, H25C, LJ31						
		LJ35, LJ40, LJ45, LJ55	LEAR35	5.27	0.50	5.41	0.36	4,210
		MU30	MU3001	0.38	0.05	0.39	0.04	308
	Medium Jet	CL30, CL60, GALX	CL600	7.36	0.63	7.39	0.60	5,831
		C680	CNA680	4.81	0.32	4.68	0.45	3,747
		C750, F2TH, HA4T, J328						
		LJ60, LJ70, LJ75	CNA750	7.09	0.40	6.83	0.66	5,467
		H25B, FA20	FAL20	4.66	0.49	4.76	0.40	3,766
		ASTR, GALX, G150, WW24	IA1125	2.05	0.22	2.08	0.19	1,654
	Large Jet	G280, GLF4, FA7X	GIV	3.17	0.32	3.25	0.23	2,542
		GL5T, GLEX, GLF5, GLF6	GV	2.51	0.33	2.65	0.19	2,075
Business Jets (Total)								**55,070**
TurboProp								
	Multi Engine	B190	1900D	0.06		0.06		42
		AC95, C425, C441, P46T						
		PAY1, PAY2, TBM8	CNA441	1.37	0.04	1.34	0.08	1,033
		AC90, B350, BE10, BE20						
		BE99, BE9L, BE9T, E110						
		MU2, P180, PAT4						
		SW2, SW3, SW4	DHC6	5.93	0.39	5.91	0.41	4,616
		PA42	PA42	1.35	0.01	1.31	0.04	991
	Single Engine	B36T, C208, PC12, TBM7	CNA208	4.32	0.14	4.05	0.41	3,252
TurboProp (Total)								**9,934**
Piston Engine								
	Multi Engine	AC50, AC80, BE55, BE58						
		BE60, C310, C340, C421						
		PA23, PA31, PA34	BEC58P	4.58	0.15	4.66	0.06	3,448
		PA30, P68	PA30	0.12		0.12		84
	Single Engine	BE17, C172,	CNA172	3.05	0.13	3.13	0.04	2,318
		C182	CNA182	0.84	0.03	0.84	0.03	635
		C206	CNA206	0.56	0.00	0.56	0.00	411
		C207	CNA20T	0.49	0.03	0.52	0.00	378
		SR20, SR22	COMSEP	2.44	0.12	2.48	0.08	1,869
		C150, P28A, P46T	GASEPF	0.78	0.05	0.83	0.00	607
		AT5T, PA32, TBM7	GASEPV	2.23	0.07	2.28	0.03	1,682
		P28A	PA28	1.09	0.02	1.10	0.01	813
Piston Engine (Total)								**12,246**
		Grand Totals		**99.25**	**6.57**	**99.16**	**6.66**	**77,249**

Source: BridgeNet International, April 2017

Future 2022 Base Case Noise Contours

Based upon the operational conditions presented previously, and the AEDT noise model, noise contours were developed. The data showed that for the 2022 base period, there will be a total of 77,249 annual operations; with 1,671 less operations forecasted in the future year than the existing conditions. The future base case 2022 DNL noise exposure contours for Chicago Executive are presented in Figure D4, *FUTURE 2022 NOISE CONTOURS*. This figure presents the 60 DNL, 65 DNL, 70 DNL and 75 DNL noise exposure contours. Note that the 60 DNL contour are included only for informational purposes.



Note: The 65 DNL contour is the threshold contour for identifying land use compatibility. The other contours are shown for informational purposes

Source: Chicago Metropolitan Agency for Planning 2013

SPONSOR'S CERTIFICATION

The 65 DNL Noise Contour Contains Approximately 617 acres, 2470 housing units, and 7,200 People.

The 70 DNL Noise Contour Contains Approximately 265 acres, 410 housing units and 980 People.

The 75 DNL Noise Contour Contains Approximately 115 acres, 0 housing units, and 0 People.

DRAFT

Planning Jurisdiction are as shown on the map.

Noise measurement sites and flight track are depicted on the Noise Measurement Sites and Flight Tracks Maps.

Residential land use is defined as incompatible within the 65 DNL Noise Contours or greater by FAA's FAR Part 150.

This Noise Map and accompanying documentation for the Noise Exposure Map for Chicago Executive Airport, are submitted in accordance with Part 150 of the Federal Aviation Regulations (14 CFR 150). To the best of my knowledge and belief, this Noise Exposure Map was prepared with the best available information and on the basis of reasonable assumptions and are hereby certified as true, complete, and representative of future aircraft noise levels.
I also hereby certify that interested persons have been afforded adequate opportunity to submit their view, data, and comments concerning the correctness and adequacy of the draft noise exposure maps and descriptions of forecast aircraft operations; and on the formulation and adequacy of the Noise Compatibility Program and accompanying documentation.

Signed ____

Airport Manager
Chicago Executive Airport

Dated __________________

FIGURE D4 *2022 Noise Exposure Map*

Chapter E, Land Use Analysis

This chapter summarizes the compatibility of various land uses with the existing (2016) and future (2022) base case noise exposure contours. One of the first steps in evaluating land use compatibility is to identify the existing and future noise exposure associated with the operation of Chicago Executive Airport. These NEMs will be compared to the recommendations within the previous Part 150 Noise Compatibility Program (2010) to determine application of these recommendations based on the updated noise contours.

Methodology

The land use and population analysis for both the existing and future "base case" noise contours and the future noise contours were derived from a variety of sources. The existing land use maps provided in the Inventory of Existing Conditions Chapter were used to determine the number of acres of different land use types. The noise contours were overlaid on these maps and a Geographical Information System (GIS) computer program was used to determine the number of acres for each land use type located within each contour. Housing units and population numbers were determined from the 2010 Census (most recently complete Census) using the same GIS program. The information was determined using the census block level data for each contour.

Existing Population Analysis/Existing Noise Contours, 2016

This section discusses the housing units and population found within the existing noise exposure contours generated by aircraft at Chicago Executive Airport. The existing noise exposure is represented by contour bands, including the 65 DNL, 70 DNL, and 75 DNL contours. A Part 150 Study and the Noise Exposure Maps use the 65 DNL contour as the threshold of significance contour for land use analysis, based on the FAA's land use compatibility guidelines. As such, the land use and population analysis will only be presented for the 65 DNL and greater noise contours.

The CFR Part 150 Land Use Guidelines (as presented in the Background Information on Noise Chapter) state that residential uses, as well as other noise sensitive uses, are not compatible within the 65 or greater DNL noise contours. However, noise sensitive uses can be made compatible within the 65 DNL noise contour through sound attenuation programs, such as sound insulation, noise easements, or land acquisition.

The existing 2016 65 DNL and greater contour contains approximately 629 acres. There are approximately 2,459 residential housing units representing approximately 7,164 people within the 65 DNL and greater contour. Table E1, *EXISTING LAND USE WITHIN THE EXISTING NOISE CONTOURS, 2016,* summarizes the population and housing parcels within the existing 2016 noise contours. There is one school, Oliver W. Holmes Middle School, located within the 65 DNL and greater noise contour. There are no historical sites listed on the National Register of Historic Places within the 65 DNL and greater contour. The 70 DNL and greater noise contour contains approximately 271 acres, with 409 housing units containing approximately 978 people. The 75 DNL and greater noise contour contains approximately 117 acres, but it does not contain any residences or other incompatible land uses.

Table E1, *EXISTING LAND USE WITHIN THE EXISTING NOISE CONTOURS, 2016*

Contour	**65 DNL**	**70 DNL**	**75 DNL**
Population			
Number of People	7164	978	0
Housing Units	2459	409	0
Number of Schools	1	0	0
Land Use			
Agricultural	0.00	0.00	0.00
Commercial	18.01	1.87	0.00
Construction	0.00	0.00	0.00
Industrial	34.75	8.98	0.00
Institutional	15.56	0.00	0.00
Right-of-way	65.75	20.31	2.35
Open Space/Recreational	13.44	0.00	0.00
Multi-family Residential	91.84	19.81	0.00
Residential	62.64	2.01	0.00
Airport	302.99	212.78	114.19
Transportation/Utilities	8.62	0.79	0.05
Vacant	15.26	4.13	0.61
Water	0.00	0.00	0.00
Total Acres	628.86	270.68	117.20

Source: Chicago Metropolitan Agency for Planning (2013); 2010 Census Data

Population Analysis/Future Case Noise Contours, 2022

A review was conducted of the existing population and housing units that could be affected five years into the future. The Existing and Future Baseline Noise Conditions Chapter discusses the noise exposure contour prepared for the year 2022. This "base case" assumes no operational changes would occur at the Airport, and is reflective of the forecast operations and aircraft types explained in previous chapters.

This section discusses the housing units and population found within the future noise exposure contours generated by aircraft at Chicago Executive Airport. The future noise contours represent a slight decrease in operations, but no facility changes. The future base case noise contours are slightly smaller than the existing noise contours a result of a change in fleet mix and phasing out of older aircraft at Chicago Executive Airport. The future 65 DNL and greater contour is expected to decrease in size from approximately 629 acres in 2016 to 617 acres by 2022, and would encompass approximately 2,466 housing units representing approximately 7,185 people. This represents an increase in housing units and people affected over existing levels due to a slight shift of the 65 DNL noise contour south of the airport. Table E2, *EXISTING LAND USE WITHIN THE FUTURE NOISE CONTOURS, 2022* summarizes the population and housing parcels within the existing 2016 noise contours.

There is one school, Oliver W. Holmes Middle School, located within the 65 DNL and greater noise contour in 2022. No Historic Sites or other noise sensitive uses are located within the 65 DNL and greater contour. The 70 DNL and greater noise contour contains approximately 265 acres, with 407 housing units containing approximately 981 people. The 75 DNL and greater noise contour contains approximately 115 acres and does not contain any incompatible land uses.

Table E2, *EXISTING LAND USE WITHIN THE FUTURE NOISE CONTOURS, 2022*

Contour	**65 DNL**	**70 DNL**	**75 DNL**
Population			
Number of People	7185	981	0
Housing Units	2466	407	0
Number of Schools	1	0	0
Land Use			
Agricultural	0.00	0.00	0.00
Commercial	16.89	1.41	0.00
Construction	0.00	0.00	0.00
Industrial	33.10	8.07	0.00
Institutional	15.62	0.00	0.00
Right-of-way	65.25	20.07	2.20
Open Space/Recreational	13.44	0.04	0.00
Multi-family Residential	91.94	19.70	0.00
Residential	62.76	1.92	0.00
Airport	294.82	209.42	112.49
Transportation/Utilities	8.38	0.68	0.02
Vacant	15.04	3.95	0.61
Water	0.00	0.00	0.00
Total Acres	617.24	265.21	115.32

Source: Chicago Metropolitan Agency for Planning (2013); 2010 Census Data